Current Management of Empyema

George W. Holcomb, III, M.D., MBA
Surgeon-in-Chief/Senior Vice-President

Children’s Mercy Hospital
Kansas City, Missouri
# Thoracoscopic Operations

## Children’s Mercy Experience (2000-2007)

<table>
<thead>
<tr>
<th>Diagnostic</th>
<th>No. of Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wedge biopsy of solitary lung lesions</td>
<td>37</td>
</tr>
<tr>
<td>Biopsy and excision of mediastinal masses</td>
<td>26</td>
</tr>
<tr>
<td>Wedge biopsy of diffuse parenchymal disease</td>
<td>15</td>
</tr>
<tr>
<td>Evaluation of penetrating thoracic trauma</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>79</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Therapeutic</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Pleural decortication for empyema</td>
<td>79</td>
</tr>
<tr>
<td>Exposure for scoliosis</td>
<td>26</td>
</tr>
<tr>
<td>Bullae resection for pneumothorax</td>
<td>25</td>
</tr>
<tr>
<td>Lobectomy</td>
<td>9</td>
</tr>
<tr>
<td>Repair of esophageal atresia and fistula</td>
<td>8</td>
</tr>
<tr>
<td>Evacuation of hemothorax and pleural effusion</td>
<td>3</td>
</tr>
<tr>
<td>Repair of bronchopleural fistula</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>151</strong></td>
</tr>
</tbody>
</table>
Thoracoscopy - Empyema

Technique

• Initial incision 4th or 5th ICS, AAL
• Use telescope to compress lung and create working space
• 2nd incision opposite 1st one, PAL
Thoracoscopy - Empyema Technique

- 3rd incision (10 mm), 9th or 10th ICS, MAL
- Site for chest tube exteriorization
- 10 mm cannulas, insufflation to 6-8 torr
- 10 mm angled telescope
Thoracoscopy - Empyema

Technique

- Rotate instruments among the three incisions
- Can remove canula, insert curved ring forceps
Thoracoscopy – Empyema Video
Why consider a change in treatment?
Treatment Of Empyema

- Fibrinolysis had been shown to be better than chest tube drainage alone in some retrospective studies.

- Primary thoracoscopic debridement had been shown to be better than tube drainage alone in several retrospective studies.

- At the initiation of this study, there were no comparative data between primary thoracoscopic debridement and fibrinolysis as initial treatment for empyema in children.
Sample Size

• We used our own institution’s retrospective data on length of hospitalization after intervention between thoracoscopic debridement and fibrinolysis with an alpha 0.05 and power of 0.8

• Sample size of 36 was calculated with 18 in each arm

Prospective, randomized trial
Empyema Study Protocol

Fibrinolysis

- 12 Fr tube placed by IR or surgery in procedure room
- 4mg tPA in 40ml NS instilled through tube following insertion and next 2 days (48 hrs)

Thoracoscopy

- Thoracoscopic debridement with chest tube left behind on – 20 cm H2O suction

Empyema Study Protocol
Primary Outcome Measure

- Length of hospitalization after intervention (tPA or thoracoscopic debridement) until discharge criteria met (chest tube removed, afebrile, & oral analgesics)
Empyema Study Protocol
Secondary Outcome Measure

• Days of Tmax ≥ 38°C
• Days of chest tube drainage
• Doses of analgesia
• Days of oxygen requirement
• Hospital charges after intervention
• Procedure charges
# Study Results

## Patient Variables at Consultation

<table>
<thead>
<tr>
<th></th>
<th>VATS</th>
<th>tPA</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age (Years)</strong></td>
<td>4.8</td>
<td>5.2</td>
<td>0.77</td>
</tr>
<tr>
<td><strong>Weight (kg)</strong></td>
<td>24.6</td>
<td>20.7</td>
<td>0.52</td>
</tr>
<tr>
<td><strong>WBC</strong></td>
<td>20.8</td>
<td>19.7</td>
<td>0.71</td>
</tr>
<tr>
<td><strong>O2 support (L/min)</strong></td>
<td>0.81</td>
<td>0.79</td>
<td>0.96</td>
</tr>
<tr>
<td><strong>Days of Symptoms</strong></td>
<td>9.0</td>
<td>10.6</td>
<td>0.32</td>
</tr>
<tr>
<td><strong>ER/PCP visits</strong></td>
<td>2.9</td>
<td>2.7</td>
<td>0.69</td>
</tr>
</tbody>
</table>

### Study Results

**Outcomes**

<table>
<thead>
<tr>
<th></th>
<th>VATS</th>
<th>tPA</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOS (Days)</td>
<td>6.89</td>
<td>6.83</td>
<td>0.96</td>
</tr>
<tr>
<td>O2 Tx (Days)</td>
<td>2.25</td>
<td>2.33</td>
<td>0.89</td>
</tr>
<tr>
<td>PO Fever (Days)</td>
<td>3.1</td>
<td>3.8</td>
<td>0.46</td>
</tr>
<tr>
<td>Analgesic Doses</td>
<td>22.3</td>
<td>21.4</td>
<td>0.90</td>
</tr>
<tr>
<td>Patient Charges</td>
<td>$11,660</td>
<td>$7,575</td>
<td>0.01</td>
</tr>
</tbody>
</table>

16.6% failure rate for fibrinolysis

*J Pediatr Surg 44:106-111, 2009*
• There appears to be no therapeutic or recovery advantages to thoracoscopic debridement compared to fibrinolysis as the primary treatment for empyema.

• Thoracoscopy results in significantly higher patient charges.

Follow-up Study
2008 - 2011

Fibrinolysis has been our initial therapy
• 4 mg tPA in 40 cc saline for 3 days through a 12 Fr chest tube
• 102 consecutive patients
• 15.7% failure rate
• Mean hospitalization after initiation of fibrinolysis –
  • 6.1 d +/- 2.5
• Mean O.R. time after failed fibrinolysis – 65 min
• Mean hospitalization after thoracoscopy – 5.9 d +/- 3.7
Comparison of Urokinase and Video-assisted Thoracoscopic Surgery for Treatment of Childhood Empyema

Samatha Sonnappa, Gordon Cohen, Catherine M. Owens, Carin van Doorn, John Cairns, Sanja Stanojevic, Martin J. Elliott, and Adam Jaffé

Department of Respiratory Medicine, Department of Cardio-Thoracic Surgery, and Department of Radiology, Great Ormond Street Hospital for Children NHS Trust; Portex Anaesthesia, Intensive Therapy and Respiratory Unit, Institute of Child Health; and Department of Public Health and Policy, London School of Hygiene and Tropical Medicine, London, United Kingdom

Background: Despite increasing incidence and morbidity, little evidence exists to inform the best management approach in childhood empyema.

Aim: To compare chest drain with intrapleural urokinase and primary insertion, chest drain and fibrinolytics, mini-thoracotomy, open decortication, and video-assisted thoracoscopic surgery (VATS). However, treatment is not standardized and currently patient care is dependent on local practice and physician preference.

- No difference in LOS (6 v 6 days)
- No difference in 6 month CXR
- VATS more expensive ($11.3K v $9.1K)
- 16 % failure rate for fibrinolysis

Am J Respir Crit Care Med 174:221-227, 2006
• RCT – Urokinase vs Thoracoscopy
• 103 children
• No difference in length of hospitalization
• Failure rates
  • 15% - Thoracoscopy
  • 10% - Urokinase
• Initial treatment should be with fibrinolytics
• Thoracoscopic debridement reserved for fibrinolytic failure
Summary

• Based on several prospective randomized trials, including one from Children’s Mercy – Kansas City, we believe that fibrinolysis should be the initial treatment approach for children with empyema.
Treatment Algorithm

EMPYEMA

- Chest tube with 3 doses of tPA
- Drainage decreased without clinical improvement
- Ultrasound or CT
  - Persistent pleural space disease: VATS
  - No pleural space disease: Continue Antibiotics
QUESTIONS

www.cmhclinicaltrials.com