Post Pneumonic Empyema: Is There Still a Role for Surgery?

M. Blair Marshall, MD
Chief, Thoracic Surgery
Professor of Surgery
MedStar Georgetown University Hospital
Georgetown University School of Medicine

Ismael Matus, MD
Interventional Pulmonary Medicine

AMERICAN ASSOCIATION FOR THORACIC SURGERY
We Model Excellence
Disclosures

- Advisory Board-ClinicalKey
- Consultant for Ethicon
- Consulting Editor-Thoracic Surgery Clinics

- Back to the question: is there a role for surgery?
What is the role of surgery for post pneumonic empyema?

How do you define surgery?
57 year old male w/ 2 week history of fever, chills, malaise transferred in from OSH

- Cachectic, chronic lymphocytic leukemia on Imbruvica (tyrosine kinase inhibitor)
  - Increased risk of infection/bleeding
- Emphysema, current smoker, 100pkyr
- Percutaneous drainage attempted, “too thick to drain”
- Transferred for decortication
• Hospital Course
  – IV abx
  – Percutaneous drain
    • TPA
  – DC home day 7
    • IV ceftriaxone (best pleural penetration) with chest drain
  – Drain removed in clinic
Background

- Post-pneumonic Empyema
  - Incidence increasing in the US
    - 3.04/100,000 in 1996 to 5.98/100,000 in 2008 (Thorax 2011)
    - Mortality of 10-20%
  - Likely related other co-morbidities
  - 1.2% in patients <39 yrs. and >20% in patients ≥80yrs. *CHEST 2014*
## ACCP Staging of Pleural Effusions

<table>
<thead>
<tr>
<th>Stage</th>
<th>Pleural Space</th>
<th>Bacteriology</th>
<th>Pleural Fluid Chemistry</th>
<th>Thoracentesis/Drainage</th>
</tr>
</thead>
<tbody>
<tr>
<td>I (uncomplicated parapneumonic)</td>
<td>Minimal amount, free flowing (&lt;10mm lateral decubitus)</td>
<td>Cx and gram stain results unknown</td>
<td>pH unknown</td>
<td>No/No</td>
</tr>
<tr>
<td>II (uncomplicated parapneumonic)</td>
<td>Small-moderate free-flowing effusion (&gt;10mm to &lt; ½ hemithorax)</td>
<td>Culture and gram-stain negative</td>
<td>pH ≥7.20 or glucose ≥ 60 mg/dL</td>
<td>Yes/No</td>
</tr>
<tr>
<td>III (complicated parapneumonic)</td>
<td>Large, free-flowing effusion (≥ ½ hemithorax); loculated or thickened parietal pleura</td>
<td>Culture or gram-stain positive</td>
<td>pH &lt;7.20 or glucose &lt;60 mg/dL</td>
<td>Yes/Yes</td>
</tr>
<tr>
<td>IV (empyema)</td>
<td>Pus</td>
<td>Tests not indicated</td>
<td>Yes/Yes</td>
<td></td>
</tr>
</tbody>
</table>
Does surgery have a role?

(Likely depends on where you work)

• Drainage (a surgical intervention)
  – No longer performed by just surgeons
  – What is the best tube?
    • Large bore (Chest tubes) versus small bore catheter
      • Bigger is not better (Rahman *CHEST* 2010)
Small vs. Large Bore Chest Tube

- Pain scores higher in large surgically placed CT.
- Small guide wire inserted tubes
  - Cause less pain
  - Do not impair clinical outcomes
- Important to flush SBCT with 30mL Q6hrs
- Remove when cavity is obliterated and output is <50 mL/day

Rahman N. The relationship between chest tube size and clinical outcome in pleural infection. CHEST 2010;137(3): 536
BTS Guidelines 2010
Fibrinolytics

- Meta-analysis of several studies: intrapleural fibrinolysis may be beneficial
- **MIST1**-(Maskell NEJM 2005)
  - Drainage w/out guidance
  - No stratification of stage of empyema
  - Participating centers had little experience
- **MIST2**-(Rahman NEJM 2011)
  - Combination therapy of TPA and DNase
### SUMMARY OF DOUBLE-BLIND, PLACEBO-CONTROLLED TRIALS OF FIBRINOLYTIC THERAPY

<table>
<thead>
<tr>
<th>STUDY</th>
<th>STUDY SIZE</th>
<th>INCLUSION</th>
<th>DRAIN SIZE</th>
<th>TREATMENT</th>
<th>MORTALITY (%)</th>
<th>SURGICAL REFERRAL RATE (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Davies et al 90 1997</td>
<td>24</td>
<td>Empyema and complex effusions</td>
<td>14 Fr</td>
<td>Streptokinase Once daily Three days</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Bouros et al 91 1999</td>
<td>31</td>
<td>Empyema and complex effusions</td>
<td>28-32 Fr</td>
<td>Urokinase Once daily Three days</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Tuncozgur et al 92 2001</td>
<td>49</td>
<td>Empyema only</td>
<td>24-36 Fr</td>
<td>Urokinase Once daily Three days</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Diacon et al 93 2004</td>
<td>53</td>
<td>Empyema and complex effusions</td>
<td>24-28 Fr</td>
<td>Streptokinase Once daily Seven days</td>
<td>4.5</td>
<td>4.5</td>
</tr>
<tr>
<td>Maskell et al 94 MIST1 2005</td>
<td>454</td>
<td>Empyema and complex effusions</td>
<td>12-20 Fr</td>
<td>Streptokinase Twice daily Three days</td>
<td>15.5</td>
<td>14</td>
</tr>
<tr>
<td>Rahman et al 95 MIST2 2011</td>
<td>210</td>
<td>Empyema and complex effusions</td>
<td>&lt;15 Fr</td>
<td>t-PA and DNase Twice daily Three days</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td><strong>NO OVERALL DIFFERENCE</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Bhatnagar Clinics in Chest Medicine Volume 2013*
Intrapleural tPA-DNase

<table>
<thead>
<tr>
<th>Outcome</th>
<th>t-PA</th>
<th>DNase</th>
<th>t-PA–DNase</th>
<th>Placebo</th>
</tr>
</thead>
<tbody>
<tr>
<td>Change from baseline in hemithorax area occupied by effusion (primary outcome) — %</td>
<td>-17.2±24.3</td>
<td>-14.7±16.3</td>
<td>-29.5±23.3</td>
<td>-17.2±19.6</td>
</tr>
<tr>
<td>Percent difference vs. placebo (95% CI)</td>
<td>2.0 (-4.6 to 8.6)</td>
<td>4.5 (-1.5 to 10.5)</td>
<td>-7.9 (-13.4 to -2.4)</td>
<td>NA</td>
</tr>
<tr>
<td>P value</td>
<td>0.55</td>
<td>0.14</td>
<td>0.005</td>
<td>NA</td>
</tr>
<tr>
<td>Surgical referral — no. referred/total no. (%)</td>
<td>3/48 (6)</td>
<td>18/46 (39)</td>
<td>2/48 (4)</td>
<td>8/51 (16)</td>
</tr>
<tr>
<td>Odds ratio vs. placebo (95% CI)</td>
<td>0.29 (0.07 to 1.25)</td>
<td>3.56 (1.30 to 9.75)</td>
<td>0.17 (0.03 to 0.87)</td>
<td>NA</td>
</tr>
<tr>
<td>P value</td>
<td>0.10</td>
<td>0.01</td>
<td>0.03</td>
<td>NA</td>
</tr>
<tr>
<td>Hospital stay — no. of days</td>
<td>16.5±22.8</td>
<td>28.2±61.4</td>
<td>11.8±9.4</td>
<td>24.8±56.1</td>
</tr>
<tr>
<td>Percent difference vs. placebo (95% CI)</td>
<td>-8.6 (-40.8 to 3.3)</td>
<td>3.6 (-19.0 to 30.8)</td>
<td>-14.8 (-53.7 to -4.6)</td>
<td>NA</td>
</tr>
<tr>
<td>P value</td>
<td>0.21</td>
<td>0.73</td>
<td>&lt;0.001</td>
<td>NA</td>
</tr>
</tbody>
</table>
tPA-Dnase Before and After
What about surgery?

- VATS versus percutaneous drainage-pediatric study (Aziz A. Surg Infect 2008)
  - 40% of catheter directed therapy failed and patients went to VATS
  - LOS and hospital costs (18 ± 3 vs. 11 ± 0.8 days; p < 0.05) and higher hospital charges ($50,000 ± 7,000 vs. $29,000 ± 1000) than those having primary VATS.

- Urokinase/percutaneous tubes versus VATS: Randomized multicenter study (Marhuenda Pediatrics 2014)
  - No difference in LOS
  - Second intervention VATS 15%, second intervention Urokinase 10%

- VATS v. Perc. Drainage - not been done in adults
Empyema

Not loculated

Drainage

Persistent collection/symptoms

TPA-DNase

Loculated/thick pleural peel

Persistent collection/sx

VATS Decortication

Failure to re-expand

Thoracotomy
Medical Thoracoscopy in Multiloculated Empyema

(Brutsche M. CHEST 2005)

- Safety and outcome of medical thoracoscopy in the treatment of multi-loculated empyema
- Retrospective study of 127 patients
  - All had multi-loculated empyema as per chest US
- Complications –
  - 9% SC emphysema n=3
  - Air leak (3-7 days) n=9
  - No mortality
Additional Studies

• Characteristics of medically and surgically treated empyema patients (Dusemund Respiration 2013)
  – Surgery patients were more likely to describe significant chest pain 12 months after surgery

• Management of parapneumonic effusion and empyema: medical thoracoscropy and surgical approach (Kern Respiration 2013)
  – Medical thoracoscropy is a simple and effective therapeutic alternative associated with better outcome and fewer complications than conservative treatment
Medical Thoracoscopy in MLE (Brutsche M. CHEST 2005)

- 94% patients were cured by nonsurgical means
  - 4 patients required second chest tube or second medical thoracoscopy
  - 6% required surgical decortication

- “MLE when stratified by US can safely and successfully be treated by medical thoracoscopy”
Medical Thoracoscopy in MLE
(Ravaglia C. Respiration 2012)

- Medical thoracoscopy was successful in 35 of 41 patients (85.4%)
  - 9 patients w/free flowing effusion (100%)
  - 22 of 24 patients w/ multi-loculated effusion (91.7%)
  - 4 of 8 patients w/ organizing effusion (50%)

- “Multiloculated empyema can be safely and successfully treated with medical thoracoscopy.”
“...with all the IR guided CTs or bedside CTs placed as first therapeutic approach in loculated collections; not just for complicated MLE but other indications...consideration should be given to the thorascopic approach (medical thoracoscopy) as it offers the ability to perform adhesiolysis and also guide placement of the CT.”
Tunneled Pleural Catheters in Chronic Pleural Infections (Davies CHEST 2008)

• Patients with chronic pleural infection and unexpandable lung who are not candidates for decortication:
  – Rib resection and long term open drainage
  – Rib resection and large chest tube insertion

• Unpleasant and reduces QOL
"Look to the future, because that is where you'll spend the rest of your life."

- George Burns
Summary

- Traditional surgery plays a minimal role in the management of post pneumonic empyema
- Surgical procedures: tube thoracostomy, VATS and thoracotomy, by surgeons, for the management of post pneumonic empyema is on the decline
- In the future, it is likely that surgeons will be rarely involved in the management of postpneumonic empyema
General Thoracic Surgery - Death by 1000 Cuts

- Endoscopic Mucosal Resection
- SBRT/RFA
- Percutaneous Tracheostomy
- POEM
- Medical Pleuroscopy
- Endobronchial Stenting
Thank you