

TUBE THORACOSTOMY

Indications:

• **Pneumothorax:**

- (*recall the British Thoracic Guidelines for PTx*)
- Chest tube placement as routine initial intervention is likely not necessary in healthy patients with small primary spontaneous or isolated small traumatic PTXs in the absence of respiratory compromise, concomitant injuries or when PPV will not be required.
- Most patients with *secondary spontaneous pneumothorax* have enough underlying disease to eventually require a chest tube.
- For patients with *traumatic aetiologies* the rapidity and type of treatment depends primarily on the stability of the patient.
 - Hypotensive patients w/ *tension PTX* require immediate decompression w/ either needle thoracostomy or chest tube.
 - A formal tube thoracostomy *must follow* all attempts at needle decompression.
 - Strongly considered in those with penetrating chest injury requiring either *PPV or long-distance retrieval*.

• **Haemothorax:**

- Used to monitor the amount and rapidity of blood output (which also determines the need for additional interventions).
- ~75% of traumatic haemothoraces can be managed with ICC & volume replacement alone.
 - The rest require immediate or delayed thoracotomy.

Indications for Surgery after Tube Thoracostomy Based on the Results of the Thoracostomy

Massive hemothorax, >1000–1500 mL initial drainage
Continued bleeding
>300–500 mL in 1st hr
>200 mL/hr for first 3 or more hr
Increasing size of hemothorax on chest film
Persistent hemothorax after two functioning tubes placed
Clotted hemothorax
Large air leak preventing effective ventilation
Persistent air leak after placement of second tube or inability to fully expand lung

• **Empyema:**

- Depends on the severity of disease, but thick pus, + gram stain, pH < 7.20, raised LDH or low glucose all require chest tube drainage.
- Therapy should not be delayed as fluid can become loculated.
- Tube left in place until volume is <150mL in 24hours (or fluid is clear yellow).
- Failed resolution or multiple locules on CT = surgical thoracoscopic decortication.

Contraindications:

- **Unstable patients:** there are *no absolute contraindications*.
- In **critical patients**, placement of the chest tube is often performed empirically (ie. confirms presence and extent of pathology, or excludes the pathology).
- For **stable patients**, relative contraindications include:
 - presence of multiple pleural adhesions
 - emphysematous blebs
 - scarring.
 - profound coagulopathy.

Treatment:

- **Tension PTX during Resuscitation:**
 - Immediate decompression of the chest must be considered in all injured patients who present in extremis with unexplained hypotension (particularly those with penetrating chest injuries).
 - Goal:
 - To open the chest cavity quickly to allow accumulated air to escape.
 - HOW?
 - Needle decompression
 - Scalpel & Forceps = open thoracostomy / “finger thoracostomy”
- **Pre-Hospital Treatment:**
 - When a patient suspected of PTX decompensates or presents in extremis.
 - HOW?
 - Needle decompression / catheter insertion.
 - Attachment to ‘flutter valve’, “Heimlich valve” or UWS-drain.
 - Alternatively, 3-sided occlusive dressing to cover open-wound.
- **ED Treatment:**
 - Standardised chest-tube tray (instruments in Table below...)
 - Most basic needs are:
 - Scalpel
 - large Kelly clamp
 - the chest tube.

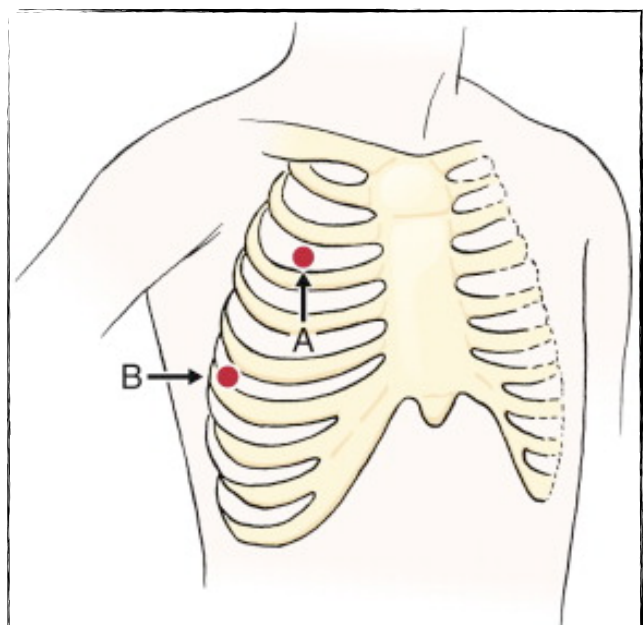
The Procedure:

- Consent
- Gown / Gloves / Mask / Goggles
- Correct site / side.

Standard sites for tube thoracostomy.

A) 2nd IC space. MC line.

B) 4-5th IC space. Midaxillary line.



Recommended Equipment for Tube Thoracostomy

Procedure

Sterile drapes

10- to 20-mL syringe and assorted needles (for local anesthesia)

Local anesthetic (1%–2% lidocaine)

Antiseptic solution

No. 10 scalpel

Large clamps (Kelly)

Needle holder

Chest tubes (size appropriate)

No. 0 or 1-0 silk or similar suture

Forceps

Straight (suture) scissors

Large, curved (Mayo) scissors

Soft arm restraints

Drainage System and Tubing

Drainage apparatus with sterile water for water seal

Hard plastic serrated connectors

Sterile tubing

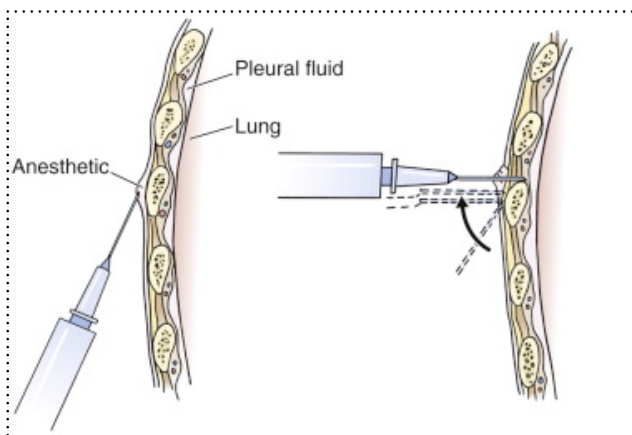
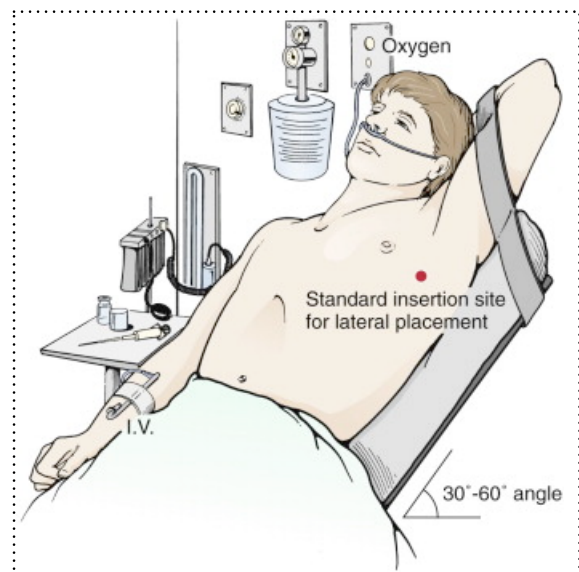
Dressing

Petroleum gauze or similar occlusive dressing

Gauze or similar pads

Patient preparation:

- Oxygen / continuous pulse oximetry.
- Elevate head of bed to 30-60°
 - Lowers the diaphragm.
- Elevate arm on effected side over the head & restrained.
- Skin should be cleaned with standard surgical scrub and draped sterilely.



Anaesthetic:

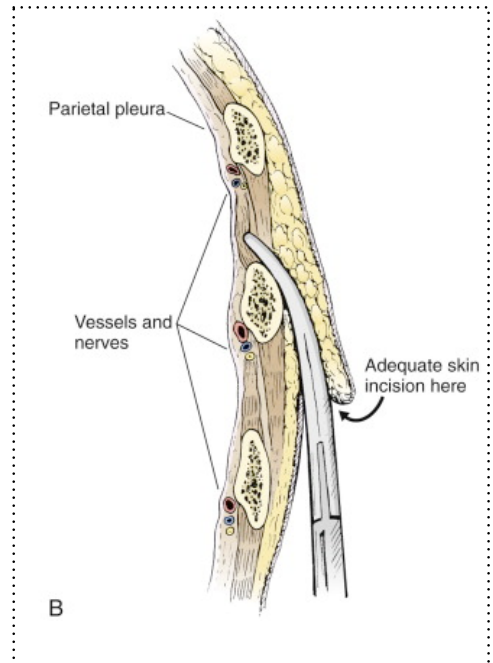
- Parental analgesics or procedural sedation for awake patients.
- Generous LA (5mL/kg lignocaine) infiltration.
- Anticipate the tract of the tube.
- Aim to aspirate air or fluid (change sites if not found).
- Further anaesthetic can be administered to the pleura, once the tube is placed.

Insertion:

A common problem: the skin incision is too short to create & maintain an adequate track to insert the thoracostomy tube.



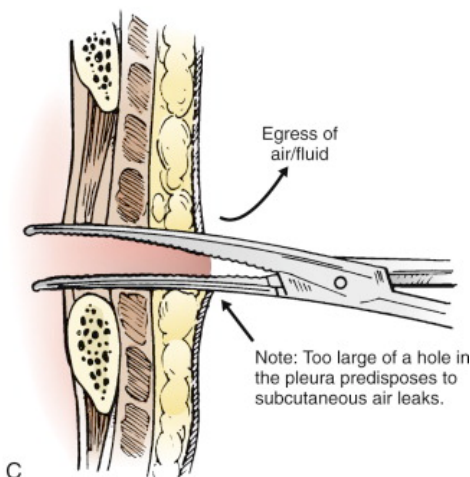
- Incision should be at least 3-5cm long.
- Incise w/ scalpel directly over the rib below the space chosen.



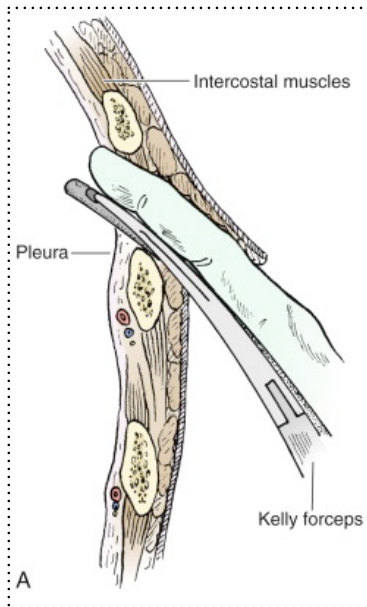
- Large Kelly clamp is used to push & spread the deeper tissues & 'blunt dissect' a track over the rib
- Aiming 'on top of the rib below'
- Firm resistance is felt upon reaching the parietal pleura.
 - @ this point, with the clamp closed - firm pressure is made to penetrate the cavity.



To prevent penetrating too deeply, hold the clamp mid-shaft a few cm's distal to the incision (as above).



- With only the clamp tips in the pleural cavity, the clamp is spread to make an adequate pleural entry and then withdrawn (place finger in track prior to clamp removal).
- This should be wide enough to comfortably insert a finger & tube.
- Avoid excess dilation which predisposes to egress of air & subcutaneous emphysema.



The tube can be passed alone or held in a large curved clamp (and into the pleura prior to withdrawing the clamp).

**** Ensure that all the holes in the tube are within the pleural space.**

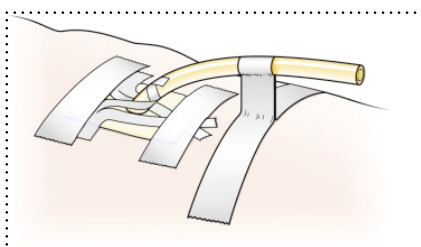
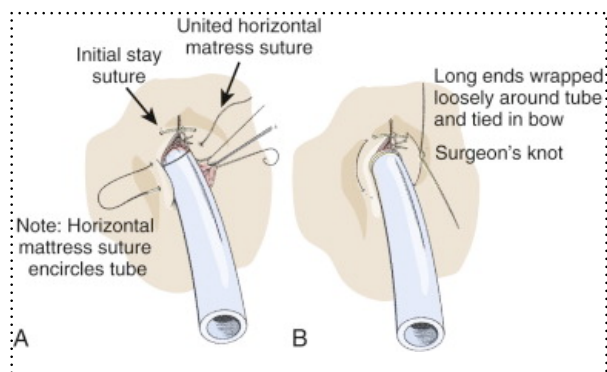
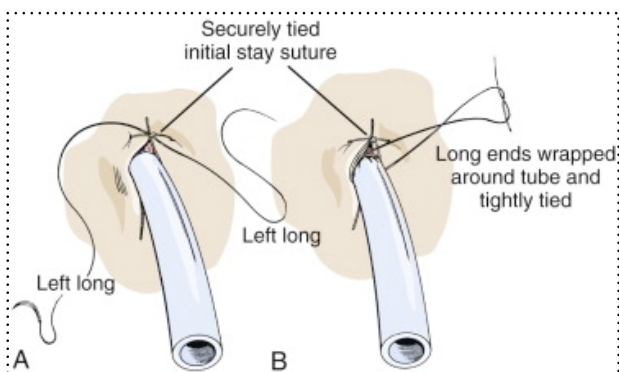
The tube should then be attached to the previously assembled water seal drain before the clamp is released. Then ask the patient to cough to observe for bubbles in the water seal chamber (a good way to assess for system patency).

Confirmation of tube placement:

- Condensation within the tube.
- Free flow of fluid / blood or air.
- Ability to rotate the tube 360° (means tube is not kinked).
- CXR is the definitive assessment of placement.

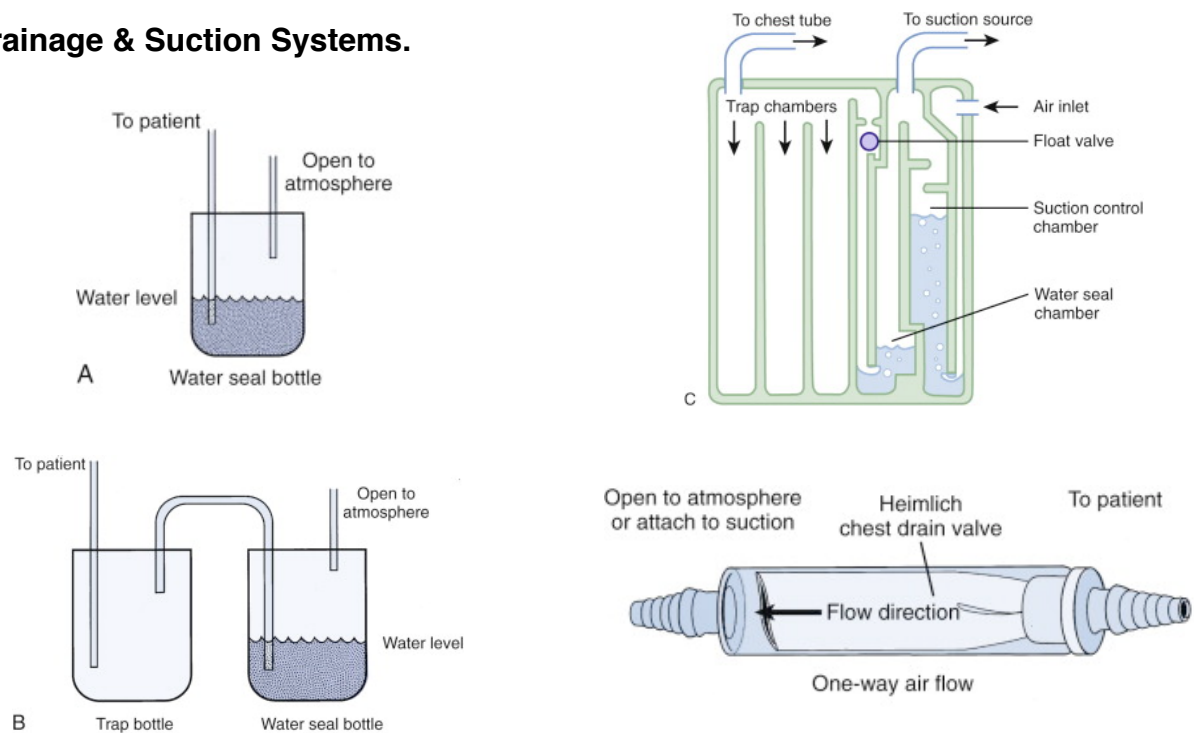
Securing the tube.

This is usually performed by suturing the tube to the skin with large '0' or '1-0' silk or nylon sutures. Two common methods include the 'stay suture' or the 'horizontal mattress' which is similar to a purse-string. (*see below*).



Further 'Y-shaped' gauze and tape will secure the tube to the skin, with a mesentery style tape attached further down the tube.

Drainage & Suction Systems.



Prophylactic Antibiotics:

Their use is common but controversial, as multicenter trials have shown no benefit. However, no standard exists.

They show no reduction in incidence of chest-tube associated empyema or pneumonia.

Tube Removal:

Rarely removed by Emergency Physicians.

Most experts recommend repeating radiology 5-12 hours following removal of the patient from suction.

For removal, the patient must be sitting upright to ~45 degrees.

Prep and drape the area as per aseptic technique.

Suturing equipment may be required if there is no 'purse-string' in place.

The patient should inhale fully and perform a mild Valsalva.

The tube should be removed whilst the patient is breath-holding.

Observe the patient, with repeat imaging 2-6 hours post drain removal.

Mini Catheter Insertion

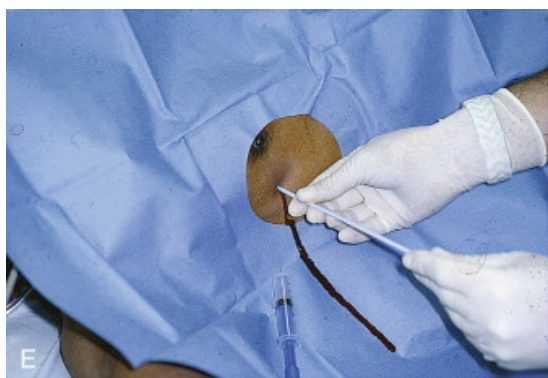
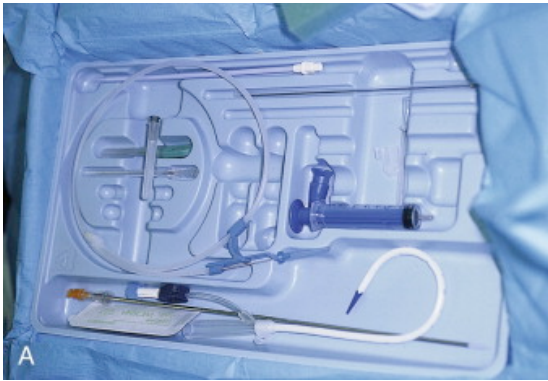
The less invasive alternative to traditional tube thoracostomy for patients with simple pneumothoraces is with a mini-catheter, commonly referred to as a 'pig-tail'.

Advantages of this technique include;

- ease of insertion
- decreased patient discomfort
- less scarring
- decreased cost.
- anterior approach available (2IC space, MC line).

Disadvantages;

- frequent catheter kinking
- clogging / clotting of lumen
- inability to perform thoracoscopic procedures through site.



The above insertion, uses the Seldinger technique following aseptic technique & infiltration with subcutaneous local anaesthetic. First, the pleural space is found with a needle (on top of the lower rib), followed by insertion of a guide-wire through that needle. The tract is dilated and the pigtail catheter inserted over the wire, through the dilated tract. It is then attached to either a Heimlich valve or formal UWSD.

Complications:

Physical Complications of Tube Thoracostomy

Infection

Pneumonia

Empyema

Local incision infection

Osteomyelitis

Necrotizing fasciitis

Injuries—Bleeding

Local incision hematoma

Intercostal artery or vein laceration

Internal mammary artery laceration (with midclavicular line placement)

Pulmonary vein or artery injury

Great vessel injury

Injuries to Solid Organs or Nerves

Lung, liver, spleen, diaphragm, stomach, colon; long thoracic nerve, intercostal nerve

Physiologic

Allergic reactions to surgical preparation or anesthesia

Pulmonary atelectasis

Reexpansion pulmonary edema

Reexpansion hypotension

Miscellaneous

Subcutaneous or mediastinal emphysema

Persistent pneumothorax

Retained hemothorax

Recurrence of pneumothorax after chest tube removal

Mechanical Complications of Tube Thoracostomy

Mechanical Problems

Chest tube dislodgment from chest wall

Incorrect tube position

Subcutaneous placement

Intra-abdominal placement

Air Leaks

Leaks within the drainage system (tubing or drainage device)

Last tube port not within pleural space

Leaks from skin site

Blocked Drainage

Flow of drainage contents into chest from elevation of drainage bottles

Kinked chest tube or drainage tubes

Clots occluding the tube