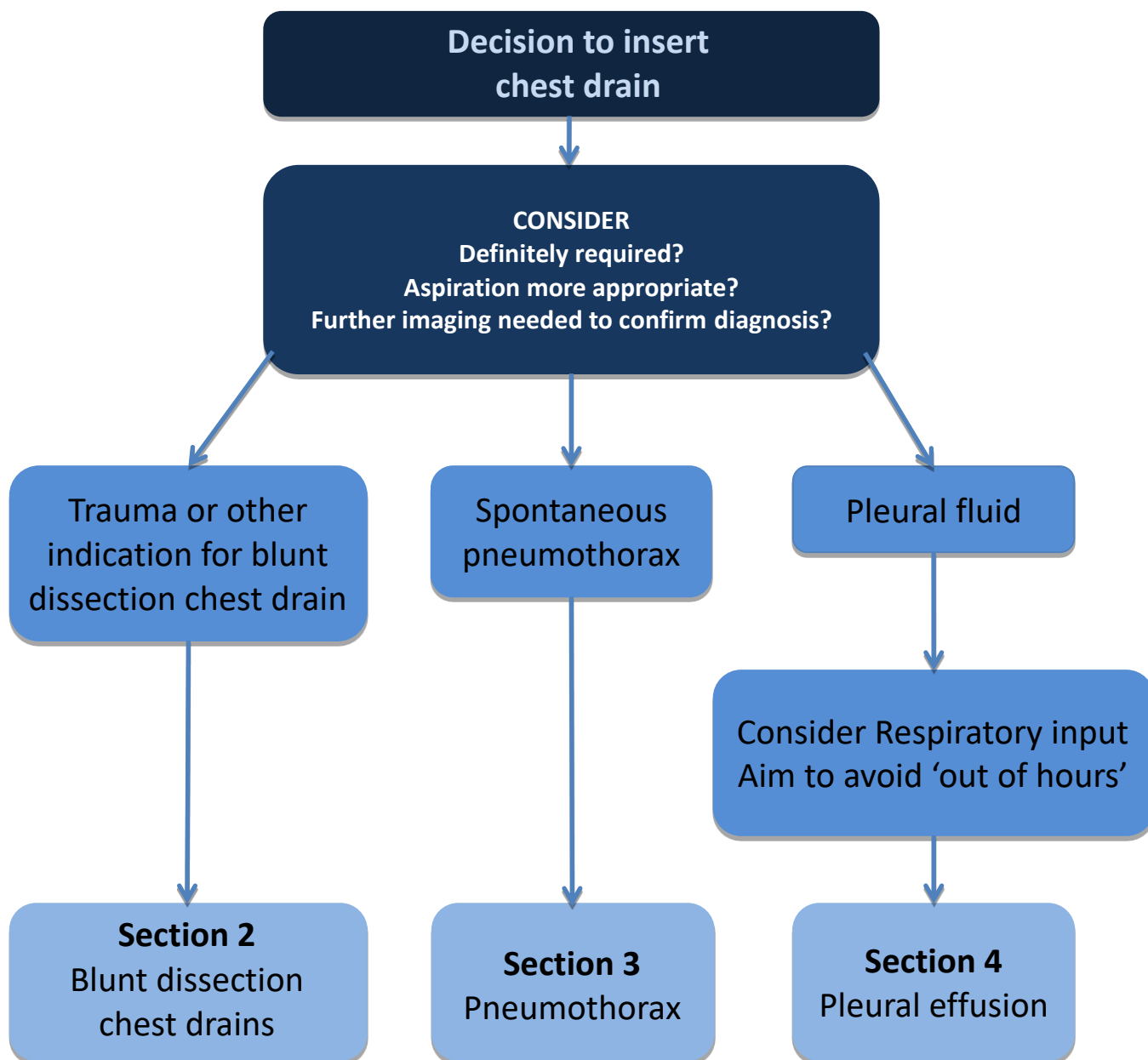


NHS Lanarkshire Drain Guidelines – Decision Flowchart



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1 Background

1.1 Introduction

Intercostal chest drains (ICDs) are required to remove air or fluid from the pleural space. The insertion of these drains, whilst in the majority of cases a straightforward process, can sometimes be associated with serious complications including patient death¹. In 2008 the National Patient Safety Agency issued a Rapid Response Report² highlighting 12 deaths related to ICD insertion reported via the National Reporting and Learning System between 2005 and 2008. A postal questionnaire sent to physicians at all UK hospitals in 2008 revealed that 67% of responding trusts had encountered a major complication from ICD insertion. Over the period 2003 to 2008, 17 deaths were recalled³. Complications causing patient harm short of death included solid organ injury due to malpositioned drains, trocars or dilators, guide wires lost into the pleural space, intrapleural or drain site infection, drain dislodgement/blockage or pain. Serious complications and deaths reported were as a consequence of both Seldinger and blunt-dissection drain insertion.

1.2 The Scope of these Guidelines

These guidelines are intended for use in all clinical areas within NHS Lanarkshire including the Emergency Department, Medical wards, Surgical wards and Respiratory units.

There are National guidelines available for specific clinical indications, including the British Thoracic Society (BTS) guidelines on pleural disease¹ and the Advanced trauma life support (ATLS) manual⁴. These local guidelines draw heavily from these sources and are not intended to replace evidence based national guidelines, but to collate the information in a single document taking into account locally used equipment.

1.3 Indications for Chest Drain

Under certain circumstances chest drains are used for the management of air or fluid within the pleural cavity. Broadly speaking the situations where a chest drain may be required can be divided into four categories. The first of these is in the context of trauma, generally haemothorax and/or pneumothorax. A blunt dissection drain is recommended in these circumstances (Section 2) and guidance is from the ATLS manual⁴. Secondly a chest drain is sometimes required for a spontaneous pneumothorax when a small bore Seldinger drain is usually most appropriate (Section 3) and specific BTS guidelines exist for pneumothorax¹. Thirdly there are times when a chest drain is required in the management of an exudative pleural effusion, including empyema (Section 4). Within the BTS pleural guidelines there are sections on the general investigation of pleural effusion and on the management of pleural infection and malignant pleural effusion¹. The last of these categories is the intra-operative insertion of chest drains, particularly during cardiothoracic surgery, and such situations are outwith the scope of these guidelines.

1.4 Choice of Technique

The historic technique for chest drain insertion is that of blunt-dissection, sometimes referred to as insertion of an Argyle or 'Surgical' chest drain. This technique involves dissection down to the pleural space through the chest wall and direct placement of a chest drain through this track, usually with a large bore tube.

Subsequently the Seldinger technique was developed for chest drain insertion. This technique

involves reaching the pleural space using a specifically designed seeker needle, passing a guide wire through the seeker needle and dilating a tract around the guide wire allowing the chest drain to be passed smoothly over this wire into the pleural space.

In theory either technique could be used in most circumstances, and the experience of the operator may influence the choice of technique. However in certain situations one technique will be more appropriate than another. For example in traumatic pneumothorax or haemothorax a blunt-dissection technique should be used, but when required for spontaneous pneumothorax or pleural effusion a smaller bore Seldinger drain is recommended.

1.5 Common Principles

The BTS Guidelines on pleural procedures contain a number of recommendations aimed at improving patient safety (Box 1). Some of these are discussed in more detail here.

TRAINING AND SUPERVISION

- All doctors expected to be able to insert a chest drain should be trained using a combination of didactic lecture, simulated practise and supervised practise until considered competent.
- Pleural procedures should not take place out of hours except in an emergency.

EQUIPMENT AND INSERTION TECHNIQUE

- Written consent should be obtained for chest drain insertions, except in emergency situations. Pain, intrapleural infection, wound infection, drain dislodgement and drain blockage are the most frequent complications of small-bore chest drain insertion. Visceral injury is the most serious complication. All of these possible sequelae should be detailed in the consent process.
- Small drains (usually inserted by the Seldinger technique) should be used as first-line therapy for pneumothorax, free flowing pleural effusions and pleural infection.
- During chest drain insertion an attempt to aspirate the pleural contents with a small needle should be made. If this is not possible, chest drain insertion should not continue.
- The dilator should not be inserted further than 1 cm beyond the depth from the skin to the pleural space.

INSERTION SITE AND IMAGING

- The preferred site for insertion of the needle for pleural aspiration should be the triangle of safety.
- Thoracic ultrasound guidance is strongly recommended for all pleural procedures for pleural fluid.
- The marking of a site using thoracic ultrasound for subsequent remote aspiration or chest drain insertion is not recommended except for large pleural effusions.

OTHER SAFETY ISSUES

- Pleural aspirations and chest drains should be inserted in a clean area using full aseptic technique.
- Non-urgent pleural aspirations and chest drain insertions should be avoided in anticoagulated patients until international normalised ratio (INR) <1.5.
- All patients with chest drains should be cared for by a medical or surgical team experienced with their management and nursed on a ward familiar with their care.

Box 1 - BTS recommendations to improve the safety of chest drain insertion and management

Training and Supervision

For the insertion of any chest drain it is recommended that doctors are trained using a combination of didactic lecture, simulated practise and supervised practise until considered competent.

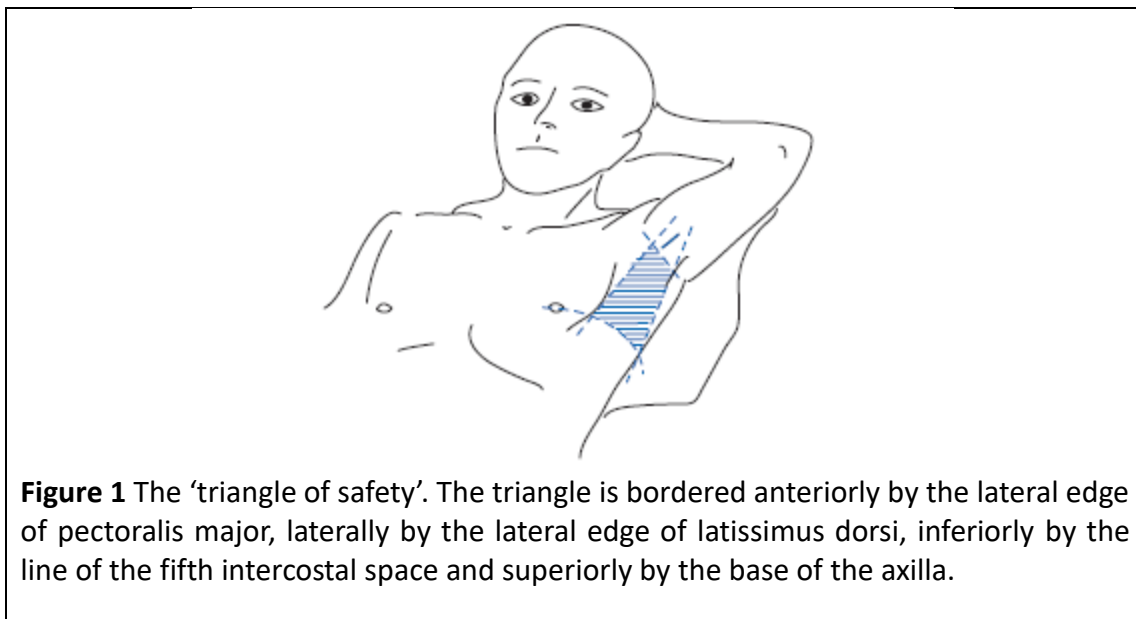
For the insertion of chest drains using blunt the blunt dissection technique the Advanced Trauma Life Support (ATLS) programme is recommended for initial training. Progression to competence to practise independently will follow further supervised practise and will depend on standards set within individual specialities such as Emergency Medicine, General Surgery and Cardiothoracic Surgery. Trainees in general medicine would not routinely be expected to insert chest drains by the blunt dissection technique, with the exception of respiratory medicine, where training and supervised procedures may be provided as part of their specialty training programme.

Before being allowed to insert Seldinger ICDs in unsupervised situations in NHS hospitals, doctors should undergo training as specified by the BTS guidelines i.e. a combination of didactic lectures, manikin practise and directly observed procedures (DOPs). Several pathways already exist to achieve this training, such as the COMEP programme organised by the NES or the IMPACT and ATLS courses. In particular, all CMT1 doctors in the West of Scotland are now routinely trained by chest physicians in an afternoon clinical skills course dedicated to Seldinger ICD insertion. Before being considered fully competent to independently insert a chest drain by Seldinger technique it is recommended that trainees should have inserted a total of four chest drains under supervision with satisfactory DOPs completed for at least two, the latter of which should have the '*Level of independent practice*' recorded as '*Competent to perform the procedure unsupervised and deal with complications*'.

Pleural procedures for effusions out of hours should be avoided or restricted to therapeutic aspiration only. If possible, definitive management should be performed by or at least discussed with the local Respiratory team.

Consent

Unless as an emergency, ICDs should not be inserted without written consent. To facilitate the consent process, the NHS Lanarkshire Consent Form should be used.



Triangle of Safety

This is the conventional site for insertion of ICD's and is detailed in Figure 1. For the insertion of

drains by blunt dissection the ATLS manual advises that a site is selected anterior to the mid-axillary line, in order to avoid the long thoracic nerve and its vascular bundle.

Good Practice

Where available, chest drains should be inserted in a clean procedures room on a ward. Currently this is not achieved with most being performed at the bedside. Sterile gowns and drapes should be mandatory.

Prior to commencing clinical procedures doctors should allocate their pager system to a colleague, if possible, to reduce the risk of interruption.

All ICDs inserted for medical indications should be managed in collaboration with respiratory units and, where appropriate, transfer to the respiratory ward should be considered.

ICD packs for medical indications have been standardised. After a review of the Seldinger ICD packs available, that produced by Rocket Medical Ltd was the preferred choice and is now stocked as standard on respiratory wards. These come in a flexible range of sizes (12, 14, 16, 18 and 20F) and the dilators are short and hence less prone to solid organ injury and the packs contain gowns and drapes to encourage aseptic technique and a number of adaptors to allow connection between firtree and luer-lock type fittings. It is hoped to roll out this standardisation to include medical admission units and accident & emergency departments where ICDs for pneumothoraces are predominantly inserted.

To improve adherence to guidelines and manufacturer's instructions for ICD insertion, a SOP (see Appendix A) has been produced covering the procedure based upon the BTS guidelines and instructions accompanying the Rocket Medical chest drains. This is used as part of the didactic training programme and subsequently is available as a reference guide.

Rocket Medical also provide larger sizes of ICD's (26, 28F) which are blunt dissection technique chest drains.

1.6 *Ultrasound Imaging*

Ward-based ultrasound imaging is strongly recommended for pleural procedures involving fluid in all but acute emergencies. This is now available on all respiratory wards in Lanarkshire Hospitals. Eventually at least one chest physician at each site will meet the Royal College of Radiology criteria to train specialist registrars in thoracic ultrasound. Such expertise would also be a natural development for senior doctors dealing with pleural effusions on medical admission units.

The marking of a site using thoracic ultrasound for subsequent remote aspiration or chest drain insertion is not recommended except for large pleural effusions.

2 Blunt dissection chest drains

Blunt dissection chest drains are recommended in the setting of trauma when drainage of air or fluid, such as blood, is required. Due to the possibility of anatomical disruption blunt dissection is

preferable so that access to the pleural space can be confirmed by palpation or visualization. An additional advantage of this technique in an emergency setting is the speed with which it can be performed, particularly as a large bore tube is recommended i.e. size 36F or 38F in a large traumatic haemothorax⁴.

The specific indications for chest drain insertion in the context of trauma are covered within the ATLS manual⁴, but would generally be indicated when patients present with traumatic simple or open pneumothorax, haemothorax or haemopneumothorax. It is also recommended that ICD insertion should be considered in patients with suspected severe lung injury requiring transport via air or ground, Individuals undergoing general anesthesia for treatment of other injuries who have suspected significant lung injury or individuals requiring positive pressure ventilation in whom substantial lung injury is suspected⁴.

A Seldinger approach is generally recommended for the management of 'medical' pleural disease, namely pleural fluid or spontaneous pneumothorax. However there are certain circumstances when a blunt dissection approach may be preferred. These might include; in very obese patients, when there is co-existing significant surgical emphysema, and when large bore drainage is required. In these situations involvement of the Respiratory team is preferable.

An SOP for the insertion of blunt dissection chest drains can be found in Appendix A.

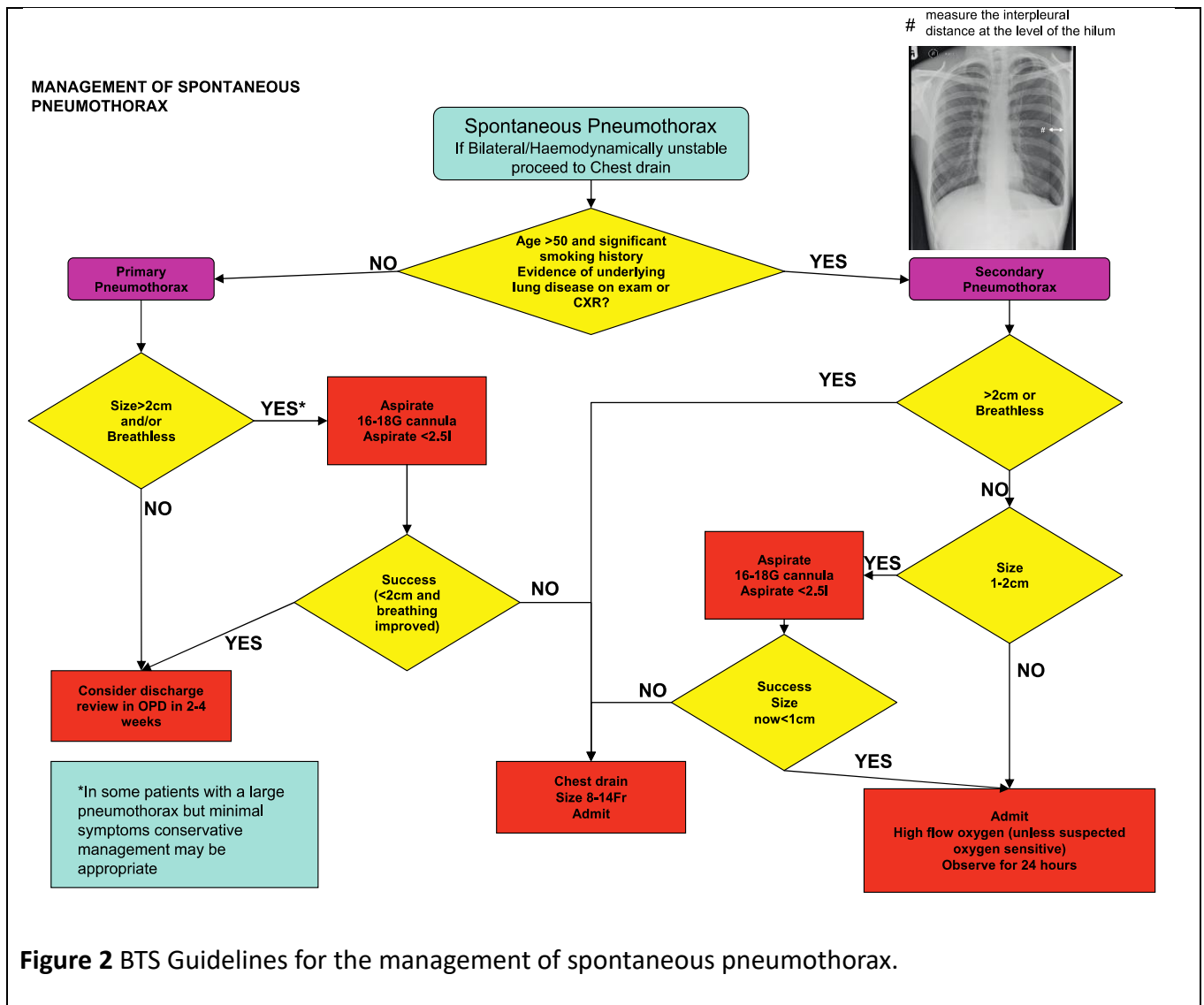
3 Spontaneous Pneumothorax

Pneumothorax is a significant health problem. Primary spontaneous pneumothorax (PSP) is a pneumothorax occurring in a previously healthy individual and secondary spontaneous pneumothorax (SSP) is pneumothorax occurring in those with pre-existing lung disease. Combined hospital admission rates for PSP and SSP in the UK have been reported as 16.7/100000 for men and 5.8/100000 for women.

Symptoms in PSP may be minimal or absent. In contrast, symptoms are greater in SSP, even if the pneumothorax is relatively small in size. The presence of breathlessness is the most important factor which influences the management strategy. The treatment of choice for patients with PSP who are breathless is simple aspiration. Treatment of choice in SSP who are breathless is insertion of a small bore ICD. Severe symptoms and signs of respiratory distress suggest the presence of tension pneumothorax which requires immediate management.

The recommended size of chest drain for spontaneous pneumothorax is 8-14F inserted using a Seldinger technique and sited within the triangle of safety. There may occasionally be circumstances under which an alternative site, drain size or insertion technique is preferable, but this should only occur with involvement of the Respiratory team.

The BTS 2010 pleural disease guideline¹ includes a useful algorithm for the management of pneumothorax which should be followed (Figure 2).



4 Pleural effusion

Pleural effusion is a common medical problem with over 50 recognised causes. The aim is to swiftly establish a diagnosis and minimise the need for repeated invasive procedures.

Not all pleural effusions require insertion of an ICD. A diagnostic tap is always the first appropriate investigation of pleural effusion to help make a definitive diagnosis. If the decision has been made that ICD is appropriate it should be inserted by an adequately trained member of staff or a junior doctor being supervised by an adequately trained member of staff.

Ideally ICD insertion should be done during daytime hours. If a patient presents 'out of hours' with respiratory distress associated with a pleural effusion it is reasonable to carry out a 'therapeutic aspiration' of 500ml of fluid to provide symptomatic relief and fluid for diagnostic purposes; deferring the insertion of an ICD until it has been decided this is the appropriate management strategy.

If the diagnostic tap reveals very turbid fluid or pus this is diagnostic of empyema and requires early liaison with the Respiratory team and early insertion of an ICD.

The recommended size of chest drain for pleural fluid is 10-14F inserted using a Seldinger technique under ultrasound guidance, ideally performed at the bedside. A slightly larger bore ICD is often used for pleural infection, including frank empyema, such as 16-20F drain. This would again be inserted by the Seldinger technique with ultrasound guidance. There may occasionally be circumstances under which an atypical site, drain size or insertion technique is preferable, but this should only occur with involvement of the Respiratory team.

The BTS 2010 guideline¹ includes a useful diagnostic algorithm (Figure 3) which should be used in the investigation and management of unilateral pleural effusion.

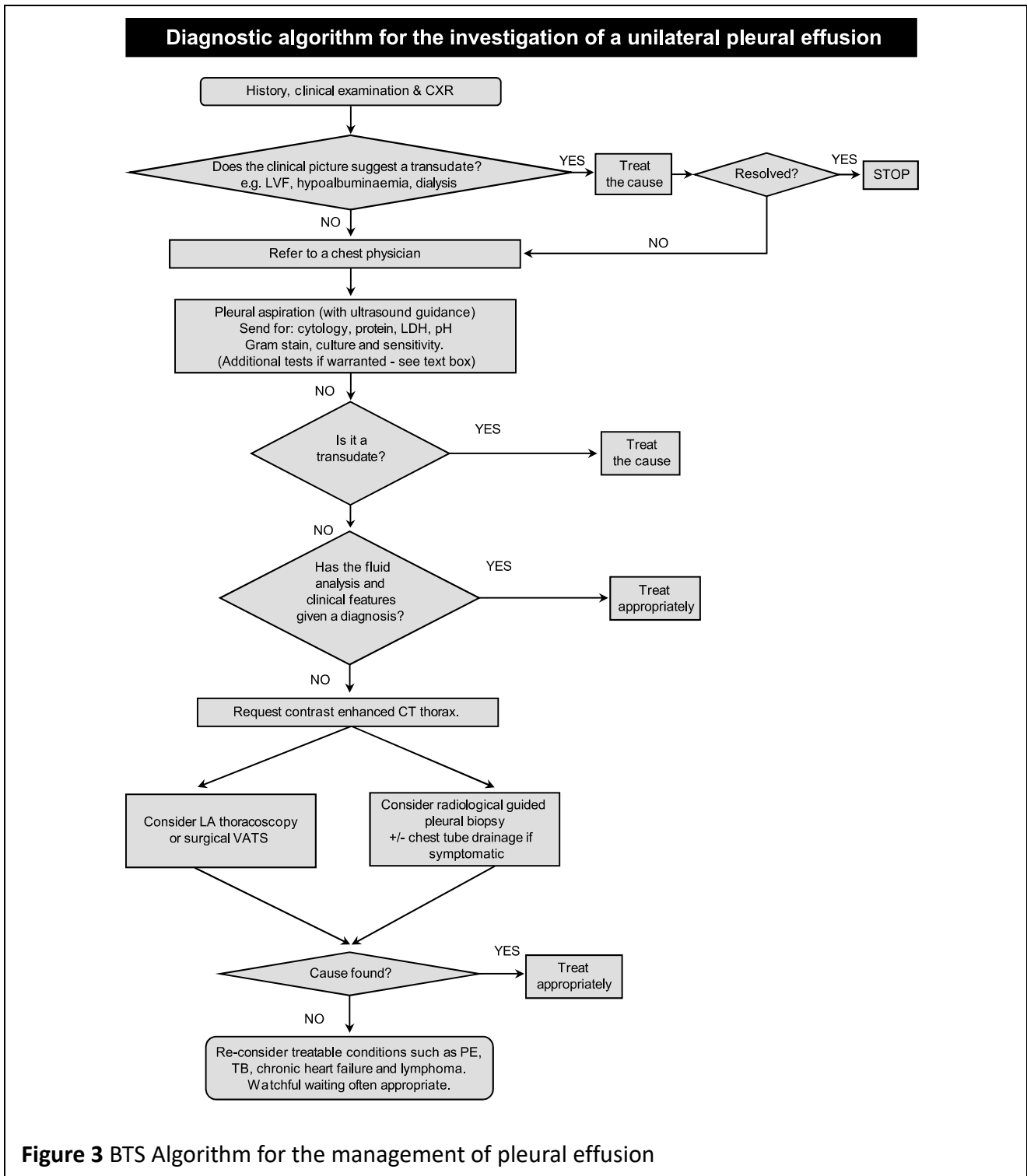


Figure 3 BTS Algorithm for the management of pleural effusion

Appendix A – Standard Operating Procedures

A.1 Chest Drain Insertion by Blunt Dissection.....	A.1
A.2 Chest Drain Insertion by Seldinger Technique.....	A.2
A.3 Chest Drain Care.....	A.3
A.4 Changing a Chest Drain Bottle.....	A.4
A.5 Flushing a Chest Drain.....	A.5
A.6 Chest Drain Suction - Altitude Bottle.....	A.6
A.7 Chest Drain Removal.....	A.7

Standard Operating Procedure	July 2016
A.1 Chest Drain Insertion by Blunt Dissection	v1.0

PURPOSE

This SOP outlines the procedure to be used for the insertion of a chest drain by the blunt dissection.

EMERGENCY SITUATIONS

In an emergency setting, particularly major trauma, decisions need to be made on the urgency with which action should be taken. Under certain circumstances it may not be possible to carry out all the steps outlined below, for example written consent or full imaging. Refer to the guidance in the Advanced Trauma Life Support manual.

DECISION

- Is a drain required in line with relevant guidelines – eg Advanced Trauma Life Support, British Thoracic Society
- Is it required urgently? (Avoid 'out of hours' where possible)
- Is there sufficient information to make a confident diagnosis? If not consider further imaging such as ultrasound or CT
- Is there a sufficiently skilled operator to insert the drain
- Are there relative or absolute contraindications to be aware of?
 - o *Clotting, platelets, allergies, body habitus*

Discuss with Senior, Cardiothoracic or Respiratory team where possible and whenever diagnosis in doubt, relative contraindications exist, atypical insertion site proposed or difficult insertion anticipated

PREPARATION

- Confirm patient ID corresponds with name band and chest imaging
- Provide patient information sheet and chance to read it
- Obtain written informed consent or complete Adults with Incapacity Act form. Inform relative if appropriate
- Review imaging to confirm site for drain and consider further imaging such as CT if diagnostic uncertainty

For Pleural Fluid

Image-guidance (bedside ultrasound) wherever possible

- o *Must be performed by someone trained in ultrasound*
- o *Note depth from skin to pleural space*

Triangle of safety wherever possible (see Figure 1) and if ultrasound not available

- Two assistants is optimal – one of whom is experienced in assisting chest drain insertion
- Select a suitable clinical area for drain insertion. If patient is in a general ward it is strongly recommended that a suitably equipped dedicated procedure room is used
- Oxygen saturation monitoring available, oxygen available
- Record baseline observations
- IV access secured and working
- Ensure the patient is comfortable with analgesia if required
- If premedication needed, reversal available
- Consider antibiotic prophylaxis for trauma patients, especially after penetrating trauma
- Check all drugs/doses/expiry dates with assistant
- Obtain equipment (*see checklist*)
- Position the patient appropriately (Figure 2)

- For pneumothorax semi-reclined position is preferred to access the triangle of safety
- For pleural fluid position for patient comfort and depending on ultrasound findings

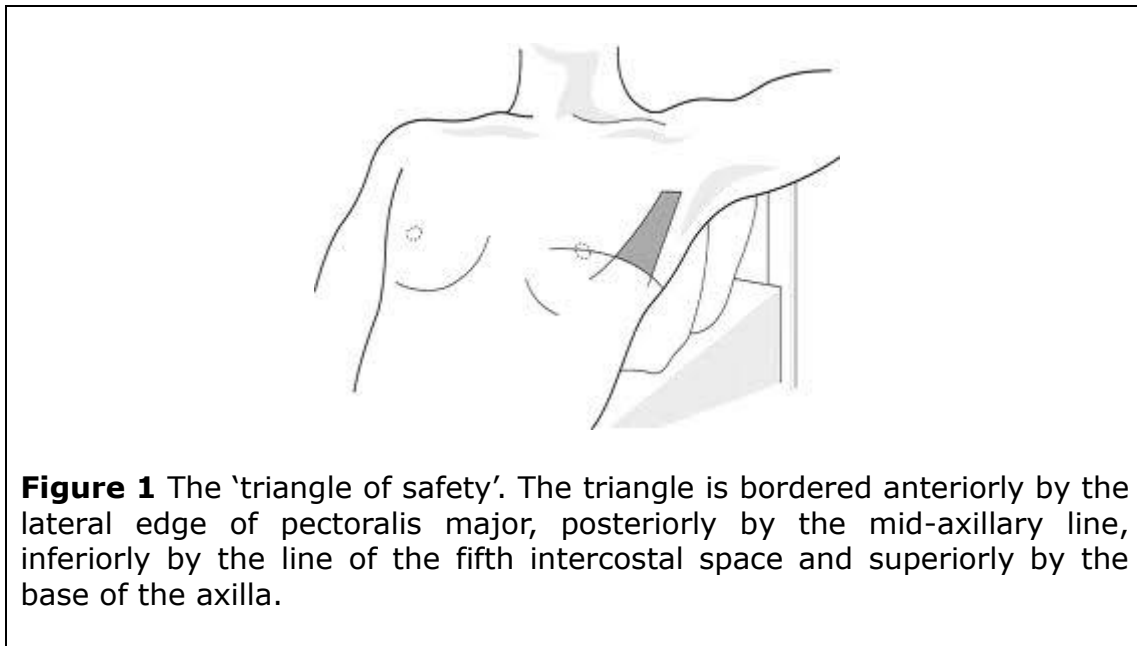


Figure 1 The 'triangle of safety'. The triangle is bordered anteriorly by the lateral edge of pectoralis major, posteriorly by the mid-axillary line, inferiorly by the line of the fifth intercostal space and superiorly by the base of the axilla.

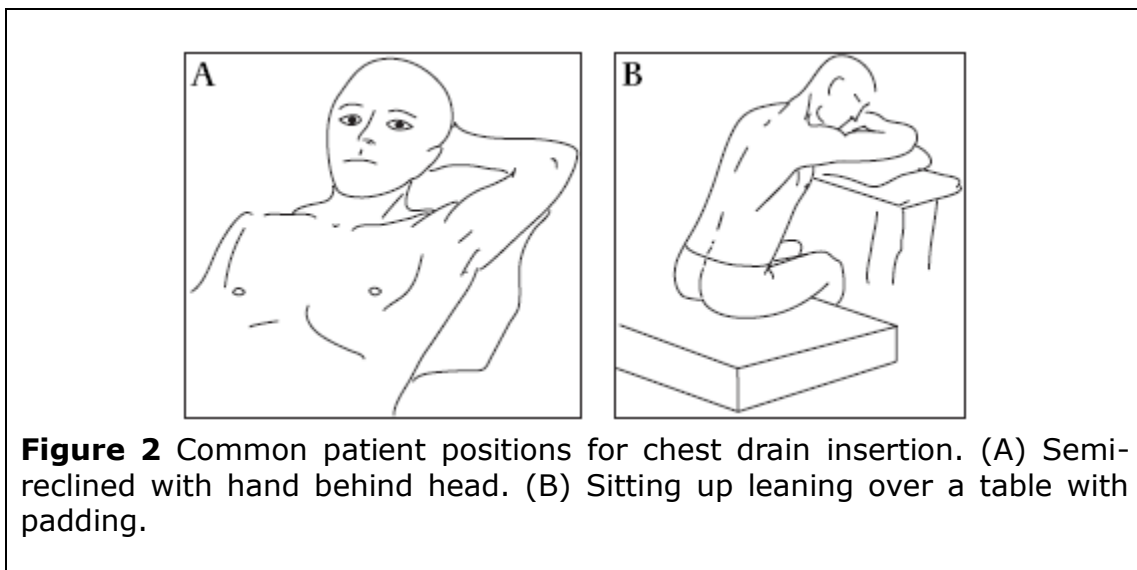


Figure 2 Common patient positions for chest drain insertion. (A) Semi-reclined with hand behind head. (B) Sitting up leaning over a table with padding.

EQUIPMENT

- Clean trolley
- Clinical waste bag
- Large sharps container
- Trolley drape
- Hernia drape
- Galipot
- Swabs

5ml syringe
21g needle (green)
23g or 25g needle (blue or orange)
11 scalpel blade with handle
Suture.
Dry dressing
Iodine or Chlorohexidine 2% and 70% alcohol solution.
Sterile surgical gown and gloves
Visor mask / goggles
Medium blunt tipped forceps x 2
Lignocaine 1% or 2%
Chest drain
Chest drain bottle and tubing
Bottle of sterile water
Clear tape
Chest drain clamp
[Portable ultrasound]

PROCEDURE

Cleansing and anaesthesia

- Full aseptic technique
- Position patient, trolley, room furniture, assistants
- Consider premedication
- Double-check equipment
- Scrub up, gown on, gloves on
- Clean skin and apply sterile drapes
- Infiltrate skin with local anaesthetic (LA)
- Infiltrate tissue, down to ribs and pleura with LA
 - *Confirm aspiration of fluid/air - if not possible further imaging required*
 - *Note depth of insertion of LA needle to pleural space*
 - *Note direction of needle insertion to pleural space*

Blunt dissection and drain insertion

- Ensure that assistant has prepared chest drain bottle with underwater seal and has tubing ready
- Make a transverse (horizontal) incision through the skin and superficial soft tissues, large enough to accommodate the drain selected. Use blunt dissection with artery forceps through the subcutaneous tissue in the horizontal plane over the upper border of the rib
- Puncture the pleura with the tip of the forceps and put a gloved finger into the incision and the pleural cavity. Sweep round with the finger to ensure there are no adhesions or internal organs that may be injured
- Trocars should **never** be used for chest drain insertion due to the high complication rate
- Take the chest drain and insert it into the pleural cavity for the desired length. The tube should be directed posteriorly along the inside of the chest wall
- Check for fogging of the tube with expiration or listen for air movement.
- Connect the end of the tube to a suitable underwater seal apparatus
- Check for bubbling or oscillation to ensure the drain is functioning.
- Secure the tube in place with sutures and dressing
- Remove drapes and help patient back into comfortable position in bed

- Obtain a chest x-ray at the end of the procedure to confirm a satisfactory position of the tube. If the position is suboptimal, the tube may be adjusted by pulling it back, but it must never be pushed further in because of the risk of pleural infection.
- Note depth of drain to skin (by markings on drain) for future reference
- Remove drapes and help patient back into comfortable position in bed

AFTERCARE

- Unclamp drain, if clamped
 - *Traumatic haemothorax - manage in line with ATLS guidelines*
 - *Pneumothorax - should never be clamped*
 - *Pleural effusion - follow local policy for drainage, generally 500ml fluid drainage then clamp for an hour, then repeat. Certainly no more than 1.5 litre initial drainage before clamping.*

For pneumothorax or any bubbling chest drain there should be absolutely no clamping

- Document procedure in medical case notes.
The use of the Chest Drain Bundle documentation (in sticker or electronic format) is recommended. See Appendix B1
- Record -
 - *Indication*
 - *Operator, assistant(s)*
 - *Consent, premedication*
 - *Insertion technique, site, anaesthetic*
 - *Drain size, depth, complications*
 - *Sutures inserted and fixation device used*
 - *Samples sent*
 - *Post-procedure instructions*
- Prescribe analgesia
- Sign for any premedication that you have administered
- Send any samples taken
- Handover to Nursing Staff and on-call medical staff if necessary
- Request chest x-ray (timing at discretion of clinical team)
- Others SOPs provide guidance on further drain care

Standard Operating Procedure	July 2016
A.2 Chest Drain Insertion by Seldinger Technique	v1.1

PURPOSE

This SOP outlines the procedure to be used for the insertion of a chest drain by the Seldinger technique for either pleural fluid or pneumothorax.

DECISION

- Would aspiration be sufficient?
- Is pleural biopsy needed? (*Respiratory team required*)
- Is it required urgently? (Avoid 'out of hours' where possible)
- Is there sufficient information to make a confident diagnosis? If not consider further imaging such as CT
- Is there a sufficiently skilled operator to insert the drain
- Are there relative or absolute contraindications to be aware of?
 - o *Clotting, platelets, allergies, body habitus*

Discuss with Respiratory team where possible and whenever diagnosis in doubt, relative contraindications exist, atypical insertion site proposed or difficult insertion anticipated

PREPARATION

- Confirm patient ID corresponds with name band and chest imaging
- Obtain written informed consent or complete Adults with Incapacity Act form. Inform relative if appropriate
- Review imaging to confirm site for drain and consider further imaging such as CT if diagnostic uncertainty

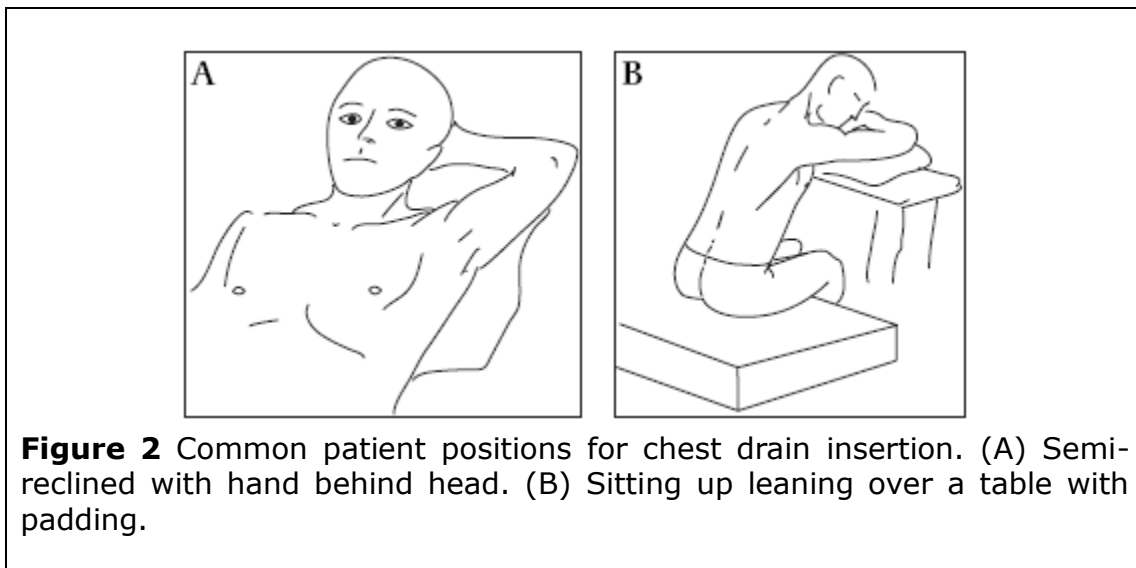
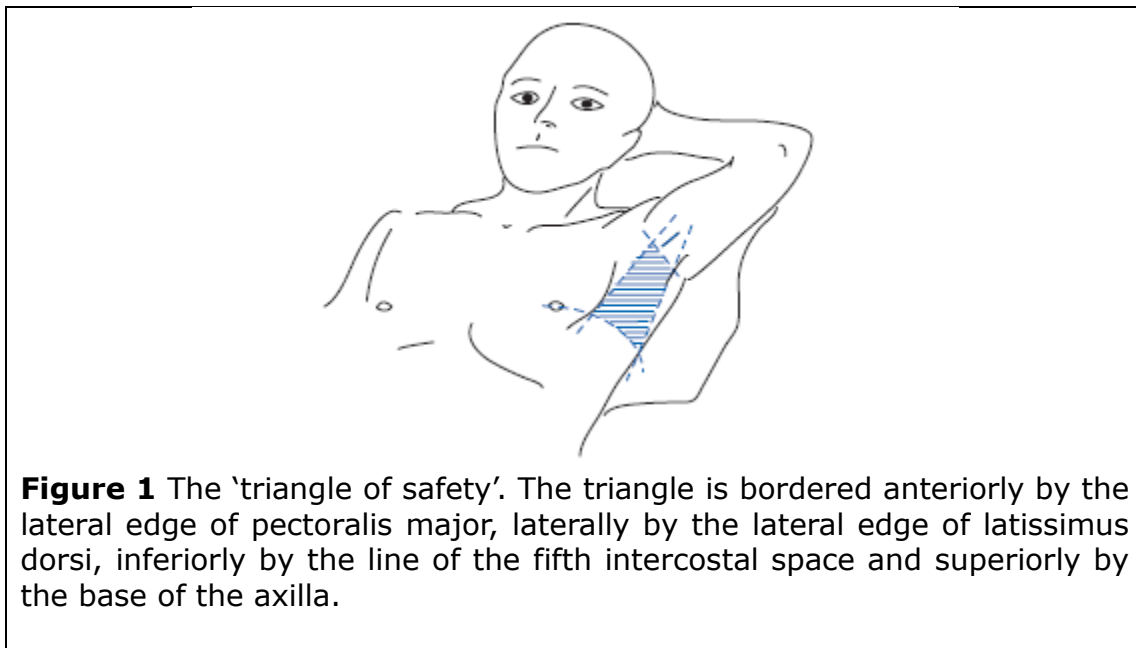
For Pleural Fluid

Image-guidance (bedside ultrasound) wherever possible

- o *Must be performed by someone trained in ultrasound*
- o *Note depth from skin to pleural space*

Triangle of safety wherever possible (see Figure 1) and if ultrasound not available

- Two assistants is optimal – one of whom is experienced in assisting chest drain insertion
- Select a suitable clinical area for drain insertion. If patient is in a general ward it is strongly recommended that a suitably equipped dedicated procedure room is used
- Oxygen saturation monitoring available, oxygen available
- Record baseline observations
- IV access secured and working
- Ensure the patient is comfortable with analgesia if required
- If premedication needed, reversal available
- Check all drugs/doses/expiry dates with assistant
- Obtain equipment (*see checklist*)
- Position the patient appropriately (Figure 2)
 - o For pneumothorax semi-reclined position is preferred to access the triangle of safety
 - o For pleural fluid position for patient comfort and depending on ultrasound findings



EQUIPMENT

NB In many clinical areas drain packs manufactured by Rocket are being used which contain much of the necessary equipment. These items are indicated by * in the list below

- Sterile gown*
- Sterile drapes*
- Gauze swabs*
- Syringes and needles*
- Scalpel*
- Suture*
- Guide wire*
- Chest drain*
- Sterile gloves

Skin antiseptic solution
Local anaesthetic
Chest drain tubing
Drain bottle + sterile water
Dressing
Chest drain clamp
Clinical waste bag
[Specimen containers]

PROCEDURE

Cleansing and anaesthesia

- Full aseptic technique
- Position patient, trolley, room furniture, assistants
- Consider premedication
- Double-check equipment
- Scrub up, gown on, gloves on
- Clean skin and apply sterile drapes
- Infiltrate skin with local anaesthetic (LA)
- Infiltrate tissue, down to ribs and pleura with LA
 - *Confirm aspiration of fluid/air - if not possible further imaging required*
 - *Note depth of insertion of LA needle to pleural space*
 - *Note direction of needle insertion to pleural space*

Guide wire insertion and dilatation

- Ensure that assistant has prepared chest drain bottle with underwater seal and has tubing ready
- Assemble and check introducer needle and syringe
- Check guide wire/feeder, dilators, drain
- Nick skin with scalpel
- Insert introducer needle until fluid/air obtained +5mm
- Secure needle position with hand, remove syringe
- Insert guide wire sufficient length to reach pleural space
 - *NB The guide wire has markings in 10cm intervals; 20-30cm length of wire should be adequate in most patients*
 - **There should be little or no resistance**
- Secure guide wire then remove introducer needle
- Use scalpel to increase size of skin incision over guide wire, if necessary
- Insert sequential dilators over guide wire
 - *Rotating motion to ease through skin*
 - *Do not remove depth guards unless absolutely necessary*

Chest Drain Insertion

- Insert chest drain over guide wire to a depth adequate to have all side ports within pleural space +5cm
 - *On Rocket drains, markers measure depth to proximal port (**not** to the end of the drain)*
 - *A typical depth would be 10cm (= 5cm chest wall thickness + 5cm 'extra')*
 - *Ensure guide wire feeds down the central 'stiffener' within the chest drain*
- Remove guide wire and central core 'stiffener' of chest drain, while holding drain secure with other hand

- Take any pleural fluid samples needed with a 50ml catheter-tipped syringe

Securing and dressing

- Attach sterile end of chest drain tubing (other end already connected to underwater seal)
 - *Confirm drainage of fluid/air and oscillation of water level in tube*
 - *You may need to get the patient to cough to start fluid flowing*
 - *If large effusion, apply clamp(or use the 3-way tap to close) at this stage to maintain control while completing the procedure*
- Assistant supports non-sterile portion of chest drain tubing while you suture the drain
 - *1-2x anchoring suture is usually sufficient*
 - *Smaller drains do not need a mattress suture*
- Apply sterile chest drain dressing
- Note depth of drain to skin (by markings on drain) for future reference
- Remove drapes and help patient back into comfortable position in bed

AFTERCARE

- Unclamp drain, if clamped
 - *Follow local policy for drainage, generally 500ml fluid drainage then clamp for an hour, then repeat*
 - *Certainly no more than 1-1.5 litre initial drainage before clamping*

For pneumothorax or any bubbling chest drain there should be absolutely no clamping

- Document procedure in medical case notes.
The use of the Chest Drain Bundle documentation (in sticker or electronic format) is recommended. See Appendix 1.
- Record -
 - *Indication*
 - *Operator, assistant(s)*
 - *Consent, premedication*
 - *Insertion technique, site, anaesthetic*
 - *Drain size, depth, complications*
 - *Sutures inserted and fixation device used*
 - *Samples sent*
 - *Post-procedure instructions*
- Insert Product Batch Number sticker into case notes if available
- Prescribe analgesia
- Sign for any premedication that you have administered
- Send any samples taken
- Handover to Nursing Staff and on-call medical staff if necessary
- Request chest x-ray (timing at discretion of clinical team)
- Others SOPs provide guidance on further drain care

More details available from the British Thoracic Society Pleural Disease Guideline 2010 available at: <http://www.brit-thoracic.org.uk>

Diagrams taken from above document.

Standard Operating Procedure	July 2016
A.3 Chest Drain Care	v1.1

PURPOSE

This SOP provides guidance on the care of a patient with an intercostal chest drain.

GENERAL

- Patients should be managed in a clinical environment where nursing staff are competent in the holistic care of a patient with a chest drain in situ with resuscitation equipment available.
- Close attention should be paid to patient comfort and adequate analgesia provided
- Chest drain bottle should;
 - Be kept below the drain insertion site at all times
 - Be kept upright at all times
 - Never be filled below the 'zero' level
 - Be replaced with a new bottle if almost full

IMMEDIATE POST INSERTION CARE

- Ensure drain is secured with sutures and appropriate dressing
- Confirm drain is swinging and whether there is active fluid drainage or bubbling
- A chest X-Ray should be obtained after insertion, the timing of this is at the discretion of the clinical team.
- **A patient with a clamped chest drain for any reason should not leave the ward and therefore should have a portable chest X-Ray.**
- Ensure the nursing staff and any relevant medical staff are aware that the drain has been inserted
- Drainage;
 - For pneumothorax or any bubbling chest drain there should be absolutely no clamping***
 - *Traumatic haemothorax - manage in line with ATLS guidelines*
 - *Pleural effusion - follow local policy for drainage, generally 500ml fluid drainage then clamp for an hour, then repeat. Certainly no more than 1.5 litre initial drainage before clamping.*
- When unclamping a drain for the drainage of pleural fluid the rate of drainage should be directly observed. If the rate is rapid it may be necessary to wait by bedside so it can be clamped again as soon as the maximum allowed volume has drained
- **When draining a pleural effusion, if a patient becomes unwell or their observations change adversely clamp the drain and seek medical review as re-expansion pulmonary oedema may be a possibility**

MONITORING AND DOCUMENTATION

- Observations should be obtained immediately after drain insertion
- The frequency of subsequent observations should be adjusted according to the patient's clinical condition and guided by the early warning score
- Observations should include; respiratory rate, SpO2 and flow of oxygen prescribed, heart rate, blood pressure, temperature and early warning score
- Drain observations should also be documented on the Chest Drain Chart (Appendix B). These observations include
 - Suction?
 - Underwater seal intact?
 - Bubbling?
 - Oscillating/Swinging?

Dressing site satisfactory?
Drain tubing satisfactory?
Current drainage level
Total volume drained (inc. Drainage from previous bottles)
Pain Control adequate?

DRAIN PROBLEMS & TROUBLESHOOTING

- Drain has stopped swinging
 - Check patient including observations
 - Look for any obvious problem with chest drain, tubing and drain bottle; patient lying on tubing, tubing twisted, drain bottle full, drain fallen out
 - If the problem is not easily remedied inform medical staff
 - Medical staff should perform similar investigations for drain problems including taking the drain dressing down and if none are evident consider whether an updated chest X-Ray and/or flushing of the drain is appropriate.
- Drain appears to have slipped partially out
 - Check patient including observations
 - Inform medical staff immediately
 - Medical staff will need to determine whether the drain is still functioning and make a plan for further action if it is not (ie. Drain removal or replacement)
- Drain has fallen out completely
 - Check patient including observations
 - Inform medical staff immediately
 - Place an occlusive dressing over the drain site
 - Obtain a chest X-Ray
 - Medical staff will need to determine whether further intervention is required, for example is a new chest drain, and if so whether it required urgently
- Drain tubing disconnected
 - Reattach drain tubing
 - Check patient including observations
 - Inform medical staff immediately
 - If patient is well and drain functioning further action may not be necessary
 - Chest X-Ray may be indicated
- Chest drain bottle knocked over
 - Return bottle to upright position
 - Ensure the fluid level is not below the 'zero' mark, if there is insufficient water replace the drain bottle
 - Check patient including observations
 - Inform medical staff
 - If patient is well and drain functioning further action may not be necessary
- Dressing no longer securely attached
 - Replace dressing
- Sutures no longer in place
 - Medical staff should ensure the drain remains in a satisfactory position and if so should re-suture the drain

Standard Operating Procedure	July 2016
A.4 Changing a Chest Drain Bottle	v1.1

PURPOSE

This SOP provides guidance on the replacement of an existing chest drain bottle with a new drain bottle.

EQUIPMENT

- Sterile gloves and apron
- Sterile sheet or drape
- Replacement chest drain bottle
- 500 ml sterile water
- [Chest drain tubing: may be packed with bottle or separately]
- [Clamp – if no 3 way tap in place]

PROCEDURE

- Wash hands and don gloves and apron
- Throughout the procedure care must be taken to avoid contaminating any drain openings by contact with the environment such as bedclothes or patient clothing
- Fill the new drain bottle to the 'zero' mark with sterile water
- Place drain connection on top of a sterile sheet or drape
- 'Clamp' drain, either by closing 3 way tap to patient or by application of a clamp to the chest drain
- Change old drain bottle for new one. The drain bottle tubing may be retained or replaced, depending on the drain system used and condition of the tubing.
- Unclamp drain
- Document final volume in old bottle on drain chart and new (zero) volume for replacement bottle

Standard Operating Procedure	July 2016
A.5 Flushing a Chest Drain	v1.1

PURPOSE

This SOP provides guidance on the care of a patient with an intercostal chest drain.

INDICATIONS

There are generally two indications for a chest drain to be flushed

- As part of routine care to maintain patency. This is usually in the case of an empyema when there may be benefit from flushing the drain at regular intervals, for example twice daily. It is recommended the flush is prescribed on the medical kardex and documented on the chest drain observation chart.
- As an attempt to unblock a drain which has stopped working. If a drain has stopped swinging and there is no drainage further assessment is required. One possibility is that the lung has completely re-expanded, but drain faults should also be considered, such as malposition, twisting, disconnection or blockage. Blockage may be evident within the visible drain tubing, or occult within the chest. If there is a blockage in the distal tubing attached to the drain bottle this should be replaced. If there is a suspicion of a blockage within the actual drain, flushing should be considered

If there is any uncertainty regarding the flushing of a drain advice should be sought from the Respiratory team.

EQUIPMENT

- Sterile dressing pack
- Sterile gloves and clean apron
- 50-100 ml bag of sterile normal saline
- 1 or 2 x 50 ml syringe - catheter tip or Luer tip depending on drain
- Needle
- Clamp [unless 3 way tap already attached to drain]

PROCEDURE

- Wash hands and don gloves
- Fill 1 or 2 syringe(s) with 50 ml of saline using aseptic technique
- Throughout the procedure care must be taken to avoid contaminating any drain openings by contact with the environment such as bedclothes or patient clothing
- If drain has 3 way tap
 - Close tap to patient
 - Place side port covering cap in sterile area
 - Attach syringe to side port
 - Close tap to distal chest drain tubing
 - Flush 50 ml of saline into chest drain, repeat if necessary
 - Attempt to aspirate fluid back
 - Close tap to patient and remove syringe
 - Replace side port cap
 - Close tap to side port
- If drain does not have 3 way tap
 - Clamp drain proximally
 - Disconnect drain tubing
 - Attach syringe to drain
 - Flush 50 ml of saline into chest drain
 - Attempt to aspirate fluid back
 - Remove syringe and reattach drain

- Unclamp
- Record flush on drain chart and Kardex including volume
- If flushing due to blockage record procedure and outcome in casenotes

When it is possible to flush fluid into a drain but not aspirate back the drain may still be functioning normally and further management will depend on the clinical scenario.

If it is not possible to either flush into or aspirate back from a drain, and it is not actively swinging, draining or bubbling, it can be considered to be a non-functioning drain and consideration should be given to drain removal.

Standard Operating Procedure	July 2016
A.6 Chest Drain and Chest Drain Suction - Atrium Bottle	v1.1

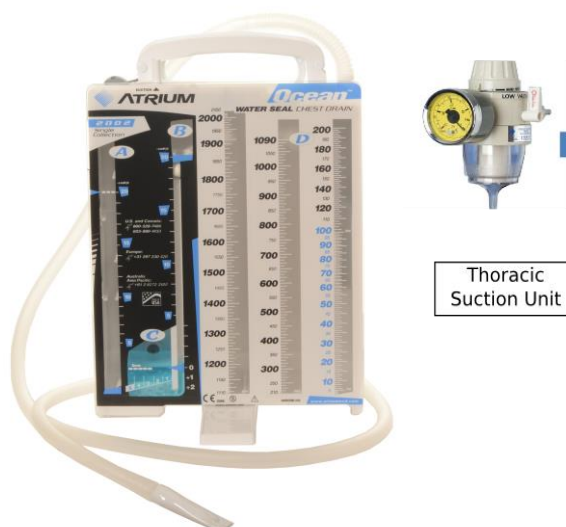
Chest drains on suction should be looked after on unit experienced in their management (such as Respiratory, High Dependency or Intensive Care Units).

PURPOSE

This SOP provides guidance on the application of suction to a chest drain by the use of an Ocean Atrium bottle attached to wall suction.

EQUIPMENT

- Atrium chest drain bottle
- Suction tubing
- Scissors
- Wall mounted Thoracic high volume/ **LOW PRESSURE** suction regulator and trap
- [Clamp – if no 3 way tap in place]



PROCEDURE

- Wash hands and don gloves and apron
- Throughout the procedure care must be taken to avoid contaminating any drain openings by contact with the environment such as bedclothes or patient clothing
- **Fill water seal (B) to 2 cm line:** Fill the new Atrium drain bottle to the 'zero' mark with sterile water by adding 45 ml of sterile water (Illustration 1) via the funnel. Twist top off bottle and insert tip into suction port. Squeeze contents into water seal until fluid reaches 2 cm fill line (Illustration 2). Once filled, water becomes tinted blue for visibility of air leaks and convenient monitoring of patient pressures. Ensure drain is swinging.

SUCTION (Optional)

In addition to the above

- **Fill suction control (A):**

To fill suction control chamber to desired suction pressure level (-10 cmH₂O), remove the tethered vent plug, pour water, and replace vent plug (Illustration 3). Once filled, water becomes tinted blue.

- **Connect chest drain to patient:**

Remove patient tube connector cap and insert stepped patient tube connector into patient catheter. Connect chest drain to patient prior to initiating suction.

- **Connect chest drain to suction**

All Atrium drainage systems will operate with either a portable pump or a wall suction commonly used for chest drainage (Illustration 4). We use a low pressure suction regulator attached to wall suction. To apply suction, connect suction source line directly to the suction control stopcock or suction connector provided.

- Apply enough suction to allow reliable bubbling through fluid in column A. If column of fluid filled to 10cm then by applying suction to allow bubbles, the suction pressure level will be -10 cmH₂O and no more. Be wary of fluid evaporating and lower than desired suction thereafter being applied.

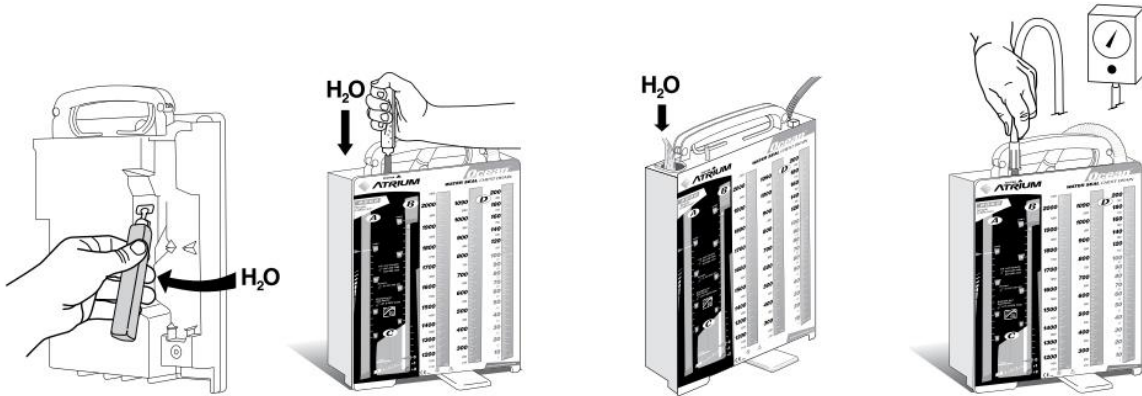


Illustration 1

Illustration 2

Illustration 3

Illustration 4

RISK AWARENESS NOTICE

**Chest Drain Underwater Seal and Chest Drain Suction -
Atrium Bottle**

Detail: Following an adverse event reported from UHH site, the review group agreed that instructions and set up of the Atrium Ocean Wet Suction Water Seal Chest Drain were confusing and could therefore lead to error. This has been reported to the company and changes have been recommended. Until these changes are in place, please see guidance below.



1. TO CREATE UNDERWATER SEAL PUT STERILE WATER INTO THE PORT MARKED SUCTION

2. TO PUT CHEST DRAIN ON SUCTION FILL THIS PORT WITH DESIRED SUCTION LEVEL (5/10/15/20 CMH20)



3. APPLY SUCTION CATHETER TO SUCTION PORT AND SWITCH ON AT WALL UNTILL GENTLY BUBBLING.

Standard Operating Procedure	July 2016
A.7 Chest Drain Removal	v1.1

PURPOSE

This SOP provides guidance on the removal of an intercostal chest drain of either the Seldinger or blunt dissection type

EQUIPMENT

- Sterile dressing pack
- Sterile gloves and clean apron
- Biological waste disposal bag
- Stitch cutter
- Occlusive dressing
- [steristrips or suture]

PROCEDURE

- Confirm that team have made decision to remove drain
- Wash hands and don gloves
- Strip down dressing
- Cut sutures
- There is no evidence that removal of the drain in end inspiration or expiration affects the risk of pneumothorax. It is however suggested that removal be avoided during active inspiration.
- Remove the drain with a brisk firm movement
- Wound closure
 - Small bore drains – usually do not require specific wound closure, although one may consider the use of steristrips
 - Large bore drains – may require closure by suturing depending on wound size. In some cases this will be by tying of a previously placed mattress suture, in others suturing is carried out after drain removal
- Place a sterile occlusive dressing over the drain site
- Dispose of drain and fluid in accordance with ward policy
- Inform nursing staff of drain removal and any sutures in place
- The requirement for post removal chest X-Ray will depend on clinical circumstances
- In some patients with large volume effusions there will be leakage post drain removal. This can be easily managed with the application on a Stoma bag over the drain site for 24-48 hours until the leakage subsides

Appendix B – Additional Material

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**B.1 Appendix 1. Patient
Information Leaflet**

*Please now read the consent form
overleaf. If you have any questions
please ask your doctor.*

*If you are happy to proceed with the
chest drain, please sign the consent
form.*

Information about
**Having a Chest Drain
Inserted**

What is a Chest Drain?

A chest drain is a plastic tube about the thickness of your little finger. It is used to drain air or fluid which can collect in the space between your lung and ribcage (known as the pleural space). A chest drain can usually be inserted at your bedside, and the procedure will only be performed by a doctor with the specific training and necessary skills. We would like to insert a chest drain for the following reason:

Having a Chest Drain inserted

Most drains are inserted into the side of the chest, just below the armpit. The specific site chosen will, however, depend on your own particular problem. The area will first be cleaned with antiseptic fluid and surrounded by sterile sheets. The site will then be numbed using a local anaesthetic injection, and a small cut will be made in the skin (about 1 inch in length). The chest drain can then be passed through this hole, using a thin wire to guide it into the correct position inside the chest.

Once in place, the chest drain tubing will be connected to a drainage bottle and secured into place with a dressing; a stitch may be

used in some cases.

It is important that you keep the drainage bottle BELOW THE LEVEL OF YOUR CHEST at all times. This prevents fluid/air moving backwards into your chest.

An x-ray will be taken once the procedure is complete, to check that the tube is in the correct position.

Risks

As with most medical procedures there are risks associated with the insertion of a chest drain and rare cases of death following chest drain insertion have been reported. However, this risk is extremely small and the risk of any serious problem occurring is low. Importantly, your medical team feels the risk of not inserting a chest drain outweighs these small risks. More common potential complications that you should be aware of include:

- 1. Pain.** Your doctor will do their best to minimize any discomfort by using local anaesthetic. Some patients are uncomfortable despite this; therefore extra painkillers can be given, if necessary.
- 2. Bleeding.** Minor bleeding is common but this will usually stop on its own. Very rarely, more significant bleeding can occur into or around the

lung and specific treatment, including surgery may be required.

3. Problems with the drain. Occasionally, the drain may become kinked or blocked after it has been inserted. This can usually be fixed but sometimes the drain may need to be removed and replaced.

4. Infection. Skin or lung infections can develop if bacteria get into the chest through the drain site. This risk is reduced by cleaning the skin beforehand, using sterile equipment to insert the drain and dressing the site afterwards. The less time the drain is kept in, the lower the risk of an infection. Therefore, it will be removed as soon as possible.

Removal of the Chest Drain

Your doctor will decide when the drain can be removed. This can usually be done at your bedside and it is not usually painful. Once the drain has been removed, the area will be dressed. Occasionally, a stitch may be inserted but this is often not required. A chest x-ray may then be taken to check for any remaining fluid or air. You will only have a small scar and this will gradually fade over time.

B.2 Appendix 2. Seldinger Chest Drain Bundle

Pleural procedure checklist

Date:	Time:	Inserted by:	Grade:
Ward	Procedure room: <input type="checkbox"/> Yes <input type="checkbox"/> No	Supervised by:	Grade:
Site: <input type="checkbox"/> R <input type="checkbox"/> L	Patient information leaflet: <input type="checkbox"/> Yes <input type="checkbox"/> No	Written consent: <input type="checkbox"/> Yes <input type="checkbox"/> No	Gown used: <input type="checkbox"/> Yes <input type="checkbox"/> No
<input type="checkbox"/> Correct side double-checked <input type="checkbox"/> CXR reviewed		USS: <input type="checkbox"/> Bedside <input type="checkbox"/> Xray department <input type="checkbox"/> None	
Ensure pt. is not on: <input type="checkbox"/> Clopidogrel <input type="checkbox"/> Warfarin <input type="checkbox"/> DOAC		<input type="checkbox"/> Coag INR <1.5 <input type="checkbox"/> Platelets >50	
Drain type: <input type="checkbox"/> Seldinger <input type="checkbox"/> Blunt	Drain size:	Pre-med:	Inserted to: _____ cm
Lidocaine: <input type="checkbox"/> 1% <input type="checkbox"/> 2% Volume: (air/fluid)	If aspiration only, volume aspirated:		
Specimens: <input type="checkbox"/> Biochem <input type="checkbox"/> Micro <input type="checkbox"/> Cytology	Appearance of fluid:		
Instructions: <input type="checkbox"/> Obs as per post procedure care <input type="checkbox"/> Post procedure cxr requested <input type="checkbox"/> Post procedure cxr reviewed <input type="checkbox"/> Other instructions	Complications:		


Please refer to SOP for pleural procedures - (insert link for FirstPort here)

LAB.PLURAL.16_07811.W

B.3 Appendix 3. Chest Drain Recording Chart

CHI no: _____
 First name: _____ DOB:/...../.....
 Last name: _____ Sex: M F
 Address: _____

or attach addressograph label here

Hospital: Hairmyres Monklands Wishaw 
 Other (specify)

Chest Drain Observation Chart

Ward:

Date of insertion:/...../.....
Site of drain:

Reason for insertion:
Observe chest drain and record whether bubbling/swinging/draining: hourly (see notes')

Date	Time	Bubbling Yes No	Swinging Yes No	Drainage type ²	Volume drained	Total Vol. drained	Flushed Yes No	Volume flushed	Suction On (Kpa)/Off	Bottle change	Site check/ Dressing change ³	Drain Clamped	Time clamped	Time unclamped	Initials
		<input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>				<input type="checkbox"/> <input type="checkbox"/>								
		<input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>				<input type="checkbox"/> <input type="checkbox"/>								
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		<input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>				<input type="checkbox"/> <input type="checkbox"/>								



- 1. Notes**
- If the chest is not swinging inform medical staff.
 - Record the type and amount of all drainage, e.g. serous fluid/fresh blood/old blood/pus.
 - Observe site for signs of infection/kinking/disconnection/displacement and change dressing as necessary.
 - Ensure the drainage bottles are positioned correctly, below the level of intrapleural drain.
 - Ensure patient's comfort and administer analgesia as prescribed if required.
 - Document the amount of suction used as per doctor's instructions if required.

- 2. Drainage Type Key:**
 SF = Serous Fluid P = Pus
 FB = Fresh Blood OB = Old Blood
- 3. Site Check/Dressing Change:**
 SC = Site checked
 DC = Dressing changed

NMAHIP-CHSTDRL031601

Patient name: _____ **CHI number:** _____

Chest Drain Observation Chart

Date	Time	Bubbling Yes No	Swinging Yes No	Drainage type ²	Volume drained	Total Vol. drained	Flushed Yes No	Volume flushed	Suction On (Kpa)/Off	Bottle change	Site check/ Dressing change ³	Pleural effusion only			Initials
												Drain Clamped	Time clamped	Time unclamped	
		<input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>				<input type="checkbox"/> <input type="checkbox"/>								
		<input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>				<input type="checkbox"/> <input type="checkbox"/>								
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		<input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>				<input type="checkbox"/> <input type="checkbox"/>								

Date	Time	Additional Comments	Initials

- 1. Notes**
- If the chest is not swinging inform medical staff.
 - Record the type and amount of all drainage, e.g. serous fluid/fresh blood/old blood/pus.
 - Observe site for signs of infection/kinking/disconnection/displacement and change dressing as necessary.
 - Ensure the drainage bottles are positioned correctly, below the level of intrapleural drain.
 - Ensure patient's comfort and administer analgesia as prescribed if required.
 - Document the amount of suction used as per doctor's instructions if required.

- 2. Drainage Type Key:**
 SF = Serous Fluid P = Pus
 FB = Fresh Blood OB = Old Blood
- 3. Site Check/Dressing Change:**
 SC = Site checked
 DC = Dressing changed

B.4 Appendix 4. Biochemical Investigation of Pleural Fluid

1. What are the sampling requirements?

- **Microbiology** – 1. One set of bacterial culture bottles; 2. One universal for gram staining and tuberculosis culture.
- **Biochemistry** – 1. One plain universal for protein, LDH, and when applicable lipids and amylase; 2. One fluoride oxalate (grey bottle) for glucose; 3. One heparinised blood gas syringe for pH. **This must be collected without air bubbles and analysed within 1 hour of collection.** Purulent samples may block or damage the gas analyser and should not be analysed (see point 4).
- **Cytology** – one universal for differential cell count.

It there are any queries please contact the Duty Biochemist.

2. What is the appearance of the effusion and what does it signify?

- Clear, straw-coloured, non-viscous and odourless: normal.
- Homogeneously bloody sample: may be consistent with a haemothorax and/or a malignant exudative process or due to a traumatic tap. **Samples that show haemolysis post-centrifugation will not be analysed for Biochemistry tests.**
- Turbid/milky/cloudy: chylothorax or pseudochylothorax (see point 9).
- If an urinothorax is suspected, request fluid creatinine. A detectable creatinine is indicative of the presence of urine in an effusion.

3. Is it a transudate or exudate?

- Total Protein: > 35 g/L – exudate; <25 g/L – transudate.
- If total protein: 25-35 g/L, check LDH: If >300 u/L (local cut-off) classify as an exudate.
- Causes of transudates: CHF, cirrhosis, nephrotic syndrome
- Causes of exudates: Infection, inflammation, neoplastic-related, drug-induced – methotrexate, amiodarone, phenytoin, beta-blockers, etc.

4. Does the effusion need draining?

- If purulent (pus visible), draining almost always indicated; pH not required.
- If non-purulent, a pH < 7.2 or [H⁺] > 63 nmol/L indicates the need for pleural fluid drainage

5. Is infection a cause of an effusion?

- Microbiology tests required - gram staining & culture.

6. Is malignancy a cause of an effusion?

- Tumour markers in pleural or peritoneal effusions are **not** recommended. Suggest cytology, radiology & serum tumour markers as appropriate.

7. Is it rheumatoid?

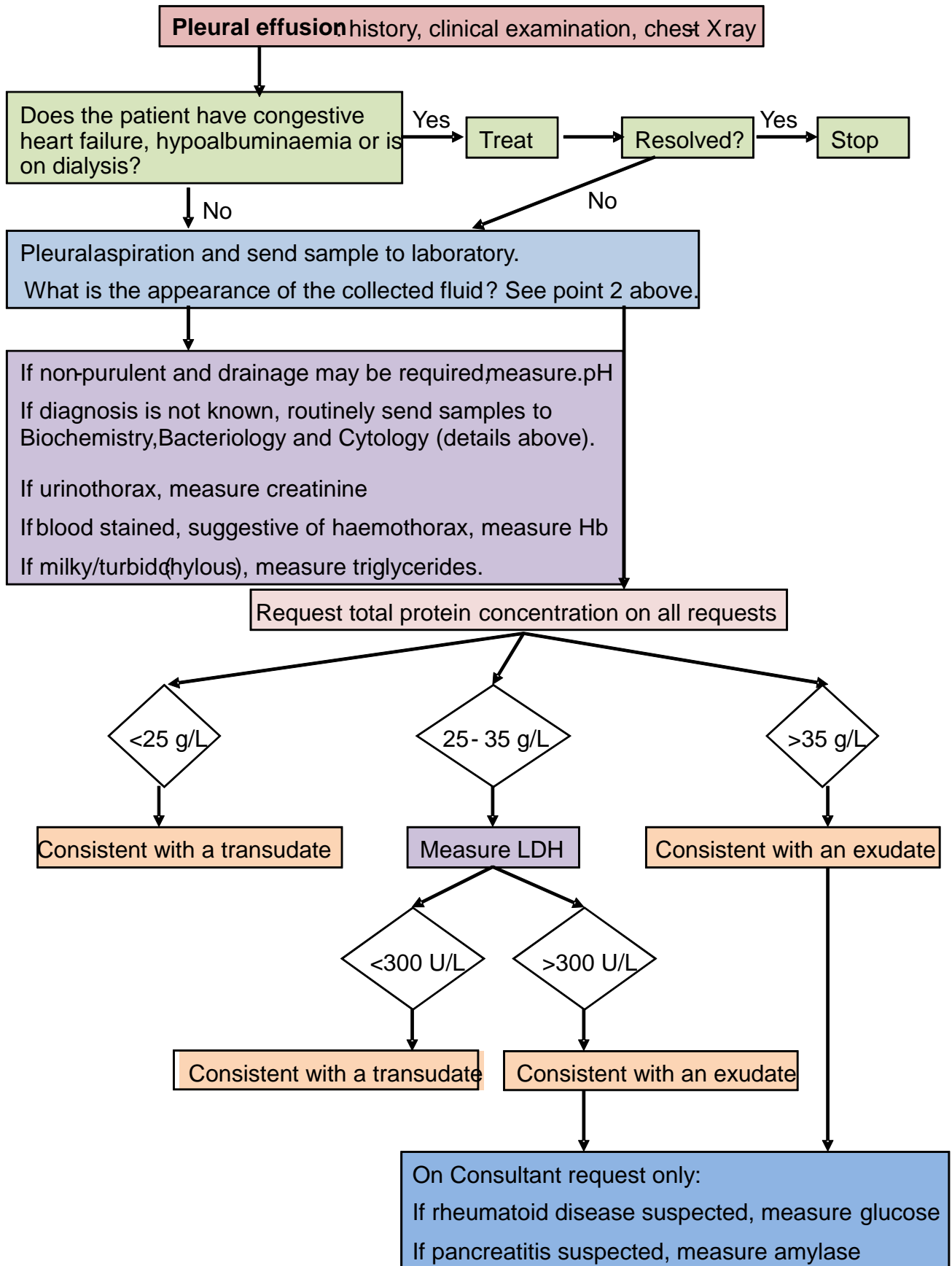
- Pleural fluid glucose <1.6 mmol/L reported in 78% of patients with rheumatoid arthritis. Rarely useful.

8. Is pancreatitis a cause?

- Amylase has been shown not to be useful in the investigation of a pleural effusion (Brance et al, *Arch Intern Med* 2001; 161: 228-232).

9. Why does the effusion appear milky or turbid?

- Chylothorax, if triglyceride concentrations >1.24 mmol/L; pseudo-chylothorax, if cholesterol >5.18 mmol/L. Rarely, clinically useful.



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