Pneumothorax - NICU - Full Paediatric Clinical Guideline - Joint UHDB

Reference no.: NIC RC 07

1. Introduction

The purpose of this guide is to ensure early diagnosis and appropriate management of pneumothorax in term and preterm neonates.

2. Aim and Purpose

For medical and nursing staff to prevent delay in diagnosis and ensure correct management of pneumothorax.

3. Definitions, Keywords

Chest x-ray - CXR

Chronic lung disease - CLD

Continuous positive airway pressure - CPAP

Intermittent Positive Pressure Ventilation - IPPV

Respiratory Distress Syndrome - RDS

Pulmonary Interstitial Emphysema - PIE

4. Main body of Guidelines -

Background

1% of all newborn babies have evidence of air leak on CXR but only 10% of these have symptoms. However, pneumothorax is common in sick infants and should be considered in:

- 1. Babies with respiratory distress
- 2. Acute deterioration in a baby receiving positive pressure respiratory support
- 3. Failure to respond to normal resuscitation measures
- 4. Those who have received prolonged resuscitation at birth

Pneumothorax is associated with intraventricular haemorrhage and CLD and mortality can be up to 20%. A tension pneumothorax is when the pressure within the pneumothorax is sufficient to affect cardiovascular stability and is a life-threatening complication and requires urgent life-saving treatment.

At Risk Groups

5. Assisted ventilation – CPAP or IPPV particularly if the mean airway pressure is >12

- 6. Breathing out of phase or poor synchronicity with the ventilator
- Underlying lung disease RDS, congenital malformations and particularly meconium aspiration (all these conditions lead to alveolar over distention and air trapping often made worse by IPPV)
- 8. Risk can be decreased through prophylactic natural surfactant therapy, higher rate conventional ventilation and muscle relaxation.

Presentation

- 9. Depending on the size of the pneumothorax as some will be asymptomatic
 - 1. Absent or decreased breath sounds on the affected side
 - 2. Asymmetrical chest expansion
 - 3. Increasing respiratory distress with hypotension
 - 4. Acute desaturation and respiratory acidosis
 - 5. Shifted apex beat
- 10. An acute collapse on the ventilator with one or more of the following
 - 1. Sudden increase in oxygen requirement
 - 2. Pallor
 - 3. Shock
 - 4. Decrease in HR and BP
- 11. Deterioration in blood gas with respiratory acidosis, hypoxia and hypercarbia.

Diagnosis

Trans-illumination

Trans-illumination of the chest using a fibre optic light can be used when a pneumothorax is suspected. Place the light-source at in the axilla and the anterior chest wall and observe for increased lucency through the chest comparing the right and left sides. A pneumothorax will show up as an area of increased trans-illumination; this is most useful in preterm thin babies. Trans-illumination will often be negative in more mature babies. Care must be taken in interpretation in preterm babies PIE and those with cystic lung disease as this may give a false positive result.

If trans-illumination is not diagnostic and if the baby is not compromised a CXR should always be arranged. If you suspect a pneumothorax from clinical examination and transillumination findings and the baby is acutely compromised then emergency treatment should not be delayed to confirm with a CXR.

Chest x-ray

A pneumothorax is, when looked for, usually easily appreciated on erect chest radiographs. Typically they demonstrate:

- visible visceral pleural edge is seen as a very thin, sharp white line
- no lung markings are seen peripheral to this line
- peripheral space is radiolucent compared to the adjacent lung
- lung may completely collapse
- mediastinum should not shift away from the pneumothorax unless a tension pneumothorax is present (discussed separately)

- subcutaneous emphysema and pneumomediastinum may also be present

Treatment

General patient management

No treatment is necessary in non-ventilated infants with a non-tension pneumothorax. However these patients must be carefully observed, usually on the neonatal unit. Ambient oxygen therapy can assist with spontaneous absorption of resolution of pneumothorax. When a symptomatic pneumothorax is present, prompt treatment is essential. Do not use CPAP or high flow oxygen therapy.

Needle aspiration

Needle aspiration (thoracocentesis) may be required in an emergency situation. This is a therapeutic and diagnostic procedure in the critically ill infant. It should only be used when the infant is in extremis as a more definitive management (chest drain) will be required.

Needle Aspiration Equipment

- 22g (blue) or 20g (pink) cannula or butterfly needle
- 3-way tap
- 10ml syringe
- bottle of sterile water
- Mediswab/Steriswab

Procedure

- 1. Clean the site with an alcohol swab
- 2. Use a 10ml syringe with a 3 way tap attached to the butterfly to draw off the free air from the pleural space
- Insert the needle at a right angle to the chest wall, through the skin into the 2nd intercostal space in the mid-clavicular line or the fourth/fifth space in the anterior axillary line, clear of the nipple
- 4. Draw back on the syringe whilst inserting the needle. Stop inserting once you begin to extract air. The needle will enter only about 0.5 cm. If you insert the needle any further there is a risk of puncturing the lung.
- (If using a gallipot with water, as the pneumothorax drains you will see bubbles of air in the water. Care must be taken not to remove too much air as this may tear the expanding lung.)

Following needle aspiration a chest drain should usually be inserted to allow full drainage and expansion of the lung except in exceptional circumstances. Complete aspiration is not recommended as the aim is only to relieve pressure and not fully drain the leak as this may make chest drain insertion more difficult and cause damage to the underlying lung.

Intrapleural chest drain insertion

An aseptic seldinger technique is used to insert chest drains, using the pleural drainage sets available on the neonatal unit. Chest drain insertion is a painful procedure if proper analgesia is not provided. A regional anaesthetic block (1% lignocaine up to 0.3ml/kg) should be given as described below in addition to IV morphine bolus (50-100microgram/kg) and background infusion if possible.

The recommended site of insertion is above the 5th rib in the 4-5th intercostal space, anterior axillary line.

Procedure

There is a safety and equipment checklist available in the appendix of this guideline. Artery forceps can be used to clamp the tubing in an emergency and should be available at all times.

- \Rightarrow Lay the baby on their side with the side requiring the chest drain uppermost. Stretch the arm out and place it above the head
- \Rightarrow The preferred site is the fourth/fifth intercostal space in the anterior axillary line
- \Rightarrow Using an aseptic technique, clean area with chlorhexidine solution
- \Rightarrow Infiltrate area with 1% Lignocaine, raising a small pea sized bleb under the skin
- ⇒ Attach 10ml syringe to the introducer (pink) needle from chest drain pack. Slowly insert the needle through the chest wall while aspirating with attached syringe. Stop and hold position as soon as air or fluid can be aspirated. Remove the syringe leaving pink needle in-situ occluding the end with your finger.
- ⇒ Insert guide-wire through pink needle with the help of the white plastic introducer until the coloured line on the wire is level with the hub. Remove plastic sleeve and then take out the pink needle over the guide wire leaving the guide wire in-situ. Take care to keep hold of the guide wire <u>at all times.</u>
- \Rightarrow Pass dilator over guide wire and advance gentle through the chest wall & then remove, taking care to not dislodge the guide wire.
- ⇒ Thread pigtail drain over the guide-wire and through the chest wall ensuring all the small drainage holes at the end are within the chest. Advance the catheter to the 2nd-3rd mark (1-2cm) in preterm and to the 3rd-4th mark (2-3cm) in term/larger babies. This can be difficult and your sterile assistant will be needed to thread the drain onto the guide wire.
- ⇒ Once the pigtail drain is inserted remove the guide-wire and connect to the underwater drainage bottle and observe for bubbling OR Heimlich Flutter Valve and observe for fluttering.
- ⇒ Assemble the chest drain circuit and connect to drainage bottle with under water seal. Ensure the drain is secured by steristrips and tegaderm over the top to secure drain (no suturing required)
- \Rightarrow Attach drainage bottle to the incubator securely with the supplied fastenings. <u>The bottle</u> <u>must always be lower than the insertion site</u>.

- ⇒ Ensure tubing from baby is secure and there is no traction pulling on the tubing. Ensure the baby is comfortable following the procedure and is given prescribed analgesia. The effectiveness should be monitored by assessing pain scores.
- \Rightarrow A post insertion CXR should be urgently requested to check the position and check for complication.
- ⇒ Underwater sealed drainage is inappropriate during transport so the use of a Heimlich Flutter Valve is used to drain air from the chest. This valve will allow air to escape from the chest but will not allow air to return through the system, i.e. passage of air is one-way only. We have some available on the unit but can be supplied by the transport team.
- ⇒ Nursing staff should observe bubbling and swinging activity in the chest drain bottle and tubing hourly or fluttering of the Heimlich valve and record this on observation chart.
- ⇒ Ensure tubing in this drainage bottle is well below the fluid level at all times. Record the amount of fluid in the drainage bottle initially and monitor the amount of fluid draining hourly and record on observation chart and change the bottle only if the bottle becomes full or contaminated.

Removal

Removal should be done aseptically by the medical team.

- ⇒ Once the chest drain has stopped bubbling/Heimlich valve stops fluttering (usually at least 24 hours following insertion) it should be closed off and a CXR taken to ensure re-expansion of the lung. If the lung remains expanded and there is no deterioration once the drain is closed (this is normally assessed over a period of 12 24 hours, longer in ventilated babies) remove the chest drain.
- ⇒ Clamp the tubing using 2x artery forceps (put gauze around tubing, or use flat forceps to avoid damage to the tubing). Clamp as near to chest wall as possible.
- \Rightarrow Ensure adequate pain relief and that the baby is kept warm and comfortable during the procedure.
- ⇒ Under aseptic conditions clean the site using chlorhexidine solution, and using a non-touch aseptic technique remove the dressing and steristrips
- ⇒ Remove the drain carefully, usually during the end of the respiratory phase, trying to keep the two skin edges of the entry site together. Care should be taken that air is not sucked into the chest after catheter removal by placing gauze over the wound.
- \Rightarrow The wound is preferably secured with steristrips, but it may need to be sutured. Seal the area with occlusion dressing/tegaderm over the top of the steristrips/sutures.
- \Rightarrow Send the drain tip for culture and sensitivity where medically indicated.
- \Rightarrow Make the baby comfortable and leave them to rest. The baby should be observed and assessed for any deterioration in condition following removal and may require a CXR.
- ⇒ If two pneumothoraces are present, remove only one drain at a time. The second drain can be examined 24 hours after the first is removed.
- \Rightarrow Give parents/ care providers a full update on the procedure and the baby's condition.

Complications

Bruising of the diaphragm/mediastinal structures

- Perforation of the lung
- Haemorrhage
- Cardiac tamponade
- Phrenic nerve injury
- Infection
- Persistence of pneumothorax

If there is a suspicion of heart of liver perforation the 3-way tap should be turned off immediately and the drain left in situ.]

5. References (including any links to NICE Guidance etc.)

- NUH Neonatal Service Guidelines
- Advanced resuscitation of the newborn infant, 1st edition. Resuscitation Council UK
- Wei, Yi-Hsuan et al. Pigtail Catheters Versus Traditional Chest Tubes for pneumothoraces in premature infants treated in a Neonatal Intensive Care Unit. Pediatrics & Neonatology, Vol 55, Issue 5,376-380
- LA Cates. Pigtail catheters used in the treatment of Pneumothoraces in the Neonate. Advances in Neonatal Care Vol.9, N0.1. PG 7-16
- Shaireen H, Rabi Y et al. Impact of oxygen concentration on time to resolution of spontaneous pneumothorax in term infants: a population based study. BMC Pediatr. Aug 2014;14:208
- Steele PW, Metz JR, Bass JW, du Bois JJ. Pneumothorax and Pneumomediastinum in the Newborn. Radiology 1971;98:629-632
- Henderson-Smart DJ, Bhuta T, Cools F, Offringa M. Elective high frequency oscillatory ventilation vs conventional ventilation for acute pulmonary dysfunction in preterm infants (Cochrane Review). In: The Cochrane Library http://www.nichd.nih.gov/cochrane/
- Morton, NS, Local and regional anaesthesia in infants, Continuing Education in Anaesthesia, Critical Care and Pain, Volume 4, Issues 5, 1st October 2004, P148-151
- Alen, RW et al. J Ped 99 629-634 (1981). Effectiveness of Chest Tube Evacuation of Pneumothorax in Neonates.
- Cartlidge PHT, Fox P, Rutter N. The Scars of Newborn Intensive Care, Early Human Development, 21 (1990) 1-10.
- Greenough A, Wood S, Morley CJ, Davis JA. Pancuronium prevents pneumothoraces in ventilated premature infants who actively expire against positive pressure ventilation. Lancet 1984;1:1-3

6. Documentation Controls (these go at the end of the document but before any appendices)

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7. Appendices

Ref: NIC RC 07

Patient Identity – Please affix label.

Chest Drain insertion LOCSSIPS Checklist

Sign in – before preparing trolley. Time out - before preparing patient. Patient identity □ All team members have introduced themselves and are Sign out – After procedure. □ Identity (patient label) aware of their role □ Procedure □ Operator and assistant confirm Procedure documented in medical notes □ Patient identity □ Site □ Seldinger □ Site (left or right) **Operator Confirms** □ Blade dissection How confirmed: □ I am competent to insert this chest □ Site drain or have appropriate □ Planned procedure □ Strength and volume local anaesthetic supervision □ Sterile precautions □ I have considered anatomical □ Gown, gloves, drape features that may influence the Cleaned and decontaminated incubator □ Guidewire removed planned insertion site □ Planned insertion technique □ I have considered less invasive □ Chest drain secured with Seldinger technique (most used) interventions (e.g., therapeutic □ Blade dissection □ Steristrips pleural aspiration) □ Analgesia considered and ready to administer □ Suture □ I have confirmed the diagnosis □ Tegaderm and reviewed relevant radiology Obs Pre Post 15mins 30mins □ Connected to closed system □ I have considered platelet count and any clotting abnormalities that Sats □ Swinging/bubbling may be relevant. □ Specimens collected (if required) FiO₂ □ Any immediate complications? HR BP

Operator:	Grade:	Date:	Time:
Assistant:	Grade:		

Patient Identity -

Equipment Checklist

Item	
Cut down pack	
Gown and gloves	
Chest drain pack – size 8.5F or 6F	
Underwater drainage set or flutter valve	
Sterile water – minimum 10ml	
Green connector	
Chlorhexidine sachet	
Sterile non-woven Gauze	
10ml syringe	
5ml syringe	
Blunt needle	
1% Lignocaine solution	
Orange needle	
Tegaderm	
Check x-ray requested	
Please document procedure progress in the medical	notes
Steristrips	
Operator	
Designation	