Insertion of a chest drain for pneumothorax

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Abstract

The insertion of a chest drain, either using the Seldinger technique or as a cut-down for a wide bore tube, is common and relatively straightforward. An appreciation of the anatomy, procedural technique and potential complications is important. The process is outlined here.

Keywords Chest drain; pneumothorax

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Learning objectives

After reading this article, you should be able to:

- describe the indications for insertion of a chest drain for pneumothorax
- make necessary preparations for chest drain insertion
- insert a wide-bore or pigtail catheter chest drain

Intercostal chest drains are an effective way of treating pneumothoraces, but require judicious planning and a considered technique due to the potential for complications.[1]

Indications for chest drainage of pneumothorax

Size and symptoms are the usual indications for insertion of a chest drain for pneumothoraces. The size of a pneumothorax is a relative indication for treatment, with radiological separation of the lung from the chest wall of >2 cm on plain film chest X-ray as a suggested threshold. Small, non-compromising spontaneous pneumothoraces may be managed conservatively. Larger pneumothoraces in the absence of dyspnoea may also be expectantly managed in otherwise stable patients and conversely, symptoms of breathlessness in pneumothoraces of any size should be considered for active treatment. Any mechanically ventilated patient with a pneumothorax should have a chest tube inserted.

Needle aspiration can be considered in the first instance for any size of pneumothorax, but should only be attempted once and further treatment should be considered if more than 2.5 L of air is aspirated.[2]

In the emergency setting of a tension pneumothorax, immediate decompression of the tension is required with wide-bore cannula insertion into the second intercostal space in the midclavicular line. This should be followed by formal chest tube drainage.

Choice of drain

Seldinger cathether drains (<14F, also known as 'pigtail' or 'small bore') are thought to be as effective as wide bore (>20F, also known as surgical) chest drains for simple pneumothoraces in the spontaneously breathing patient. Wide-bore chest drains are more effective in mechanically ventilated patients.[3] Although pigtail catheter drainage may be better tolerated by the patient, it should not be assumed to be safer as a result — the rate of insertion complications is similar between the two types of chest drains.[4] 12F Seldinger chest or 28F wide-bore drains are typically used for isolated pneumothorax.

Equipment

Sterile chest drain insertion packs are available, but it is advisable to ensure that you have all necessary equipment (Table 1) available prior to scrubbing up.

Preparation

Confirm the presence of pneumothorax and refer to radiological imaging to confirm the laterality. Check recent blood tests for coagulation screen and platelet count, correcting any clotting defect where possible. If the patient has had previous pleural procedures, consider the possibility of pleural adhesions and the need for expert advice.

The patient must be consented for the procedure, explaining the indications, benefits and risks clearly. The patient should have oxygen saturation monitoring and be offered premedication with 5–10 mg oral morphine or 1–2 mg midazolam intravenously.

Undress the patient to the waist and raise the bed so that the working area is comfortably at arm level. A variety of positions

Equipment required for wide-bore chest drain insertion

Disposables
- Absorbent pads
- Sterile Trolley Drape
- Sterile gown and gloves
- Sterile drape(s) for patient (single fenestrated or several utility drapes)
- Gallipot or kidney dish
- Sterile 10x10 cm gauze

Instruments
- Sterile scissors
- Roberts or Spencer–Wells clamps
- Chest drain (usually 28F)
- Sterile chest drain tubing
- Drain bottle

Sharps
- Filter needle
- 25G needle
- 21G needle
- 20 ml syringe
- Scalpel (No.11 blade)
- Sutures on large, curved hand-held needle (e.g. 2–0 Ethilon or No. 2 silk)

Liquids
- 1 L sterile saline
- Povidine-iodine 10% or chlorhexidine 2% antiseptic prep
- Lidocaine (1% or 2%)

Table 1

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Patient positioning		
Patient at 45° Arm abducted at 90° and internally rotated with forearm on bed	Patient at 45° Arm abducted and externally rotated with hand behind head	Patient sitting Arms flexed at 90° with forearms folded on table in front of patient

Table 2

have been described and should be chosen according to patient comfort and operator preference (Table 2). Absorbent pads are placed under the patient and tucked into pyjama bottoms.

Establish the site of insertion. The 'triangle of safety' for chest drain insertion is between the third to fifth intercostal spaces, bounded anteriorally by the lateral border of pectoralis major, posteriorally by the anterior border of latissimus dorsi.

Prepare the field with povidine–iodine or chlorhexidine and allow to dry. Drape widely, leaving the fenestration in the drape over the area previously marked for insertion. Draw up sufficient local anaesthetic: the maximum safe dose of lidocaine is 3 mg/kg (i.e. 21 ml of 1% lidocaine in a 70-kg patient).

Anaesthetic

Using a 25G needle, infiltrate 2 ml of local anaesthetic into the skin, raising a bleb approximately 2 cm wide over the lower part of the intercostal space chosen. With the 21G needle, give a further 5 ml of lidocaine to anaesthetize the periosteum of the ribs above and below the intercostal space. Walking the needle inferiorally off the rib above the chosen space until bone is no longer encountered, aspirate to ensure that a vessel has not been entered and adminster an intercostal block of 2–3 ml. Repeat for the rib above and below. Finally, advance the needle into the chosen space, anaesthetizing the muscle and aspirating intermittently. When the pleura is breached, air will be aspirated. Withdraw the needle slightly and anaesthetize the pleura. Allow the anaesthetic 2 minutes to take effect.

Insertion of a wide-bore drain

Make 1.5–2 cm incision parallel to the rib, at the lower part of the space. Two sutures, one for securing and one horizontal mattress suture for later wound closure can be placed at this stage (Figure 1).

Using the Roberts clamp or Spencer–Wells, spread the subcutaneous tissues and muscle at the lower margin of the space, opening the instrument parallel to the rib. As the pleura is entered, there will be a give and a small gush of air. Open the instrument to dilate this entry hole and admit a finger into the chest cavity to palpate for adhesions of the lung to the chest wall. Your finger should be comfortably admitted into the tract to ensure that the drain will pass easily.

Some thoracic surgeons will withdraw the sharp tip well inside the drain and use it to provide rigidity to guide the drain into position. The trocar should *never* be used to create or dilate the tract. Alternatively, mount the end of the drain onto the Roberts to facilitate entry. Once inside the cavity, the trocar or Roberts are removed. The tube is then advanced in an apical direction until resistance is felt or the patient complains of shoulder tip pain. Withdrawal by 2 cm ensures that the tip does not impinge on the apical pleura. The distance marker on the drain should be noted (see Figure 2).

Insertion of a Seldinger drain

After administering local anaesthetic, connect the blunt Tuohy introducer needle to a 20 ml syringe. It should be inserted into the lower part of the intercostal space with the bevel pointing upwards. When air is aspirated, advance a further 5 mm to ensure the pleural cavity is entered and remove the syringe. Insert the guidewire, flexible end first, stopping if any resistance is encountered. It is possible to puncture structures including the heart with a guidewire! Leave at least 20 cm of wire outside and remove the introducer needle. Make a 3 mm stab incision in the skin only around the wire entry point and mount the dilator. The wire should be held at all times. Dilate the skin, subcutaneous tissues, muscle, fascia and pleura with the dilator and then remove, leaving the guidewire in place. Do not introduce the

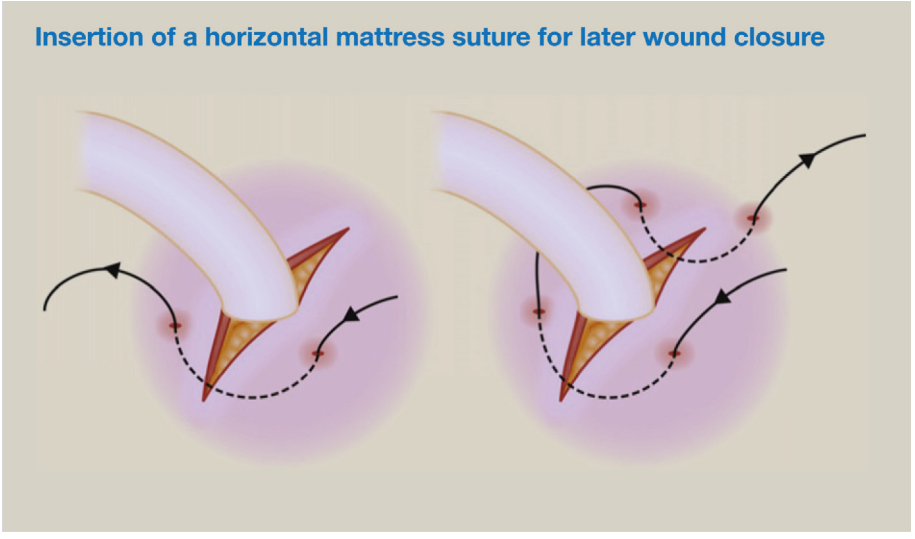

Figure 1

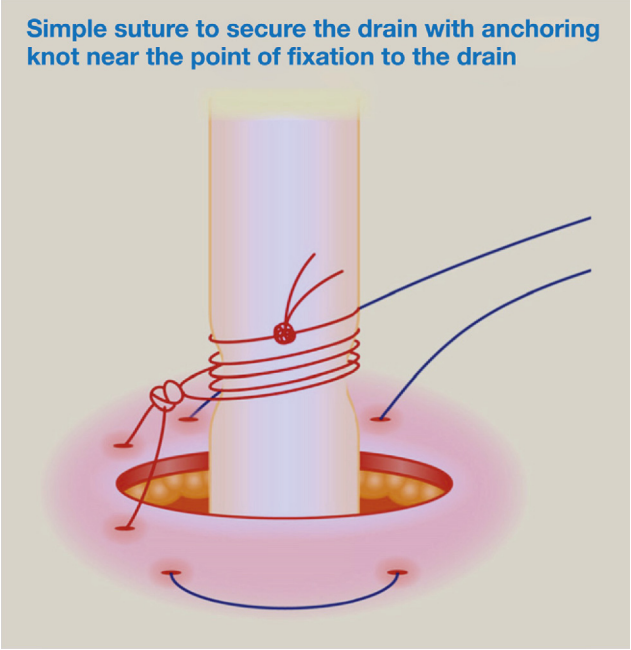

Figure 2

dilator too deep as this is a rigid structure and can cause damage to organs within the chest. Feed the chest drain on, pulling back the guidewire to ensure it can be grasped emerging from the end of the drain before inserting the catheter. Once inserted, the guidewire can be removed and a three-way tap applied to the drain. The distal end of this is attached to a converted to allow connection to an underwater seal. The pneumothorax can also be aspirated via the tap using a 50 ml syringe. A single 2 Silk suture is used to secure the drain.

Confirmation

The drain can now be connected to the tubing and attached to the underwater seal. Fogging in the drain tubing, a swing in the fluid level or bubbling in the bottle on expiration or coughing confirm position.

Secure the drain by wrapping the stitch a few times around the drain itself, near the anchor point on the skin (Figure 2). Wide-bore drains should be slightly indented by the stitch. Cut a slit into a square dressing and dress the drain insertion site.

A chest X-ray should always be taken to confirm the position, assess re-expansion and to rule out intrathoracic bleeding after drain insertion.

Troubleshooting

Breaching the pleura should be the only significant resistance encountered during insertion of a chest drain. Struggling outside the chest wall indicates the need for dilation of the tract. Unexpected resistance inside the chest should not be forced against: seek senior help.

When inserting a chest drain for pneumothorax, aspiration or drainage of blood should raise suspicions of lung parenchymal or intercostal vessel injury. Large volumes should prompt urgent consultation with a thoracic surgeon. ◆

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