



## GUIDELINE

# Pneumothorax

<b>Scope (Staff):</b>	Nursing and Medical Staff
<b>Scope (Area):</b>	NICU KEMH, NICU PCH, NETS WA

### Child Safe Organisation Statement of Commitment

CAHS commits to being a child safe organisation by applying the National Principles for Child Safe Organisations. This is a commitment to a strong culture supported by robust policies and procedures to reduce the likelihood of harm to children and young people.

This document should be read in conjunction with this [disclaimer](#).

- Also refer to [Intercostal Catheter \(ICC\) Insertion and Management](#).

## Aim

Outline the process for investigating and diagnosing a pneumothorax along with management and associated conditions.

## Risk

Failure to appropriately diagnose and treat a pneumothorax can lead to adverse outcomes for the infant.

## Background

Air leak into the intra-thoracic space is the most encountered air leak syndrome in the newborn. The incidence of pneumothorax is increased in the presence of underlying lung disease or in association with high tidal volumes during resuscitation/mechanical ventilation, or active expiration during mechanical breaths.

The incidence of pneumothorax in preterm neonates has decreased significantly since the introduction of exogenous surfactant.

## Pathophysiology

Pneumothorax results from the over distension and rupture of an alveolus, the air travelling up the vascular sheath into the mediastinum and into the pleural cavity. Uneven ventilation and air trapping both contribute to air leak. Air in the mediastinum seldom produces enough tension to cause circulatory embarrassment but when it does, compression of mediastinal structures can impede venous return and cause circulatory collapse. High pressures within the pleural space collapse the lung and result in hypoxia and hypercapnia.

## Clinical Presentations

The condition may present as a sudden deterioration in the infant's clinical state or in the resuscitation room or as marked respiratory distress. There is usually:

- Respiratory distress
- Decreased air entry on the affected side.
- Cyanosis/fall in the oxygen saturations
- Chest asymmetry
- Sudden increase in oxygen requirement in an infant already on respiratory support
- Signs of shock or inability to ventilate if the pneumothorax is under tension

## Diagnosis:

### 1. Transillumination

Transillumination of the chest with a high intensity fibreoptic cold light source (transilluminator) is a useful method of making the diagnosis in an emergency.

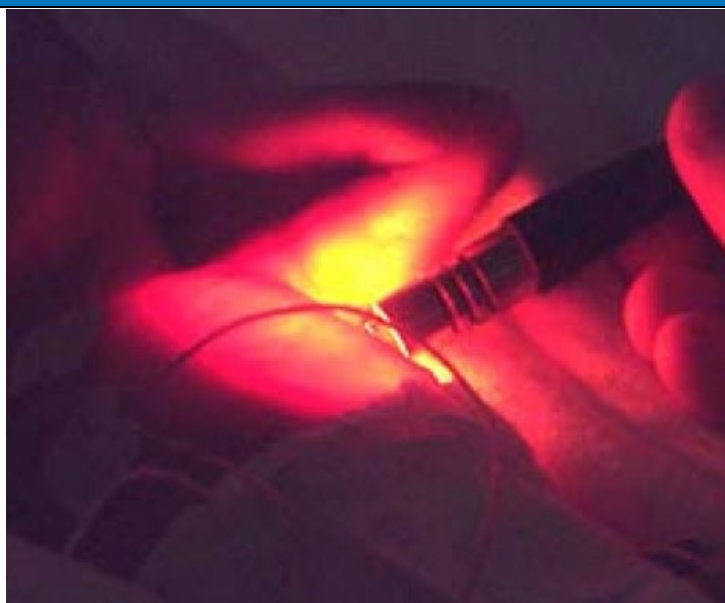
Transillumination is most useful in smaller infants. In term infants, or those with a thick chest wall, transillumination may fail to detect pneumothorax.

### Procedure

Steps
1. Lower the lights in the room this allows hyper-lucent areas to be seen if present. If unable to lower the light, a large covering may be required over the practitioner and infant
2. Place the transilluminator along the posterior axillary line on the side on which the air collection is suspected. Move the transilluminator up and down along the posterior axillary line and above the nipple to detect any areas of increased transmission of light
3. Place the transilluminator in the third or fourth intercostal space on the left midclavicular line and angle the light towards the xiphoid process to detect any areas of increased transmission of light

## Steps

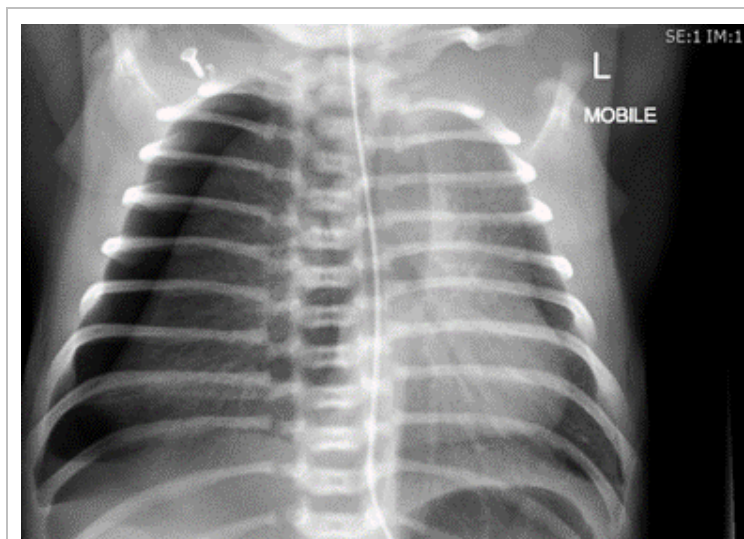
4. Transillumination should be done on both sides of the chest to give a comparison



- A **false-positive** result may occur with pulmonary interstitial emphysema and pneumomediastinum.
- A **false-negative** result may occur in infants with a thick layer of subcutaneous fat or oedematous infant. A bright room and weak light source also produce a false negative result.

## 2. Chest X-Ray

Confirmation by X-ray only if the infant is stable.



X-Ray of an infant with large pneumothorax; in addition to the air in the pleural space and collapsed lung on the right side there is a flattening of the diaphragm and shift of the mediastinum to the opposite side.

## 3. Lung ultrasound

For those trained in lung ultrasound, this can be a quick and accurate diagnostic tool for detection of pneumothorax.

## Management

- In an unstable infant, immediate drainage of the air is imperative. Do not wait for a chest X-ray under such circumstances. The pneumothorax should be aspirated with a needle and 3-way tap attached to a syringe. [Refer to Appendix 1: Needle Aspiration of the Chest.](#)
- Small pneumothoraxes may require no specific treatment apart from close observation.
- A larger pneumothorax may be aspirated on one occasion with a needle and 3-way tap attached to a syringe. [Refer to Appendix 1: Needle Aspiration of the Chest.](#)
- A tension pneumothorax is likely to require insertion of an intercostal catheter with an underwater seal after the initial needle aspiration. Refer to [Intercostal Catheter \(ICC\) Insertion and Management.](#)
- **Note:** Intubating an infant when it is known to have a pneumothorax can result in further deterioration because positive pressure ventilation will increase the air leak and place it under tension. Drain the air first to stabilise the infant and then intubate.

## Associated Air Leak Syndromes

Pneumomediastinum, pneumopericardium and pneumoperitoneum may all also occur in combination with pneumothorax. Pneumopericardium and pneumomediastinum occasionally present as emergencies under tension requiring urgent intervention.

Pneumopericardium is a rare form of air-leak syndromes associated with increased morbidity and mortality. It usually occurs in association with other air leaks (pneumothorax and pneumomediastinum). The clinical presentation of pneumopericardium can range from an asymptomatic neonate to one with life-threatening cardiac tamponade. Neonates can present with any or a combination of following findings such as hypotension, hypoxemia, bradycardia, and muffled heart sound. The classic radiographic finding in pneumopericardium is the “halo” sign, which appears as a continuous radiolucent band of air that outlines the heart and extends to the level of the great vessels.

The outcome of pneumopericardium when it causes circulatory collapse is often fatal. The procedure for the immediate drainage of the air is by [Emergent pericardiocentesis, see appendix 2.](#)

### Related CAHS internal policies, procedures and guidelines


[Intercostal Catheter \(ICC\) Insertion and Management.](#)

[Resuscitation: Neonatal](#)

## References and related external legislation, policies and guidelines

1. Eifinger F, Lenze M, Brisken K, Welzing L, Roth B, Koebke J. The anterior to midaxillary line between the 4th or 5th intercostal space (Buelau position) is safe for the use of thoracostomy tubes in preterm and term infants. *Pediatric Anesthesia*. 19(6):612-617, June 2009.
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3. Bruschetti M, Romantsik O, Ramenghi LA, Zappettini S, O'Donnell CP, Calevo MG. Needle aspiration versus intercostal tube drainage for pneumothorax in the newborn. *Cochrane Database Syst Rev*. 2016 Jan 11;(1):CD011724
4. Raimondi F, Rodriguez Fanjul J, Aversa S, et al. Lung ultrasound for diagnosing pneumothorax in the critically ill neonate. *J Pediatr*. 2016;175:74-78.
5. Catarossi L, Copetti R, Brusa G, et al. Lung ultrasound diagnostic accuracy in neonatal pneumothorax. *Can Respir J*. 2016:6515069
6. Liu J, Chi JH, Ren XL, et al. Lung ultrasonography to diagnose pneumothorax of the newborn. *Am J Emerg Med*. 2017;35(9):1298-1302.
7. Gomella TL, Cunningham MD, Eyal FG. Pericardiocentesis chapter in book *Neonatology: management, procedures, on-call problems, diseases, and drugs*. 8<sup>th</sup> ed. McGraw Hill.
8. Ruoss JL, Smith-Raska M, Doherty EG. Emergent pericardiocentesis (video corner). *NeoReviews* 2016;17(10):e627-e629
9. Benheim A, North J. Pericardiocentesis. In *Book Atlas of procedures in neonatology*. Ed. MacDonald MG, Ramasetu J. 4<sup>th</sup> Ed. Lippincott Williams and Wilkins, Philadelphia. 2007

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

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## Healthy kids, healthy communities

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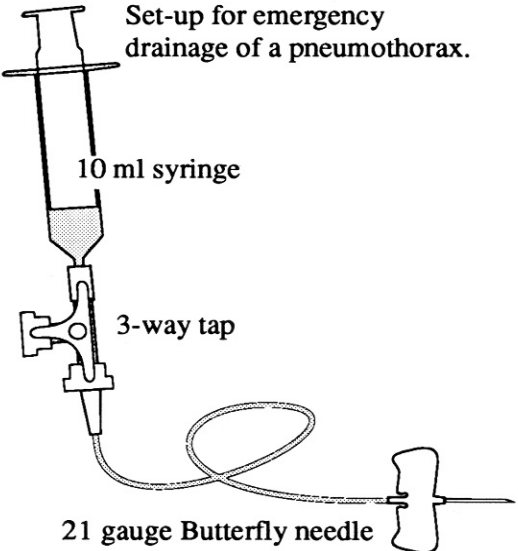

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## Appendix 1: Needle Aspiration of the Chest

Needle aspiration of the chest is performed as an emergency procedure only to remove air from between the parietal and visceral pleura, while avoiding laceration to the lung or blood vessels.

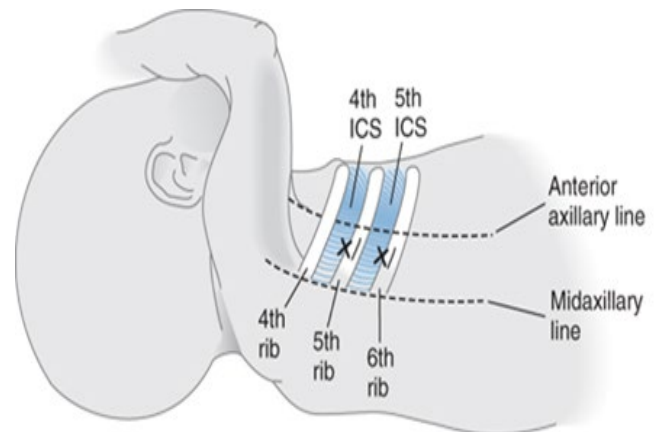
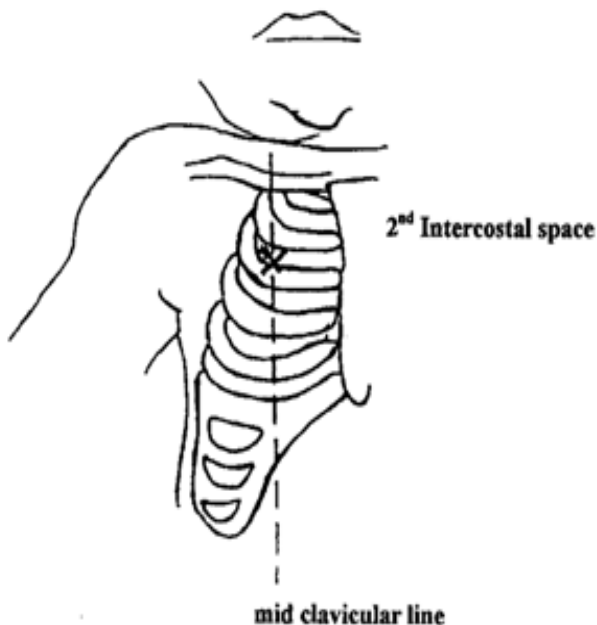
### Equipment

- 10 mL Luer lock syringe and 3-way tap
- 20–22-gauge intravenous cannula, depending on size and gestation of baby (preferred), 25 cm extension tubing. A 23-gauge butterfly needle may be used instead of the cannula.
- Skin cleaning solution/swab for aseptic technique.
  - ≤ 27 weeks - use Povidone - iodine 10% solution/swab
  - > 27 weeks - use 1% Chlorhexidine solution

Steps	
<ol style="list-style-type: none"> <li>1. Confirm pneumothorax by transillumination, lung ultrasound if credentialed or CXR if stable.</li> <li>2. Position the infant supine and supported. Administer analgesia/local anaesthesia if needed and time permits.</li> <li>3. Attach 3-way tap to 10 mL luer lock syringe and turn the 3-way tap so that all ports are in the off position.</li> <li>4. Remove the caps from the 3-way tap. Attach a 25cm extension tube to the other end of the 3-way tap if a cannula is being used</li> <li>5. Add the butterfly needle extension to the 3-way tap if using this method.</li> </ol>	
<p>Set-up for emergency drainage of a pneumothorax.</p>  <p>10 ml syringe</p> <p>3-way tap</p> <p>21 gauge Butterfly needle</p>	

## Steps

6. Using a povidone iodine or chlorhexidine wipe, swab the skin around the 2<sup>nd</sup>-3<sup>rd</sup> rib along the mid-clavicular line. Place a finger on the infant's 3<sup>rd</sup> rib and guide the intravenous cannula, or butterfly needle, along the finger and insert it into the 2<sup>nd</sup> intercostal space, along the mid-clavicular line, at an angle of 90°. **Avoid the nipple area**
7. An alternative site to drain is the 4th-5th intercostal space in the mid axillary line.



**X** marks the 4<sup>th</sup> and 5<sup>th</sup> intercostal space in the mid axillary line for placement of cannula or butterfly.

8. Once in position, remove the needle from the cannula and attach the extension tubing (with 3-way tap and syringe) to the cannula, or to the butterfly extension
9. Turn the 3-way tap to aspirate air from the infant's chest into the syringe. Turn the 3-way tap to expel the air into the atmosphere. Measure and document the volume of expelled air.

**Take care while manipulating the 3-way tap to avoid accidental reinjection of air into the chest cavity.**

10. Continue to aspirate until resistance is met. If a butterfly needle is used, remove after the aspiration is completed
11. Once the infant is stable, perform CXR or repeat lung ultrasound.

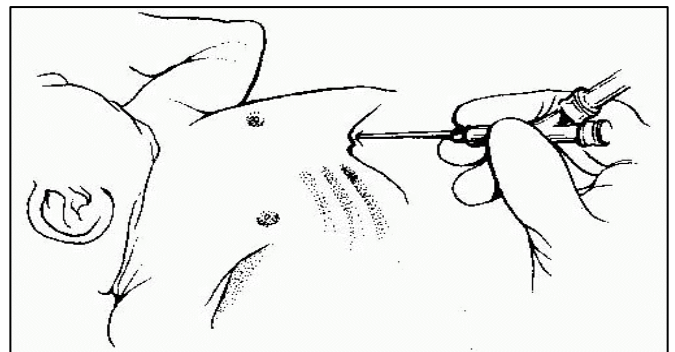
## Appendix 2: Emergent Pericardiocentesis

This is a **high-risk procedure** for evacuation of a pericardial effusion (fluid) or pneumopericardium (air) in the setting of cardiac tamponade and haemodynamic instability. This procedure video is available via CAHS Library and Information Services. Login at [Pericardiocentesis - Emergent Procedures - NeoReviews Video Library](#)

Ideally, pericardiocentesis should be done under echocardiography guidance and by cardiologists. If this is not possible due to an unstable and rapidly deteriorating infant needing full resuscitation, it must be performed by a senior clinician in the presence of, or after discussion with the consultant. If time permits, discuss the procedure with parents.

At least **three** clinicians are required for the procedure, two to perform the procedure and one for monitor vital signs throughout the procedure. Ensure patient identification verified prior to procedure.

- Provide analgesia (morphine/fentanyl) as indicated during this emergent procedure.
- Clinician 1 (lead) and 2 (assistant) to perform hand hygiene and follow [Surgical Aseptic Technique](#).
- Prepare equipment: attach 21/23G butterfly needle to a 3-way tap and a 10 or 20 mL syringe Turn the three-way tap so that it is open to syringe ready for aspiration (as per [needle aspiration of a pneumothorax](#)).
- Position patient supine. Clean the skin over xiphisternum, precordium, and epigastric area with appropriate antiseptic solution for gestational age and allow to dry.
- Arrange sterile drapes leaving subxiphoid area exposed. Administer local anaesthesia ([Lignocaine 1%](#)) at the insertion site (0.5 cm below and 0.5 cm left to the xiphoid process).
- Clinician 1: Insert the butterfly at an angle of 30 degrees to the skin and directed towards left shoulder whilst clinician 2 maintains gentle suction on the syringe as the needle advances.
- Clinician 1 to stop advancing the needle as soon as air or fluid is able to be aspirated. Continue to aspirate until resistance is felt then remove the needle. Place dry dressing over the site.
- Clinician 3 to monitor vital signs closely throughout. If ectopic beats appear during the procedure, stop aspirating and retract the needle slightly.



### Complications

Haemorrhage, pneumopericardium, pneumomediastinum, pneumothorax, cardiac perforation, liver perforation, arrhythmia, hypotension, death.