Complications after pleural chest tube placement

Dr. Luigi Festi

U.O. Chirurgia Generale ad indirizzo Toracico
Ospedale Universitario di Circolo
Varese
British Thoracic Society (BTS) guidelines suggest that a chest drain should be inserted for:

- Malignant pleural effusion
- Empyema
- Traumatic haemothorax
- Pneumothorax
- Postoperatively
Absolute contraindications do not exist per se, although coagulopathies and platelet defects might weigh on the clinician’s judgment.
Clinical guidelines

- The site of chest tube insertion should generally be in the “safe triangle”, in the mid axillary line.
- Imaging should be used to select the appropriate site for chest tube placement.
- Ultrasonography guided insertion can help ensure the placement is safe.
- Small bore drains should be inserted under image guidance with a guidewire (dissection not required).
- Blunt dissection must be performed if a large bore chest drain is inserted.
- A chest radiogram must be available at the time of insertion except in the case of tension pneumothorax.

“Safe triangle”

Any other placement of a chest drain outside the “triangle of safety” should be discussed with a senior clinician:

- Apical pneumothorax
- Loculated effusion

*BTS guidelines*
Finger sweep

- To ensure the lung is non-adherent to the chest wall before tube placement
- To place the chest tube on the superior rib margin to avoid injuring the inferior intercostal neurovascular bundle

Chest drain insertion is not a harmless procedure – are we doing it safely?
Elsayed H et al, Interactive CardioVascular and Thoracic Surgery, 2010
Sample incidents are given below:

- **Death**: puncture of heart, lungs, liver and haemorrhage
- **Severe harm**: inserting the drain in the wrong side, damages to vessels, trachea and liver during insertion
- **Moderate harm**: poor management of the drain once inserted (e.g. underwater seal not maintained, inappropriate clamping or failure to clamp). Other incidents relate to delays in insertion because of the non availability of equipment, delay in obtaining x-rays and/or the interpretation of the x-rays

_NHS, National Patient Safety Agency, 2008_
• The National Patient Safety Agency (UK) reported 2152 complications that were related to chest drain placements between January 2005 and March 2008.
• 15 serious complications
• 12 fatalities were reported
• Most serious complications were related to the site of drain insertion
• The use of trocar-chest tube has been linked to a significant incidence of intraparenchymal and intrafissural insertion of chest drains (21% intrafissural and 9% intraparenchymal, by Remérand et al)

Imaging Review of Procedural and Periprocedural Complications of Central Venous Line, Percutaneous Intrathoracic Drains, and Nasogastric Tubes, Al-Jahdali H et al, Pulmonary Medicine, 2012
Complications:

- **Perforation** (Pericardium, cardiac chambers, aorta, thoracic duct, stomach, spleen, liver)

  Pseudopneumothorax!!
  (lung bullae, diaphragmatic rupture, stomach contents)

*Imaging Review of Procedural and Periprocedural Complications of Central Venous Line, Percutaneous Intrathoracic Drains, and Nasogastric Tubes, Al-Jahdali H et al, Pulmonary Medicine, 2012*
Complications:

- Intercostal artery bleeding
- Unilateral pulmonary edema
- Misplacement
- Subcutaneous or direct abdominal placement
- *Infarction of a peripheral segment of lung (rare)*
- *Subcutaneous emphysema*
- *Pleural empyema*
- *Tube dislodgment*
- *Tube obstruction*
- *Tube rupture*
- *Wound infection or bleeding*  

* late complications
### Table 2. Complications of ED TT Placement in 90 Patients

<table>
<thead>
<tr>
<th>Complication</th>
<th>Count (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Immediate complications (total)</td>
<td>63 (70.0%)</td>
</tr>
<tr>
<td>Intercostal vessel laceration</td>
<td>1 (1.1%)</td>
</tr>
<tr>
<td>Retroperitoneal placement</td>
<td>1 (1.1%)</td>
</tr>
<tr>
<td>Misplacement</td>
<td></td>
</tr>
<tr>
<td>Kinked</td>
<td>9 (10.0%)</td>
</tr>
<tr>
<td>Advanced too deeply</td>
<td>26 (28.9%)</td>
</tr>
<tr>
<td>Advanced too deeply and kinked</td>
<td>4 (4.4%)</td>
</tr>
<tr>
<td>Inadequately advanced</td>
<td>11 (12.2%)</td>
</tr>
<tr>
<td>Unresolved pneumothorax</td>
<td>11 (12.2%)</td>
</tr>
<tr>
<td>Delayed complications (total)</td>
<td>40 (44.4%)</td>
</tr>
<tr>
<td>Empyema</td>
<td>2 (2.2%)</td>
</tr>
<tr>
<td>Reaccumulation of pneumothorax</td>
<td>35 (38.9%)</td>
</tr>
<tr>
<td>Insertion site infection</td>
<td>2 (2.2%)</td>
</tr>
<tr>
<td>Persistent pleural effusion</td>
<td>1 (1.1%)</td>
</tr>
</tbody>
</table>

* 13 patients had both an immediate and a delayed complication.
The table below provides the number of chest tubes placed and the rate of malpositioning for different approaches. The anterior approach is located at the 2nd intercostal space on the mid-clavicular line, while the lateral approach is at the 5th intercostal space on the mid-axillary line.

### Table 2: Chest tubes placed and rate of malpositioning

<table>
<thead>
<tr>
<th>Malposition Type</th>
<th>Overall Number</th>
<th>Ventral Approach</th>
<th>Lateral Approach</th>
<th>p-Value</th>
<th>RR (95% CI)</th>
<th>NNT (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radiological Malposition</td>
<td>101</td>
<td>21 (20.8%)</td>
<td>80 (79.2%)</td>
<td>0.15</td>
<td>38.1% (9.7-150.2%)</td>
<td>6 (CI 95%; 0-383)</td>
</tr>
<tr>
<td>Extrathoracic</td>
<td>22 (21.8%)</td>
<td>2 (9.5%)</td>
<td>20 (25.0%)</td>
<td>0.42</td>
<td>n.a.</td>
<td>—</td>
</tr>
<tr>
<td>Abdominal</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1.00</td>
<td>n.a.</td>
<td>—</td>
</tr>
<tr>
<td>Parenchymal</td>
<td>4.0</td>
<td>1 (4.5%)</td>
<td>3 (3.8%)</td>
<td>0.045</td>
<td>127.0% (13.9-1159.4%)</td>
<td>99 (CI 95%; 9-∞)</td>
</tr>
<tr>
<td>Interlobar</td>
<td>17 (16.8%)</td>
<td>0</td>
<td>17 (21.3%)</td>
<td>0.013</td>
<td>n.a.</td>
<td>—</td>
</tr>
<tr>
<td>Functional Malposition</td>
<td>6 (5.9%)</td>
<td>1 (4.5%)</td>
<td>5 (6.3%)</td>
<td>0.66</td>
<td>76.2% (9.4-617.6%)</td>
<td>67 (CI 95%; 8-∞)</td>
</tr>
</tbody>
</table>

**RR:** relative risk; **NNT:** number needed to treat.

* Functional malposition was defined as radiological malposition with a clinical need for repositioning of the chest tube.

* p derived from Fisher's exact test; n.a.: not applicable.
Complications after chest tube insertion: nursing staff

- Correct functioning of chest tubes (variation in the fluid within the tubing when the patient breathes quietly, obstruction and dynamic obstruction in case of posterior chest tube, aspiration, correct junction of tubes)
- Change of the fluid and/or air-leakage
- Subcutaneous emphysema
- Insertion site infection or bleeding
Clinical governance leads in local organisations should audit current practice and develop local policies to ensure:

- Chest drains are only inserted by staff with relevant competencies and adequate supervision
- Ultrasound guidance is strongly advised when inserting a drain for fluid
- Clinical guidelines are followed and staff made aware of the risks, reflecting the question above
- Identify a lead for training of all staff involved in chest drain insertion
- Written evidence of consent is obtained from patients before the procedure, wherever possible
- Local incident data relating to chest drains is reviewed and staff encouraged to report further incidents

Because of the risks from inserting chest drains, the clinical team should question:

- Do I need to do this?
- Does it need to be done as an emergency-can it wait?
- Have I had enough training to feel confident to do this? Are senior staff to hand?
- Am I familiar with this equipment?
- Is ultrasound available, with trained staff, to position it safely?
Take home message:

• Chest tube insertion should be made by experienced clinicians
• First aid clinicians can proceed to chest drainage in case of emergency (anterior approach* is preferred in case of tension pneumothorax)
• Chest tubes management should be ensured by medical/nursing staff

* 2nd intercostal space on mid-clavicular line