Paediatric Intensive Care Unit Nursing Guideline:

Chest Drains

A chest drain is a tube inserted into the pleural space to drain its contents of air or fluid. The tube remains in place until drainage is complete (Havelock et al, 2010).

Indications

Pneumothorax
- In any ventilated patient
- Tension pneumothorax (after initial needle relief)
- Persistent/recurrent pneumothorax

Pleural effusion
- Empyema (pus)
- Chylothorax (lymphatic fluid)

Haemothorax (traumatic)
Post surgery (thoracotomy)

Preparation

Verbal consent if appropriate
- should encompass indications, alternatives to procedure, common & serious complications (Havelock et al, 2010)

IV access
Monitoring - ECG, BP, SaO_2
Analgesia and sedation
- plus naloxone & flumanezil if using opiates and benzodiazepines and airway not protected

CXR (except for tension pneumothorax)
Ultrasound guidance reduces complications (gold standard)

Equipment for insertion

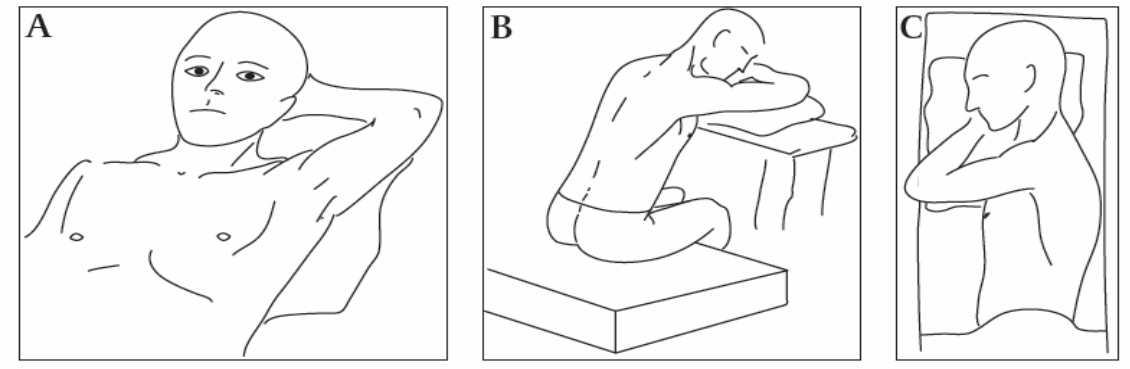
Sterile gloves
Gown
Face mask
Hat
Dressing pack (Cut down set / insertion pack may be needed *)

Drapes
Chloroprep skin disinfection
Lidocaine 1%
Insertion pack
Selection of syringes and needles
Gauze
Scalpel
Chest tube (kit for insertion using Seldinger technique) – check size
Suture (1.0 silk)
Stitch cutter
Closed drainage system and tubing
1L sterile water
Transparent dressing plus tape
Chest drain clamps x 2
Universal container ± anaerobic blood culture bottle for pleural fluid

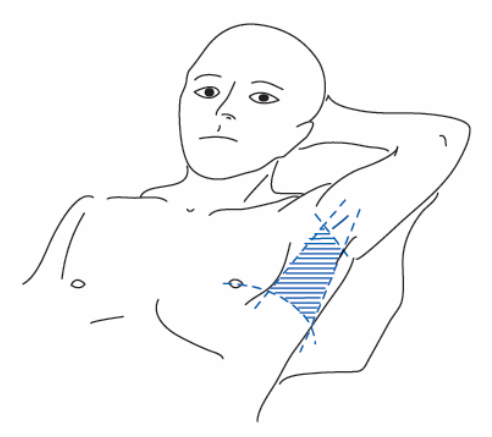
- The nurse should fill the drainage bottle with sterile water to the fill line using an aseptic non-touch technique (ANTT).
- Ensure the drainage tube is 2cm below the water level - this ensures minimum resistance to drainage of air and will maintain the underwater seal even following a large inspiratory effort.

*If the Consultant wants to insert a larger drain using blunt dissection then the cut down or insertion set will be needed.

Patient Position (Havelock et al, 2010)



Site: 5th intercostal space in mid-axillary line within the *triangle of safety*:



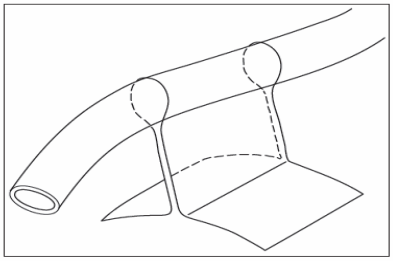
Principles of Insertion

Aseptic technique (prevent empyema/infection at site)
Local anaesthetic (lidocaine 1%)
Seldinger technique:

- Needle aspiration to confirm position
- Guide wire passed through needle, needle withdrawn
- Dilator inserted (to 1cm in adults) – may need small incision
- Series of enlarging dilators to widen tract
- Drain inserted over wire (aiming upward for pneumothorax, downward for fluid)

Attached to drainage system (UWSD/Heimlich valve)
Sutured to secure drain +/- mattress suture for wound closure (purse string no longer used as painful for patient and results in scarring)
Transparent dressing used to allow inspection for leakage/infection (do not need gauze)
Omental tag may be used to prevent kinking and tension at insertion site
Equipment disposed of according to hospital policy
Child made comfortable and reassured/comforted
CXR performed

Omental tape technique:



Complications (Havelock et al, 2010)

Infection (intrapleural/insertion site)
Pneumothorax
Procedure failure

Pain
Haemorrhage (be aware of clotting)
Drain dislodgement
Drain blockage
Visceral injury (can puncture lung, liver, spleen) – most serious

Potentially dangerous conditions that require urgent attention:

- Large amount of bubbling in the water seal chamber - might signify a large patient air leak or a leak in a system
- Sudden or unexpected cessation of bubbling - may indicate a blockage in the tubing
- Large amount of bloody discharge - might indicate haemothorax or trauma to underlying organ(s)
- Increasing dyspnoea, increased heart rate, lowered blood pressure & low oxygen saturation - may signify recurrent pneumothorax (after drain removal) or insufficient drainage or tube blockage

If high volume, low suction used:

- Absence of gentle bubbling in drainage bottle - may indicate disconnection of the suction pressure or inadequate suction force to counteract the large air leakage

Specific Nursing Care

- Bubbling chest drains are **NEVER** clamped – a tension pneumothorax will quickly develop (Havelock et al, 2010).
- 2 clamps must be kept at the bedside in case of accidental disconnection. It is not necessary to clamp the drain for moving or transferring the child (Dixon 2006).
- 'Milking' the tube is no longer recommended as it creates exceedingly high negative pressures that can cause trauma to the lung (Havelock et al, 2010).

Nursing Care	Rationale
Observations: Respiratory – rate, colour, work of breathing, SaO_2, chest movement, auscultation (tidal volumes/peak pressures if ventilated)	- Deterioration may indicate displacement, occlusion or recurring pneumothorax – call for help, high flow O_2, check drainage system.
CVS – heart rate and rhythm, blood pressure, peripheral perfusion	- Changes may indicate pressure on CVS.

Temperature, CRP, WCC	- Infection at site and empyema are recognised complications
Chest drain observations (hourly): Swinging/bubbling/static? Drainage – record type and volume (see management of parapneumonic effusion/empyema below)	**Swinging** (tidaling) on inspiration indicates tube patent. IPPV causes a reverse swing compared to spontaneous ventilation (Dixon 2006). **Bubbling** only occurs if pneumothorax present – will stop when lung fully inflated. Excessive bubbling may indicate an air leak. **Static** – examine the tubing for kinks/blockage. Ask patient to cough, if able (increased pressure should cause fluid to move). If no movement inform medical team **Drainage** represents serous fluid loss - the doctor may wish to prescribe IV replacement (Dixon 2006). Excessive drainage may result in re-expansion pulmonary oedema (BTS 2005). If sudden cessation of drainage, suspect blockage. Inform medical team in both instances.
Site. Is there: - Evidence of wound infection - Leakage of fluid/air - Surgical emphysema ('crackling' felt under skin)	 - Inform medical team; take swab - Change dressing if wet/soiled - Surgical emphysema may indicate drain not fully inserted
Drainage System: - Ensure tubing remains below water level - Keep drainage bottle approx 30cm below child's chest (Dixon 2006) -Keep bottle upright - Do not allow dependent loops of tubing to form - Ensure connections are secure (beware can disconnect under tapes)	 - Ensures seal preventing influx of air - Prevents backflow of fluid/air - If it tips, stand upright immediately and reassess patient. Replace if water lost. - Can increase resistance. Position in flat loops on bed and move tubing regularly to aid drainage - Connections usually taped to prevent disconnection. If disconnection occurs - reconnect immediately if clean; otherwise clamp or insert drain under water, then attach clean drainage system (Dixon 2006).
Physiotherapy and encouragement of	Facilitates drainage

deep breathing & coughing	
Pain assessment & analgesia as routine	Chest drains are uncomfortable. Uncontrolled pain may affect coughing, ventilation and sleep and thus impede re-inflation of the lung
Label drainage bottles and tubing	Important to understand position and purpose
Replace drainage bottle before 2/3 full	If overfull will increase resistance to drainage (Dixon 2006)
Patient position: Semi-recumbent with regular position changes	Encourages drainage and prevents stiffening of shoulder joints
If drain falls out – pull suture to close skin (if present) and cover with occlusive dressing. Inform doctor and monitor patient. Prepare for insertion of a chest drain.	Prevents air entering the pleural space

Changing the bottle

The UWSD bottle is changed when 2/3 full to prevent increased resistance to drainage (Dixon 2006).

Prepare clean trolley as follows:

- 2 x clamps
- Closed drainage system and tubing
- 1 L sterile water
- Mediwipe x 2
- Sterile towel
- Gloves

Action	Rationale
Wash hands using Aycliffe technique, put on apron and gloves	Prevent cross-infection
Stop suction if using and disconnect suction tubing from old UWSD bottle	Negative pressure will make disconnection difficult
Open closed drainage system and tubing onto trolley using packaging as sterile field. Pour in sterile water to fill line ensuring tubing is 2cm below water level	Prevents contamination of drainage system Creates underwater seal
Clean around the connection with Clinell wipe; allow to dry for 30 seconds. Place sterile towel under connection.	Prevents contamination and introduction of infection
Clamp close to chest wall using 2 clamps (turn 3-way tap off to patient if pigtail drain)	Prevents air entering chest cavity
Disconnect old drainage system and connect clean drainage system using ANTT; ensure connection is secure	Use of aseptic non-touch technique prevents introduction of infection; any disconnection would allow influx of air
Place new drainage system at least 30cm below level of patient's chest	Prevents backflow of fluid/air
Unclamp or open 3–way tap (re-attach to	Allows drainage of air/fluid

suction if appropriate)	
Reassess patient, ensure he/she is comfortable	Alerts to deterioration in condition
Record any drainage on fluid balance chart	To keep accurate record of fluid balance
Double bag and dispose of equipment according to hospital policy	Prevent cross-infection

Management of parapneumonic effusion/empyema

A parapneumonic effusion is a pleural fluid collection in association with an underlying pneumonia. Fibrin is deposited, white cells increase and the pleural fluid thickens becoming overt pus – empyema (BTS 2005).

Small drains (8-12FG), including pigtail drains, are inserted to minimise patient discomfort. According to the British Thoracic Society (2005):

- The drain should be clamped for 1 hour once 10ml/kg is drained to prevent re-expansion pulmonary oedema.
- If the patient complains of breathlessness or chest pain, the drain must be immediately unclamped and medical advice sought.
- If there is sudden cessation of fluid draining, a blockage must be suspected. Check for kinks: if none, obstruction with thick pus must be suspected and medical advice sought (the drain may need flushed with 10ml sodium chloride 0.9%).

Intrapleural fibrinolytics (e.g. urokinase) are recommended for the treatment of parapneumonic effusion and empyema as they have been shown to shorten hospital stay (BTS 2005). The drain is usually clamped for 4 hours post-instillation and the patient turned to aid dispersion. Physiotherapy is often timed to coincide with this. Suction (5-10cmH_2O) is believed to improve drainage (BTS 2005).

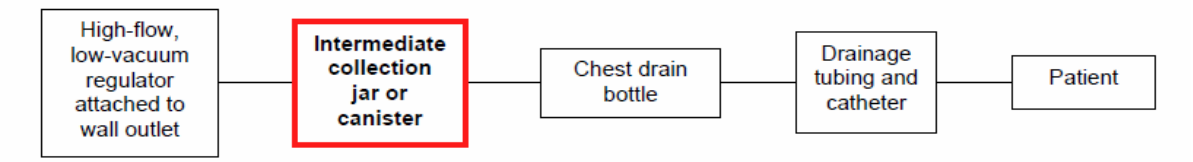
Use of suction

The addition of suction increases the negative pressure thus enhancing lung re-expansion (BTS 2005). It is most commonly used for persistent air leak or for patients with empyema.

Action	Rationale
Only use a high-volume, low pressure-suction unit	Prevents excessive negative pressure which may damage the lung
Place a second suction bottle between the suction unit and the underwater seal bottle (see diagram)	Prevents any overflow of secretions reaching the suction unit. If allowed: suction would fail, a closed system would ensue and tension pneumothorax may occur (MHRA 2010)

Ensure adequate analgesia prior to commencing/increasing suction via the chest drain	The addition of suction may be painful (Mackenzie & Maguire 2004)
The amount of suction is prescribed by the consultant and must be documented - Usually 10-20cmH_2O via underwater seal (Havelock et al, 2010)	Incorrect suction pressures may result in harm
Check the amount of suction delivered regularly	To ensure patient safety
When discontinuing suction, immediately remove the suction tubing to the underwater seal	If tubing remains connected a closed system ensues which could result in tension pneumothorax (Mackenzie & Maguire 2004)

Line diagram of suction system including the essential intermediate collection jar or canister (MRHA 2010):



The intermediate collection jar/canister may be a VacSac or an additional chest drain bottle.

Removal

- Decided on the basis of clinical signs and CXR demonstrating re-inflation
- Tubing may be clamped for 4-6 hours, CXR taken, and then drain removed. If there is evidence of deterioration in this time, then the chest drain is immediately unclamped.
- Analgesia ± sedation needed. Consider using entonox. Distraction will be beneficial
- Traditionally removed on inspiration – no evidence to support this (Havelock et al, 2010).
- Removal is with a brisk movement while assistant pulls mattress suture (nb. there will be no suture to close wound if small bore tube used)
- Occlusive dressing applied

- Monitor patient's vital signs and observe for signs of distress

- Chest X-ray usually taken 1 hour post-removal

- Remove suture (if applicable) after 3-5 days.

Note: (Horizontal) mattress suture can be viewed on You Tube: http://www.youtube.com/watch?v=Svcau54Svyg

Tension Pneumothorax

- Medical emergency
- Patient will have tachypnoea, increased work of breathing, decreased SaO_2, tachycardia, hypotension, pallor, distress, unequal chest movement, decreased air entry and hyper-resonance to percussion on side of pneumothorax. There may be tracheal deviation.
- If ventilated, TVs will fall (if pressure controlled) or peak P will rise (if volume controlled)
- Treatment: call for help, give 100% O_2 and perform needle thoracentesis.

Needle thoracentesis (ALSG 2005):

- A 16 guage (white) over-the-needle cannula (or larger) is attached to a 20ml syringe
- Alcohol swab is used as skin prep.
- The needle is inserted over the top of the rib into the 2nd intercostal space in the mid-axillary line
- Air is aspirated until the patient appears comfortable.
- Urgent insertion of chest drain to prevent recurrence.

Variations:

- A 3-way tap with extension may be attached to the cannula to aid removal of air
- Sodium chloride 0.9% in the syringe will bubble when pneumothorax is located
- A posey IV shield will help keep cannula in situ

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Date produced: March 2012 Review date: March 2015

Appendix

Chest drains available on PICU:

<u>Pigtail drains</u>: Fuhman Pleural/Pneumopericardial drainage set

- 8.5fr/15cm6fr/15cm
-
- 10.2fr/15cm

Vinyl connecting tube needed to connect to drainage system.

Set components:
- Introducer needle
- Wire guide
- Dilator
- Radiopaque pigtail catheter
- Three-way stopcock
- Multipurpose tubing adapter

<u>Thal Quick chest tube set</u>:

- 12fr/22cm
- 16fr/41cm

Set components:
- Scalpel
- EchoTip echogenic introducer needle
- Amplatz Extra-Stiff Wire Guide
- Marked dilator
- Chest tube inserter
- Thal-Quick Chest Tube

<u>Trocar catheter</u>:

- 10 fr
- 12fr
- 16fr

An insertion pack / cut down set is needed for trocar catheter (contains small clamps (2 x curved, 1 x straight), scissors, forceps, scalpel, galipot, gauze).