Chest Drain Insertion: Medical and Nursing Management in NICU (Butterfly Ward)

Introduction
A chest drain is used in the management of infants to remove air (pneumothorax), fluid (blood, pleural effusion, chyle) or pus (empyema) from the pleural (or occasionally the extrapleural) space.

This procedure covers insertion and management of both intercostal catheters (ICC) - pig-tail type and the ICCs with rigid trocar introducer.

A related procedure is emergency needle decompression which is used where an infant has acutely collapsed with a tension pneumothorax, and precedes definitive drainage by an ICC.

Aim
The aim of this guideline is to outline the principles of management of infants requiring a chest drain on the Neonatal Intensive Care Unit (NICU) – Butterfly Ward of the Royal Children’s Hospital.

Definition of Terms
- Pneumothorax – accumulation of gas in the pleural space
- Tension Pneumothorax – gas in the pleural space resulting in collapse of the lung and severe respiratory compromise
- Chylothorax – accumulation of chylous fluid in the pleural space
- Haemothorax – accumulation of blood in the pleural space
- Pleural effusion – accumulation of fluid in the pleural space

Intercostal catheter (ICC) with rigid trocar – an ICC that has a rigid trocar (note in neonates the trocar is NEVER used as part of the insertion technique) and requires a skin incision and blunt dissection down to the pleural space to insert.

Pig-tail catheter – a soft catheter with a flexible guide wire; inserted using a seldinger method that does not require a skin incision or blunt dissection.

Under Water Seal Drain (UWSD) – Drainage system of 3 chambers consisting of a water seal, suction control and drainage collection chamber. UWSDs are designed to allow air or fluid to be removed from the pleural cavity, while also preventing backflow of air or fluid into the pleural space.

Indications
Intercostal Catheter (ICC) insertion is indicated to:
- evacuate trapped air, fluid or pus in the presence of respiratory compromise
- decrease tension
- allow proper lung function

Assessment
Clinical Signs:
- Restlessness, irritability, lethargy, increasing respiratory distress
- Sudden deterioration associated with decreased breath sounds and chest movement on the affected side
- Asymmetry of chest wall movement
- Apical impulse displacement
- Tachycardia followed by bradycardia and fall in blood pressure

Confirmation:
- Transillumination & chest x-ray (for suspected tension pneumothorax with imminent collapse do not wait for x-ray; perform emergency needle aspiration if confirmed on transillumination or strongly suspected on clinical grounds)
- Transillumination often produces false negative results in the near term and older babies
Consultation:
- The duty Neonatologist must be contacted whenever a decision to insert any type of intercostal catheter is being considered
- In the case of an ICC being considered in a surgical patient the surgical team must always be part of this discussion

Management

Procedure:
1. Equipment
   - Paediatric Pack
   - Gown Pack
   - Surgical Mask & Hat
   - Sterile gloves
   - Sterile drapes
   - 1% Lignocaine (50mg in 5mls)
   - 2ml Syringe
   - Drawing up needle
   - 25G needle
   - Chlorhexidine wash
   - 3.0 silk suture with curved needle
   - Tegaderm x1 and Steristrips
   - **Cook Pigtail Catheter Set:**
     - 8.5F Catheter (<= 28 weeks)
     - 10.2F Catheter (>28 weeks)
     - Introducer
     - ‘Christmas Tree’ connector
     - 3-way Tap
     - 10ml Syringe
   - **ICC with trocar**
     - Size 10-12F is used in babies >1500g and size 8-10F in those <1500g.
     - Small (#11) scalpel blade
   - Disposable UWSD unit
   - Bottle of sterile water
   - Suction wall regulator
   - Long suction tubing (if suction prescribed)

2. Process
   *In the non-intubated patient consider the need for intubation prior to ICC insertion. Intubation facilitates rapid stabilisation and makes administration of narcotic analgesia less hazardous.*

For the resuscitated and intubated patient:

- Preparation, identification of land marks, and infiltration with local anaesthetic
  - Inform parents and obtain consent if practical to do so prior to the procedure – alternatively, inform them as soon as is possible after the procedure.
  - Administer IV analgesia if not already prescribed and perform pain score prior to procedure.
  - Place baby on their side with the hemi-thorax to be drained uppermost.
  - Ensure optimal oxygenation and ventilation during procedure.
  - Localise the area of exposed chest. Clean area with two 2% aqueous chlorhexadine swab sticks leaving to dry for 1 minute whilst assembling equipment on sterile field.
    - Pneumothorax: 4th intercostal space anterior axillary line aiming anteriorly.
    - Pleural effusion: 5th intercostal space mid-axillary line aiming posteriorly
  - Put on hat & mask then scrub.
  - Draw up 1% Lignocaine (0.5ml for preterm / 1.0ml for Term). Insert 25g needle down onto the rib and intercostal muscles, drawing back to ensure you are not in a vessel. Slowly inject the lignocaine as you withdraw the needle.

3. Insertion of Pigtail ICC:
   - Attach 10ml syringe to the introducer.
   - Grasp the introducer tip with straight artery forceps (2cm from the tip if >1.5kg / 1.5cm from the tip if <1.5kg).
• Whilst withdrawing the syringe, advance the introducer into the 4th intercostal space directly above the 5th rib until air or fluid is withdrawn easily and the artery forceps come to rest on the skin.
• Remove the syringe placing a finger over the introducer lumen.
• Insert the guide wire through the introducer to a length of 5-8 cm (there is a silver mark at 10cm)
• Holding the wire at all times, carefully thread the white cap off the wire, next unclamp the artery forceps and take out the introducer.
• Holding the wire in place, thread the dilator over the end of the wire then with a twisting motion advance it over the wire to a distance of: 1cm (preterm) or 2cm (term) from the surface of the skin.
• Holding the wire in place, remove the dilator.
• Now advance the curly end of the ICC over the wire and insert to the 3-5th mark (1-2cm for preterm / 2-3cm for term).
• Holding the catheter in place, withdraw the guidewire.
• Attach the 3-way tap and blue 'Christmas tree' connector to the end of the catheter and in turn connect this to the drainage tubing (cut end passed from assistant) ensuring the 3 way tap is closed to the patient.
• Place a single stitch through the skin and then secure around the catheter with caution not to occlude the catheter (Note that Purse string sutures are no longer the recommended securing modality due to scarring of the chest wall).
• Place the catheter on the chest wall and tape down securely with steristrips (preterm) or sleek (term) and then Tegaderm. Attach the catheter to UWSD below the neonate's chest level and secure to neonate and bed. Open the 3-way tap.

4. Insertion of ICC with trocar
   • Remove the trocar from the catheter and clamp the proximal end with an artery forcep.
   • Before placing the sterile drapes, superimpose the ICC over its projected course (i.e. medially and towards the apex of the lung) to estimate how far the ICC needs to be inserted.
   • Using a small (number 11) scalpel blade make a 0.5cm incision through the skin and subcutaneous tissue.
   • Using straight mosquito forceps to bluntly dissect away the subcutaneous tissue and intercostal muscles, the parietal pleura is reached. Open the parietal pleura by blunt dissection. At this point the hiss of air escaping the pleural space may be heard.
   • Grasp the distal end of the ICC with curved artery forceps. Advance the ICC into the pleural space directing the tip anteriorly as well as superomedially (for a pneumothorax).
   • Connect the ICC to a sealed underwater suction apparatus, remove the proximal clamp on the ICC, and note whether the fluid is swinging and/or bubbling.

5. Post insertion:
   • An x-ray should be performed to document ICC position and resolution of the chest pathology. If the ICC needs to be withdrawn, it should be done so under sterile conditions.
   • Document procedure in the notes.
   • Check for swinging or bubbling in the underwater seal.
   • Ensure no tension on the drainage tubing and ICC.
   • Pigtail catheters should never be clamped - instead use the 3-way tap attached.
   • Pneumothorax: turn on wall suction and increase slowly until a suction pressure of 10cm H2O is reached
   • Pleural effusion: No suction.
   • Do not weigh the baby or take the baby out of the cot for a cuddle with parents except with Consultant’s approval.
   • Exercise extreme caution when positioning the infant with an ICC in situ.
   • Keep the underwater seal below the level of the baby at all times.

Complications:
1. Failure to adequately drain sufficient air or fluid – reposition catheter
2. Catheter inserted too far – withdraw appropriate length
3. Blood in catheter – most likely minor lung trauma that resolves spontaneously within a few minutes. If continues or associated with cardiovascular compromise notify Consultant immediately.
4. Major haemorrhage – serious lung contusion/ major vessel or cardiac perforation – activate emergency call system; notify Consultant immediately; initiate resuscitation measures.
Nursing Care during Insertion:

- Assess and document pain score and administer analgesia as prescribed
- Ensure continuous cardio-respiratory and SpO₂ monitoring, and report changes or deteriorations to doctor
- Ensure 2 drain clamps remain at bedside
- Attach suction regulator to wall suction outlet
- Chest drain set-up:
  - Perform hand hygiene
  - Open drain packaging in a clean, “no touch” manner
  - Prepare drain as per manufacturer’s instructions
  - Pass sterile end of tubing to doctor inserting drain when doctor is ready
  - Apply suction to drain if prescribed
  - Secure drain and tubing to infant and bed
  - Secure all connections with cable ties
  - Perform hand hygiene
- Observe for and document bubbling, swinging and drainage
- Observe for signs of complications and report these to doctor immediately

Use of 3-way tap to connect ICC to UWSD:

If a 3-way tap is required between the ICC and UWSD unit, the following items are required;
- 3-way tap
- 2 x Vygon connector no. number 893.00
- Vygon connector number 801.00

Refer to picture below to see how these are used to join ICC with UWSD unit:

Companion Documents

Refer to Chest Drain Management Clinical Guideline (Hospital) for ongoing management of Chest Drains
Neonatal Pain Assessment Clinical Guideline (Hospital)

Links
Atrium education website