

PROCEDURE DOCUMENT

Burton Hospitals
NHS Foundation Trust



PROCEDURE FOR THE INSERTION AND MANAGEMENT OF CHEST DRAINS

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Burton Hospitals NHS Foundation Trust

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PROCEDURE FOR THE INSERTION AND MANAGEMENT OF CHEST DRAINS

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Burton Hospitals NHS Foundation Trust

PROCEDURE FOR THE INSERTION AND MANAGEMENT OF CHEST DRAINS

1. INTRODUCTION

A chest drain is a tube inserted through the chest wall between the ribs and into the pleural cavity to allow drainage of air (pneumothorax), blood (haemothorax), fluid (pleural effusion) or pus (empyema) out of the chest. In any one patient it is essential to understand what the drain is trying to achieve. The effective drainage of air, blood or fluid from the pleural space requires an adequately positioned drain and an airtight, one-way drainage system to maintain sub-atmospheric intrapleural pressure. This allows drainage of the pleural contents and re-expansion of the lung. In the case of a pneumothorax or haemothorax this helps restore haemodynamic and respiratory stability by optimising ventilation/perfusion and minimising mediastinal shift.

Incorrect placement and management of a chest drain can lead to significant morbidity and even mortality¹. National guidelines² and MHRA safety alerts³ indicate the need for a Trust-wide policy.

The aim of this Policy is to rationalise the use of chest drains throughout the organisation and standardise the care of the adult patient with a chest drain. This Policy therefore applies to all clinical areas within the Trust.

2. OBJECTIVES

1. To identify the need for a chest drain and select the appropriate drain and drainage system
2. To identify the safe insertion and subsequent removal of a chest drain
3. To ensure appropriate standardised documentation is used across the Trust
4. To identify appropriate training for all personnel involved in the insertion/management of chest drains
5. To identify requirements for audit

3. RESPONSIBILITIES

It is the responsibility of each member of staff involved in the insertion and management of chest drains:

- to comply with the standards set out in this policy
- to work within their own competence
- to report all chest drain issues (including near miss events) using the Trust's Incident Reporting procedures

These issues should be discussed at relevant directorate Clinical Governance Groups and any identified actions resulting from incidents implemented. It is the responsibility of each member of staff and individual clinical departments to ensure they adhere to the training and audit requirements set out in this Policy.

4. INDICATIONS FOR USE

Identification of the indication for a drain may be made by a combination of context (pathology, mechanism of injury), clinical examination and radiological imaging (including bedside ultrasound). Further details are beyond the scope of this Policy and can be obtained from local and national⁴ guidelines.

5. IMAGING

A recent chest radiograph should be available prior to performing a pleural aspiration.

The use of ultrasound-guidance for aspiration/drain insertion for fluid is associated with lower complication rates and is particularly useful for effusions and empyema as the diaphragm can be localized and the presence of loculations and pleural thickening defined. Therefore, thoracic ultrasound guidance is **strongly recommended** for all pleural procedures for pleural fluid. This should be done at the bedside just prior to the procedure except for large pleural effusions where the site may be marked away from the bedside. Ultrasound is not necessary in cases of pneumothorax.

Following full clinical assessment, if there is any doubt, further imaging should be arranged.

6. INSERTION OF A CHEST DRAIN

All personnel involved in the insertion of chest drains should be adequately trained and supervised. It has been shown that physicians trained in the method can safely perform the procedure with 3% early complications and 8% late⁵. With adequate training the risk of complications can be significantly reduced.

Insertion of a chest drain in a non-emergency situation will be a consultant-led decision. It is the consultant's responsibility to identify adequately trained doctors to perform the procedure. A trained nurse should be present to assist in the procedure. Nurses may wish to refer to the Royal Marsden Manual of Clinical Procedures via the Trust's intranet site under: – Royal Marsden -> Procedures- > 9.5 Chest drain: insertion. View all procedures alphabetically -> Intrapleural drain insertion, Changing a bottle and Drain removal.

Complications of most surgical procedures are higher when performed after midnight. Most pleural procedures do not need to be performed as an emergency and therefore should not be carried out overnight except in the case of significant respiratory or cardiovascular compromise. It may be considered in certain circumstances that pleural aspiration is safer than a chest drain. Insertion of a chest drain in an emergency situation will be the responsibility of the most senior, experienced available member of staff. Emergency insertions in trauma situations should follow ATLS (Advanced Trauma and Life Support) guidelines.

Clinical assessment should take into consideration risk factors associated with insertion of a chest drain e.g. clotting. Although there is no published evidence that abnormal blood clotting or platelet counts affect bleeding complications of chest drain insertion, it is good practice to correct any coagulopathy or platelet defect prior to drain insertion.

6.1 Before insertion of the Chest Drain

6.1.1 Consent

Consent should be obtained and documented as per Trust guidance. The identity of the patient should be checked and the site and insertion of the chest drain confirmed by reviewing the clinical signs and the radiological information.

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.

Pain, intrapleural infection, wound infection, drain-related visceral injury and drain blockage are the most frequent complications of large-bore chest drain insertion. All of these possible sequelae should be detailed in the consent process.

6.1.2 Aseptic Technique

All drains should be inserted with full aseptic precautions (washed hands, gloves, gown, antiseptic preparation for the insertion site and adequate sterile field) in order to avoid wound site infection or secondary empyema. A large area of skin cleansing should be undertaken using two applications of Chloraprep, allowing it to dry in between applications. The procedure should be carried out in a clean area appropriate for such procedures.

6.1.3 Patient Position

The patient should be positioned appropriately; this will depend on the reason for insertion and the clinical state of the patient. The most commonly used position is with the patient lying at 45° with their arm raised behind the head to expose the axillary area or in a forward lean position. The procedure may also be performed with the patient lying on their side with the affected side uppermost. In trauma situations emergency drain insertion is more likely to be performed whilst the patient is still in supine as part of the primary trauma survey.

6.1.4 Premedication / Local Anaesthetic

Adequate use of local infiltration of local anaesthetic (up to 3mg/kg of Lignocaine) allowing sufficient time to work is essential. Use of other parenteral analgesics is useful but will not provide sufficient analgesia alone. If sedation techniques are being used, the procedure should be performed with appropriate monitoring and resuscitation equipment immediately available (see 1. Protocol for Conscious Sedation in Cardiology, 2. ED Conscious Sedation procedure, 3. Policy for Safety & Sedation in Endoscopic Procedures, found on the Medicine intranet site.) Supplemental oxygen should also be considered in conjunction with the Trust policy for Oxygen Therapy Use in Adult In-Patients.

Antibiotic prophylaxis is not recommended for most patients requiring a chest drain, but should be considered for trauma patients requiring, especially after penetrating trauma.

6.1.5 Chest Drain Tubes

Chest drains come in a range of sizes suitable for a variety of purposes (typically 10-36Ch) and may be inserted via an open surgical incision (thoracostomy) or using the Seldinger technique incorporating a guide wire and dilator system.

Small drains should be used as first-line therapy for pneumothorax, free flowing pleural effusions and pleural infection.

Traumatic pneumothoraces, haemothoraces and empyemas may need larger drains, typically 26Ch and above.

Some chest drains are still supplied with a sharp trocar that was originally intended to aid insertion. Their use for insertion of a drain in a stabbing motion through skin, muscle and pleura is not to be recommended as it is difficult to control in all but the most experienced of hands and can easily result in damage to both intra-thoracic and intra-abdominal organs.

6.2 Inserting the Drain

The position of the drain is determined by the location and the nature of the collection to be drained. The 4th/5th intercostal space in the mid-axillary line is generally used for most situations. This area is commonly known as the “safe triangle”, bordered by the anterior border of latissimus dorsi, the lateral border of the pectoralis major, a line superior to the horizontal level of the nipple and an apex below the axilla.

Location of fluid will usually have been confirmed by bedside ultrasound. Aspiration of fluid or air confirms that the operator is in the pleural space and that it is safe to proceed. If fluid or air is not aspirated the procedure should not proceed and further radiological help sought. Aspiration is not required with open drain insertion.

Further details of the chest drain insertion procedure are beyond the scope of this document.

Once the drain is adequately inserted it should be connected to an appropriate drainage system. The drainage system of choice will be determined by the clinical indication for insertion with the principle of closed drainage common to each. An underwater seal drainage system employs positive expiratory pressure and gravity to drain the pleural space. This ensures minimum resistance to drainage of air and maintains the underwater seal even in the face of a large inspiratory effort. The underwater seal acts as a one-way valve through which air is expelled from the pleural space and prevented from re-entering during the next inspiration. Retrograde flow of fluid may occur if the collection chamber is raised above the level of the patient. The collection chamber should be kept below the level of the patient at all times to prevent fluid being siphoned back into the pleural space. If the drainage tube is allowed to slip out of the water then air easily passes back up the tube during inspiration and the lung will collapse.

Drainage can be allowed to occur under gravity or suction may be applied. When utilising suction, only recommended equipment should be used⁶.

Portable systems may be used for patients with on-going air leaks or fluid drainage. These are based on a one-way flutter system which theoretically may be advantageous as resistance to airflow is generally lower than with conventional underwater seal units.

Chest drains should be secured with 1/0 silk suture anchored to the skin and the drain with a suitable non slip knot technique. This should prevent excessive travel of the drain in and out of the chest wall. String sutures should be avoided as they convert a linear wound into a circular wound which can be painful and leave an unsightly scar.

Purpose designed dressings should be used where available i.e. "Drainfix" for small bore drains and "Mefix" for large bore drains. Large amounts of tape and padding to dress the site are unnecessary and may restrict chest wall movement or increase moisture collection. Dressings should allow wound site inspection and drain connections should not be covered. An "omental tag" of adhesive dressing tape may be used to support the tube and protect it further against being pulled out.

6.3 Following Insertion of the Chest Drain

It is essential to:

- check the underwater seal oscillates during respiration.
- order a repeat chest x-ray to confirm the position of the tube and the degree of lung re-expansion and exclude any complications. This is not needed after simple and uncomplicated pleural aspiration of fluid.
- advise the patient to keep the underwater bottle below the drain insertion site, upright and avoid compressing the tube by sitting or lying on it.
- ensure regular analgesia is prescribed whilst the chest drain is in place.
- ensure all sharps disposed of in accordance with the Trust policy.
- document the procedure in the patient's medical and nursing records as per Trust guidance. The position of insertion and the length of the tube after insertion should be documented.

7. MONITORING / RECORDING

A Trust Chest Drain Observation Chart (Appendix 1) should be utilised for every patient with a chest drain. The frequency of observations depends on clinical presentation/progress and medical request but should be at least 4 hourly.

Fluid within the tube should swing with respiration due to changes in intrapleural pressure. With normal respiration, the fluid should rise on inspiration and fall on expiration. Bubbling and swinging are both dependant on an intact underwater seal and so can only be picked up if the drain tube extends below the water level in the bottle. Bubbling and swinging should be assessed with the patient deep breathing and if possible coughing. This also has the benefit of assessing adequacy of analgesia.

Absence of swinging indicates that the drain is occluded or is no longer in the pleural space. It may be necessary following clinical assessment and

unsuccessful flushing of the drain to obtain a chest x-ray to determine the underlying cause.

Bubbling in the underwater seal fluid chamber generally indicates an on-going air leak which may be continuous, present on one phase of spontaneous ventilation or only on coughing. Persistent bubbling throughout the respiratory cycle may indicate a continuing broncho-pleural air leak. Faulty connections and entrained air through the skin incision should also be assessed.

A drain inserted for a fluid collection such as an effusion or empyema will need the volume and nature of the drain fluid recording. Drains inserted just for fluid should not bubble so the presence of this feature is abnormal and should be recorded. Any abnormal signs or complications should be referred for medical review.

A drain inserted for drainage of a haemothorax (+/- pneumothorax) needs blood loss to be recorded accurately with any sudden increases in drain volume referred immediately for medical review. With fractured ribs most bleeding is from the intercostal vessels, which slow down as the lung reinflates. However continued bleeding into the drain bottle is indicative of pathology that may need thoracic surgical intervention. After thoracic trauma more than 1500ml of blood into the bottle initially or continued bleeding of greater than 200ml/hr requires discussion with the thoracic surgeons.

To ensure patency small bore drains should be flushed regularly with normal saline; the flush should be prescribed and carried out by appropriately trained personnel.

8. MANAGEMENT OF THE CHEST DRAIN AND DRAINAGE SYSTEM

Examination of the patient from the patient to the drainage bottle should take place regularly to inspect all aspects of the patient and the drainage system.

Large pleural effusions should not be allowed to drain all at once. The rapid shift in pleural pressures and re-expansion of the previously collapsed lung can cause re-expansion pulmonary oedema, a potentially fatal complication. No more than 1-1.5 litres of fluid should be allowed to drain before the tube is clamped. If the patient starts to cough or complains of chest pain before this point is reached, drainage should be stopped and may be resumed a few hours later.

As a general rule chest tubes for pneumothorax should not be clamped. Exceptions to this may be when the drainage bottle requires replacement or when testing the system for air leaks. Clamping a pleural drain in the presence of a continuing air leak may result in a tension pneumothorax or possibly worsening surgical emphysema. A bubbling drain therefore should never be clamped.

If a chest tube is clamped it should be under the direct supervision of a respiratory physician or surgeon on a ward with experienced nursing staff. A patient with a clamped tube should not leave the specialist ward environment. Clear instructions should be communicated and documented that if the patient becomes breathless or develops surgical emphysema, the chest tube must be unclamped immediately and the medical team alerted. Drains for fluid drainage can be clamped or closed to control drainage rate as necessary.

8.1 Changing the Drain Bottle

When changing the drain bottle because it is overfull, temporary clamping of the drainage tube may be necessary to prevent ingress of air into the pleural cavity. It is acceptable to clamp the tube between thumb and forefinger. This has the advantage of removing the risk of inadvertently leaving the tube clamped. Local policy should be followed with regard to asepsis and infection control.

8.2 Suction

A patient who is free from pain, to the degree that an effective cough can be produced, will generate a much higher pleural pressure differential than can safely be produced with suction. This combined with a functional underwater seal will result in re-inflation of the lung.

If a patient cannot re-inflate his own lung or persistent air leak is preventing re-inflation, a high volume, low pressure thoracic suction in the range of 10-30cm water should be used. Prescription of suction is a medical responsibility and should be clearly documented in the medical notes. Purpose made low grade suction units (max 30kPa) should be used when applying to a chest drain⁶.

The use of suction may cause continuous bubbling from the tube; movement/swinging of fluid in the tube may not be visible.

8.3 Mobility

If appropriate, patients should be encouraged to walk around, unless the drain is on suction when the patient will be restricted to the bedside. Exercise to prevent complications such as DVT is essential, as are deep breathing exercises to aid re-expansion of the lung.

8.4 Dressings

Dressings should be changed regularly for the following reasons:

- to enable the insertion site to be monitored for signs of infection a swab should be taken from the chest drain site if there are any clinical signs of infection
- to monitor for surgical emphysema
- to ensure the chest drain remains well placed and the anchor suture is intact

8.5 Analgesia

Breathing with a chest tube in place can be painful and adequate analgesia should be prescribed on a regular basis.

9. REMOVAL OF THE CHEST DRAIN

The timing of removal of the chest drain is dependent on the original reason for insertion and clinical progress. Adequate pain relief should be ensured before removal of the chest drain. As for insertion, an aseptic technique should be used for removal and the chest drain and drainage kit disposed of appropriately. When

the tube is ready to be removed, the patient should be asked to perform a Valsalva manoeuvre (to increase the pleural pressure and prevent air entering the pleural cavity) and the tube is withdrawn quickly.

The wound site should be checked, condition documented and an appropriate dressing applied.

A CXR should be considered following removal of the chest drain to ensure resolution of the original pathology.

10. VENTILATED PATIENTS

The general principles of chest drain management detailed in this document apply to patients undergoing positive pressure ventilation. However there are some additional risks and precautions which must be taken. The major risk is of a simple pneumothorax rapidly becoming a tension pneumothorax due to the positive intra thoracic pressure. The following apply to patients receiving any sort of positive pressure respiratory support (IPPV, CPAP, NIV):

- Any sudden alteration in either ventilatory or cardiac status should raise the possibility of chest drain malfunction and tension pneumothorax. This should be managed along ALS guidelines with needle thoracocentesis in the face of life threatening instability.
- Simple pneumothoraces should never be aspirated due to the risk of producing even a small visceral pleural tear and air leak. Pneumothoraces should be treated only with formal chest drains.
- Chest drains should never be clamped other than under the direct supervision of an ITU consultant or thoracic surgical consultant. Even when changing drainage bottles it is not necessary to clamp drains as the positive intra thoracic pressure will prevent development of significant pneumothorax.
- The presence and position of pleural effusions should always be determined by CT scan or bedside ultrasound prior to chest drain insertion. Do not rely on the appearances of plain chest radiology.
- Suction must only be applied using dedicated suction drainage bottles and by staff competent in their use.

11. CHEST TRAUMA

When inserting a chest drain on a patient who has undergone chest trauma, the local policy should be followed (i.e. blunt trauma admitted under orthopaedics; penetrating trauma admitted under General Surgery; both nursed on Ward 20 or HDU/ITU depending on clinical condition). Discussion with the Cardiac Surgery registrar should take place if there is initial drainage of 1500 mls of blood following chest tube insertion, continued drainage of blood from the chest tube at a rate of 200 mls/hr over the following 2 hrs or the patient requires ongoing transfusion to maintain cardiovascular stability. Discussion with the Thoracic Surgery registrar

should take place if there is a persistent large air leak following a chest tube insertion (See Traumatic Chest injury guidelines).

12. TRAINING

Individual clinical departments should specify what level of seniority is expected to insert chest drains and this should be indicated in relevant induction programmes. It is the responsibility of each department to assess and evidence staff competence.

Post-graduate teaching programmes should make training on the insertion and management of chest drains a priority for all relevant grades and professions in all specialties.

Bedside ultrasound may be provided by the radiology department, or by competent Physicians/Surgeons (by prior agreement within departments – for example only Respiratory Consultants/Registrars or trained acute physicians may use bedside thoracic ultrasound within Medicine). Non-radiologists should aim to achieve Level 1 competence as recommended by the Royal College of Radiologists as soon as possible.

It is recommended that each department keep a list of senior, permanent staff with competence in the procedure. Junior doctors should be signed off as competent by one of these staff members before being allowed to insert drains independently.

It is the responsibility of each clinical specialty to ensure any patient with a chest drain should be cared for by staff adequately trained in the management of chest drains (for example all patients with chest drains within the Medical Directorate at should be cared for on Respiratory Ward 5 or the AAC).

13. AUDIT

Regular audit should be carried out by individual clinical departments to monitor compliance with this policy.

14. REFERENCES

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5. Collop NA, Kim S, Sahn SA. Analysis of Tube Thoracostomy Performed by Pulmonologists at a Teaching Hospital. *Chest*. 1997;112(3):709-713. Available at: <http://www.chestjournal.org/cgi/doi/10.1378/chest.112.3.709>.
6. Medicines and Healthcare products Regulatory Agency. Medical Device Alert. 2010/040.

Chest Drain Checklist

Before preparing trolley ▶▶▶ Before preparing patient ▶▶▶ Before leaving ward

SIGN IN

Patient has confirmed:

- Identity
- Site
- Procedure
- Consent

Site marked/not applicable

Known allergy?

- No
- Yes

Recent/current anticoagulants

- No
- Yes

Risk of blood loss?

- No
- Yes

TIME OUT

All team members have introduced themselves by name and role

Confirm:

- Patient
- Site
- Procedure

Discuss anticipated clinical events

- Pain
- Breathlessness
- Vasovagal episode
- Bleeding

All necessary equipment available (use separate checklist)

SIGN OUT

Procedure documented in medical notes

Verbal handover to nursing team

Specimens taken and sent to lab

- Yes
- No
- N/A

CXR ordered

Analgesia prescribed

Name _____

Signature _____

Date _____