CHEST TUBE COMPLICATIONS
THE GOOD, THE BAD AND THE UGLY

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The “Good”
why we do it

ANATOMY

From Moore & Dalley 1969
HISTORY

• ~440 BC empyema tx: incision, cautery, and insertion of metal tube

• 1876 Continuous instillation of antiseptic

• 1918 Empyema Commission

WHY

• Drainage of pleural space.

  • Pus
  • Fluid
  • Blood
  • Air
  • Chyle (rare)
HEMOTHORAX

- 102 pts. who underwent tube thoracostomy in the emergency department were followed
- Chest tubes were placed within 45±30 min of arrival
- 24h blood loss via CT was 817±823 mL
- Nine patients (9%) developed empyema:
  - Residual hemothorax 33%
  - No residual hemothorax 2%
  - p=0.001
- Significant association (regression):
  - Injury Severity Score
  - Residual Fluid conferred a 1.25-fold (95% CI 1.17 - 1.35) increased risk of empyema

PREHOSPITAL

- Tension pneumothorax a rapid killer
- Needle decompression of chest can be life saving
LOCATION

- 25 physicians, 84% ATLS cert.
- 88% identified correct landmark
- 60% correctly identified the 2nd intercostal space
- All placed needle medial to the midclavicular line
- 8% named site of needle pericardiocentesis

LOCATION

- 680 pts., mean BMI 27.9 (15.4-60.7)
- 5th ICS @ Ant. Axillary Line 13 mm shorter than 2nd ICS @ mid-clavicular
- 42.5% of patients “thicker” than standard 5-cm decompression needle

OUTCOMES

- George Washington Memorial Bridge
- Historical Control trial
- Survival from 50m fall
- Airway Management, Needle Decompression, Volume Resuscitation
**BLUNT TRAUMA**

- Survival from 50m fall
- Before: 11% survival
- After: 31% survival

![Graph showing survival rates from 1950-1969](Image)

**UNEXPECTED SURVIVORS**

- Review of Needle Thoracostomy in 2006
- 39 patients received decompression
- 18% survival in cardiac arrest group

![Graph showing survival rates](Image)

**UNEXPECTED SURVIVORS**

- 336 adult trauma pts. with ISS > 15, chest AIS ≥ 3
- Mortality 13% (CI 12.3–13.7%)
- 20 “unexpected survivors” (5.9%) and 5 “unexpected deaths” (1.5%)
- Unexpected survivors:
  - 80% intubated prehospital
  - 35% chest decompression prehospital
- Unexpected deaths:
  - 0% intubated prehospital
  - 0% chest decompression prehospital

![Diagram showing survival rates](Image)
THE “BAD” areas of uncertainty

TEACHING

• Evaluation of chest tube training in medical students, residents, and the US Army Forward Surgical Team members rotating through the institution.

• One hundred twenty-eight subjects
  – 67% residents or US Army FST members
  – 77% novices
  – 23% experts

Critical Elements for Chest Tube Insertion

1. Identify insertion site 5th intercostal anterior MAM on affected side or nipple line (not in children)
2. Sterile preparation of chest
3. Anesthetize skin and subcutaneous tissue and pericardium of underlying rib and pleura just above the rib
4. 2 cm incision transverse incision parallel to the line of ribs at the predetermined site with a 11 scalpel
5. Bluntly dissect the subcutaneous tissue with a hemostat or scissors
6. Gently open the top of the underlying rib in the most lateral intercostal space
7. With the tip of the hemostat puncture the parietal pleura while pushing the top border of the rib
8. Enter pleural space over the top of the ribs to avoid damaging the neural vascular bundle
9. Enter in a parallel fashion to avoid laceration to the lung
10. Once inside the pleura spread the hemostat widely and withdraw while still open
11. Create a sufficient opening in the pleura for the chest tube
12. Place finger inside half of pleural space and move finger 90 degrees to confirm correct location and advance on injection with dilator
13. Clot or saline is injected and aspirated
14. Connect to an underwater seal collection chamber
## TEACHING

### Steps Most Frequently Performed

<table>
<thead>
<tr>
<th>Step</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Sterile preparation</td>
</tr>
<tr>
<td>2.</td>
<td>Connect chest tube to wall suction</td>
</tr>
<tr>
<td>3.</td>
<td>Avoid the neurovascular bundle</td>
</tr>
<tr>
<td>4.</td>
<td>Spread herniated diaphragm</td>
</tr>
<tr>
<td>5.</td>
<td>Place finger inside pleura to check for adhesions</td>
</tr>
</tbody>
</table>

### Size

- Prospective observational study of all patients requiring open chest tube drainage w/in 12 hours
- Small chest tubes (28–32 Fr) vs. Large (36–40 Fr)
- 275 CT for Hemothorax
  - 52.3% small & 47.7% large
  - Larger tubes were placed more frequently in patients with:
    - GCS < 8, severe TBI, SBP < 90, ISS > 25
  - No difference in:
    - Volume of blood drained
    - Duration of tube placement
    - Pneumonia
    - Empyema
    - Retained hemothorax
    - VATS
    - Thoracotomy
    - Pain

## Duration

- 19,831 pts. lobectomy for lung cancer
- Hospital volume:
  - low (<24 per year)
  - medium-low (25 to 43)
  - medium-high (44 to 67)
  - high (>68)
- Chest tube removal occurred earlier in the high-volume group than in the low-volume group (mean 4.0 days versus 5.1; p < 0.001)
WHEN TO REMOVE

• Randomized trial of <150mL vs. <200mL 24h chest tube drainage as removal criteria
• Baseline characteristics were comparable
• shorter LOS in <200mL group: 4.1 vs. compared to 4.8, p=0.04
• no differences in:
  – radiological reaccumulation
  – thoracentesis

Hessami 2009

POST-REMOVAL CXR

• 214 TICU pts. with chest tube, <150mL drainage on H2O seal
• serial CXRs were obtained 1, 10, and 36 hours after removal
• None of the patients experienced hemodynamic or respiratory deterioration after chest tube removal
• 12% pneumo, all present on initial CXR
• 3% required intervention

Pizano 2002

OUTPATIENT RESIDUALS

• Observation of post-pull pneumo or effusion in 710 pts.
• 21.3% had pneumothorax or effusion on discharge
• 4% required intervention
• readmission rate higher: 6.6% vs. 0.7%
• persistent effusion or pneumo on outpt. evaluation associated with readmission

Kugler 2015
PNEUMOTHORAX

- Pneumothoraces, including primary spontaneous pneumothorax (PSP), secondary spontaneous pneumothorax (SSP), and traumatic and iatrogenic pneumothoraces
- Compare the effectiveness of drainage via:
  - single-lumen (5F catheter) central venous catheter
  - conventional (14-20F catheter) chest tube
- 212 patients:
  - 55% PSP
  - 13% SSP associated with chronic obstructive pulmonary disease
  - 9% traumatic pneumothorax
  - 23% iatrogenic pneumothorax
- Failure rate similar between CVC and CT (18% vs 21%, P = .60)
- Durations of drainage shorter in CVC 3.3 vs 4.6 days, P<0.01
- Hospital LOS shorter

Contou 2012

THE “UGLY” case review

UW Medicine

PNEUMOTHORAX

- Pts. with a first episode of symptomatic PTX
- Randomized to Manual Aspiration or Chest Tube
- 56 pts. included. Baseline characteristics were similar.
- Immediate success rates:
  - 66.0% manual aspiration
  - 80.6% for chest tube (p = 0.26).
- Two week success rates were 100% in both groups.
- Hosp. LOS shorter in aspiration group: significant difference in hospital stay in favour of MA: 2.4 vs 4.4 days (p < 0.02).
- One year recurrence rates in aspiration trended lower: 4.0% vs 12.9% p = 0.37

Parise 2012
CASE 1

CASE 2

CASE 3
SUMMARY

• Use it only if you need it
• Most experienced operator present
• Touch the pleura on insertion
• Smallest tube for the application
• Remove as soon as possible