Chest Trauma
Intercostal Chest Drains

Drainage of the pleural space by means of a chest tube is the commonest intervention in thoracic trauma, and provides definitive treatment in the majority of cases. While a relatively simple procedure, it carries a significant complication rate, reported as between 2% and 10%. While many of these complications are relatively minor, some require operative intervention and deaths still occur.

Indications

A chest tube is indicated to drain the contents of the pleural space. Usually this will be air or blood, but may include other fluids such as chyle or gastric/oesophageal contents. Chest tube insertion is also appropriate to prevent the development of a pleural collection, such as after a thoractomy or to prevent a tension pneumothorax in the ventilated patient with rib fractures.

Absolute Indications

- Pneumothorax (tension, open or simple)
- Haemothorax
- Traumatic Arrest (bilateral)

Relative Indications

- Rib fractures & Positive pressure ventilation
- Profound hypoxia / hypotension & penetrating chest injury
- Profound hypoxia / hypotension and unilateral signs to a hemithorax

In most cases it is appropriate to wait for the chest X-ray to identify a pneumothorax or haemothorax before placing a chest tube. A haemothorax may also be identified on FAST ultrasound examination. However there are instances where the patient is in extremis and it is appropriate to place a chest tube without waiting for imaging studies. Patients in traumatic arrest with no cardiac output should have immediate decompression of both chest hemithoraces to exclude tension pneumothorax. Similarly, patients in shock or profoundly hypoxic with unilateral chest signs or evidence of penetrating trauma to a hemithorax should have a chest drain placed emergently.

Chest tube placement may be diagnostic as well as therapeutic. After entering the pleural cavity a finger is inserted, and depending on the position of the tract one may feel the texture of the lung surface (for contusion), the surface of the diaphragm (for lacerations) and the heart (for the presence of tamponade).

The nature of the materal draining from the tube is also important. If it is blood, the chances of requiring a thoracotomy are much higher if the blood is bright red and arterial rather than the dark red of venous blood. Drainage of intestinal contents implies either an oesophageal injury or stomach / bowel injury with diaphragmatic tear. A persistent air leak implies an underlying lung laceration, and large leaks may indicate bronchial disruption.

Technique

Although often performed in emergent conditions, attention to technique in placing the chest tube is vital to avoid complications from the procedure.

Site

The chest tube is placed (on the correct side) in the mid- or anterior- axillary line, behind pectoralis major (to avoidhaving to dissect through this thick muscle). On expiration, the diaphragm rises to the 5th rib at the level of the nipple, and thus chest drains should be placed above this level. Rib spaces are counted down

CHEST TRAUMA

INITIAL EVALUATION
PNEUMOTHORAX
TENSION PNEUMO
OPEN PNEUMO
HAEMOTHORAX
CONTUSION
RIB FRACTURE / FLAIL
AORTIC INJURY
CHEST DRAINS

CHEST DRAIN

PRIMARY SURVEY
AIRWAY
BREATHING
CIRCULATION
DISABILITY
EXPOSURE

ADJUNCTS
CXR
FAST

SECONDARY SURVEY

Prehospital chest tube insertion

Site of insertion

from the 2nd rib at the sternomanubrial joint. Practically, the highest rib space that can be easily felt in the axilla (usually the 4th or 5th) is the most appropriate.


Site of insertion

Anaesthesia / Analgesia

Chest tube insertion is a painful procedure, especially in muscular individuals. A combination of intravenous analgesia and local anaesthesia is used for the procedure. An intravenous opioids such as morphine is standard analgesia for trauma patients. It is best given in small aliquots titrated to effect, to avoid subsequent respiratory depression from overdose. An analgesic dose of ketamine (20mg adult) is a good alternative to opioids for chest tube insertion.

For local anaesthesia, 10-20mls of local anaesthetic is required. This is infiltrated under the skin along the line of the incision. The needle is then directed perpendicular to the skin and local anaesthetic infiltrated through the layers of the chest wall down onto the rib below the actual intercostal space. Here local is injected around the periosteum of the rib. The needle is then angled above the rib and advanced slowly until air is aspirated. The last 5 mls or so of local anaesthetic is then injected into the pleural space.


Digital exploration

Procedure

The steps in insertion of a chest drain are as follows:


Drain insertion

1. The area is prepped and draped appropriately
2. An incision is made along the upper border of the rib below the intercostal space to be used.
   The drain track will be directed over the top of the lower rib to avoid the intercostal vessels lying below each rib.
   The incision should easily accommodate the operator's finger.
3. Using a curved clamp the track is developed by blunt dissection only. The clamp is inserted into muscle tissue and spread to split the fibres. The track is developed with the operator's finger.
4. Once the track comes onto the rib, the clamp is angled just over the rib anddissection continued until the pleural is entered.
5. A finger is inserted into the pleural cavity and the area explored for pleural adhesions.
   At this time the lung, diaphragm and heart may be felt, depending on position of the track.
6. A large-bore (32 or 36F) chest tube is mounted on the clamp and passed along the track into the pleural cavity.
7. The tube is connected to an underwater seal and sutured / secured in place.
8. If desired, a U-stitch is placed for subsequent drain removal (see below).
9. The chest is re-examined to confirm effect.
10. A chest X-ray is taken to confirm placement & position.


Drain sutured in place


Underwater Seal

Position

For blunt trauma patients lying supine, drains should be placed anteriorly in the chest. This pevents a tension pneumothorax developing if the chest tube is blocked by dependent lung tissue. Normal movement of the lungs will allow drainage of a basal haemothorax through an anterior chest tube.


Drain in oblique fissure blocked by lung tissue

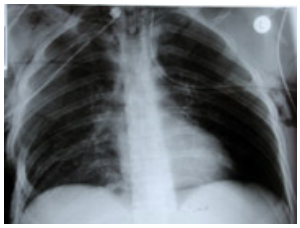

Lower chest CT showing tension pneumothorax

For penetrating trauma where patients are not restricted to the

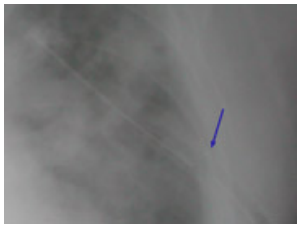
supine position, haemothoraces may be more efficiently drained with a posterior, basally directed drain.

The final resting place of the tube is determined in part by the direction of the track it follows through the chest wall. If a drain is to lie anteriorly in the chest, the track should be developed in a slightly anterior direction. If the track is directed posteriorly, the drain may fall back to lie in the oblique fissure, where it may become blocked with lung tissue.

Chest tubes should be inserted so that the last hole of the drain is inside the thoracic cavity. However if passed too far into the chest, drains can cause severe intractable pain as they abut the mediastinum.



Drains inserted too far into thoracic cavity



Drain not fully inserted Last hole nearly out

Underwater Seal

An underwater seal is used to allow air to escape through the drain but not to re-enter the thoracic cavity. The drainage bottle should always be kept below the level of the patient, otherwise its contents will siphon back into the chest cavity.

Persistent bubbling of air through the water indicates an air leak from the lung. Chest tubes should NEVER be clamped for any reason, to avoid the development of a tension pneumothorax.

The air outlet of the underwater seal may be connected to moderate suction (-20cm water) to assist in lung re-expansion. This is more important in the presence of an air leak.

Removal

Chest drains may be removed when they are no longer draining any fluid and any air leak has resolved. Removal is ideally performed with two people - one to remove the tube and one to occlude the drain site. The tube should be removed either at the end of expiration or at peak inspiration, to avoid further air being entrained into the pleural cavity.

The area is cleaned and sterilised. An occlusive dressing is prepared and held ready. Any stay sutures are removed. With the patient holding his breath (out or in), the tube removed rapidly and the occlusive dressing applied.

Some surgeons prefer to use a purse-string or U-suture to close the wound. This may be placed at the time of drain insertion. While there is no detriment in using a closing suture, they probably serve little purpose and the purse-string especially may produce an ugly scar.

Complications

"There is no organ in the thoracic or abdominal cavity that has not been pierced by a chest drain." Chest drains used to be inserted with a steel trocar and a lot of brute force. If a trocar comes with the chest drain set it should be discarded or only used to hold up tomato plants.

Acute complications (technique)

- Haemothorax, usually from laceration of intercostal vessel (may require thoracotomy)
- Lung laceration (pleural adhesions not broken down)
- Diaphragm / Abdominal cavity penetration (placed too low)
- Stomach / colon injury (diaphragmatic hernia not recognised)
- Tube placed subcutaneously (not in thoracic cavity)

- Tube placed too far (pain)
- Tube falls out (not secured)

Late complications

- Blocked tube (clot, lung)
- Retained haemothorax
- Empyema
- Pneumothorax after removal (poor technique)

References

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