EMPYEMA

Grand Rounds
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Empyema

- Background
- Diagnosis
- History of treatment
- Issues in modern treatment
- Cases
Background

- 65,000 pts per year in the US
- 20% Mortality
- 15-20% of patients will require surgical treatment
- Median hospital duration is 15 days

Definition

“The inflammatory process in a preformed anatomical space defined by the visceral and parietal pleura”

Diagnosis

- History & Physical
- Radiological
- Pleural fluid analysis
Physical Characteristics

- Shortness of Breath >80%
- Cough >70%
- Fever >80%
- Chest pain >60%
Empyema - Radiographic Characteristics
Empyema-Radiographic Characteristics

Empyema Necessitans
Diagnosis- Pleural Fluid Analysis

- Frank pus
- Gram stain (direct)
- Culture (indirect)

pH<7.2,
Glucose<400mg/l,
LDH >1000 IU/ml,
Total protein>3g/ml,
WBC >15,000 cells/mm³

Etiology

- Parapneumonic 40-60%
- Post surgical 20-30%
  - Lung resection
  - Esophagectomy,
  - Mediastinal procedures
- Post traumatic 5-10%

Empyema-Pathophysiology

Stage I
- Increased permeability of inflamed pleural surfaces
- Pleural fluid- Sterile
- Uncomplicated parapneumonnic effusion

Stage II
- Fibrinopurulent stage
- Pleural fluid clear but high WBC’s
- Begin to see chemistry changes in pH, protein
- Bacterial presence more likely

Stage III
- Organizing phase
- Collagen deposition
- Entrapment of lung
- Effusion grossly purulent
Empyema - Pathophysiology

- Fibrino purulent phase
- Organizing phase

Stage I.
Stage II.
Stage III.

Fog of anamnesis

Diagnosis of pneumonia/pleural fluid

weeks
0 1 2 3 4 5 6

Images show CT scans at different stages of empyema progression.
Treatment

ubi pus evacua - “if you find pus remove it”
Treatment

- Complete evacuation of the content of infected space
- Elimination of cavity
- Control of causative organisms/sterilisation
- Forced auxiliary treatment such as aggressive physiotherapy,
- Nutritional support in every phase of treatment.

Empyema Treatment - History

229BC-Hippocrates Limited rib resection
1843-Trouseau Thoracentesis
1879-Estlander Thoracoplasty
1893-Fowler Decortication
1927-Alexander Extrapleural paravertebral thoracoplasty
1935-Eloesser Eloesser flap
1945-Tillet Fibrinolytics
1963-Clagett open drainage and irrigation
1983-Miller Complete flap closure without open drainage
Open Window Thoracostomy
Claggett Procedure

- Dressing changes to clean cavity
- Instill 0.25% neomycin
- Closure of skin
Open Window Thoracostomy

Eloesser Flap

- Tongue of skin created to prevent closure
- Window created at most dependent portion of empyema
Open Window Thoracostomy
Current Indications

- Chronic empyema
- Used in transition to a more radical procedure
- Debilitated patient
- Expectation of long term drainage
- Postpneumonectomy empyema
Thoracoplasty
Thoracoplasty
Plumbage Thoracoplasty
Plumbage Thoracoplasty
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When writing please mention Diseases of the Chest
Thoracoplasty - Current Indications

- Infected spaces after pulmonary resection
- Apical spaces after lobectomy
- Empyema after pneumonectomy
- Unresolved chronic empyema unrelated to pulmonary resection
- Posttuberculous apical empyema
Decortication
Decortication
Muscle Flap Interposition
Post Lung Resection Empyema

- Post Lobectomy - 0.01% - 2.00%
- Post-pneumonectomy 2-16%
- Residual space and air leak

Post Lung Resection Empyema

- Muscle flap closure
- Limited Thoracoplasty
- Open window thoracostomy
Summary of Treatment Modalities

- Antibiotics
- Tube Drainage (thoracentesis or tube thoracostomy)
- Intrapleural fibrinolytics
- VATS drainage
- Open thoracotony
- Chronic open drainage/Thoracoplasty
Treatment Dilemmas

- To lyse or not to lyse?
- Surgical vs. Nonsurgical
- VATS vs. open decortication
- Duration of antibiotic therapy?
Fibrinolytics and Empyema

- First used in 1945
- Streptokinase is the most widely studied
- Principle of therapy is to lyse fibrinous septations and allow improved drainage of pleural fluid

Video thorascopic view of intrapleural fibrinous septations
Randomized Double blinded trial performed in 52 Centers

All pts underwent tube drainage of parapneumonic effusion and were randomized to placebo or 250,000 IU streptokinase administered through tube

Primary endpoints- requirement of further surgery or death
MIST1 Trial

454 Patients eligible and provided consent

226 Randomly assigned to streptokinase
- 20 Patients excluded
- 18 Did not receive study drug (died, underwent surgery, or withdrew consent)
- 2 Lost to followup
- 206 Patients completed trial

228 Randomly assigned to placebo
- 7 Patients excluded
- 6 Received no trial drug (died, underwent surgery, or withdrew consent)
- 1 Lost to followup
- 206 Patients completed trial
Results

• NO reduction in the need for surgical intervention with streptokinase administration
• NO reduction in mortality at either 3 or 12 months
• NO reduction in hospital stay
Surgical vs. Non Surgical Therapy
A Randomized Trial of Empyema Therapy*
Wait MA et al

- 20 pts with complicated empyema thoracis randomized to either chest tube + fibrinolytics vs. VATS alone
- VATS had significantly higher treatment success (91% vs. 44% p<0.05)
- VATS had shorter duration of chest tube drainage (5.8 vs. 9.8 days p=0.03)
- Shorter hospital stay (8.7 vs 12.8 days p<0.001)
- Average cost VATS $16,642 vs CT $24,052
VATS

• No randomized trials

• Large series report 80-85% success with VATS

• Success of VATS depends on interval of preoperative symptoms

Duration of Antibiotic Therapy
Microbiological Aspects

- A lack of detectable causative organisms reported between 47% and 56%
- 5-10% of parapneumonic effusions become empyema
- Blood cultures positive in only 10% of patients
# Organism of Etiology

<table>
<thead>
<tr>
<th>Community acquired</th>
<th>Hospital-acquired</th>
</tr>
</thead>
<tbody>
<tr>
<td>• <em>Streptococcus pneumoniae</em></td>
<td>• <em>Staphylococcus aureus</em></td>
</tr>
<tr>
<td>• <em>Haemophilus influenzae</em></td>
<td>• <em>Gram negative organisms</em></td>
</tr>
<tr>
<td>• <em>Staphylococcus aureus</em></td>
<td></td>
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</tbody>
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* Pleural bacteriology differs from pneumonia bacteriology

* >50% of organisms are resistant to penicillins

>70% of *staph aureus* species are penicillin resistant
Survival According to Type of Infection
Algorithm for Management of Parapneumonic Effusions/Emphyema

Diagnosis of parapneumonic effusion

Therapeutic thoracentesis or tube thoracostomy

Successful resolution
  - Observation, reimaging and antibiotics

*Unsuccessful resolution
  - Medically stable
    - VATS/Thoracotomy Drainage
  - Medically unstable
    - More tubes
    - Supportive care
    - Open window thoracostomy
    - Fibrinolytics?

*Decision for surgery in 24-48hrs
Empyema
Expect the Unexpected
Case 1

• 65 y/o obese male presented to ER with left chest pain after episode of binge drinking
• PMHX: hypertension, ETOH abuse
• PSHX: Nissen fundoplication, Cholecystectomy
• WBC 16,000
• CXR obtained
Case 1

- Pleural Fluid Analysis:
  - pH = 7.1
  - glucose = 324 mg/l
  - LDH = 1275 IU/ml
  - total protein = 4.3 g/ml
  - WBC > 30,000 cells/mm³

- CT report: Empyema with lower lobe atelectasis suggesting trapped lung
Case 1

Chest tube drainage and repeat CT

Intrapleural fibrinolytics and repeat CT

No change in loculated pleural effusion

CT surgery Consult

To OR for Decortication
Case 1 Intraoperative Findings

- Fibrinous peel overlying lung
- Undigested food
- Perforation in apex of prior nissen fundoplication
Case 2

- 44 y/o male presented with cough, fever
- PSHX: underwent right pneumonectomy 21 years prior to treat TB
Case 2

- VATS exploration identified a retained 21 year-old surgical sponge
- "Gossypiboma" removed surgically
Case 3

- 26 y/o male presented with cough, fever, chills
- PMHX: several episodes of pneumonia
- CXR: opacification of right chest
- Chest tube placed
- CT scan performed
Case 3

CT Report:
Impression:
1) Right basilar empyema with lower lobe atelectasis
2) Middle lobe atelectasis
Case 3- Operative Course

- Bronchoscopy - complete obstruction of bronchus distal to right upper lobe takeoff
- Right middle and lower bilobectomy

Pathology:

1) Chronic inflammation and atelectasis of middle and lower lobes
2) Foreign body causing obstruction of bronchus

ALWAYS PERFORM BRONCHOSCOPY !!!!
Conclusions

• Basics of treatment for >2,000 years has been drainage of infected fluid, obliteration of space

• Unclear role of fibrinolytics

• Be prepared for unusual sources of pleural space infection