1. Introduction

1.1. Pneumothorax is a life threatening condition with high mortality and morbidity. It has been suggested that early recognition and treatment are beneficial to avoid damage as a result of hypoxemia, hypercaapnia and impaired venous return.

1.2. A pneumothorax occurs when the tiny alveoli in a baby’s lung burst, leaking air in to the space between the lungs and chest wall.

2. Aim

2.1. To quickly and safely perform and assist in the insertion of the chest drain to avoid deterioration in the baby’s condition, wound site infection or secondary empyema

3. Definitions of Terms

- Pneumothorax – Air leaks in to the space between the chest wall and the outer tissues of the lungs.
- Empyema- a build-up of pus in the chest cavity
- Trocar drain tube - A trocar is a metal rod that inside the chest tube for easier insertion through the intercostal muscles. The tube is made of clear, rigid yet flexible plastic which may have a radio opaque strip incorporated into it, which enables x-ray detection. It has a proximal and distal end. The proximal end is inserted into the pleura and has a number of holes at the insertion end which facilitate drainage. The distal end is connected to the drainage system.

- Heimlich Chest Drain/valve - a specially-designed flutter valve used to replace underwater bottles in chest drainage. The valve allows fluid, clots and air to flow out of the chest without reflux into the pleural cavity. The valve functions in any position, is not restricted to use at a level below the patient’s chest, there is no need to clamp the chest catheter during transport.

- Thoracentesis - is an invasive procedure to remove fluid or air from the pleural space.

- Transillumination - The fibreoptic light probe placed on the baby’s chest wall. The affected side transmits excessive light.

- NCPAP - Nasal Continuous Positive Airway Pressure.

- PEEP - Positive End Expiratory Pressure.

- IPPV - Intermittent Positive Pressure Ventilation.

- ET - Endotracheal Tube.

4. Responsibilities

- It is the responsibility of the:
- Multi-disciplinary team to ensure their training and competency is correct.
- Multi-disciplinary team to keep the parents updated on the baby’s condition and to obtain informed consent wherever possible for the procedure.
- Nurse to prepare the equipment and assist in the procedure, keeping the infant as comfortable as possible.
- Nurse to observe the baby’s condition for signs of deterioration.
- Medical staff to perform the procedure using an aseptic non-touch technique quickly and safely.

5. Indication

5.1. Pneumothorax. Confirmation of this condition can be made by transillumination of the chest wall and chest X-ray. If there is any doubt further imaging should be arranged.

6. Causes and associations of pneumothorax

- The newborn during the first breaths.
- Excessive resuscitation at birth.
- Direct injury to the lungs e.g. direct perforation by suction catheters and ET tube.
- Respiratory distress syndrome
- Meconium aspiration syndrome
- Congenital malformations
- The addition of PEEP to IPPV
- NCPAP
- Prolonged inspiratory time
- High peak inspiratory pressure

7. Signs and Symptoms of pneumothorax

- Sudden deterioration with desaturation,
- Increasing respiratory distress,
- Rapid breathing,
- Grunting,
- Nostril flaring,
- Chest wall retractions,
- Diminished chest wall movement,
- A deviated mediastinum,
- Change in the location of heart or lung sounds when the organs are moved by the presence of air,
- Decreased or unequal air entry
- Blood gas level shows hypoxia, respiratory and metabolic acidosis

8. Complications of chest drains

- Accidental injury or perforation of intrathoracic and/or abdominal organs.
- Introduction of pleural infection, eg, thoracic empyema.
- Damage to the intercostal nerve, artery or vein.
- Converting a pneumothorax to a haemopneumothorax.
- Resulting intercostal neuritis/neuralgia.
- Chest tube kinking, clogging, or dislodging from the chest wall.
- Persistent pneumothorax.
- Persistent or unexplained air leak in the tube.
- Subcutaneous emphysema, usually at tube site.
- Recurrence of pneumothorax upon removal of chest tube;
- Lung fails to expand due to plugged bronchus; bronchoscopy required

9. Precautions/Contraindications

- Small sized spontaneous pneumothorax that, in the absence of lung disease, is likely to resolve with conservative management
- There is a 10-20% chance of causing a pneumothorax if thoracocentesis is attempted and the baby does not have a pneumothorax
10. Guidelines for Emergency chest drain packs – Needle Thoracentesis (see Appendix 1)

10.1. This is used for the collapsed infant needing immediate treatment.

### Method 1 procedure for Emergency Thoracentesis

<table>
<thead>
<tr>
<th>Steps</th>
<th>Equipment</th>
</tr>
</thead>
</table>
| 1 | Transilluminator  
  | 5-20 ml syringe  
  | 22 gauge cannula  
  | Skin prep |

<table>
<thead>
<tr>
<th>Procedure</th>
</tr>
</thead>
</table>
| Identify site of insertion (this is the second intercostal space in the mid-clavicular line) by palpating the infant’s sternum to find the manubriosternal angle (or angle of Louis). This marks the approximate level of the second pair of costal cartilages, which, in turn attach to the second ribs. Follow the ribs along the side of the pneumothorax to the mid-point between both ends of the clavicle.  
  | Apply skin prep  
  | Insert a 22 gauge cannula into the second intercostal space (i.e. below the second rib and aiming just above the third rib) perpendicular to the chest  
  | As you insert the 22 gauge cannula/needle aspirate with a syringe until you get air entering the syringe. Do not drain the pneumothorax using this as the needle can damage the underlying lung (NLS 2016) |

### Method 2 procedure for Emergency Thoracentesis

<table>
<thead>
<tr>
<th>Steps</th>
<th>Equipment</th>
</tr>
</thead>
</table>
| 1 | Transilluminator  
  | Butterfly 22 gauge  
  | 20ml syringe  
  | 20ml water for injection  
  | Container for sterile water e.g. universal pot filled with water for injection  
  | Skin prep |

<table>
<thead>
<tr>
<th>Procedure</th>
</tr>
</thead>
</table>
| Identify site of insertion as above Method 1  
  | Apply skin prep  
  | Insert 22 gauge butterfly needle as above Method 1 |


11. **Guidelines for formal chest drain insertion** *(see Appendix 2)*

<table>
<thead>
<tr>
<th>Steps</th>
<th>Pre-insertion procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>Prepare Equipment</strong></td>
</tr>
<tr>
<td></td>
<td>• Equipment for the administration of local anaesthetic</td>
</tr>
<tr>
<td></td>
<td>o Lidocaine (on medical decision)</td>
</tr>
<tr>
<td></td>
<td>o 2ml syringe</td>
</tr>
<tr>
<td></td>
<td>• Orange needle (25 gauge)</td>
</tr>
<tr>
<td></td>
<td>• I.V. cut-down set (this will contain forceps etc)</td>
</tr>
<tr>
<td></td>
<td>• Dressing towel</td>
</tr>
<tr>
<td></td>
<td>• Skin prep Chlorhexidine gluconate 0.05%</td>
</tr>
<tr>
<td></td>
<td>• Opsite spray</td>
</tr>
<tr>
<td></td>
<td>• Sterile gloves</td>
</tr>
<tr>
<td></td>
<td>• Masks</td>
</tr>
<tr>
<td></td>
<td>• Trocar catheter</td>
</tr>
<tr>
<td></td>
<td>• Heimlich valve</td>
</tr>
<tr>
<td></td>
<td>• Vygon green connector</td>
</tr>
<tr>
<td></td>
<td>• 5ml syringe</td>
</tr>
<tr>
<td></td>
<td>• Surgical blade</td>
</tr>
<tr>
<td></td>
<td>• For securing trocar:</td>
</tr>
<tr>
<td></td>
<td>o Dermiclear/sleek tape</td>
</tr>
<tr>
<td></td>
<td>o Mersilk 3/0 328</td>
</tr>
<tr>
<td></td>
<td>o Tegaderm dressing</td>
</tr>
<tr>
<td>2</td>
<td>• Give information and obtain consent for the procedure from the parents/carers wherever possible. Document this.</td>
</tr>
<tr>
<td>3</td>
<td>• Monitor the patient’s cardiorespiratory status and oxygen saturations throughout the procedure.</td>
</tr>
<tr>
<td>4</td>
<td>• Premedicate infant for pain control and assess need for further medication throughout the procedure. Pain relief may be:</td>
</tr>
<tr>
<td></td>
<td>o Morphine (bolus dose) if infant is on an existing infusion or there is no time constraint</td>
</tr>
<tr>
<td></td>
<td>o Lignocaine – Neonate and child 1 month - 12 years – Local infiltration of 0.3ml/kg of 1% solution.</td>
</tr>
<tr>
<td>Steps</td>
<td>Insertion procedure</td>
</tr>
<tr>
<td>-------</td>
<td>---------------------</td>
</tr>
</tbody>
</table>
| **1** | **During procedure**  
- Position the patient supine with the affected side slightly elevated and the arm on the affected side restrained superiorly (over the head) or anteriorly. Ensure the baby is kept warm and still throughout the procedure. |
| **2** | - The doctor should choose the spot between the 4th/5th intercostal space, midaxillary line in the for insertion of the drain. The nipple usually lies in the fourth intercostal space and can be used as a handy reference point. |
| **3** | - Make a 0.5cm incision along the line of the intercostal space just above the rib below. |
| **4** | - Bluntly dissect the subcutaneous tissue just over the top of the rib below, and puncture the parietal pleura with the tip of the clamp/forcep. |
| **5** | - Advance the chest drain tube into the pleural space during expiration.  
- Ensure tube is in the pleural space by listening to air movement, and by looking for fogging in the tube during expiration. |
| **6** | - Attach the tube to the valve  
- You may need to cut the beveled end off certain thoracic catheters to make an airtight connection to the connecting tubing.  
When attaching the valve to the connecting tubing, make sure the arrow on the valve points away from patient, to avoid a tension pneumothorax. |
| **7** | - Once the chest drain is inserted it may be secured by  
  o suture  
  o occlusive dressing e.g. Tegaderm  
  o or by tape |
| **8** | - Connect it to the green Vygon connector and Heimlich valve and observe for fluttering movements which indicates that air is escaping. |
| **9** | - Settle the baby comfortably |
| **10** | - Dispose of all sharps/waste of as per NDHT policy |
| **11** | - Document the procedure, date and time of insertion, the batch number of the chest tube, the position of the insertion, size & length of the tube, baby’s condition and tolerance of procedure |

<table>
<thead>
<tr>
<th>Steps</th>
<th>Following Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1</strong></td>
<td>- Inform the parents of completion of procedure and baby’s condition.</td>
</tr>
<tr>
<td><strong>2</strong></td>
<td>- Obtain chest X-ray to verify position</td>
</tr>
</tbody>
</table>
| **3** | - Perform and document 1-4 hourly observations including:
Chest Drain Insertion for Pneumothorax for Neonates (Guidelines)

12. Cross references

- Chest drain removal guidelines
- Pain management guidelines

13. Standards/ Key Performance Indicators

13.1. Key Performance indicators on which to base care in the Special Care Unit are:

- Nice Neonatal Quality Standards
- NHS Toolkit for High Quality Neonatal Services
- National Neonatal Audit Programme
- NHS Standard Contract for Neonatal Critical Care

14. Monitoring Compliance with and the Effectiveness of the Guideline

- Staff are informed of revised documentation. There is an expectation that staff are responsible to keep updated on any improvements to practice and deliver care accordingly.
- Data is collected by use of Badger database and can be used to generate output for clinical and operational benchmarking.
- Intensive care incidents are monitored by the neonatal governance team and neonatal network. Incidents are reported by the Datix system and South West Neonatal Network incident reporting process.
• Non-adherence is reviewed and action plans made if required. Discussion and reviews occur at Directorate meetings, Governance meetings Paediatric Team meetings and Ward meetings. Learning and action plans are cascaded at these meetings and improvements implemented.

14.1. Key findings and learning points are disseminated to relevant staff.

15. **Consultation, Approval, Review and Archiving Processes**

15.1. The author consulted with all relevant stakeholders. Please refer to the Document Control Report.

15.2. Any revisions to the final document will be recorded on the Document Control Report.

15.3. The guidelines will be reviewed every 3 years. The author will be responsible for ensuring the guidelines are reviewed and revisions approved by Paediatric Specialist Team in accordance with the Document Control Report.

15.4. All versions of these guidelines will be archived in electronic format by the author within the Neonatal guideline policy archive.

16. **References and Additional Reading**

• British National Formulary for Children (2010-2011)
• Fletcher and MacDonald. Procedures in Neonatology
Appendix 1 - Emergency Chest Drain Equipment

- 20/24 gauge cannula
- 3-way tap
- Syringe (5-20ml)
- Butterfly cannula
- Sterile water container for sterile water

Appendix 2 - Chest drain assembly

- How to assemble chest drain together
- Chest drain trocar/cannula
- Heimlich valve
- Vygon green connector