

# Chest Drain Insertion (Seldinger Technique)

**Indications:** pneumothorax (tension pneumothorax post-needle thoracostomy, unresolved primary pneumothorax after failed aspiration or >2cm/symptomatic secondary pneumothorax); symptomatic unilateral pleural effusion; empyema

**Tube thoracostomy preferred if:** chest trauma; haemothorax; complex empyema; chylothorax; pleurodesis; bronchopleural fistula

**Relative contraindications:** coagulopathy (INR >1.4, platelets <50, therapeutic anticoagulant <24 hours, clopidogrel <7days); diaphragmatic hernia

## Introduction

- **W**ash hands, **I**ntroduce self, **P**atients name & DOB & wrist band, **E**xplain procedure and get **w**ritten consent
  - Risks: pain; bleeding; infection; organ puncture & damage (lung, heart, liver); subcutaneous emphysema; persistent site leak; pneumothorax; re-expansion pulmonary oedema
- **\*\*Check patients clotting screen, platelet count and if they have been on an therapeutic anticoagulant/clopidogrel\*\***
- Consider pre-procedure analgesia
- Ensure assistant is available and clinical and non-clinical bins are close by to dispose of waste
- Confirm the correct side to insert the drain (3 point check)
  1. Review chest X-ray
  2. Examine patient's chest
  3. If effusion, confirm position and size with portable ultrasound scanner

## Preparation part

- Wash hands and apply surgical hat and mask
- Clean a large trolley
- Gather equipment onto bottom of trolley (think through what you need in order)
  - Cleansing snap-sponge x2 (iodine or alcohol/chlorhexidine)
  - Sterile drape with hole in centre (or 4 drapes without holes in)
  - 20ml syringe and 3 needles (1 orange 25G, 2 green 21G) for local anaesthetic
  - Chest drain kit
    - Scalpel and blade
    - Introducer needle (has 1cm demarcations) with syringe
    - Guidewire
    - Dilator
    - Chest drain tube (small e.g. 12Ch for pneumothorax or non-viscous effusion; large e.g. 18Ch for haemothorax or empyema)
    - 3-way tap and drainage tubing adaptor
  - Thick silk suture (e.g. USP 2 with large curved needle e.g. 90mm 3/8c)
  - Cotton gauze swabs x3 (used whenever needed throughout procedure to dry/clean sterile area and at end to dress)
  - Dressing (e.g. tegaderm film x3 or Hypofix or drainfix)
  - Equipment to be kept outside of the sterile field
    - Ultrasound scanner with curved probe if effusion ( $\pm$  sterile probe cover and gel if you want to re-scan after sterilising)
    - Incontinence pad
    - Chlorhexidine hand scrub solution
    - Sterile theatre gown
    - Sterile surgical gloves
    - 20ml 1% lidocaine (maximum 3mg/kg – note 1ml 1% lidocaine = 10mg)
    - Closed drainage bottle + connection tubing + 1L sterile water
- Walk to patient
- Wash hands
- Open the chest drain kit to form a large sterile field on the top of the trolley
- Open packets (without touching the instruments themselves) and drop sterile instruments neatly into the sterile field
- Prepare drainage bottle (non-sterile)
  - Open bottle packaging, remove inlet cap and pre-fill to 'prime' mark (usually at ~200ml) with the sterile water
  - Open connection tubing and attach the distal end into the bottle's inlet, leaving the proximal end in the sterile packet
  - Place bottle on floor and the proximal end of the tube in its packet on the patient's bed so it is accessible

**NOTE:** the distal end of the connection tube must be underwater so that air cannot track up the tube and into the pleural cavity during inspiration where negative intra-thoracic pressure creates suction



## Patient part

### Positioning and exposure

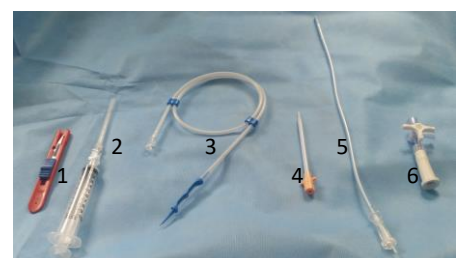
- Expose patient's chest
- Position patient
  - For effusion: sitting upright on edge of bed with crossed arms leaning on an elevated bedside table; or lying at 45° with their arm raised behind their head
  - For pneumothorax: lying on bed sideways with pneumothorax side upwards and their arm rested superiorly on their head, and you standing in front of them)
- Place incontinence pad below site on bed (to catch spillage) if effusion
- Locate insertion point:
  - 5<sup>th</sup> intercostal space, mid-axillary line
  - Within the *safe triangle* formed by
    - Anterior border of latissimus dorsi
    - Lateral border of pectoralis major
    - Horizontal line from the nipple (5<sup>th</sup> intercostal space)
  - Just above a rib (to avoid neurovascular bundle)
- Use different site if there is overlying infection
- Confirm effusion is present at proposed entry site
  - Effusion: using portable ultrasound scanner (different sites may be used if there is more fluid elsewhere)
  - Pneumothorax: using clinical examination
- Mark insertion point with a skin pen/indentation

### Preparation

- Wash hands using Chlorhexidine solution, then apply sterile gown and gloves using the [surgical scrub technique](#)
- Sterilize area
  - Work from middle outwards in one spiral motion (using cleansing snap-sponge)
  - Repeat this with 2<sup>nd</sup> cleansing snap-sponge
  - *Discard used snap-sponges as they are no longer sterile, but note all equipment used after this (including all needles) can be returned to the sterile field after use*
  - Apply the sterile drape over the patient's body so that the hole is in the correct place to allow access to the insertion site (or apply 4 drapes centred around exposed insertion site if no holes)
- Anaesthetise tract
  - Ask assistant to snap open lidocaine bottle and hold open upside-down
  - Draw up lidocaine using 1<sup>st</sup> green needle on 20 ml syringe and expel any air
  - Change to the orange needle and insert at an acute angle to form a single subcutaneous bleb around insertion site in order to anaesthetise the skin
  - Change to the 2<sup>nd</sup> green needle and insert perpendicular to the skin to anaesthetise the insertion tract
    - This is done by instilling lidocaine in small increments of increasing depth – only anaesthetise the intercostal muscles and pleura (the fat in between has no nerves)
    - Always aspirate when advancing the needle (so you know when you get to the pleural cavity) and aspirate before injecting lidocaine (to check you are not in a vessel)
    - When fluid or air (from pleural cavity) is aspirated, withdraw 2mm and anaesthetise pleura up, down, right and left (*NB: you should not continue anaesthetising after aspirating fluid in a potentially malignant effusion because it can seed malignant cells*)
    - **DO NOT PROCEED** if you do not get an aspirate with the green needle!
- Now **wait 1 minute** for the anaesthetic to work, while you prepare the Seldinger equipment and put in order:
  1. Scalpel: remove cap
  2. Introducer needle: remove insert (if present) and attach syringe
  3. Guidewire: remove plastic cap (if present) and straighten the J-tip it using the plastic nozzle – depending on the kit, this is either done by slightly retracting the guidewire in its sheath or by separating the sheath and the plastic nozzle
  4. Dilator: remove the safety guard (if present)
  5. Drain
  6. 3-way tap: remove the cap from the drain end i.e. threaded end (if present) and close that port, put the bung on the middle opening and attach the drainage tubing adaptor to opposite end (NB. if there are male and female adaptors, select the one that will fit on to the end of the bottle's drainage tubing)

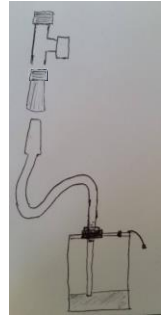
### Seldinger insertion procedure

- Make a 5mm skin incision (with the scalpel perpendicular to the skin, press the scalpel blade straight in and out)
- Introducer needle insertion
  - Point the bevel toward lung apex if pneumothorax, or to lung base if effusion
  - Slowly advance the needle through the insertion tract aspirating during infiltration until fluid or air is aspirated
  - Holding the needle steady by the skin with one hand, detach syringe



- Guidewire insertion
  - Place the guidewire nozzle into the end of the needle and use your thumb to seed the guidewire out of its sheath directly into the end of the needle, so half the wire is in the chest
  - From now on, keep hold of the guidewire at all times with one hand, as close to the skin as possible – you can hold it in a loop to make things easier
  - Note exactly how far the introducer needle is in the chest (it has cm demarcations) then withdraw the needle and thread it right the way off the end of the guidewire, ensuring the guidewire remains in place

*Note: if you need to move the hand holding the guidewire to the other side of an instrument on the wire, then ensure your other hand has hold of the guidewire temporarily while you move it so you never let go of the guidewire*
- Tract dilation
  - Compare the introducer needle depth of entry with the dilator and hold it at (or, if present, move the safety marker to) that point +1cm so you cannot insert the dilator too deep
  - Thread the dilator over the guidewire and insert into the chest (up to the safety marker/your finger) with a rotational movement
  - Withdraw the dilator and thread right the way off the end of the guidewire, ensuring the guidewire remains in place
  - Larger drain kits will have 3 dilators – repeat the process with each dilator, in increasing width
- Drain insertion
  - Thread the drain over the guidewire until the tip is near the skin
  - Now retract the guidewire slowly until the end comes out of the end of the drain
  - Holding the end of the guidewire, insert the drain into the chest (point curve toward lung apex if pneumothorax, or to lung base if effusion)
  - Insert the drain to the depth of 2x the chest wall diameter (usually ~12cm)
  - When the drain is in place, remove guidewire and then the central stiffener of drain and end cap
  - Attach the threaded end of the closed 3-way tap (hold finger over end of drain to stop spillage until this is attached)



### Securing drain

- Suture in place
  - Perform a simple hand stitch just above the drain site
    - Insert the needle through the superficial skin ~1cm length
    - Pull through so that half the length of the thread is on either side of the skin
    - Cut off the needle using scalpel
    - Tie ends together with three simple knots – final knot should be tight but loose to skin (consider tying knot around the dilator)
  - Wrap suture ends in opposite directions around drain and tie a tight simple knot so the drain tube kinks – repeat this three times as close as possible to each other
  - Cut the loose ends of the suture off
- Complete circuit
  - Attach the proximal drainage bottle tubing to end of 3-way tap via the tubing adaptor (NB. if there was only a male drainage tubing adaptor in the kit and the drainage bottle tubing also has a male end, the proximal bottle connection tubing may need to be cut with the scalpel so it will fit on to the male adaptor)
  - Retract drape over tubing
- Dress the drain (example)
  - Place a gauze between the drain and the chest wall below and apply a tegaderm film over the top
  - Place a second gauze below the three way tap (so it doesn't dig in)
  - Apply tegaderm films over the tubing above and below the 3-way tap

### To complete

- Confirm it works
  - Open the 3-way tap and confirm drainage (i.e. pleural fluid draining in effusion or air bubbling in pneumothorax)
  - Check the drain is swinging (i.e. the fluid in the chest drain tubing rises with inspiration and falls with expiration due to changes in thoracic pressure – ask patient to breathe in and out and/or cough) and, if pneumothorax drain, bubbling
- Collect and send pleural fluid samples if required
- Thank patient and cover them
- Bin waste and gloves, dispose of sharps safely in sharps bin, clean trolley and wash hands
- Advice – see [chest drain management](#)
  - Patient: ensure the chest drain bottle is kept upright and is below the level of their umbilicus at all times; tell nurse if they experience pain/SOB/cough
  - Nurse: in effusion, clamp drain after 1L removed or if pain/SOB/cough (may be re-expansion pulmonary oedema)
  - Don't drain >1L fluid at a time (usually drain 1L then clamp for 1hour – this cycle can be repeated multiple times)
  - Never clamp a pneumothorax drain (even during removal)
- Prescribe post-insertion analgesia
- Order a post-insertion CXR (check positioning and for pneumothorax)
- Fully document procedure in patients notes
- Re-review patient later

- To remove drain: remove sutures, ask patient to perform Valsalva manoeuvre or expire fully, then briskly pull drain out while an assistant applies steri-strips over wound (for Seldinger drains) or ties the previously placed closure (usually placed for large bore trauma chest drains). Apply pressure for 5 minutes, check bleeding has stopped and then apply impermeable dressing.