EMPYEMA:
Objectives

- Define empyema
- Identify the causes
- State the signs and symptoms
- Explain the diagnosis
- Describe methods of treatment
Introduction

• Empyema is an accumulation of pus in the space between the lung and the membrane that surrounds it (pleural space) that occurs when an infection spreads from the lungs.
• This pus contains white blood cells that fight infection (polymorphonuclear leukocytes) and blood proteins involved in clotting (fibrin). When pus builds up in the pleural space, it puts pressure on the lungs and results in shortness of breath and pain.
• As fibrin is laid down, it separates the pleural fluid into tiny pockets (loculation).
• Formation of scar tissue can entrap sections of lung and cause permanent lung damage.
Definition of Empyema

• It is the presence/accumulation of pus between the pleural cavity of the lung.
• Empyema in the pleural cavity is sometimes called empyema thoracis, or empyema of the chest.

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Stages of Empyema

• Stage I - “Exudative”
  • sterile pleural fluid develops secondary to inflammation without fusion of the pleura; swelling of pleural membranes

• Stage II - “Fibrinopurulent”
  • a fibrinous peel develops on both pleural surfaces limiting lung expansion due to heavy fibrin deposits

• Stage III - “Organizing”
  • in-growth of capillaries & fibroblasts into the fibrinous peel and deposition of collagen
Etiology of Empyema

- Empyema thoracis can be caused by a number of different organisms, including bacteria, fungi, and amoebas, in connection with pneumonia.
- Common cause is pulmonary infection as a result of aerobic bacteria such as *Streptococcus pneumonia*, *Staphylococcus aureus*, *E. coli*, *Klebsiella pneumoniae*, *Hoemophilus influenzae*.
- Other causes include:
  - Chest trauma (blunt chest wound, chest surgery, lung abscess, or a ruptured esophagus)
  - Septicaemia (very rare blood borne infection)
  - Subdiaphragmatic causes as liver abscess
Etiology Cont'd

- In children 40% of empyema is caused by *S. pneumoniae*, 15% were penicillin-resistant, 44% negative culture (pretreatment with antibiotics in community setting).
- In older children it is most commonly caused by pneumococcus.
- *S. pneumoniae* responsible for 60%-75% community acquired pneumonia, only 2% develop empyema.
- *S. aureus* account 1-2% community-acquired pneumonia, 10% adult and 50% children develop empyema.
- In hospital, the staphylococcus and gram negative are most common.
Clinical Features

• The signs and symptoms of empyema vary according to the location of the infection and its severity.

• Patients usually exhibit symptoms of pneumonia, including fever, fatigue, cough, shortness of breath and chest pain.

• In severe cases, the patient may become dehydrated, cough up blood, greenish–brown sputum, or run a fever as high as 105F, or even fall into a coma
Diagnosis

- On a chest X-ray, empyema thoracis will appear as a cloudy or opaque area.
- When listening to sounds within the patient’s chest with a stethoscope, the sounds of breathing will be partly muffled and harder to hear in the patients with empyema.
- The diagnosis of empyema, however, has to be confirmed with laboratory tests based on fluid analysis because its symptoms can be caused by other disease conditions.
- Aerobic pus usually gives off a little odor
The white patch in both x-ray photographs is due to the presence of pus.
Thoracentesis

- This is a procedure which involves the insertion of a needle into the pleural cavity through the back between the ribs on the infected side, and a sample of fluid is withdrawn.
- It is performed under local anesthetics.
- If the patient has empyema, there will be leukocytosis, a high level of protein, and a very low level of blood sugar.
Thoracentesis Cont'd

• This is the most useful test that conducts analysis of aspirated pleural fluid which shows:

  • *transudative effusions*: lactate dehydrogenase (LD) levels less than 200 IU and protein levels less than 3 g/dl

  • *exudative effusions*: ratio of protein in pleural fluid to serum greater than or equal to 0.5, LD in pleural fluid greater than or equal to 200 IU, and ratio of LD in pleural fluid to LD in serum greater than or equal to 0.6

  • *empyema*: acute inflammatory white blood cells and microorganisms
Management/Treatment

• Effective management require:
  1. Control of infection and sepsis by antibiotics.
  2. Evacuation of pus from pleural space.
  3. Obliteration of the empyema cavity.
• Delay in drainage increase mortality from 3.4% to 16%.
• Empyema is treated using a combination of medications and surgical techniques
• Treatment with medication involves intravenously administering a two-week course of antibiotics.
• It is important to give antibiotics as soon as possible to prevent first-stage empyema from processing to its later stage.
• The antibiotics most commonly used are penicillin and vancomycin.
Antibiotic Therapy

- Dependent on identification of causative organism
- Appropriate therapy requires isolation of organism from blood, pleural fluid or sputum
- Empiric therapy should be based on local epidemiology and should cover *S. pneumoniae*, *S. pyogenes* and *S. aureus*
- Broad spectrum therapy with Ceftriaxone/Cefotaxime plus Clindomycin
Table 58-5. Choice of Antibiotics against Pathogens in Empyema

<table>
<thead>
<tr>
<th>Organism</th>
<th>Antibiotic</th>
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<tbody>
<tr>
<td>Community-acquired infections</td>
<td></td>
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<tr>
<td>Gram-positive bacteria</td>
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<tr>
<td><em>Streptococcus pneumoniae</em>&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Third-generation cephalosporin (ceftriaxone)</td>
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<td></td>
<td>Extended-spectrum quinolone (levofloxacin)</td>
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<td><em>Haemophilus influenzae</em></td>
<td>Third-generation cephalosporin</td>
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<td><em>Staphylococcus aureus</em></td>
<td>Oxacillin, nafcillin</td>
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<tr>
<td><em>Streptococcus pyogenes</em>&lt;sup&gt;b&lt;/sup&gt;</td>
<td>High-dose penicillin</td>
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<tr>
<td>Gram-negative bacteria</td>
<td></td>
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<tr>
<td><em>Klebsiella pneumoniae</em></td>
<td>Third-generation cephalosporin</td>
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<tr>
<td>Suspected anaerobes&lt;sup&gt;c&lt;/sup&gt;</td>
<td>Clindamycin</td>
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<tr>
<td>Hospital-acquired infections</td>
<td>Amoxicillin/clavulanate</td>
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<tr>
<td>Gram-positive bacteria</td>
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<tr>
<td><em>S. aureus</em></td>
<td>Oxacillin, nafcillin</td>
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<tr>
<td>Gram-negative bacteria</td>
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<tr>
<td><em>Pseudomonas aeruginosa</em></td>
<td>Ciprofloxacin and gentamicin</td>
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<td></td>
<td>Imipenem and gentamicin</td>
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<tr>
<td><em>Klebsiella pneumoniae</em></td>
<td>Third-generation cephalosporin</td>
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<tr>
<td>Anaerobes</td>
<td>Piperacillin/tazobactam</td>
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<td>Clindamycin</td>
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<td>Amoxicillin/clavulanate</td>
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Chest Tube Drainage/Rib Resection

- First step in treating acute empyema
- Performed under general anesthesia
- Done for the dependent rib
- Open all the intact cyst that leads to conversion of empyema with free pus
- Then place intercostal tube for drainage and close the wound
- Antibiotics should continue for 6 weeks
Fibrinolytic Therapy

• Studies used Streptokinase or Urokinase
• Most effective in the early fibrinopurulent stage and may make surgical drainage unnecessary
• Life-threatening complications rare
• Potential adverse effects includes:
  1. Bleeding
  2. Bronchopleural fistula
Videoscopic Assisted Thoracoscopy Surgery (VATS)

• Minimally invasive
• Can be used at any stage
• Advantages includes:
  1. Allowance of direct visualization of pleura and lung
  2. Optimal placement of chest tube
  3. Fibrinolysis & decortication can be performed.
• Retrospective case reviews suggest children with failure of conventional CT therapy exhibit
Thoracostomy

- Open drainage with pleural peel decortication
- Excision of the thick fibrous pleural rind and removal of infectious material
- Longer & complicated procedure
- Reserved for late presenting empyema with significant fibrous pleural rind, complex empyema & chronic empyema