

CHEST DRAINS

PRACTICE GUIDELINE[®]

DOCUMENT SUMMARY/KEY POINTS

All staff caring for a patient with a chest drain should read this practice guideline.

- Chest drains are inserted to facilitate the drainage of air and / or fluid from the thoracic cavity, preventing it from being reintroduced.
- The indications for insertion of a chest drain include pneumothorax, haemothorax, chylothorax, pleural effusion and empyema.
- Do not clamp chest drains unless there is a clinical purpose to it or unless instructed by a medical officer.
- Hourly observations should include fluid amount, type, colour, consistency, the suction setting and assessing the presence of oscillation and/or air bubbling.
- Chest drains should be secured to the patient to avoid disconnection while maintaining visibility.
- When mobilising a pair of spencer wells forceps must be carried in the event of accidental disconnection.

CHANGE SUMMARY

- When mobilising a pair of spencer wells forceps must be carried in the event of accidental disconnection.
- CHW and SCH drain dressing images included: Note different techniques.
- Minor review in January 2016: Section 11.2, added 'review coag studies if applicable'

This document reflects what is currently regarded as safe practice. However, as in any clinical situation, there may be factors which cannot be covered by a single set of guidelines. This document does not replace the need for the application of clinical judgement to each individual presentation.

Approved by:	SCHN Policy, Procedure and Guideline Committee	
Date Effective:	1 st May 2016	Review Period: 3 years
Team Leader:	Clinical Nurse Educator/Nurse Educator	Area/Dept: ESW CHW/CICU SCH

READ ACKNOWLEDGEMENT

- Medical and nursing staff who are involved in caring for patients with chest drains should read and acknowledge this document.

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1 Scope and Purpose

Chest drains are inserted into the thorax and are used for draining air or fluid from the pleural, mediastinal or pericardial cavities. This guideline covers the set-up and maintenance of chest drains in all areas of the hospital. Various types of drains and underwater systems are available and this guideline is intended to cover the principles in the care of infants and children with a chest drain and drainage system.

2 Background and Definitions^(1, 2, 3, 4, 5)

1. Thoracic cavity incorporates:

- Right lung
- Left lung
- Mediastinum (heart-aorta and great vessels, oesophagus, trachea, thymus, thoracic duct and other lymphatics)

2. Pleural anatomy:

Lungs are surrounded by thin tissue called the pleura, a continuous membrane that folds over itself. The area between the pleura is called the pleural space.

- Parietal pleura lines the chest wall
- Visceral pleura covers the lung

3. Chest drain:

Is any drain inserted into the thoracic cavity, commonly into the pleural space.

4. Mediastinal chest drain:

- Sits in the mediastinum
- Placed in the chest following cardiac surgery to drain blood and fluid from the mediastinum.

5. Pleural drain:

Is a tube inserted into the pleural space and attached to a drainage system. It allows continual removal of air and/or fluid from the pleural space.

6. Pericardial drain:

- A tube inserted into the pericardial sac
- Potential for cardiac tamponade post cardiac surgery if the drain becomes blocked or dislodged

7. Under water seal drain:

The underwater seal prevents back flow of fluid and air into the pleural space due to pressure.

8. Conditions which may require the insertion of a chest drain:

- **Pneumothorax** – Occurs when there is an opening on the surface of the lung or in the airways, or the chest wall, or both which allows air to enter and accumulate in the pleural space.
- **Haemothorax** – Blood in the pleural space may occur after thoracic surgery and traumatic injuries.
- **Pleural Effusion** – Fluid in the pleural space (see below for fluids definitions).
- **Chylothorax** – Chyle in the pleural space.
- **Transudate** – a clear fluid that collects in the pleural space when there are fluid shifts in the body from conditions such as congestive heart failure, malnutrition, renal and liver failure.
- **Exudate** – a cloudy fluid with cells and proteins that collects when the pleura is affected by malignancy or inflammatory conditions such as pneumonia.
- **Empyema** – a collection of pus in the pleural space. Most commonly occurs as a complication in pneumonia due to *Staphylococcus aureus* or *Streptococcus spp.*
- **Pericardial effusion** – accumulation of fluid in the pericardial cavity

9. Chest drain unit components:

- **A:** Suction control regulator – controls the amount of negative pressure that can be transmitted to the pleural or mediastinal space.
- **B:** Water seal chamber
- **C:** Air leak monitor
- **D:** Collection chamber – Fluids drains directly into the chamber and is measured in mL.
- **E:** Suction bellow



3 Types of Chest Drain Units¹

3.1 Atrium dry suction chest drain unit (underwater sealed drain)

1. Infant/paediatric size (200mL) (CHW only)



2. Single collection (2000mL)



3.2 Atrium Express Mini (500mL)

(CHW only)



4 Insertion of a Chest Drain

4.1 Equipment

- Sterile plastic sheet
- Dressing pack
- Sterile drapes
- Small suture tray
- Scalpel
- 2/0 silk suture or 3/0 prolene or nylon.
- Sterile gown and gloves
- Goggles
- Sterile forceps
- Chest drain catheter of appropriate size
- Lignocaine 1% ampoule
- Sterile marking pen
- Appropriate size sterile drainage unit pack – includes tubing, connections, sterile water ampoule
- Drawing up needle if required
- 5mL syringe
- 23 gauge needle
- Aqueous chlorhexidine
- Adhesive dressing to secure drain to patient
- Two 7 inch Spencer wells forceps
- Suction apparatus and tubing connected to wall outlet
- Specimen jar if required
- **CHW only:** Chest opening trolley if on ESW

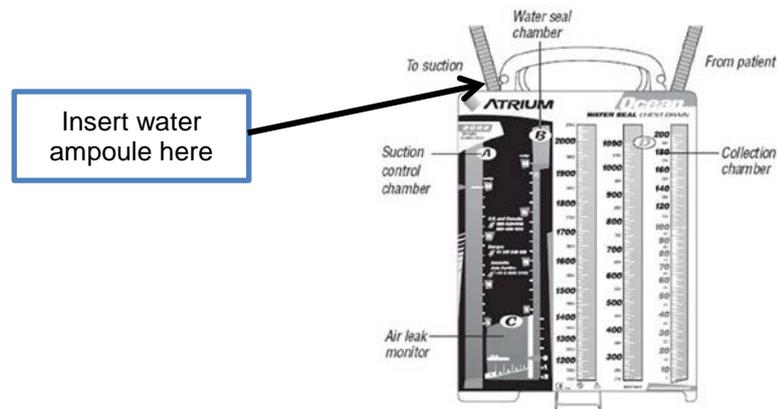
4.2 Preparation of procedure

Ideally this procedure should be performed in the operating suite, anaesthetic bay or intensive care areas, as there are trained staff and equipment in these areas. Chest drains may also be inserted in emergency department and ward as necessary.

1. Explain the procedure to the patient and family using developmentally appropriate communication strategies⁵.
2. Provide appropriate analgesia and sedation as per local guidelines. CHW refer to [Pain Management Practice Guideline](#) (section 11.9) and the [SCHN Procedural sedation \(Paediatric ward, clinic and imaging areas\) Practice guideline](#). In patients with pneumothorax, nitrous oxide is contraindicated during this procedure as it can cause a rapid increase in the volume of pneumothorax.⁶
3. Position the patient appropriately depending on the site of the air or fluid to be drained, with consideration given to the patient's clinical status.
4. Unless contraindicated oxygen therapy should be administered during procedure.
5. Oxygen saturation and ECG monitoring during the procedure.

4.3 Procedure

1. Place sterile plastic sheet onto trolley and open equipment needed onto sheet.
2. Remove water ampoule from the back of the Atrium dry suction chest drain unit and squeeze all contents into the suction port, located at the top of the drain. The water should fill to the 2cm mark and will turn blue.



3. Maintain the sterility of the chest drain connection using aseptic technique (AT).
4. Medical Officer (MO)/Surgeon will insert chest drain as per local protocols.
5. Once catheter has been inserted, attach to patient end of the tubing.
6. Ensure the chest drain system is below the level of the patient's chest – see [Patient Care](#) point 3.
7. Attach to suction as ordered – see [Patient Care](#) point 4.
8. Ensure that the tubing is taped securely to the patient – See [Patient Care](#) point 1.
9. A chest x-ray (CXR) must be performed post insertion to confirm the correct position^{7,8}.
10. Ensure that the chest drain or drains are correctly labelled.
11. Document procedure in patient record.

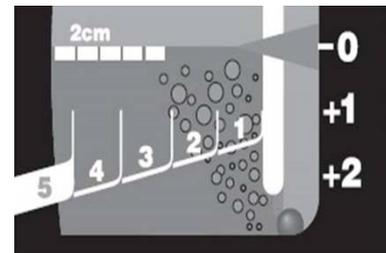
4.4 Complications^{5,9,10}

- Bleeding
- Infection
- Subcutaneous emphysema
- Pneumothorax
- Damage to internal structures such as diaphragm, liver, aorta and lung itself (malposition of tube)
- Intercostal nerve injury

5 Observations

1. Auscultate the patient's lung fields to assess the quality of air entry. Observe the child's chest expansion to ensure it is equal¹¹.
2. Assess for the presence of an air leak. Bubbling in the unit can indicate an air leak, however in the presence of a pneumothorax this is a normal finding^{7,9}.

Atrium chest drain unit: Bubbling in chamber 'C' will indicate an air leak. The numbering system will demonstrate the severity of the air leak i.e. 1=small leak, 5=large leak^{3,4}. Document the severity of the air leak in the progress notes and on the Chest Drain Chart (see [Appendix 1 \(CHW\)](#) and [Appendix 2 \(SCH\)](#) for examples of site specific forms).



- Mini chest drain unit (CHW only):** If there is a concern of an air leak and there is nil drainage present in the unit, using a Luer lock syringe insert 20mL of sterile normal saline or water into the unit via the sample collection port at the base of the unit. While keeping the unit below the level of insertion at the chest, tilt the unit until the fluid is visible in the 'A' chamber. Bubbling will be visible in chamber 'A' if an air leak is present. If there is already drainage in the unit, then bubbling will be visible if there is an air leak.²
3. Assess the presence of oscillation or "swing". This indicates that the tube is in the right position because of normal lung movement during respiration (normal thoracic pressure). If there is no oscillation or "swing", this could mean there is an obstruction in the tubing (see [Troubleshooting](#)). There will usually be no oscillation or swing if suction is used^{7, 11}.
 4. Hourly fluid drainage observations for^{5,9} (see [Appendix 1 \(CHW\)](#) and [Appendix 2 \(SCH\)](#) for examples of site specific form):
 - o Amount – This is read at an eye level while the chest drain in on the floor to ensure accuracy.
 - o Type
 - o Colour
 - o Consistency
 - o Suction setting
 - o Swing
 - o Bubbling
 5. Vital signs as indicated by patient's condition at least every four hours or as required.
 6. Assess patient's pain levels hourly and administer analgesia as required as per local guidelines. **CHW** refer to [Pain Management Practice Guideline](#) (section 11.9).

6 Patient Care

1. Secure tubing to patient

Ensure that the tubing is taped securely to the patient so that drainage tube will not kink or pull when patient moves (**As per site specific practice: CHW see below and SCH see next page**)⁽⁶⁾. IN THE CONSCIOUS PATIENT – DO NOT PIN THE DRAIN TO THE PATIENT'S BED as the patient may move suddenly and dislodge the drain. Ensure the drain is visible at all times⁹.

Two pairs of Spencer Wells forceps should always be kept at the bedside for each drain and in sight so that they are readily available if there is a sudden disconnection or air leak. A clamp is also available on the Single collection Atrium dry suction chest drain unit and the Express Mini chest drain unit.

A clear occlusive dressing is used to secure drain to patient. Change dressing if visible ooze from the chest drain site or concerns about skin breakdown. In the case of skin breakdown an absorbent dressing may be applied.

Dressing at CHW

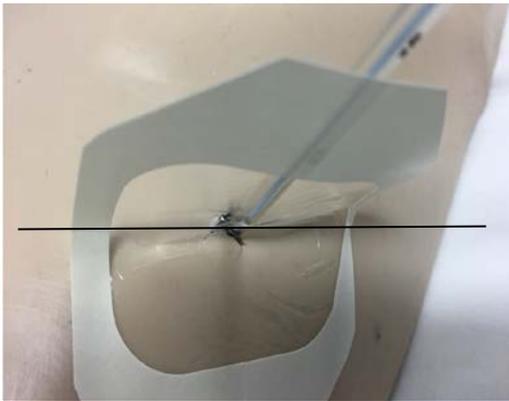


Figure A

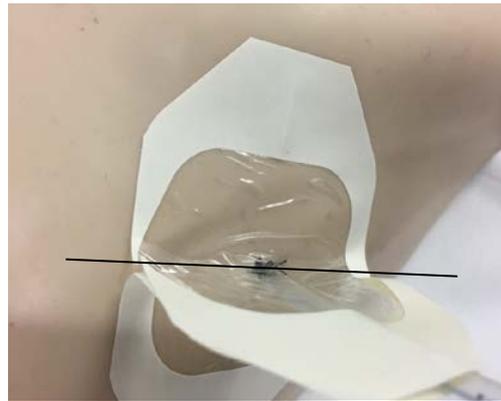


Figure B

Dressing for Intercostal Catheters (ICCs) at SCH



1. Apply clear adhesive dressing with the midpoint of the dressing at the insertion site (shown with black line)



2. Repeat on opposite side



3. Remove outer paper, ensure dressing is airtight. Anchor tube with tape to patient's body lower down to prevent traction.

2. Pressure area care

Ensure the patient is not lying or resting on the tubing. Assess skin integrity under the dressing and drain tubing each shift and with every dressing change.

3. Maintain patency of the system

Ensure that the patency of the system is maintained at all times by gently tapping the tube hourly to remove thick drainage or clots. Aggressive milking or stripping is not recommended as this creates an increase in negative pressure in the tube and may cause a pneumothorax^{5,7,9}. Ensure tubing is not kinked or blocked and prevent fluid-filled loops that can interfere with drainage. Ensure any tapes applied to the drain connections do not impair the ability to view and observe the drainage contents.

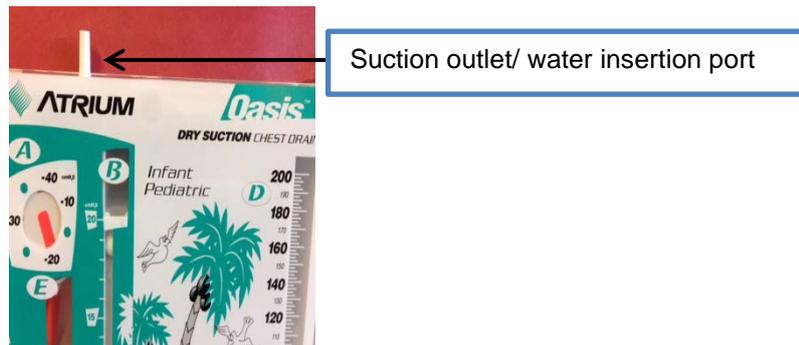
4. Maintain the underwater seal

Ensure that the underwater seal is maintained in the Atrium dry suction chest drain unit at all times by keeping the drain unit upright and the water level is adequate⁷.

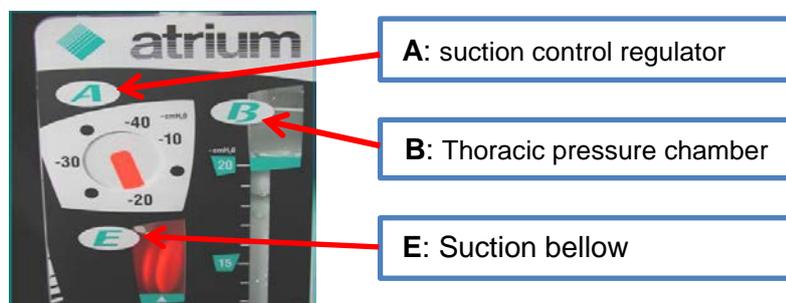
DO NOT raise drainage unit above level of patient's chest. This will cause a back flow of drainage into the pleural space⁹. Refer to [Clamping of drains](#). The positioning of the drainage unit below the patient promotes drainage by gravity^{5,7}.

5. Suction settings^{4,7}

The **standard suction setting** is -20cmH₂O, although there may be instances in which the physicians may deviate from this. The suction is regulated by the dry valve on the underwater seal drain. This can be attached to low suction. Once the suction tubing is detached from the wall suction, the suction will be turned off. The suction can be disconnected and the drainage unit placed on free-drainage for transfers or short walks. Please refer to [step 6 Positioning and Mobilising Patient](#). If more than one drainage unit is in use, they should be connected to the same suction outlet with a "Y" connection and second piece of tubing. If suction is not applied to the drainage unit, DO NOT cover the suction outlet as this is an air vent which prevents air pressure build-up in the drainage unit. Similarly, if the suction is turned off, the suction tubing must be disconnected from the drainage unit so that the vent is open (see diagram).



Atrium dry suction chest drain unit: The suction setting can be selected by dialling up the measurement on the side of the 'A' chamber. When the suction is attached, the orange bellow should be inflated to the arrow in the 'E' chamber. Increasing the wall suction will inflate the orange bellow further (see diagram below).



Express Mini chest drain unit (CHW only): The suction setting is pre-set at -20cmH₂O and cannot be adjusted. When sufficient suction is attached, a tick will appear in the 'C' chamber (See diagram below).



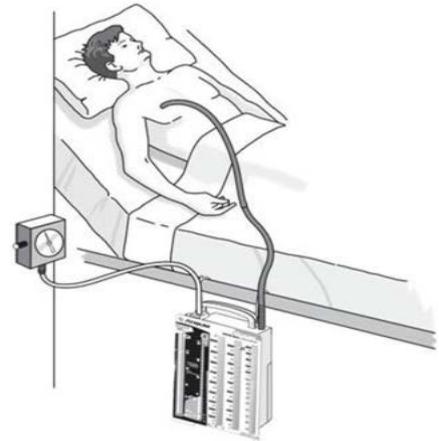
6. Positioning and mobil

Ensure that the patient is in the best position to allow for drainage of air/fluid. Nursing staff may assist the patient with frequent position changes and mobility as appropriate and encourage deep breathing and coughing to assist drainage⁵.

Prior to transfers and short walks, confirm with the nurse caring for the patient if the suction can be disconnected and the drainage unit placed on free-drainage.

Whilst the patient is mobilising, keep the chest drain below the level of insertion, unclamped and upright. Ensure that the suction tubing is reconnected to the drainage unit following transfers and short walks.

When mobilising, a pair of spencer wells forceps must be carried for each drain in the event of accidental disconnection. Please refer to [Section 10- Trouble Shooting](#). Patients and parents/carers should be educated about mobilising with a chest drain under nursing staff supervision to avoid kinking or accidental disconnection. (2)



7. Unit and tube changes

The Atrium dry suction chest drain unit only needs to be changed when it is full or at nurses discretion. The Express Mini chest drain units are re-usable for the same patient. Refer to [section 7.3](#) for management of the Express Mini chest drain.

Change patient tubing only if necessary, such as for blockage, air-leak or purulent drainage.

8. Specimen Collection

Samples of fluid can be taken from the needless leur lock sampling port located on the patient tube connector near the corrugated section of the tubing. Clean port using 2% chlorhexidine gluconate in 70% alcohol (large) swabs. Using aseptic technique, disconnect tubing and remove desired amount of fluid.



7 Procedure for Chest Drain Unit Change

7.1 Equipment required

- Sterile package which includes drainage unit with tubing and drain connections.
- Sterile gloves
- Clamps (at bedside and x1 clamp is available on the tubing for Express Mini)
- 2% chlorhexidine gluconate in 70% alcohol (large) swabs.
- Goggles
- Apron
- Gauze
- Measuring jug and syringe (for Express Mini)

7.2 Procedure for Atrium dry suction chest unit

1. Unwrap the first blue layer of packaging of new drainage unit.
2. At the bedside, turn off the suction and remove suction tubing from drain suction outlet. Clamp the tubing as close to change of drainage unit as possible. To protect the integrity of the drain tubing, when clamping place gauze underneath the metal forceps.
3. Wash hands for 3 minutes and put on sterile gloves.
4. Remove remainder of packaging from new drainage unit
5. Insert water ampoule into Atrium dry suction chest drain unit suction port (**refer to diagram on page 11**). The water should fill to the 2cm mark and will turn blue. If the ampoule is accidentally spilled, then 45mL of sterile water can be inserted into the water seal chamber. If accidental spillage occurs from the collection chamber into the water seal chamber and this fluid comes in contact with pleural fluid, it will turn green. If it comes in contact with blood, it will turn purple.
6. Using aseptic technique and the 2% chlorhexidine gluconate in 70% alcohol (large) swabs, unclick the connectors and place on new chest drain unit.
7. Attach suction tubing to the new unit if applicable.
8. Ensure the system is secured and correctly set up prior to recommencing the suction and unclamping the forceps.
9. RELEASE CLAMPS and restart suction as ordered.

7.3 Procedure for Express Mini chest drain unit (CHW only)

The Express mini chest drain unit are re-usable for the same patient.

1. While wearing sterile gloves and goggles. Temporarily clamp the chest drain and remove suction (see **Fig C**)
2. Using 2% chlorhexidine gluconate in 70% alcohol (large) swabs to hold the ends of the tubing disconnect tubing (See **Fig D**)
3. Using aseptic technique empty the contents of the drain into a pan/jug and dispose of contents in contaminated waste (See **Fig E**)
4. Reconnect tubing
5. RELEASE CLAMPS and restart suction as ordered.

Fig C



Fig D



Fig E



Fig F



6. Alternatively, clean port with 2% chlorhexidine gluconate in 70% alcohol (large) swabs and empty drain by screwing a luer-lock syringe firmly onto the port located on the bottom of the Express Mini aspirating contents (see **Fig F** above).

8 Notify Medical Officer if there is:

- A sudden increase in the amount of drainage⁵.

- A change in the type of drainage (e.g. becomes cloudy/frank blood)⁷.
- A sudden cessation of drainage, when previously large amounts, and change in patient's vital signs⁷.
- Commencement of air bubbles and signs of pneumothorax⁷.
- Large amounts of drain losses.
- Air collection in dressing around insertion site.

9 Clamping of Drains

NEVER CLAMP THE CHEST DRAIN UNLESS THERE IS A CLINICAL PURPOSE OR INSTRUCTED BY THE MEDICAL OFFICER.

Clamp drain only:

- If tubing is accidentally disconnected^{7,5}.
- Just prior to changing the drainage unit or removing the chest drain^{7,5}.
- When more than one drain is connected to one chest drain unit, both drains should be clamped prior to removal. This prevents possible fluids/air entering the second drain once the first drain is removed.
- You may be required to check for a leak in the system. Clamping off the tube systematically can identify the presence and/or location of the leak⁷.
- Occasionally the consultant may request for the chest drain to be clamped to assess collection of fluid or air before removing it. While it's clamped, observe the patient for any signs of respiratory distress that could indicate the development of a tension pneumothorax. Monitor and document the patient's observations – including oxygen saturations (SpO₂), respiratory rate (RR) and heart rate (HR) ½ hourly while the drain is clamped.
- Moving/Transporting patients:
 - Cardiothoracic patients: Clamp drain when there is the risk of the drainage unit being raised during the movement of the patient causing a spill of fluid back into the chest^{7, 8}.
 - Surgical patients: Clamping is not required.

Following administration of urokinase via the drain clamp for four hours. Refer to [SCHN Intrapleural Urokinase in Empyema Drug Protocol](#). During this period, patient should remain in the ward for close monitoring. If the child develops respiratory distress whilst the drain is clamped, release the clamp immediately to let air/fluid escape. **Notify medical officer.**

10 Trouble Shooting

Oscillation/fluctuations (Swing) ceases

If the chest drainage unit is not on suction this could mean that there is an obstruction by a clot or lung tissue; a kink in the tubing; the patient may be lying on it; or a loop has become filled with fluid⁷. A gradual decrease in fluctuation may indicate lung re-expansion⁷. Infants may not generate enough thoracic pressure; therefore “swing” may not be present in this instance.

Blockage of drain

- Sudden cessation of bubbling (for pneumothorax) or drainage loss: considerable loss could mean the tubing is blocked or the air/drainage loss has ceased⁷.
- Check tubing for kinks or obstruction.
- Tap tubing and reposition the patient.
- Observe patient for respiratory difficulties/distress. Note any tachypnoea and/or dyspnoea.
- Consider changing tubing

Air bubbling – if no evidence of leak notify Resident Medical Officer (RMO)

- If there is no pneumothorax or the patient has not had a lobectomy, this will mean there is an air leak somewhere in the system between the patient and the drainage unit. Constant bubbling is usually the result of poor connections.
- To assess the presence of an air leak use two clamps to systematically clamp off the tube, only releasing one at a time and always working backwards from the patient to the chest drain unit⁷.

Accidental disconnection of drainage tubing from drain

- Clamp drain immediately to avoid air entering pleural space.
- Re-establish connection with a new drainage unit as soon as possible, using aseptic technique.
- Observe for signs of pneumothorax.
- Notify RMO who may request a chest x-ray.

When the chest drain becomes dislodged

- **If chest drain inserted to drain fluid:**
 - Close hole with fingers using gloves if possible.
 - Call a rapid response and observe for signs of a tension pneumothorax.
 - Place child in Fowler position.
 - Ask child (if old enough) to cough.
 - Cover hole with an adhesive occlusive dressing.
 - Check patient's vital signs.

- **If chest drain inserted to drain air:**
 - Call a rapid response to escalate care and observe for signs of a tension pneumothorax.
 - Secure drain site with occlusive dressing and only seal 3 sides to allow air to escape.
 - Place child in Fowler position.
 - Check patient's vital signs.

If patient develops respiratory difficulties/distress

- Administer oxygen via mask.
- Notify RMO immediately.
- Monitor and document respiratory rate, saturations and heart rate every 15 minutes.
- Note particularly rate, depth and of pattern of respirations¹².
- Escalate care accordingly.

11 Removal of chest drain

This procedure requires **two registered nurses**, one of whom has completed the chest drain competency. See local NE/CNE for appropriate accreditation process.

Under the direction of the medical/surgical team, a chest drain is ready for removal when:

- There has been a cessation or sufficient decline in drainage volume⁸.
- A recent CXR demonstrates resolution of collection of fluid/air⁸.
- As per post-surgical notes.
- If the chest tube is damaged and/or needs replacement (a replacement tube should be in situ before the damaged tube is removed).

11.1 Equipment

- Dressing pack
- Stitch cutter
- **CHW:** 0.1% Chlorhexidine aqueous solution
- **SCH:** 0.5% Chlorhexidine aqueous solution
- Large Steri-strips

- Adhesive occlusive dressing
- Sterile gloves
- Extra gauze
- Goggles
- Apron

11.2 Preparation of Patient

1. Documentation by the medical/surgical team that drain can be removed.
2. Determine type of drain.
3. Review coagulation studies if applicable.
4. Explain the procedure to child and family, using developmentally appropriate communication tools⁵.
5. Provide appropriate analgesia as per local guidelines. **CHW** refer to [Pain Management Practice Guideline](#) (section 11.9) to ensure effective pain management^{7,8}. For example: Morphine, oral midazolam, oxycodone, paracetamol. Ensure analgesia is administered beforehand and given time to take effect⁸.
6. Auscultate the child's lung fields to determine a baseline assessment of air entry.

11.3 Procedure for removal of chest drain

(refer to [section 13](#) for removal of pigtail catheters)

1. Assess air entry with stethoscope and monitor respiratory status, including oxygen saturation levels.
2. Open equipment.
3. Clamp drain or drains if more than one is connected to the same unit.
4. Turn off suction and remove from suction port.
5. First nurse wash hands for 3 minutes and put on sterile gloves.
6. Second nurse removes any dressings.
7. First nurse place sterile towel under the chest drain at the chest insertion point.
8. First nurse clean drain site and drain (approx.4-5 cm of drain) with aqueous chlorhexidine.
9. First nurse cut suture and remove suture. If purse string suture refer to [section 11.4](#).
10. If age appropriate, ask the child to take a deep breath and hold their breath during removal of the drain⁷. Otherwise, remove drain at the beginning of expiration to prevent drawing air into the pleural space⁷.
11. In patients receiving positive pressure mechanical ventilation, the chest drain should be removed at the end of inspiration to ensure full inflation of the lungs.

12. The second nurse then holds the drain site in preparation for drain to be removed.
13. First nurse remove drain with steady downward movement without delay⁸.
14. Second nurse pinches wound closed to prevent air entry.
15. The first nurse then places steri-strips across the wound to hold closed⁵. An adhesive occlusive dressing can then be applied.
16. Immediately post removal, assess air entry with stethoscope and assess respiratory status, including oxygen saturation levels⁸. If pneumothorax suspected, immediate chest x-ray is required.
17. Document procedure in patients notes.
18. Determine with medical/surgical team if a CXR should be ordered. If so, ensure that this is performed at least 4 hours post drain removal to detect any accumulation of air/fluid^{7,8}.

11.4 Procedure when Purse-String Suture is used

- Follow steps 1 to 8 (Section 11.3).
- Instead of cutting and removing the suture, the suture is untied and unravelled from around the tube. This suture could be blue or black in colour.
- The second nurse holds the two ends of the suture material with slight tension as the first nurse removes the drain. As the drain comes out the tension on the suture will pull the wound closed and prevent the entry of air.
- The second nurse then ties the suture and the excess suture material is removed with the stitch cutter.
- An adhesive occlusive dressing can be applied.
- The suture should be removed 4-5 days post drain removal.

11.5 Nursing observations post removal of chest drain

1. **Observe patient** for: ⁸
 - Tachypnoea, dyspnoea
 - Decrease in oxygen saturation levels
 - Anxiety and/or distress
 - Decreased breath sounds on the affected side
 - Unequal chest wall movement - decreased movement on affected side.
2. **Possible complications** include^{9,13}:
 - Pneumothorax

- Recollection of fluid/air
- Bleeding from drain site
- Infection
- Subcutaneous emphysema - air trapped under the skin

If any of the above signs develop, **notify medical officer immediately.**

12 Pericardial drain

A drain is inserted within the pericardial sac to remove excess fluid that can cause compression of the heart chambers, resulting in decreased cardiac output. This accumulating fluid can be acute or chronic¹⁴.

Pericardial effusions are diagnosed by echocardiogram^{14,15}. A chest x-ray should demonstrate cardiomegaly and ECG changes may be present¹⁴.

Pericardiocentesis –puncturing of the pericardial sac to aspirate fluid¹⁶. This may also be performed to obtain the fluid for diagnostic purposes. Echo-guided percutaneous pericardiocentesis is recommended as it decreases the risk of life-threatening complications¹⁴.

Subxiphoid pericardiotomy – removal of a portion of pericardial membrane to drain pericardial effusion¹⁷.

12.1 Pericardial effusions can be caused by^{16, 18-22}:

- Post-operative cardiac surgery
- Infection
- Inflammation
- Autoimmune
- Malignant neoplasm or lymphoma
- Chest trauma:
 - Penetrating or blunt injury -cardiopulmonary resuscitation
 - Perforation or atrial wall puncture by transvenous pacemaker
- Drug reaction
- Myocardial infarction
- Chronic renal failure
- Radiation
- Unknown cause

12.2 Nursing care

- Refer to [Section 5](#) and [Section 6](#) for observations and nursing care of pericardial drains.
- Suction will be ordered at the discretion of the patient's consultant.

12.3 Possible complications include:

- Tamponade/haemorrhage – tachycardia, dyspnoea, chest discomfort, shock, unconsciousness, hypotension paradoxical pulse, pericardial rub, venous hypertension^{14,15,23}.
- Arrhythmias¹⁹
- Infection⁹
- Dislodgement of chest drain

12.4 Removal of pericardial drains

- Refer to [Section 11](#) on how to remove the pericardial drain, keeping in mind possible complications e.g. tamponade.
- The patient should be cardiac monitored and vital signs, including BP should be monitored ½ hourly for 2 hours post removal of pericardial drain.

13 Pigtail Catheter

A pigtail catheter is a drain designed to drain body fluids from an organ, duct or abscess. Pigtail catheters are inserted by an interventional Radiologist/Cardiologist under image guidance or in emergency, intensive care or by the cardiothoracic surgeon in the operating theatre²⁴. Insertion may be performed in the emergency department for adolescents presenting with pneumothorax.

Pigtail catheters may have a 'tap' at the connection of the tubing closest to the patient's chest. It is important that this tap is in the open position unless ordered.

Pneumonia in children is often associated with parapneumonic effusions which can develop into an empyema²⁴. Loculated pleural collections (empyema) are often managed with intrapleural fibrinolytic agents, such as urokinase²⁵. Children with an empyema often require insertion of a chest drain or pigtail catheter.



Occasionally the consultant may request a pleural pigtail catheter be flushed with normal saline if there is concern the drain is blocked²⁶. This should only be performed by a medical officer, Cardiothoracic Nurse Practitioner, Nurse Practitioner or an accredited Registered Nurse¹¹.

13.1 Urokinase

- For more information refer SCHN [Intrapleural Urokinase in Empyema Drug Protocol](#).

13.2 Observations

- Refer to [Section 5](#) and [Section 6](#) for observations and nursing care of pigtail catheters.

13.3 Removal of pigtail drains

Under the direction of the medical/surgical team, a chest drain is ready for removal when:

- There has been a cessation or decline in drainage volume⁸.
- A recent CXR demonstrates resolution of collection of fluid/air⁸.
- Ultrasound shows no residual fluid.
- As per post-surgical notes.
- If the chest tube is damaged and/or needs replacement.

Certain types of pigtail drains have an internal locking suture running through the catheter which secures (locks) the loop at the end of the catheter. Before removal of a pigtail with an internal locking suture, this suture must be released (unlocked) in order for the loop of the catheter to be able to straighten and be removed easily (**See Figure I and J**).

Other types of pigtail drains do not have this internal locking suture but are simply sutured to the skin at the insertion site. There is not an internal locking suture that is required to be released prior to removal. **See pictures below:**

Fig G



Fig H



If unsure about the mechanism required to release the lock on the pigtail drain, please discuss with the doctor who inserted it.

Equipment

- Dressing pack
- Stitch cutter
- **CHW:** 0.1% Chlorhexidine aqueous solution
- **SCH:** 0.5% Chlorhexidine aqueous solution
- Large Steri-strips
- Adhesive occlusive dressing
- Sterile gloves
- Extra gauze
- Metal forceps
- Goggles
- Apron

Preparation of patient

Refer to [Section 11.2](#) on how to prepare the patient for removal of pigtail catheter.

Procedure for removal of pigtail drain

1. Pigtail drain should never be clamped prior to removal to ensure release of suture. If connected to a single chest drain unit clamp other chest drains that are insitu.
2. Determine which type of pigtail catheter is used:
 - i. **Internal locking suture:** Stabilise the catheter with one hand, position a blunt object (metal forceps) into the Mac-Loc release notch (**see fig. I**). Pry upward until the locking lever is free (**see fig. J**), this will loosen the suture. Unwind the suture from around the locking lever. The pigtail loop is now released.
 - ii. **External suture to the skin:** If there is no locking suture then the drain will be sutured to the skin. This suture needs to be cut to free it from the skin prior to removal. Continue as below.
3. Open equipment.
4. Remove any dressings.
5. Wash hands again for 3 minutes and put on sterile gloves.
6. Place sterile towel under the chest drain at the chest insertion point.
7. Clean drain site and drain (approx.4-5 cm of drain) with aqueous chlorhexidine.
8. If external suture insitu remove from skin using stich cutter.
9. If age appropriate, ask the child to take a deep breath and hold their breath during removal of the drain⁷. Otherwise, remove drain on expiration².
10. The second nurse then holds the drain site in preparation for drain to be removed.
11. First nurse remove drain with steady downward movement without delay⁸. It is normal to have slight resistance when pulling the drain out. If there is too much resistance, do not force the drain out. Stop the procedure and contact the medical officer.
12. Second nurse pinches wound closed to prevent air entry.
13. The first nurse then places steri-strips across the wound to hold closed⁵. An adhesive occlusive dressing can then be applied.
14. Assess air entry with stethoscope and monitor respiratory status, including oxygen saturation levels⁸.
15. Document procedure in patients notes.
16. Determine with medical/surgical team if a CXR should be ordered. If so, ensure that this is performed at least 4 hours post drain removal to detect any accumulation of air/fluid^{7,8}.

Fig I



Fig J



Nursing observations post removal of pigtail drain

1. Observe patient for⁸:

- Signs of haemorrhage
- Tachypnoea, dyspnoea
- Decrease in oxygen saturation levels
- Anxiety and/or distress
- Decreased breath sounds on the affected side
- Unequal chest wall movement - decreased movement on affected side

2. Possible complications include^{9, 13}:

- Pneumothorax
- Recollection of fluid/air
- Bleeding from drain site
- Infection
- Subcutaneous emphysema – air trapped under the skin
- Suture remaining lodged in the chest

14 References

1. Carroll, P. Atrium Interactive Computer-Based Training [Internet]. 2014 [cited 2014 Dec 16]. Available from: http://www.atriummed.com/EN/chest_drainage/training/101-1/index.html
2. Atrium Medical Corporation. Managing chest drainage powerpoint presentation for nursing educators [Internet]. 2014 [cited 2014 Dec 16]; Available from: <http://www.atriummed.com/PDF/ManagingChestDrainage.ppt>
3. Atrium Medical Corporation. Managing dry suction chest drainage [CD-ROM]. [Cited 2008 Apr 11].
4. Atrium Medical Corporation. A personal guide to managing dry suction chest drainage. New Hampshire; 2009.
5. Crawford D. Care and nursing management of a child with a chest drain. Nursing children and young people. 2011 Dec; 23(10):27-33.

6. Ferner RE, Mackenzie AA, Aronson JK. The adverse effects of nitrous oxide. Adverse drug reaction bulletin. 2014 April; 285: 1099-1102.
7. Briggs D. Nursing care and management of intrapleural drains. Nursing Standard. 2010 May; 24(21):47-55.
8. Hunter J. Chest drain removal. Nursing standard. 2008 July 16;22(45):35-38.
9. Sullivan B. Nursing management of patients with a chest drain. British Journal of Nursing. 2008 6(17).
10. Miyazaki T, Yamasaki N, Tsuchiya T, Matsumoto K, Hatachi CO, Nagayasu T. The assessment of chest tube insertion to intercostal nerve damage in thoracic surgery. American Thoracic surgery. 2013 May 22;35.
11. Woodrow P. Intrapleural chest drainage. Nursing standard. 2013 Mar;27(40):49-56.
12. Coughlin AM. Go with the flow of chest tube therapy. Nursing. 2006;36(3)36-41.
13. Given J. Management of procedural pain in adult patients. Nursing Standard. 2010 May10;25(14): 35-40.
14. Kouchoukos NT, Blackstone EH, Hanley FL, Kirklin JK. Cardiac Surgery. 4th ed. Philadelphia: Elsevier Saunders; 2013.
15. Sargrista-Sauleda J, Merce AS, Soler-Soler J. Diagnosis and management of pericardial effusion. World Journal of Cardiology. 2011 May 26;3(5):135-143.
16. Saltzman AJ, Paz YE, Rene AG, Green P, Hassanin A, Argenziano MG, Rabbanni L, Dangas G. Comparison of surgical pericardial drainage with percutaneous catheter drainage for pericardial effusion. Journal of Invasive Cardiology. 2012 Nov;24(11):590-593.
17. Muhammad MIA. The pericardial window: is a video-assisted thoracoscopy approach better than a surgical approach? Interactive Cardiovascular and Thoracic Surgery. 2010 Oct;12(2):174-178.
18. Mirhosseini SM, Fakhri M, Mozaffary A, Lotfaliany M, Behzadnia N, Aval ZA, Ghiasi SMS, Boloursaz MR, Masjedi MR. Risk factors affecting the survival rate in patients with symptomatic pericardial effusion undergoing surgical intervention. Interactive Cardiovascular and Thoracic Surgery. 2012 Dec 18;16(2013):495-500.
19. Moss E, Miller CS, Jensen H, Basmadjian A, Bouchard D, Carrier M, Perrault LP, Cartier R, Pellerin M, Demers P. A randomized trial of early versus delayed mediastinal drain removal after cardiac surgery using silastic and conventional tubes. Interactive Cardiovascular and Thoracic Surgery. 2013 Apr 13;17(2013):110-115.
20. Bodson L, Bouferrache K, Vieillard-Baron A. Cardiac Tamponade. Current Opinion in Critical Care. 2011;17:416-424.
21. Senkus E, Jassem J. Cardiovascular effects of systemic cancer treatment. Cancer Treatment Reviews. 2010 Nov 9;37(2011):300-311.
22. Khandaker MH, Espinosa RE, Nishimura RA, Sinak LJ, Hayes SN, Melduni RM, Oh JK. Pericardial disease: diagnosis and management. Mayo Foundation for Medical Education and Research. 2010 June;85(6):572-593.
23. Maisch B, Seferovic PM, Ristic AD, Erbel R, Reinmuller R, Adler Y, Tomkowski WZ, Thiene G, Yacoub MH. Guidelines on the diagnosis and management of pericardial diseases. European Heart Journal. 2004;25:587-610.
24. Yu H. Management of pleural effusion, empyema and lung abscess. Seminars in Interventional Radiology. 2011;20(1):75-86.
25. Abu-Daff S, Maziak DE, Alshehab D, Threader J, Ivanovic J, Deslaurier V, Villeneuve PJ, Gilbert S, Sundaresan S, Shamji F, Loughheed C, Seely, JM, Seely AJE. Intrapleural fibrinolytic therapy (IPFT) in loculated pleural effusions- analysis of predictors for failure of therapy and bleeding: a cohort study. BMJ. 2013 Jan;3(2):1-6.
26. Hogg JR, Caccavale M, Gillen B, McKenzie G, Vlamincck J, Fleming CJ, Stockland A, Friese JL. Tube Thoracostomy: A Review for the Interventional Radiologist. Mayo Foundation for Medical Education and Research. 2011;28(1):39-46.

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