GUIDELINE

Intercostal Catheter Insertion and Management

Scope (Staff):	Nursing and Medical Staff
Scope (Area):	NICU KEMH, NICU PCH, NETS WA

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CAHS Child Safe Organisation Commitment Statement

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Aim

To outline the insertion and management of intercostal catheters for preterm and term infants in the neonatal unit.

Risk

Insertion of an intercostal catheter is an invasive procedure. Failure to adhere to this guideline will lead to adverse events.

Background

Intercostal Catheters (ICC) may be used to drain a pneumothorax or pleural effusion or may be placed post thoracic surgery. Pleural effusions vary considerably and should only be drained if compromising respiration.

Pleural air leak is common in neonatology. Many pneumothoraces are insignificant and may not require treatment. Others can be life threatening and require immediate needle drainage (See Appendix 1 in Pneumothorax guideline) prior to an ICC insertion.

Key points

- **Intercostal Catheter insertion is a complex and potentially dangerous procedure and should only be performed after simulation training and then with adequate supervision.**
- This procedure is a surgical aseptic technique with full PPE. See appendix 1.
- Place the catheter in the best position to drain air or fluid from the pleural cavity. In general, as infants are usually nursed supine, the catheter should sit anteriorly to drain air and posteriorly to drain fluid. Drainage of effusions should always be a consultant decision.
- Management decisions for pneumothoraces should be made by a **Senior Registrar** (preferably in conjunction with the consultant).
    - In emergent situations where there is a desaturated infant with a tension pneumothorax and there is not an SR/Consultant immediately available, a registrar may need to make the call and perform needle aspiration until a senior doctor arrives.
- Ultrasound in conjunction with x-ray is useful in diagnosing and managing both air leaks and effusions and monitoring the progress of pneumothoraces /effusions.
- Adequate analgesia must be used for catheter placement (Lidocaine, Morphine) and while the catheter is in situ (Morphine Infusion) with pain scores clearly documented.
- Surgical chest drains should NEVER be put on suction unless ordered by the surgeon.

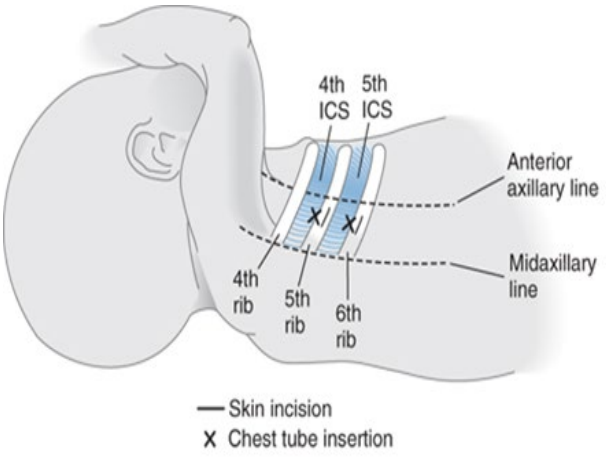
Intercostal Catheters

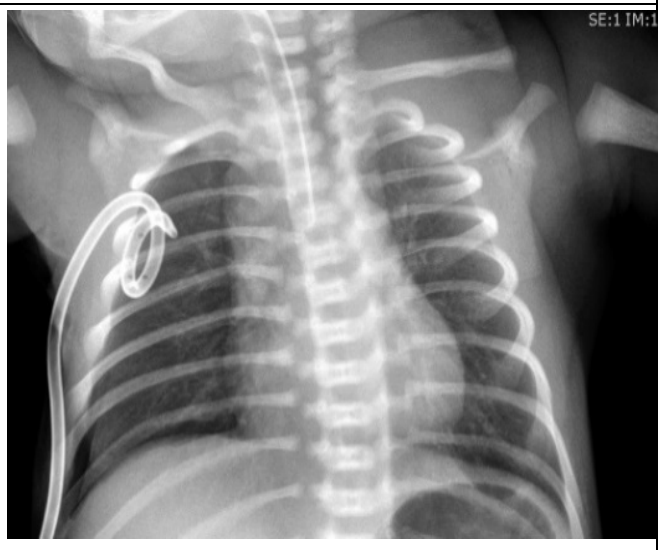
Types of Catheters

Pigtail (Preferred option)	• These catheters are placed by a Seldinger technique. • They curl inside the chest and are soft. • Available in various sizes.
Straight, rigid, large bore	• Rigid straight tube. • Needs a cutdown and blunt dissection technique. • Usual surgical drain type. • May be used for large pleural effusions or pneumothoraces where pigtail catheter does not adequately drain fluid or air.

Catheter Placement

Pneumothorax	• 3rd to 5th intercostal space mid axillary line. • Angle anteriorly. This may be helped by placing infant with insertion site up ~30° and ensuring holes in pigtail face up as it is advanced.
Effusion	• 4th to 5th intercostal space in mid axillary line. May be required to be placed lower in 6th intercostal space, but if so under ultrasound guidance. • Aim to place in paravertebral gutter or point of maximal effusion. Angle posteriorly. This may be assisted by placing catheter with infant flat on back and ensuring holes in pigtail face down as catheter is advanced.





X-ray post insertion of intercostal catheter on the right side.

Securing

- Suturing is usually not necessary for pigtail catheters but is usually required for rigid catheters. Be aware that suturing can leave disfiguring scars.
- Use steri-strips and a tegaderm to secure pigtail catheters.
- Secure drainage tubing to the bed to prevent tension and accidental dislodgement.

Dressings

- Observe catheter insertion site for signs of infection or inflammation and ensure dressing remains clean and intact.
- Change the dressing by aseptic technique if there is a large amount of exudate staining or leakage through the dressing. Caution must be undertaken when changing a dressing due to the high risk of non-intentional catheter displacement or accidental removal.

Documentation

- Complete MR423 Intercostal Catheter Insertion, Removal and Management form.
- Document insertion date and position on top of MR489 Observation Chart and in MR420 progress notes or DMR.
- Document removal of ICC including dressings and sutures on MR423, MR420 and complete Neonatal Wound Assessment and Wound Management Tool MR492.
- Hourly documentation of any bubbling, swinging or drainage and suction pressure on MR489.00A/B Fluid Balance Chart A/B.

Complications and troubleshooting

Deterioration of the neonate with an ICC

- If an infant deteriorates with an ICC insitu, alert medical staff. Look for disconnection or blockage.
- For straight, rigid ICCs - A non-toothed clamp is to be kept at the bedside for each chest drain (for use in emergency if accidental disconnection occurs from suction unit).

Complication	Action
Pneumothorax	• Notify medical staff. Signs and symptoms include: ○ Decreased SpO2 ○ Increased WOB ○ diminished breath sounds ○ decreased chest movement

Complication	Action
	○ tachycardia, or bradycardia ○ hypotension • An urgent chest X-ray or ultrasound may be needed. • Check drain system is intact: no leaks, blockages, kinks or clamps on. • Prepare for emergency chest aspiration and/or insertion /repositioning of chest drain.
Catheter becomes blocked with serous fluid	• Attempt to unblock the catheter with gentle flushing with air through the 3 way tap adjacent to the ICC hub. This should always be an aseptic procedure and performed by medical staff. • Flushing of the catheter with saline may be required. Follow Appendix 3: Flushing and Aspirating ICC and Specimen Collection
Accidental disconnection of the drainage system	• Clamp the drain tubing at the patient end. Clean ends of drain and reconnect. • If a new drainage system is needed cover the exposed patient end of the drain with sterile dressing while new drain is set up. Ensure clamp is removed when new drain is connected. • Check vital signs. Alert medical staff and complete a CIMS.
Accidental drain dislodgement	• Apply pressure to the exit site and seal with an occlusive dressing over the top. • Check vital signs. Alert medical staff and complete a CIMS.
Unable to Remove Chest Drain	• If the drain is unable to be removed with reasonable traction being applied, notify the responsible medical team.

See the appendices for the following detailed procedures

Appendix 1: Intercostal Catheter Placement

- Pigtail with Seldinger wire – Size 8.5Fr or 10.2Fr
- Pigtail size 6Fr
- Straight, rigid ICC

Appendix 2: Underwater Seal Drainage Units

Appendix 3: Flushing, Aspirating ICC and Specimen Collection

Appendix 4: ICC Removal

Related CAHS internal policies, procedures and guidelines
Neonatology Guidelines • Aseptic Technique in the NICU • Pain Assessment and Management • Pneumothorax

References and related external legislation, policies, and guidelines
• MacDonald MG, Ramasethu J, Rais-Bahrami K. Atlas of procedures in neonatology. Philadelphia: Lippincott Williams & Wilkins; 2013.

This document can be made available in alternative formats on request.

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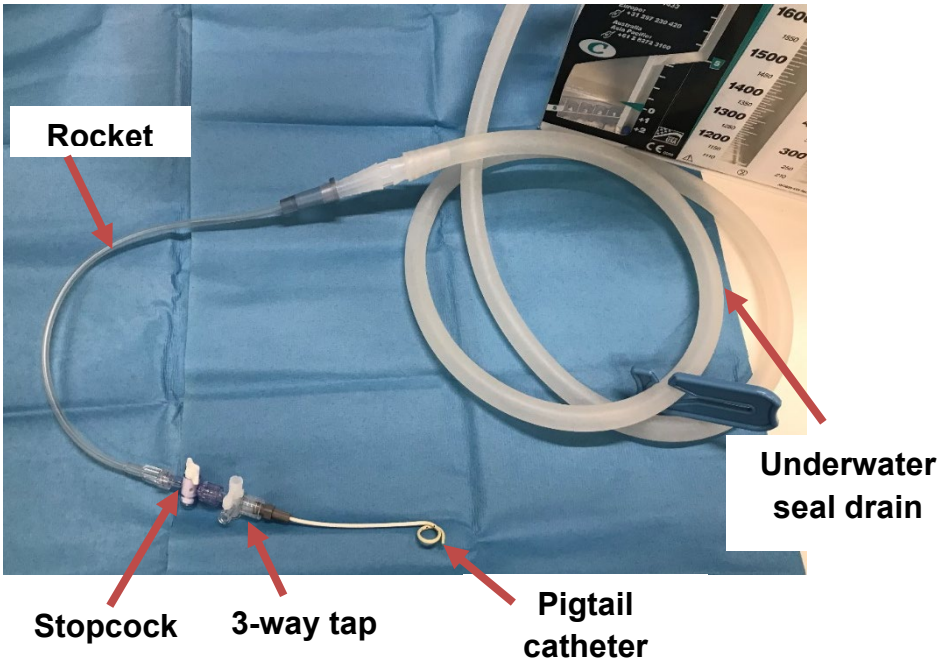
Appendix 1: Intercostal Catheter Placement

This is a complex and potentially dangerous procedure and should only be performed after simulation training and then with adequate supervision.

This is a surgical aseptic procedure requiring PPE and a large sterile field.

Equipment

- Sterile drapes, large clear plastic drape
- Sterile instrument tray
- Sterile gown and gloves
- Skin prep solution
    - >27 weeks gestation – Chlorhexidine 1% / Ethanol 70% liquid
    - <27 weeks gestation – Povidone-Iodine 10% swab
- Lidocaine 1% with 1mL syringe, drawing up needle and 25g needle
- Scalpel (for straight, rigid ICC only)
- ICC
    - Pigtail with Seldinger wire 8.5Fr or 10.2Fr
    - Pigtail 6Fr
    - Straight, rigid ICC
- Rocket drainage connector set (30cm) (Pigtail only)
- 3-way tap
- Leukostrips and Tegaderm
- Underwater seal drain (see appendix 3)

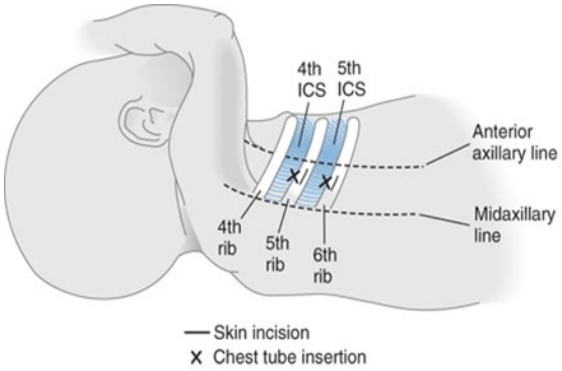


Pigtail with Seldinger wire – Size 8.5Fr or 10.2Fr

Procedure TIME OUT to confirm correct patient, side, site and equipment prior to starting the procedure

Steps

1. Give analgesia prior to the procedure. Morphine infusion/bolus.
2. Monitor heart rate, respirations and oxygen saturations during the procedure.
3. Assemble appropriate underwater seal drainage unit.
4. Position baby supine with *drain insertion site 30° up for pneumothorax drainage and flat on back for drainage of fluid. Insertion site should be well posterior of the nipple/ breast bud.



5. Don PPE, open all equipment on sterile field.
6. Complete dry run through of the procedure.
7. Prep the area with appropriate cleaning solution for gestation and place plastic sterile field with hole cut in middle over patient. Ensure infant can still be visualised after draping.
8. *With the pigtail curled up, hold against patient's chest wall, and determine the length to which the pigtail needs to be inserted for correct placement. Make a note of the mark on the pigtail to use.
9. Infiltrate the area with Lidocaine
10. Introduce ICC needle, over the rib until air (or fluid) draws back. Aim anteriorly for air and posteriorly for fluid.
11. A syringe of saline may be attached to facilitate visualisation of air
12. Advance the soft tipped J-wire (J end first) through the needle until the silver marking is at the needle hub.
13. Remove the needle taking care not to dislodge the wire.
14. Place the dilator over the wire, hold just above skin and with a twisting action dilate the hole through to the pleura. Remove without dislodging the wire.
15. Place the pigtail catheter over the wire with holes anterior for pneumothorax and posterior for effusion.
16. Introduce to the pre-determined length*. Remove wire and place 3-way tap on, 'off to patient'.
17. With a three way tap on the catheter, confirm aspiration of air (or fluid) with a syringe.

18. Secure the catheter with steristrips and a clear tegaderm to ensure insertion site can be seen.
19. With assistant attach to underwater seal drain with AT. Secure catheter to bed linen to prevent accidental dislodgement.
20. Perform CXR for placement and evidence of drainage.
21. Complete documentation

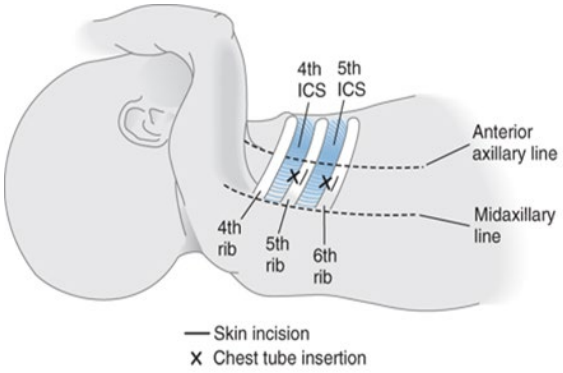
Pigtail size 6Fr

A smaller catheter for small babies (<750gm). It is introduced directly by needle.

Procedure TIME OUT to confirm correct patient, side, site and equipment prior to starting the procedure

Steps

1. Give analgesia prior to the procedure. Morphine infusion/bolus.
2. Monitor heart rate, respirations and SaO2 during the procedure.
3. Assemble appropriate underwater seal drainage unit.
4. Position infant supine and as directed* with arm above the head.



5. Don PPE, open all equipment on sterile field.
6. Complete dry run through of the procedure.
7. Position baby supine with *drain insertion site 30° up for pneumothorax drainage and flat on back for drainage of fluid. Insertion site should be well posterior of the nipple/ breast bud.
8. Prep the area with appropriate cleaning solution and place plastic sterile field with hole cut in middle over patient, ensure infant is visible.
9. *With the pigtail curled up, hold against patient's chest wall and determine length at which pigtail needs to be inserted in for correct placement. Make a note of the mark on the pigtail to use.
10. Infiltrate the area with Lidocaine

11. Mount catheter on needle using plastic straightener. Ensure holes are facing up and aim anteriorly for pneumothorax and aim posteriorly with holes facing down for effusion.
12. Insert needle (and catheter) through the skin and into the pleural space until air (or fluid) flashback.
13. Gently advance the catheter over the needle to pre-determined length*. Place 3-way tap on catheter 'off to patient'.
14. With a three way tap on the catheter confirm aspiration of air (or fluid) with a syringe.
15. Secure the catheter with chevron pattern steristrips and a tegaderm. Clear tegaderm to ensure insertion site can be seen.
16. With an assistant, attach to underwater seal drain using AT. Secure catheter to bed linen to prevent accidental dislodgement.
17. Perform CXR for placement and evidence of drainage.
18. Document procedure and CXR findings.

Straight, rigid ICC

Straight, rigid catheters are seldom used. Insertion is by cutdown and blunt dissection of the chest wall**.**

Procedure TIME OUT to confirm correct patient, side, site and equipment prior to starting the procedure.

Steps

1. Give analgesia prior to the procedure. Morphine infusion/bolus.
2. Monitor heart rate, respirations and oxygen saturations during the procedure.
3. Assemble appropriate underwater seal drainage unit.
4. Position infant supine and as directed* with arm above the head.
5. Apply PPE, open all equipment on sterile field.
6. Complete dry run through of the procedure.
7. Position baby supine with *drain insertion site 30° up for pneumothorax drainage and flat on back for drainage of fluid. Insertion site should be well posterior of the nipple/ breast bud.
8. Prep the area with appropriate cleaning solution and place plastic sterile field with hole cut in middle over patient. Ensure infant can still be visualised after draping.
9. Infiltrate the area with Lidocaine.
10. If the catheter is mounted on an introducing spike, discard this and mount the catheter on curved artery forceps.

11. With a small scalpel, make a 0.5cm incision along the line of the ribs down to, but not through the muscle layer.
12. Use mosquito forceps to blunt dissect the muscles down to the pleural layer. Air or fluid leak will confirm entry into the pleural cavity.
13. Place the catheter through the wound until all holes are in the chest cavity. If for a pneumothorax, ensure the catheter is directed anteriorly and for effusion, ensure catheter is directed posteriorly.
14. With a three way tap on the catheter confirm aspiration of air (or fluid) with a syringe.
15. Secure the catheter with steristrips and a tegaderm. Suturing may be required. Clear tegaderm to ensure insertion site can be seen.
16. With an assistant, attach to underwater seal drain using ANTT. Secure catheter to bed linen to prevent accidental dislodgement.
17. Perform CXR for placement and evidence of drainage.
18. Document procedure and CXR findings.

Appendix 2: Underwater Seal Drainage Units

Atrium Oasis

This drain is used in the treatment of:

- Pneumothorax
- Pre-TOF repair (attached to Replogle tube)
- Post-op wound drainage (wound drain is not connected to suction unless specified by Surgeon.)

Atrium Oasis (Latex free)	
	1. Remove the ampoule of sterile water from the back of the drain. Add water to the water seal chamber through the suction port. Fill the water seal chamber to the 2cm fill line **2**. Dial the Suction control to -10. This can be increased as per medical order. **3.** Connect suction to the suction port. Set the wall low suction pressure at a minimum of - 80mmHg. **4**. Ensure that the bellows expand to the delta mark. This demonstrates that the suction is working. If the bellows is not at or past the delta mark, increase suction pressure at the wall. **5.** To connect multiple chest drains to one suction source insert a 'Y' connector onto the wall suction tubing then connect each drain onto one end of the 'Y'. 6. If the chest drain is not used with suction: the suction outlet port (BLUE) **MUST** remain open to air to allow air to vent from the system. If suction is ceased, disconnect suction tubing from the top of the drain and from the wall suction.

Rocket Drainage Unit - This drain is used in the treatment of air leaks only

Suction for Rocket and Atrium drains	
	• Rocket Underwater Seal drain apply wall **low** suction **- 40mm/Hg** • Atrium Oasis Underwater Seal drain apply wall **low** suction **-80mmHg**

Heimlich Valve – Used by NETS or when loss of power	
	• Heimlich valve is a mechanical one-way valve. • Used for retrieval as easily transportable. • Blue end connects to the ICC. • Clear end left open.

Appendix 3 – Flushing and Aspirating ICC (+/- Specimen Collection)

- Flushing an ICC blocked by fibrin, blood or chyle.
- Collecting drainage specimens for culture or to look for chyle (in chylothorax)
- Flushing and aspirating an ICC is a Standard Aseptic Technique procedure and is performed by staff deemed competent in this procedure.

Equipment

- Blue tray, Dressing pack and Sterile Gloves
- Sterile specimen container and red combi-stop
- 2% Chlorhexidine / 70% Alcohol swab
- Luer lock syringes (3, 5, 10 or 20mL for either flushing, aspirating or collecting a specimen)
- Normal saline for injection (POSIFLUSH SALINE IS NOT SUITABLE FOR THIS PROCEDURE)

Procedure

1. Perform hand hygiene
2. Clean blue tray and gather equipment. Ensure 3-way tap on ICC is accessible
3. Perform hand hygiene
4. Prepare equipment. Open dressing pack in blue tray.
5. Open syringe packet, leaving syringe in packet to maintain sterility.
6. Place blue drape under the 3-way tap of the ICC.
7. Perform hand hygiene and don gloves
8. Remove red combi-stop and discard. Wipe port with chlorhexidine / alcohol swab and allow to dry. Ensure 3-way tap is turned off halfway between ports.
9. Connect syringe. Open 3-way tap and gently aspirate. If taking a specimen 5mls of fluid will suffice. Place fluid in sterile specimen pot.
10. If aspirating chest tube to remove fluid, gently aspirate until resistance is felt.
11. If flushing the catheter to unblock, flush with 2 – 5mL (maximum 10mL) of warm sterile normal saline. Ensure sterile procedure and sterile handling of ports throughout.
12. Turn 3-way tap halfway between ports and remove the syringe.
13. Clean port with chlorhexidine / alcohol swab and allow to dry. Put on new combi-stop. Ensure 3-way tap is open to both ends of the ICC.
14. Perform hand hygiene, document volume aspirated and send specimen to lab (if applicable).

Appendix 4 – ICC Removal Procedure

Once the air leak or collection of fluid has resolved the catheter can be clamped for a few hours and the X-ray or ultrasound repeated. If there is no recollection, the catheter may be removed.

Post ICC removal:

- Re-accumulation of air or fluid may occur
- Insertion site may require suturing and leukostrips to close if a rigid catheter was used
- Insertion sites of pigtail catheters are generally self-sealing and the wound can be dressed with a fresh Tegaderm.

Therefore, the procedure should be set up as a surgical aseptic procedure and medical staff should be present at the bedside during the removal. If suturing is **not** required, ICC removal can be performed by a nurse deemed competent.

Equipment

- Dressing pack
- Adhesive remover wipe
- 0.9% Sodium Chloride
- Gauze
- Tegaderm
- Leukostrips (if required)
- Stitch cutter (if required)
- Suturing equipment:
    - Sutures (2.0 Propylene)
    - Lidocaine with 1ml syringe, drawing up needle, and 25g needle (to infiltrate prior to suturing)
    - Sterile drape
    - Instrument tray
    - Skin prep
        - >27 weeks gestation – 1% Chlorhexidine solution
        - <27 weeks gestation – Povidone-Iodine 10% swab

Steps

1. Clamp ICC and turn off suction if not already done.
2. Perform hand hygiene.
3. Prepare equipment. Place blue drape under the baby and ICC to ensure free access to the ICC.

4. Perform hand hygiene.
5. Don full PPE.
6. Remove tegaderm and leukostrips. Cut suture if applicable. Use adhesive remover if required
7. Place folded gauze over the insertion site and remove ICC on expiration. Ensure insertion site is covered as quickly as possible to minimise air being reaccumulated in the chest.
8. Seal insertion site with gauze (cut to size) and tegaderm. If an argyle catheter was used, leukostrips or suturing will be required to seal the insertion site.
9. Observe for signs of re-accumulation of air or fluid.
10. Document ICC removal in progress notes/DMR and on the observation chart. The volume of fluid in the drainage unit should be documented on the observation chart.
11. Monitor removal site for signs of infection or inflammation and ensure dressing remains clean and intact. Dressings to remain in situ for 5 days post removal. Complete Neonatal Wound Assessment and Management Tool MR492 and if sutures are insitu note date to be removed. Sutures should be removed after 5-7 days.