EMPYEMA

Catheter Based Treatment vs. VATS

UCHSC Department of Surgery
Grand Rounds
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OVERVIEW

• Empyema
  – Pathogenesis
  – Treatment

• Catheter based treatment
  – Fibrinolytics
    • Why it works
    • How to
  – Current Literature

• Conclusions and Recommendations
Empyema

- **Etiology**
  - Chest trauma
  - Surgery
  - TB
  - Malignancy
  - Pneumonia
    - 70% of all empyemas

- **Bacterial pneumonias**
  - Up to 40% - pleural effusions
  - Small + abx = resolution

- **Three stage progression:**
  - Exudative
  - Fibropurulent
  - Organizational
Exudative

- Exudative pleural fluid + neutrophils
  - Induced endothelial injury
- Resorptive capacity of the pleural space is exceeded
  - ~500ml/day subplueral lymphatics
- Resolves with resolution of pneumonia
  - abx
  - +/- drain effusion
Fibropurulent

- Deposition - FIBRIN
  - Possible loculations
  - Fibrin occlusion of lymphatics
  - Opportunity for intervention!
Thoracic Empyema

- **Treatment**
  - Sterilization of cavity
    - abx 4-6 weeks
    - afebrile / leukocytosis resolves
  - Pleural drainage
    - Obliteration of empyema cavity
    - lung expansion
Getting Started

• 250,000 IU Streptokinase in 100ml of NS
  – Bacteria derived protein = antigenic!

• Clamp CT for 3-4 hours

• Rotisserie!

• Unclamp / record output

• Repeat if necessary
  – 12-18 hours
  – No significant activation of systemic fibrinolytic system
Evidence
Main Results -

“Only one small randomised study was identified. (Wait 1997). Some methodological quality considerations cast doubt on the validity of the study…”
<table>
<thead>
<tr>
<th>Reference</th>
<th>Study design</th>
<th>Number of patients/dose</th>
<th>Streptokinase dose (IU)</th>
<th>Success criteria</th>
<th>Success rate (%)</th>
<th>Complications</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Burgh (1977)*</td>
<td>Retrospective case series</td>
<td>12 empyemas</td>
<td>250 000 in 100 ml NS daily; clamped 4 h</td>
<td>Volume of fluid drainage; OKR improvement</td>
<td>89</td>
<td>1 fever; decreased Hgb</td>
<td>Failed conventional drainage; chest tubes 10–12 mm; 2–10 instalations</td>
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<tr>
<td>Lynn (1989)*</td>
<td>Retrospective case series</td>
<td>3 empyemas</td>
<td>250 000 in 100 ml NS daily; clamped 4 h</td>
<td>Clinical and OKR improvement</td>
<td>100</td>
<td>None</td>
<td>Failed chest tube drainage; 4–10 instalations</td>
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<tr>
<td>Mitchell (1989)*</td>
<td>Retrospective case series</td>
<td>9 empyemas</td>
<td>100 000–250 000 in 100 ml NS daily; clamped 4 h</td>
<td>Increased drainage; OKR improvement; no further surgery</td>
<td>44</td>
<td>2 fever; chest pain</td>
<td>Successful only in CPE</td>
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<tr>
<td>Willis-Ediger (1990)*</td>
<td>Retrospective case series</td>
<td>3 empyemas</td>
<td>240 000 in 100 ml NS daily; clamped 4 h</td>
<td>Increased drainage; OKR improvement</td>
<td>100</td>
<td>None</td>
<td>Failed chest tube drainage; 1–10 instalations</td>
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<tr>
<td>Aly (1991)*</td>
<td>Retrospective case series</td>
<td>9 empyemas</td>
<td>250 000 in 100 ml NS daily; clamped 4 h</td>
<td>Increased drainage; OKR improvement; resolution of fever</td>
<td>89</td>
<td>None</td>
<td>Failed chest tube drainage; 1–4 instalations</td>
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<tr>
<td>Hanke (1992)*</td>
<td>Retrospective case series</td>
<td>12 CPE</td>
<td>250 000 in 20–60 ml NS daily; clamped 2 h</td>
<td>Increased drainage; OKR improvement; clinical improvement</td>
<td>67</td>
<td>None</td>
<td>Failed chest tube drainage; 1–7 instalations</td>
</tr>
<tr>
<td>Alfageme (1993)*</td>
<td>Retrospective case series</td>
<td>5 empyemas</td>
<td>250 000 daily</td>
<td>Increased drainage; OKR improvement</td>
<td>100</td>
<td>None</td>
<td>Failed chest tube drainage; none</td>
</tr>
<tr>
<td>Rosen (1993)*</td>
<td>Retrospective case series</td>
<td>120–136 000 I0g in 50 ml NS daily; clamped 2 h; rotate patient</td>
<td>Clinical improvement</td>
<td>100</td>
<td>1 high fever</td>
<td>None</td>
<td>Failed chest tube drainage; 2–6 instalations; paediatric cases</td>
</tr>
<tr>
<td>Bours (1994)*</td>
<td>Prospective case series</td>
<td>20 empyemas</td>
<td>250 000 in 100 ml NS daily; clamped 3 h</td>
<td>Clinical and radiologic improvement</td>
<td>95</td>
<td>1 high fever</td>
<td>Failed chest tube drainage; 3–10 instalations</td>
</tr>
<tr>
<td>Taylor (1994)*</td>
<td>Retrospective case series</td>
<td>15 empyemas</td>
<td>250 000 in 100 ml NS daily; clamped 3 h</td>
<td>Clinical outcome; OKR improvement; CT guidance</td>
<td>73</td>
<td>None</td>
<td>Failed chest tube drainage; 4–6; 8–12F catheters</td>
</tr>
<tr>
<td>Chin (1994)*</td>
<td>Prospective case series</td>
<td>11 empyemas</td>
<td>250 000 in 100 ml NS daily; clamped 3 h</td>
<td>Clinical and radiologic improvement;OKR + OKR assessment</td>
<td>69</td>
<td>None</td>
<td>Failed chest tube drainage; 1–10 instalations</td>
</tr>
<tr>
<td>Saurus-Sanchez (1996)*</td>
<td>Prospective multicentre case series</td>
<td>20 empyemas</td>
<td>250 000 in 100 ml NS daily; clamped 4 h; patient rotation</td>
<td>Clinical and radiologic resolution; OKR + OKR assessment</td>
<td>69</td>
<td>2 transient AMS; 3 pluricase pain; 1 low grade fever; chest pain</td>
<td>Failed chest tube drainage; 2–10; riocatheter</td>
</tr>
<tr>
<td>Labaer (1996)*</td>
<td>Retrospective case series</td>
<td>21 empyemas</td>
<td>250 000 in 100 ml NS daily; clamped 3 h</td>
<td>Increased OKR improvement</td>
<td>68</td>
<td>1 rash; chest pain; favor bleeding</td>
<td>Failed chest tube drainage; 2–8; 1 instations</td>
</tr>
<tr>
<td>Rougie (1996)*</td>
<td>Retrospective case series</td>
<td>16 empyemas</td>
<td>250 000 in 20–50 ml NS daily; clamped 2 h; or via needle CT guidance</td>
<td>Increased OKR improvement</td>
<td>88</td>
<td>1 chills; chest pain; favor bleeding</td>
<td>Failed chest tube drainage; 1–9; 1 instations</td>
</tr>
<tr>
<td>Chin (1997)*</td>
<td>Prospective case series</td>
<td>22 empyemas</td>
<td>250 000 in 100 ml NS daily; clamped 4 h</td>
<td>Plural drainage &lt;50 ml; clinical &amp; radiologic resolution</td>
<td>78</td>
<td>None</td>
<td>1–10 instalations</td>
</tr>
<tr>
<td>Bours (1997)*</td>
<td>Prospective case series</td>
<td>23 empyemas</td>
<td>250 000 in 100 ml NS daily; clamped 3 h</td>
<td>OKR + OKR + OKR + OKR improvement</td>
<td>95</td>
<td>2 high fever</td>
<td>Failed chest tube drainage; 3–10; 1 instations</td>
</tr>
<tr>
<td>Doerres (1997)*</td>
<td>Prospective case series</td>
<td>20 empyemas</td>
<td>250 000 in 20 ml NS daily</td>
<td>Clinical outcome; OKR; CT</td>
<td>92</td>
<td>None</td>
<td>14F catheter; none required; systemic fibrinolysis or bleeding did not occur</td>
</tr>
<tr>
<td>Warr (1997)*</td>
<td>Prospective randomised SK vs saline</td>
<td>9 empyemas</td>
<td>250 000 in 100 ml NS daily</td>
<td>&gt;50% of original fluid volume drained; T ≤38°C; WBC ≤11 K</td>
<td>44</td>
<td>Not reported</td>
<td>36F chest tube; 5K failures salvaged with VATS</td>
</tr>
</tbody>
</table>

NS = normal saline; SK = streptokinase; VATS = video-assisted thoracoscopic surgery; US = ultrasound; OKR = chest radiography.
Streptokinase Efficacy

- Randomized, single institution, 24 patients
- CAP and parapneumonic effusion (all infected)
- Randomized to Streptokinase or Saline
  - 14 f catheter; 250,000 U SK daily x 3 days
  - Appropriate abx given
- Results
  - SK group
    - Drained greater amount of fluid (daily and overall)
    - Greater improvement on x-ray
    - None required surgical intervention
  - 3 pts in control group required surgery
  - No clinical evidence of systemic fibrinolysis

Davies et al., Thorax
1997;52:416-421
Pediatric Empyema
Catheter Based Treatment

• Single institution, 32 patients, parapneumonic effusions
  – Group 1 = pleural fluid volume > 1/3\textsuperscript{rd} of involved lung
  – Group 2 = air fluid levels, multiple loculations, necrotic debris, pleural thickening

• Treatment
  – 25,000 IU/kg SK in NS, clamped 4h, repeat q 12-18h
  – Continued treatment if > 100ml / day
  – Terminated if resolution of fever, symptoms, drainage < 50ml / 24 hr, and significant improvement on imaging (eg full lung expansion)
  – Non-responders to SK = VATS

• Results
  – Group 1- 96% avoided surgery
  – Group 2- 72.2% avoided surgery
VATS vs. Urokinase
Childhood Empyema

- PRT, single institution, 60 patients
  - Randomized on presentation to VATS or UK tx
  - Catheter drainage
    • Image guided catheter; UK q 12 hours x 3 days
    • Failure = 4d + fever + fluid collection

- Results
  - No difference - duration of hospital stay
  - Failure rates similar = 5 failures
    • VATS ARM - 4 conv to thoracotomy; 1 VATS x 2
    • UK ARM - 5 needed VATS or thoracotomy
  - Expense
    • VATS on average = $2,250 more expensive
    • U.S. = ~ 6,660 cases of empyema / year
    • Savings = $15 million / year
Keys to Success

• Drainage of parapneumonic effusion
  – Correct placement of tubes (image guidance)
  – Drain it EARLY

• Fibrinolytic treatment
  – EARLY
  – Frequent monitoring with repeat dosing

• The PROPER and EARLY use of intrapleural fibrinolytics obviates the need for surgery in most cases of pneumonia with parapneumonic effusion!
References

5. Use of fibrinolytic agents in the management of complicated parapneumonic effusions and empyemas. Thorax 1998;53(Suppl 2);565-572