1.0 Introduction
Chest Physiotherapy is a therapeutic intervention in the treatment of sick babies on Neonatal units. Chest percussion followed by suction is the most commonly used treatment modality. It must only be undertaken by Nursing staff who have received specific training.

The SWMNN Advanced Respiratory Physiotherapist can be contacted during office hours for general queries and advice concerning respiratory physiotherapy via email: n.hawkes@nhs.net or work mobile phone - 07766 133977.

2.0 Benefits
Chest Physiotherapy techniques are utilised to improve the respiratory function of the ventilated and extubated neonate, particularly when respiratory function is compromised by excessive secretions and mucus plugging. The main effects are:

- Improvement in oxygenation – seen in saturations and blood gases
- Reduction in ventilatory support
- Improvement in carbon dioxide clearance
- Increased secretion clearance
- Improvement in chest X-ray appearance - inflation of collapse, reduction in infective consolidation where secretions are present

It is vital that respiratory physiotherapy is utilised selectively and appropriately with a high standard of handling, positioning, pacing and supporting the baby to minimise stress and potential discomfort in line with the Network developmental care guidelines.

2.1 Indications for percussion
Percussion involves a rhythmical patting action over the chest wall using a wrist action whilst holding the palm cup percussor. It is thought to cause pressure changes in the airways which stimulate mucous clearance by ciliary stimulation, gas liquid interaction and by the release of pulmonary chemical mediators that improve ciliary transport speed.
**Indications for the ventilated baby**

- Chest Xray changes:
  - Infective collapse/consolidation\(^{21}\)
  - Segmental +/- lobar lung collapse secondary to mucous plugging \(^{21,32,45}\)
  - Aspiration

- Tenacious secretions\(^{21}\) not cleared effectively with suction +/- saline

- Signs of acute secretion retention –
  - Decreasing saturations
  - Increased pCO\(_2\), (this can be acute on chronic respiratory acidosis in Chronic lung disease)
  - Decreased pO\(_2\),
  - Decreased tidal volumes in pressure controlled mode,
  - Increased peak airway pressure in volume controlled mode
  - Increased airway resistance
  - Increased endotracheal tube leak
  - Decreased chest movement
  - Secretions heard with stethoscope in large airways/ decreased air entry

**Extubated baby** –SiPAP, CPAP , Heated High Flow Nasal Cannula Oxygen (HHFNC) or self ventilating \(^{11}\)

- Individualised clinical indications \(^{11,12}\):
  - Residual secretion clearance issues associated with indications listed above +/- chest X-ray changes \(^1\)
  - Secretion retention/infection in chronic lung disease
  - Congenital neuromuscular pathologies resulting in poor airway protection. These babies may require prophylactic physiotherapy and parental teaching and completion of competencies prior to home.

**2.2 Risks of percussion**

Vigorous percussion in vulnerable extremely preterm infants and the poor use of supportive developmental care techniques\(^2\) has, in the past, been reportedly linked with Intraventricular haemorrhage (IVH)\(^{20,24}\) and Encephaloclastic porencephaly,\(^{18,20,23,24}\)

**2.3 Special precautions/cautions**

- Early uncomplicated respiratory distress syndrome\(^9,32\)
- Recent surfactant therapy (see unit policy)
- Poor skin integrity
- Cardiovascular instability \(^{12,21}\)
- Platelet levels < 100 x 10\(^9\) per litre
- In the proximity of chest drain sites and Broviac lines
- Reflux - to be considered when positioning.
- Severe trunk/limb oedema – can reduce effectiveness
- Acute necrotising enterocolitis \(^{32}\)
- In the proximity of recent wound/stomas
- Recent cranial or eye surgery, including ROP laser therapy \(^{32}\)
- Pulmonary Interstitial Emphysema \(^{21}\)

**2.4 Contraindications to percussion**

- Undrained pneumothorax \(^{21,34}\)
- Acute pulmonary haemorrhage \(^{27,32}\)
- Rib Fractures or severe osteopenia/bone pathology \(^{21,24,27,32}\)
- Recent intraventricular haemorrhage (24 - 48 hrs) \(^{18,20}\)
- Severe physiological instability \(^{7,21,24,32}\)
• Extreme prematurity (< 1500g/26 weeks gestation) in first week of life 20,21,32,43
• Platelet levels < 50 x 10^9 per litre 32 or prolonged clotting (only consider treatment if absolutely necessary) in the absence of any acute bleeding. Decision to be made by Consultant.

3.0 Procedure

3.1 Timing
Ideally percussion and suction should be undertaken on clinical indications - according to the baby's respiratory status 4,25. Treatment episodes should be planned to be pre-feed or no less than 30 minutes post feed.

If medical staff recommend physiotherapy on a regular basis, the absolute maximum for this should be 4 hourly 26 (unless there is an episode of acute deterioration) – babies need to rest and have protected sleep for brain growth 42. The need for ongoing percussion must be assessed daily and discontinued when the desired clinical parameters of improvement have been achieved.

3.2 Pre Procedure assessment
The baby's clinical status must be assessed prior to any physiotherapy intervention 27,32. This should include ……
• Review of recent respiratory history/trends
• Response to handling, desaturations and apnoeas
• Observation – colour, chest movement, level of comfort
• Auscultation
• Review and analysis of recent arterial/capillary gases
• Ventilatory review - including oxygen requirement, mode of ventilation, tidal volumes, pressures, resistance, percentage of endotracheal tube leak.,
• Latest chest x-ray appearances
• Microbiology results- sputum and blood cultures
• Cardiovascular status
• Relevant drug history – e.g. antibiotics/steroids

3.3 Developmental Care during Physiotherapy
The baby must receive excellent nesting and developmental care support throughout all procedures encompassed in these guidelines. Treatment must be paced according to the individual baby’s needs 42 and to minimise stress. This is in line with the SWMNN Developmental Care guidelines 42.

Before intervention, the baby is given an auditory approach signal – talking by nurse or parent, and tactile approach with a hand placed gently but firmly on the chest. This gives feedback on secretion vibrations and chest movement.

3.4 Positioning – see SWMNN Developmental Care guidelines for correct handling and positioning 42.

If there is an area of acute collapse/infective productive consolidation, the most effective position for treatment is with that particular area uppermost 21,24. Turning the baby alters the distribution of ventilation and perfusion 21. However, careful consideration must be taken as to whether the baby tolerates a position especially when there is a ventilation/perfusion mismatch or contraindication e.g. prone with umbilical lines, or post abdominal surgery.

Positions frequently used are side-lying, prone and supine. Turning assists in the mobilisation of secretions, increasing the oxygen may be necessary to keep the baby's saturations between 91-95% 39. Tilting between supine and side lying can be used for babies who cannot tolerate full side
lying or as part of a staged turn. A quarter turn prone facing right, with head towards that side is a particularly effective position for babies who have a persistent right upper lobe collapse. In this position ventilation to the dependant side can be improved. Each treatment episode should be carried out in a maximum of 2 positions. The exception to this is when the baby is extubated and requires a treatment programme e.g. the baby with neurological issues resulting in impaired swallowing /Chronic lung disease/Cystic Fibrosis.

The frequency of turning the baby will be in line with the baby's clinical status e.g chest x ray and tolerance/comfort as well as observations – gases/saturations etc. Whilst frequent position changes are to be discouraged, care must also be taken to avoid leaving the infant in one position for prolonged periods. Positioning for comfort should be the aim and each baby’s cares should be planned according to specific needs.

Head down tilt is contraindicated, due to risks of IVH, reflux and respiratory compromise.

3.5 Percussion
Vinyl percussors are used – these are available in all units where percussion is utilised. They are single patient use.

The head must be stabilised with one hand all the time during percussion to prevent movement of the head during treatment.

There are 2 sizes of percussors, the choice of which is determined by the size of the baby’s chest. The diameter should not extend beyond the surface markings of the lungs. The whole circumference of the percussor must make contact with the baby’s chest. Ideally percussion should be directly on the skin, but if not practical due to lines, one layer of vest is acceptable. A cushion of air is produced between the percussor and the baby’s skin which creates an energy wave through the chest wall that dislodges secretions from the bronchial wall. The ideal rate is approximately 3/second

Percussion episodes should be as short as possible, to a maximum of 1-2 minute according to the baby’s stability/tolerance/gestational age followed by suction. The baby should then be reassessed to see whether further percussion is required. Extubated more robust babies can receive up to 2-3 minutes of treatment as indicated.

The pressure must be gentle but effective; there should be no skin reaction. Any signs of distress/stress – squirming/facial cues/physiological disturbances should be addressed – e.g. pacing the baby, giving time out/containment holding.

The percussor should be kept in the incubator to maintain cleanliness and warmth. It can be washed with soap and warm water and cleaned with an alcowipe.

3.4 Post percussion suction
Percussion is followed by endotracheal tube (ETT) suctioning as indicated. See local unit suction policy

The catheter for open suction must have a mülly tip (larger end hole and 2 opposite pressure relieving side-eyes) and be no larger than 2/3 of diameter of ETT. Graduated catheters must be used so that the depth can be limited to avoid contact with the carina, thus minimising vagal stimulation, cardiovascular instability and trauma.

Recommended pressures for suction vary from 8 -10 kpa, according to the size of the baby:
Oral suction must follow to clear secretions from around the ETT. Use a catheter no larger than 10Fg. Yankauers for regular mouth care are not recommended unless it is an emergency situation.

**0.9% saline instillation** via ETT prior to suction **must** be used as clinically indicated, 3,7,26,34,35,36,37,38,41 These indications are tenacious secretions/mucous plug(s) and secretions partially occluding the ETT. 26,36 Ampoules should be warmed to the baby’s temperature in the incubator 15. Standard volumes are of 0.2-0.3 ml per instillation.

The baby’s normal range of saturations for their gestation (91-95%) 36 must be maintained throughout all procedures, utilising individualised pre/post oxygenation (5-10%) The rate of respiration can be increased temporarily post suction by the use of manual breath/inspiratory breath button on the ventilator. It is essential that hyperoxia is avoided 5,26,33,39,40 47 If tidal volumes are improved above volumes appropriate for that baby’s gestational age or weight, it is advised that ventilation is reviewed to reduce the risk of volutrauma and hypocarbia 25,48

Babies on high frequency ventilation can receive percussion if there are signs of inadequate secretions clearance. 20,45 Closed suction technique should then be utilised to minimise alveolar collapse 44,46 (see unit guidelines) Senior medical staff may wish to increase pressure temporarily following suction to remedy this.

**Extubated baby – SiPAP, CPAP, Heated High Flow Nasal Cannula Oxygen (HHFNC) or self ventilating**

Oral suction with size 8 or 10 catheter is performed to clear secretions. Suction to clear the nares may be required with a smaller catheter.

The suction should be turned off when not in use to reduce noise in the incubator 42

**4.0 Training**

The physiotherapy techniques described herein should only be undertaken by Nursing staff of band 5 and above. Best practice must be maintained at all times. Teaching is provided to Nursing, Medical and Physiotherapy staff throughout the SWMNN through in-house or more formal educational format.

Before treating a baby with percussion, staff **must**

- Attend a talk given by the SWMNN Respiratory Physiotherapist covering both theory and practical aspects of chest physiotherapy
- Spend one-to-one time treating a patient with the SWMNN Physiotherapist together plus supervised time with an experienced senior member of the Nursing staff who has received training.

All Nursing staff must thereafter attend update lectures and/or practical sessions with the Physiotherapist every 2 years. Medical staff involved in recommending percussion will receive regular updates.

**5.0 Categories of evidence**

The majority of studies in this area are somewhat dated, 20 however practice is to a degree evidence based, having been the subject of a Cochrane review ‘Chest Physiotherapy for reducing respiratory morbidity in infants requiring ventilatory support’ in July 2008: 20
The extensive literature search uncovered only 3 randomised controlled trials, with only 106 patients. The studies were also run over wide time-span (1983, 1987 and 2003). Practice has already altered significantly, even since the last study.\textsuperscript{22}

On guideline literature search review in 2011, there have been more recent relevant papers located and these have been referenced. The most extensively comprehensive piece of work has been a PhD publication by Judith Hough ‘The Effect of Chest Physiotherapy on Lung Function in Preterm Infants’\textsuperscript{21}

Professional comparison and accountability is vital within this area. Current practice has been compared with that of neonatal physiotherapy specialised staff in other Networks, and specific areas of practice has been discussed and agreed upon – this is when other unit guidelines have been referenced. This guideline review has been reviewed and commented upon by Physiotherapists regarded as experts within the field, including Judith Hough, and committee members of the Neonatal Sub-group of the Association of Chartered Physiotherapist in Paediatrics.

6.0 Audit
Following approval and implementation, practice covered by this guideline will be audited. Suggested standards should include:

- 100% of all nurses using percussion have received training, are competent and have awareness of the guideline content.

7.0 References


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35) Pulchalski M (2007) ‘Should normal saline be used when suctioning the endotracheal tube of the neonate?’ *Medscape* Medscape.com


41) Tasota F (2002) 'Myth Vs reality: instillation of normal saline with suctioning'

42) Thompson K, Curson C, Bedson N, (2011) 'Developmentally Appropriate Care – handling and positioning'

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48) Zach T 'Paediatric Periventricular Leukomalacia' *Medscape* 2010