Guideline for pleural drain insertion on medical in-patients

Nottingham University Hospitals

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Original Document (ver1) Dr.Chris Whale

The guideline has been registered with the Trust. However, clinical guidelines are guidelines only. The interpretation and application of clinical guidelines will remain the responsibility of the individual clinician. If in doubt contact a senior colleague or expert. Caution is advised when using guidelines after the review date.

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1.1 **Who is this document for?**

This document is aimed at medical teams outside respiratory medicine and will

a) Identify the situations in which a chest drain should be inserted

b) Identify who should insert the drain

c) Specify how the procedure is carried out and

d) Highlight when to refer patients to respiratory physicians.

It will cover medical situations and therefore not include post-operative drain insertion or trauma situations. This document incorporates the guidelines produced by the British Thoracic Society.

This document aims to improve management of pleural disease by

a) Optimising the number of drains inserted

b) Minimising the risks associated with the procedure and

c) Ensuring correct technique and reducing patient discomfort.

1.2 **Key Points**

The main medical indications for inserting a chest drain are as part of the management of pleural effusions and pneumothoraces. In general:

- **All cases seen within normal working hours should be discussed with respiratory medicine prior to drain insertion.**

- **Pleural procedures should not take place out of hours except in an emergency**

- **Out of hours drain insertion should be reserved for patients with a pneumothorax who are symptomatic and patients with empyema who have pus aspirated from the pleural space.**

- **Pleural aspirations and chest drains should be inserted in a clean area using full aseptic technique**
• Non-urgent pleural aspirations and chest drain insertion should be avoided in anticoagulated patients until INR<1.5. Platelets should be above 50,000

• It is strongly recommended that all pleural aspirations and chest drain insertions for fluid should be inserted under image guidance (eg. Ultrasound)

• A 12 F Seldinger drain should be used as first line therapy for pneumothorax, free-flowing pleural effusions and pleural infections.

• Written informed consent should be obtained for all pleural procedures except in emergencies (Tension Pneumothorax).

Any adequately trained doctor can place the drain.

Nomenclature used in this document

A seldinger drain refers to a small bore (=12 F) drain inserted using a guide wire

A surgical drain refers to a larger bore (16-32F) drain inserted using blunt dissection
1.3 **Pneumothorax- General principles regarding chest drain insertion**

  a) Primary pneumothorax.

  For the management of primary pneumothorax, refer to the algorithm in figure 1.

  If the primary pneumothorax requires a chest drain, insertion of a small bore (12F) drain using the Seldinger technique is usually satisfactory (See section 1.8).

  **Hint: The drain should be directed towards the apex with a pneumothorax.**

  b) Secondary Pneumothorax.

  For the management of secondary pneumothorax, refer to the algorithm in figure 1.

  If the secondary pneumothorax requires insertion of a drain, the options are insertion of a large bore surgical drain (See section 1.7) or a small bore ‘Seldinger’ drain (See section 1.8). The choice of drain will partly depend on operator experience. In some situations, assistance from the interventional radiology service may be required. This should be considered in the context of secondary pneumothorax, particularly if there is a loculated collection, since drain insertion might be safer under image guidance.

**Table 1.3 – Indications for the different types of drain**

<table>
<thead>
<tr>
<th>Type of drain</th>
<th>Indication</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Small bore ‘Seldinger’ drain</td>
<td>Simple pneumothorax and easy procedure anticipated.</td>
</tr>
<tr>
<td>b) Large bore ‘surgical’ drain</td>
<td>When identification of and entry into the pleural space with blunt dissection is considered necessary to avoid lung puncture eg. loculated pneumothorax, very small pneumothorax.</td>
</tr>
<tr>
<td>c) Radiologically sited drain</td>
<td>When it is difficult to localise the site of pneumothorax.</td>
</tr>
</tbody>
</table>
c) Tension pneumothorax

This is a medical emergency and requires prompt treatment. In this situation, put a cannula into the pleural cavity via the second intercostal space, anteriorly, in the mid-clavicular line. Subsequently, insert a drain in the ‘triangle of safety’ (see figure 4). If opting for a Seldinger drain;

- Be careful not to damage the underlying lung, which may have partially re-inflated following cannula insertion.

- Ensure the drain does not subsequently kink/block resulting in recurrent tension pneumothorax.

- Respiratory referral is mandatory as pleurodesis is normally recommended.
1.4 Figure 1-Algorithm for the treatment of spontaneous Pneumothorax

Measure the interpleural distance (between lung margin and chest wall) at the level of hilum.
1.5 Pleural effusion - General principles regarding chest drain insertion

For the management of a unilateral exudative pleural effusion, refer to the algorithm in figure 4.

1.5.1 An intercostal drain for pleural effusion should only be required out of hours (5pm to 9am) in the context of a complicated parapneumonic effusion with associated signs, clinical suspicion, or test results indicative of sepsis or when a patient has an empyema and pus has been aspirated from the pleural cavity.

**Hint:** If pleural fluid pH > 7.2, there is rarely a need to insert a drain immediately. If a drain is required, it should be directed towards the base of the lung.

1.5.2 If the patient has a large pleural effusion (not empyema/complicated parapneumonic effusion) and has symptoms of distressing dyspnoea, therapeutic aspiration of 500-1000 ml of pleural fluid usually provides enough symptomatic relief to allow a definitive procedure to be carried out electively at a later time point by the respiratory team.

**Hint:** Take care to avoid introducing air into the pleural space by using a three-way tap, which is never opened to the air.

If this situation arises at the weekend, the therapeutic aspiration can be repeated if symptoms recur.

In other situations, the pleural effusion should be left until the results of the initial diagnostic aspiration (50 – 100 mls) are available. If the results from the initial pleural aspiration do not lead to a diagnosis, the next best investigation may be a medical thoracoscopy. In this situation, the procedure is safer and easier with a significant pleural effusion.

If the patient is known to have a malignant pleural effusion, consider talc poudrage via medical thoracoscopy to achieve effective pleurodesis. 7
1.6 Algorithm for out-of-hours management of a new pleural effusion

A) Parapneumonic effusion

Diagnostic aspiration (50 mls)

Frank pus

Insert drain
(12F
Seldinger-
regular
flushes)

Respiratory referral

No pus

Preferably delay drain insertion

Diagnostic aspiration (50ml)

Respiratory referral

B) Undiagnosed effusion, not para-pneumonic

Out-of-hours drain seldom indicated

Comfortable

Diagnostic aspiration (500-1000ml)
i.e. not to dryness

Respiratory referral

Very SOB

Therapeutic aspiration

Respiratory referral

Hint:

**Diagnostic pleural aspiration.**
Send for: cytology, protein, LDH, glucose, pH, gram stain, MC&S.

Consider: cell count with differential (EDTA), amylase & TB culture..

Hint: Pleural fluid should be passed through the blood gas machine ASAP to determine pH rather than sending to the clinical chemistry laboratory. If the pleural fluid contains pus, determination of pH is not necessary, and indeed is contraindicated (Pus may damage the blood gas machine).
1.7 Practical points- Insertion of a large bore surgical chest drain

1) Confirm and clarify that a surgical chest drain is indicated. Surgically inserted chest drains should be inserted by blunt dissection. Trocars should not be used

2) Ensure there are no contra-indications e.g.
   - Site location is difficult.
   - Operator not experienced.
   - Patient is not co-operative.
   - Bleeding tendency

3) Carry out a pre-procedure risk assessment.

4) Exclude a bleeding diathesis (if clinically appropriate, check clotting screen).

5) Check to confirm the clinical signs and radiological findings are consistent.

6) The patient should then be consented for the procedure in keeping with national guidelines, and consent form signed. Specific complications to mention during consent include pain, bleeding, infection and persistent pneumothorax.

Hint: Provide the patient with an information sheet where possible.

7) A cannula should be inserted into a vein to allow administration of medication. Premedication could be with i/v anxiolytic eg: Midazolam (1-2 mg titrated to achieve adequate sedation) or an analgesic (eg: 2.5 mg i/v morphine given immediately prior to the procedure or 10 mg oromorph given one hour prior to the procedure.) Flumazenil and Nalaxone should be available. Analgesia should be prescribed for all patients with chest drain in place.

Hint: Easier if the cannula is in the back of the hand.

8) Ensure oxygen and saturation monitoring equipment is available.
Figure 4: The ‘triangle of safety’
The procedure.

9) The patient can be placed in a semi-recumbent position, in the lateral decubitus position or sat in a chair, leaning forward with the arms crossed and resting on a solid table. The position should take into account both patient and operator comfort.

10) Each position allows for exposure of the axilla and access to the ‘triangle of safety’ (see figure 4). The lateral border of pectoralis major and the anterior border of latissimus dorsi form the sides of the ‘triangle of safety’. The apex of the triangle is towards the top of the axilla, with the triangle base formed by an imaginary line at the level of the nipple/5th intercostal space. This area avoids the internal mammary artery, liver, spleen and aorta and reduces the amount of muscle damage.

**Hint:** Use ultrasound where possible, with the patient remaining in the same position until the drain is inserted. Avoid using a previously marked ultrasound guided ‘X marks the spot’, which becomes unreliable due to patient movement.

11) Insertion of the drain should be carried out under sterile conditions, with the operator wearing gown and gloves. The skin in the axillary region should first be cleaned with iodine/chlorhexidine in 70% alcohol and drapes used to further demarcate the sterile area.

12) The drain should be inserted just above a rib in the lower part of the intercostal space, to avoid the neurovascular bundle that runs just below each rib.

**Hint:** This becomes a less reliable ‘rule’ as you move in a posterior direction outside the triangle of safety, since the bundle may not run directly below the
overlying rib, but instead the intercostal artery may run in parallel, in the mid-intercostal space.

13) Insert local anaesthetic. Check the drug and expiry date. Use <20ml of lidocaine 1%. Initially, with an orange needle, insert a bleb of anaesthetic just below the skin surface. Change to a green needle and anaesthetise the intercostal muscles, other soft tissues and pleura. Aspirate as the needle is inserted to prevent injection into a vessel and to help locate fluid or air in the pleural cavity.

14) A drain should not be inserted if free air (pneumothrax) or fluid (pleural effusion) cannot be aspirated.

15) An incision should be made in the skin using a scalpel, just above and parallel to the rib, with the incision length just greater than the diameter of the drain.

16) Blunt dissection should then be performed with a round-tipped instrument to divide through the muscle fibres and soft tissues down to the pleural surface. Repeated opening and closing of the clamp allows the muscle fibres to be separated, forming a path down to the parietal pleura. The track can then be continued through the pleura and should be achieved with minimal force. A sudden ‘pop’ occurs on entry into the pleural space followed by the sensation of free movement of the instrument tip or emergence of pleural fluid.

**Hint: The procedure should be pain free for the patient. If not, use more local anaesthetic and seek assistance. Do not proceed. Consider repeating ultrasound.**

17) Where entry into the pleural space is difficult, the incision could be enlarged to allow a finger to be passed through the track into the pleural space. A finger
sweep can identify underlying organs or any local adhesions. **If required, call for more experienced assistance (eg. Respiratory or Medical SpR on-call.)**

**Hint: Ensure the incision & track are big enough to allow the drain to pass.**

18) The large bore tube can then be inserted. The trochar should be withdrawn a few centimetres before gentle insertion through the chest wall. This allows the trochar to be directed towards the optimal position, before feeding the drain over the trochar. The trochar should never protrude from the drain and enter the pleural space.

19) Alternatively, the trochar should be removed and the tip of the tube grasped in the tip of a pair of forceps. The forceps can then be passed down the track and after releasing the clamp, the drain can then be passed through into the pleural space without resistance. This technique usually requires a larger incision than the former technique described (in para 18) and a track that is larger than the external diameter of the drain.

**Hint: Never use force. The drain should glide into the pleural cavity in the same way as a straw would pass through the lid of a disposable cup.**

20) Once the drain has been sited in an appropriate position, it is attached to a single flow drainage system with an under water seal. Ensure that the drain tip is in the pleural space by checking that the fluid in the drainage system is swinging with respiration.

21) A vertical mattress stitch (see Figure 5) should be inserted across the incision to assist wound closure once the drain is removed. A non-absorbable suture (eg 1-0 silk) should be used.

**Hint: This suture is easiest sited before passing the chest drain.**
22) A further stitch is required to anchor and secure the drain. Pass the needle through skin and subcutaneous tissues near to the drain to close down the incision. Tie and knot the two ends of the securing suture close to the skin, then wrap the free ends around the drain. Tie and knot the free ends, with some traction on the drain. Form a further knot 1-2 cm away and then wrap the two free ends around the drain. Again, tie and knot the ends, with a second traction point on the drain.

**Hint:** Do not use ‘purse-string’ sutures. They can be painful and scar.

23) Check the drain is secure, before covering with a simple dressing.

24) An ‘omental tag’ (Images 1-4) can be used to support the chest drain. The tag reduces stress at the suture site if there is traction on the drain, keeps the drain away from the skin and reduces kinking.

25) If draining an effusion, do not remove more than 1 Litre in the first half an hour (This avoids rapid initial decompression of the lung and reduces the risk of re-expansion pulmonary oedema).

26) Obtain a CXR to confirm tube position

**Hint:** As fluid is removed, some patients experience chest tightness and pain.

Consider clamping the drain and administering opiate analgesia.
Images 1 - 4

Images 5 - 8
1.8 **Practical points - Insertion of a Seldinger chest drain.**

1) Confirm and clarify that a Seldinger chest drain is indicated.
   - Simple pneumothorax
   - Experienced operator
   - Non-viscous pleural effusion after discussion with respiratory team.

2) Ensure there are no contra-indications (See section 1.7).

3) Carry out a pre-procedure risk assessment.

4) Exclude a bleeding diathesis (recent platelet count and clotting screen).

5) Check to confirm the clinical signs and radiological findings are consistent.

6) The patient should then be consented for the procedure in keeping with national guidelines, and consent form signed. Specific complications to mention during consent include pain, bleeding, infection and persistent pneumothorax.

**Hint: Provide the patient with an information sheet where possible.**

7) A cannula should be inserted into a vein to allow administration of medication. Premedication could be with I/V anxiolytic eg: Midazolam (1-2 mg titrated to achieve adequate sedation) or an analgesic (eg: 2.5 mg i/v morphine given immediately prior to the procedure or 10 mg oromorph given one hour prior to the procedure.) Flumazenil and Nalaxone should be available. Analgesia should be prescribed for all patients with chest drain in place.

**Hint: Easier if the cannula is in the back of the hand.**

8) Ensure oxygen and saturation monitoring equipment is available.
The procedure

9) The patient can be placed in a semi-recumbent position, in the lateral decubitus position or sit in a chair, leaning forward with the arms crossed and resting on a solid table. The position should take into account both patient and operator comfort.

10) Each position allows for exposure of the axilla and access to the ‘triangle of safety’ (see figure 4). The lateral border of pectoralis major and the anterior border of latissimus dorsi form the sides of the ‘triangle of safety’. The apex of the triangle is towards the top of the axilla, with the triangle base formed by an imaginary line at the level of the nipple/5th intercostal space. This area avoids the internal mammary artery, liver, spleen and aorta and reduces the amount of muscle damage.

Hint: Use ultrasound where possible, with the patient remaining in the same position until the drain is inserted. Avoid using an ultrasound guided ‘X marks the spot’, which becomes unreliable due to patient movement.

11) Insertion of the drain should be carried out under sterile conditions, with the operator wearing gown and gloves. The skin in the axillary region should first be cleaned with iodine/chlorhexidine in 70% alcohol and drapes used to further demarcate the sterile area.

12) The drain comes in a self-contained kit and the operator should be familiar with the components of the kit before progressing. The kit has a scalpel, an introducer needle and syringe, a 50 centimetre guidewire, a dilator, a pleural catheter (Images 5 & 6) and a connector.

13) The drain should be inserted just above a rib in the lower part of the intercostal space, to avoid the neurovascular bundle that runs just below each rib.
Hint: This becomes a less reliable ‘rule’ as you move in a posterior direction outside the triangle of safety, since the bundle may not run directly below the overlying rib, but instead the intercostal artery may run in parallel, in the mid-intercostal space.

14) Insert local anaesthetic. Check the drug and expiry date. Use <20mL of lidocaine 1%. Initially, with an orange needle, insert a bleb of anaesthetic just below the skin surface. Change to a green needle and anaesthetise the intercostal muscles, other soft tissues and pleura. Aspirate as the needle is inserted to prevent injection into a vessel and to help locate fluid or air in the pleural cavity.

15) A drain should not be inserted if free air (pneumothorax) or fluid (pleural effusion) cannot be aspirated.

16) An incision should be made in the skin using the scalpel (Image 7), just above and parallel to the rib, with the incision length just greater than the diameter of the drain.

17) Connect the syringe to the introducer needle (Images 8 & 9).

Hint: The introducer needle has a curved tip, which will encourage the guidewire to pass in a certain direction once it has been fed through (Images 10, 11 & 12).

Remove the obturator before using.

18) The introducer needle should then be passed through the incision, subcutaneous tissues and intercostal muscles and subsequently, through the parietal pleura, aspirating as the needle passes, until air or pleural fluid is
identified. Once in the pleural space, do not advance the needle any further.

Use the needle to estimate the depth from the skin to the pleural space.

**Hint: The procedure should be pain free for the patient. If in doubt, do not proceed. Call for more experienced assistance (eg. Respiratory or Medical SpR on-call). Consider repeating ultrasound.**

19) The syringe is then removed and the guidewire is passed through the introducer needle into the pleural cavity (Image 13). Never force the guidewire in.

**Hint: Less than 2cm of guidewire needs to enter the pleural space.**

20) The introducer needle is then retracted and withdrawn over the guidewire, which is left in situ.

21) The dilator (Image 14) is then passed over the guidewire with slight twisting action to slightly enlarge the track into the pleural cavity and facilitate the passage of the pleural catheter. Many of the reported injuries as a result of chest drain insertion were due to visceral puncture due to the dilator. Force is unnecessary and the dilator only needs to be passed 1 cm beyond the depth to the pleura as measured with the introducer needle. The dilator should easily pass through into the pleural cavity. If there is resistance it could because the guidewire may have been kinked when the dilator was introduced. If this is the case never force the dilator in. You may have to remove the guidewire and if this is kinked repeat the procedure with a new guidewire.
Hint: **Only the tip of the dilator should enter the pleural space to avoid damaging underlying structures.**

22) The dilator is removed.

23) The drainage catheter (Images 15 & 16) is fed over the guidewire. The guidewire should emerge and be grasped at the proximal end of the catheter, before the catheter is fully advanced to avoid losing the guidewire within the pleural cavity.

**Hint: The catheter is quite flexible and has a stiffener to aid insertion. This is not always needed and can be removed before use.**

24) The guidewire is then retracted and removed, leaving the drain tip in the pleural space. The catheter can then be attached (Images 17 & 18) to a single flow drainage system with an under water seal. Ensure that the drain tip is in the pleural space by checking that the fluid in the drainage system is swinging with respiration.

25) Secure the drain with a non-absorbable suture (see section 1.7.22).

26) Check the drain is secure, before covering with a simple dressing.

27) An ‘omental tag’ (Images 1-4) can be used to support the chest drain. The tag reduces stress at the suture site if there is traction on the drain, keeps the drain away from the skin and reduces kinking.

28) If draining an effusion, do not remove more than 1 Litre in the first half an hour (This avoids rapid initial decompression of the lung and reduces the risk of re-expansion pulmonary oedema).

29) Obtain a CXR post procedure to confirm tube postion

**Hint: As fluid is removed, some patients experience chest tightness and pain.**

**Consider clamping the drain and administering opiate analgesia.**

1) **References:** BTS Pleural Disease Guideline 2010
Images 9 - 12

Images 13 - 16
Images 17-18
1.9 Removing a locked pigtail catheter (Images 19-21)

Pigtail catheters are inserted by radiologists to drain fluid collections and abscesses. The distal end of the catheter contains drainage holes with a J-shaped tip (the locking pigtail) to prevent migration during use. The proximal end of the catheter with the locking pigtail is provided with a locking hub. When in locked position, the suture is captured in the locking hub, retaining the pigtail in the desired position. No external sutures are used to secure the pigtail catheter. The locking hub has an arrow which should point towards the “Locked position” (see Image).

**Hint:** Never attempt to remove catheter prior to unlocking the pigtail.

**To remove the pigtail:**

There are two ways to release the lock on the pigtail prior to safe removal. Before unlocking disconnect the drainage tube (which connects the pigtail to the chest drain bottle) from the hub.

**Method 1:**

Using the key supplied (if not available a 2 p coin can be used) rotate the locking hub counterclockwise 180 degrees to the “unlocked” position. Withdraw the catheter gently. Never forcefully pull the catheter out as there is potential to damage the intercostal vessels.

If unsuccessful try method 2

**Method 2:**

Cut the catheter along the full circumference of the catheter immediately distal to the locking hub (at the junction between the white rigid plastic and the blue flexible catheter-see Image 21). The catheter can then gently be pulled out.

Please be aware that once the catheter is cut along its full circumference the suture is no longer secured to the catheter and may be left behind in the patients body (the suture is non-absorbable monofilament Nylon). Gently pull the suture out.

**Hint:** If the catheter is cut make sure that both the suture and catheter is removed.

If even after cutting there is resistance to removing the catheter stop and contact interventional radiology.
Images 19-21

The Pigtail (19)  
Hub in locked position (20)

Hub in unlocked position (21)
Figure 5: Vertical mattress suture

For more information, see - [http://www.aafp.org/afp/20021215/2231.html](http://www.aafp.org/afp/20021215/2231.html)

- The vertical mattress suture uses the “far-far, near-near” technique.
- The “far-far” suture passes 4 - 8 mm from the wound edge, fairly deep.
- The needle then is placed backwards in the needle holder.
- The near-near suture is placed with 1 –2 mm of the wound edge, at a shallow depth (1 mm) in the upper dermis.
- Both ends of the suture thread are tied on one side of the wound (the same side where the suture passage began.)