Intercostal Catheters in the Neonate

Guideline Responsibilities and Authorisation

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Target Audience	NICU Medical and Nursing team
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Guideline Review History

Version	Updated by	Date Updated	Summary of Changes
1.0	M Bailey-Wild	March 2022	New guideline

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Contents

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1 Overview

1.1 Purpose

Pulmonary air leak is a risk of mechanical ventilation, but also a cause of respiratory distress in the newborn infant. Drainage of air and/or fluid accumulation in the chest is an important and necessary skill and is often performed on an emergency basis.

Needle thoracocentesis or the insertion of a chest drain or an intercostal catheter (ICC) into the pleural space allows air/fluid to drain from the pleural space with the goal of lung re-expansion, re-establishment of negative pleural pressure, restoration of adequate ventilation and oxygenation, relief of respiratory distress, and improvement in hemodynamic stability.

1.2 Scope

Nurse Practitioners, Clinical Nurse Specialists, Registrars, Fellows and Senior Medical Officers competent at ICC insertion or under supervision of senior practitioner

1.3 Patient / client group

Newborn infants under the care of Waikato Neonatal Intensive Care.

1.4 Exceptions / contraindications

Small air or fluid collection without significant haemodynamic or respiratory symptoms.

1.5 Definitions and abbreviations

Chylothorax	accumulation of lymphatic fluid (chyle) in the pleural space
CNS	Clinical Nurse Specialist
Empyema	a collection of pus in the pleural space
ETT	Endotracheal tube
Haemothorax	a collection of blood in the pleural cavity
ICC	Intercostal Catheter
Medical staff	Neonatal Nurse Practitioners, Clinical Nurse specialists, Registrars, Fellows, SMOs
NICU	Neonatal Intensive Care Unit
NNP	Neonatal Nurse Practitioner
Pleural effusion	an accumulation of fluid in the pleural space
Pneumothorax	a collection of air or an air leak in the pleural space
SC	subcutaneous

SMO	Senior Medical Officer
Tension Pneumothorax	a medical emergency where accumulating air in the pleural space produces a mediastinal shift, pushing the heart, lungs, trachea, and large vessels to the unaffected side of the chest cavity. The compression on the heart and great vessels impede cardiac output and venous return. Gas accumulates in the pleural space and the surrounding tissue acts as a one-way valve where gas enters the pleural space during inspiration but cannot exit. This accumulation and pressure leads to a sudden acute cardio-respiratory collapse.

2 Clinical management

2.1 Indications

Small pneumothoraces may resolve on their own over time, but larger air leaks and fluid collections must be drained either by needle thoracocentesis or intercostal catheter insertion to re-establish negative pressure and lung reinflation.

Indications for ICC insertion

- Evacuation of pneumothorax
  - Respiratory distress
  - Tension pneumothorax
- Evacuation of large pleural effusion – consider Trocar intercostal catheter (without trocar) as pigtail may block frequently.

2.2 Roles and responsibilities

Medical team – to collect and set up sterile equipment required

Nursing staff – to assist with positioning of infant (as outlined below) and prepare Evacuation Device

2.3 Competency required

Nurse Practitioners, Clinical Nurse Specialists, Registrars, Fellows and Senior Medical Officers competent at ICC insertion or under supervision of senior practitioner.

2.4 Equipment

2.4.1 Needle Thoracocentesis

- 70 per cent isopropyl alcohol swab/2% chlorhexidine
- one pair sterile gloves
- 22-20G butterfly needle
- 3 way tap
- 10ml Syringe

2.4.2 Intercostal Catheter Insertion

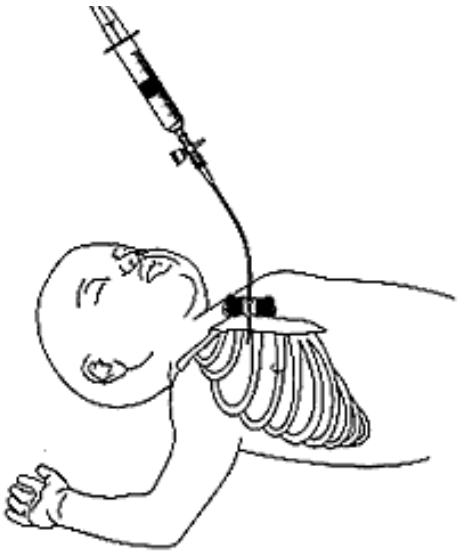
- Universal Large Sterile Pack
- Gloves and Gown, mask
- Thoracostomy tube pig tail catheter (Cook, Fuhrman Pleural and Pneumopericardial Drainage Set, 6 or 8 french) -
- Chlorhexidine 2% swabsticks x3 (<1000g consider sterile water)
- Tegaderm sheets
- Evacuation device – (Atrium Oasis, Dry Suction Chest Drain **or** Pneumostat chest Drain Valve used primarily for retrieval/transport)

2.5 Guideline

As an initial method of drainage in emergency situations needle thoracocentesis may be employed with great effect to evacuate air, resulting in rapid improvement of vital signs. In addition, there is some evidence to suggest that needle thoracocentesis can prevent the need for an indwelling ICC in up to 30% of cases. If recurrent drainage is required, insertion of an ICC is indicated. In particular, consider prior to retrieval of any infants with documented air leak.

2.5.1 Emergency Needle Thoracocentesis Procedure

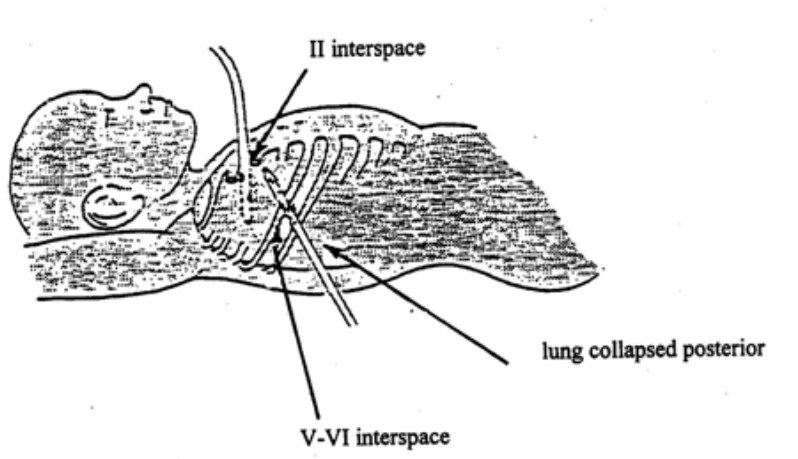
1. Position infant supine, prepare area with alcohol wipe



2. Insert butterfly needle into the pleural space (directly over the top of the rib in the second or third intercostal space in the midclavicular line) until air is aspirated into the syringe. Expel air through the three-way tap. Continue until no further air can be aspirated.
3. Minimise movement in the needle to avoid lacerating the lung or puncturing blood vessels.

2.5.2 Intercostal Drain insertion procedure

1. Consider pain relief, e.g. sucrose or procedural sedation as per NICU drug Guidelines e.g. fentanyl or midazolam
2. Determine location of air collection
   a. Physical examination
   b. Transillumination
   c. Radiograph (consider repeat if needle aspiration has been done)
3. Support the infant with artificial ventilation as required
4. Monitor vital signs
5. Position infant with affected side elevated 60 to 75 degrees off the bed, secure arm across the head, with shoulder internally rotated and extended. (This position is very important because it allows air to rise to the point of tube entry into the thoracic cavity, outlines the latissimi dorsi muscle, and encourages the correct anterior direction of the tube)
6. Use sterile procedure: put on a cap, mask, sterile gown and gloves, and prepare sterile field.
7. Prepare the skin with antiseptic solution over the entire lateral portion of the chest to the midclavicular line. Allow skin to dry
8. Drape surgical area from third to eighth ribs and from latissimus dorsi muscle to midclavicular line.
9. Locate essential landmarks
   a. Nipple and fifth intercostal space
   b. Mid-axillary line
   c. Midway mid-axillary and anterior axillary line in fourth for fifth intercostal space, a horizontal line form nipple is a good landmark



10. Consider use of Lidocaine 1% subcutaneously, 3 mg/kg (0.3 mL/kg)
11. Use Seldinger technique to introduce pigtail catheter

Seldinger Technique

1. Insert needle just until air escapes/ bevel of syringe moves
2. Insert guidewire – until white mark on wire is just into cannula
3. Use dilator to just go through the skin
4. Feed pigtail onto guide wire and insert through chest wall – to 3rd mark on catheter (NB ALL holes **must** be inside the chest wall)
5. Remove guidewire
6. Connect three-way tap
7. Connect evacuation device (which has been already set-up for you as per instructions for device)
8. Stabilise chest drain with two Tegaderm sheets in opposing position
9. Obtain CXR for confirmation of chest drain position
10. Ensure air is bubbling and fluid swinging
11. Tape/Clip tube to bed, to ensure minimal drag on patient
12. Ensure evacuation device is always lower than the patient.

2.5.3 Trocar intercostal catheter insertion (consider in pleural effusions or by surgical team request)

Equipment

- Argyle 8, 10 or 12 Fr sterile intercostal catheter (trocar-less product also available from theatre, oracle code 267972)
- Sterile surgical instrument pack
- Size 11 scalpel blade
- 3/0 black silk suture on a curved edge needle
- Skin preparation
- 1 per cent lignocaine, syringe and needle
- Underwater seal drainage system or a Heimlich valve
- Sterile gown, gloves and drapes
- Semi-occlusive dressing, tapes

Procedure

1. Observe standard precautions.
2. Mask, sterile gown and gloves are required as for any sterile procedure.
3. Place infant under radiant heater to maintain infant's temperature.

4. Monitor heart rate and saturation levels and ensure infant can still be partly visualised after draping to create a sterile field.
5. Position the infant with the effected side uppermost and the arm extended above the head (a nappy cloth roll may help maintain a good position). Ensure limbs are adequately restrained.
6. Prepare the field with antiseptic solution and drape.
7. Infiltrate local anaesthetic (Lidocaine 1% 3 mg/kg (0.3 mL/kg)) at insertion site (fourth or fifth intercostal space in the anterior axillary line. This corresponds to a point 1-2 cm lateral to and 0.5-1 cm below the nipple).
8. Select intercostal catheter size:

Infants	> 1,500 g	10 or 12 Fr
	< 1,500 g	8 or 10 Fr

9. Make a 1 cm incision through the skin and subcutaneous tissue using a small (number 11) scalpel blade.
10. Bluntly dissect away the subcutaneous tissue and intercostal muscles using straight mosquito forceps to reach the parietal pleura. Aim to dissect a passage just above a rib border in order to avoid the neurovascular bundles running below each rib. Open the parietal pleura by blunt dissection. At this point the hiss of air escaping the pleural space may be heard.
11. Remove the trocar from the ICC (if present) and grasp the distal end with curved artery forceps. Advance the ICC into the pleural space 3-5 cm (at the 1-3 cm marking on the catheter), directing the tip anteriorly as well as superomedially, so that the tip lies anteriorly inside the chest cavity.
12. Connect the ICC to a Heimlich valve or an underwater seal drainage system, and note whether the fluid is swinging and/or bubbling. Fogging within the catheter may be seen when within the pleural space.
13. Place a single stitch through the wound so that the skin is drawn snugly around the ICC. Purse string stitches are not used as they leave an unsightly scar. Wrap the ends of the suture around the ICC several times and tie securely.
14. Secure the ICC to the chest wall with steristrips as shown in diagram. This helps to maintain the anterior position of the ICC and minimises trauma to intrathoracic structures due to movement of the extrathoracic portion of the ICC. then cover with tegaderm

15. Alternatively, sandwich the wound and tube between two Tegaderm dressings.

Figure 4: Diagram for securing ICC

2.6 Potential complications

- Bleeding
- Infection
- Pneumothorax
- Malposition – catheter tip not positioned in collection
- Accidental disconnection
- Accidental removal
- Pain
- Lung trauma

2.7 After care

Check the tube position and resolution of the pneumothorax by transillumination and chest X-ray as soon as possible.

If there is any doubt about the position of the drain or it appears in an unusual position, consider obtaining a lateral CXR for additional assessment of position.

Determine the need for ongoing analgesia based on an assessment of physiological and behavioural responses associated with pain (using N-PASS) – refer to Pain Management of Infants in NICU procedure

Infants requiring an intercostal catheter will be cared for in NICU/SCBU..

Ongoing management of intercostal Catheters should be as directed in Chest Drains in Neonates: Nursing Management procedure

2.8 ICC removal

This is a delegated medical responsibility that may be undertaken by an experienced neonatal nurse. The chest drain will usually be clamped for 12-24 hours and an x-ray of chest taken to ensure no re-accumulation of air has occurred. **This is a two person procedure** with **one sterile and one assisting.**

1. Assemble equipment for sterile procedure plus scalpel blade, steristrips, tegaderm, and gauze.
2. Doctor/NS-ANP or nurse puts on sterile gloves.
3. Position baby (chest drain side slightly tilted upwards). Remove tegaderm, and any other securing dressings/sutures, and hold drain up slightly.
4. Wound is held together as drain removed
5. The wound should be sealed following removal of the drain. This may be by using steristrips applied to close drain site or by using a small gauze square placed over the thoracotomy incision. Apply tegaderm over the top of the steristrips or the gauze.
6. A routine chest X-ray 4 hours after drain removal is no longer mandatory. Chest X-rays should be performed if the baby has any significant clinical change following the drain removal.
7. Document removal of drain in Multidisciplinary notes and on the Level 3 chart.

3 Patient information

Once a decision to insert an intercostal catheter has been made, parents should be updated. In an emergency this may be following the procedure. Analgesia and ventilation support may be considered during the procedure.

4 Audit

4.1 Indicators

- The threshold for intercostal catheter insertion meets criteria 2.1
- Documented monitoring of heart rate, saturations & oxygen requirement before, during and after procedure
- Monitor intercostal catheter associated incidents

5 Evidence base

5.1 Summary of Evidence, Review and Recommendations

Please refer to 2019 Cochrane Systematic Review:

Bruschettini M. et al. Needle aspiration versus intercostal tube drainage for pneumothorax in the newborn. Cochrane database of Systematic reviews. 2019.
DOI: https://doi.org/10.1002/14651858.CD011724.pub3

5.2 Bibliography

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The Royal Children's Hospital Melbourne, Australia, Clinical Practice Guideline on *Chest drain management*, [Internet, last updated 2016], Available from: https://www.rch.org.au/rchcpg/hospital_clinical_guideline_index/Chest_Drain_Management/

Chest Drains in the Neonate (Starship Childrens Hospital, 2018) https://www.starship.org.nz/guidelines/chest-drains-in-the-neonate/

Van den Boom J; Battin M. Chest radiographs after removal of chest drains in neonates: clinical benefit or common practice? Archives Dis in Child Fetal & Neo Ed. 2007 Jan;92(1): F46-8.

5.3 Associated Waikato DHB Documents

- Chest Drains in Neonates: Nursing Management procedure (Ref. 2859)
- Fentanyl for Neonates drug guideline (Ref. 2916)
- Lidocaine 1 Percent for Neonates drug guideline (Ref. 6368)
- Midazolam for Neonates drug guideline (Ref. 2939)
- Pain Management of Infants in NICU procedure (Ref. 3712)
- Sucrose Oral Liquid for Analgesia in Neonates and Infants drug guideline (Ref. 2905)