

Severe pediatric respiratory disease: Does physiotherapy have a place?



Chest Physiotherapy

accepted as part of the care of critically ill infants and children, largely due to risks of ETT obstruction.

- ▣ Short term aim is to remove obstructive secretions from the airways thereby
 - reducing work of breathing
 - improving delivery of mechanical ventilation;
 - improving gaseous exchange
 - preventing and resolving respiratory complications
 - facilitating early weaning from the ventilator
- ▣ Longer term aim is to
 - Prevent postural deformities
 - Improve exercise tolerance
 - Return to optimal function

Chest Physiotherapy

- CPT and suctioning may affect
- Respiratory system
 - Cardiovascular system
 - Central nervous system
 - Metabolic demand.

CPT is met with the most pronounced variation in vital signs when compared to any other routine ICU interventions.



Complications

- hypoxia
- increased metabolic demand and O₂ consumption
- cardiac arrhythmias
- changes in blood pressure
- raised intracranial pressure
- gastro-oesophageal reflux
- pneumothorax
- death

Complications

Neonates

- CPT ↑'s incidence of intracranial hemorrhages in preterm infants with RDS
- Potentially severe hypoxemia
- Arrhythmia, apnea, ↓ BP, ↑ ICP
- Reports of rib #'s



When should one consider CPT

The “ventilated child”?

Risk of

- ☐ Hyperinflation
- ☐ Positional atelectasis and/or consolidation
- ☐ Impaired mucociliary clearance
- ☐ Decreased FRC
- ☐ Foreign body (ETT) and inadequate humidification of vent gases → increased amount/tenacity secretions → obstruction, infection, atelectasis → chronic disease



The “ventilated child”

- Do all ventilated children need “prophylactic” physiotherapy?
- Can “physiotherapy” prevent complications/infections?
- What is physiotherapy???

Good general ventilatory management

- Analgesia
- Regular changes in position and early mobilisation
- Lung protective ventilatory strategies
- Minimal effective FiO_2
- Adequate humidification
- hygiene and infection control practices

The “ventilated child”

“In mechanically ventilated children, CPT cannot be regarded as a standard treatment modality. CPT must be considered as the most stimulating and disturbing intensive care procedure in mechanically ventilated patients”



What conditions might benefit from CPT?

- Clear benefit
 - Cystic fibrosis



What conditions might benefit from CPT?

- Probable benefit
 - Atelectasis with mucus plugging



What conditions might benefit from CPT?

- Probable benefit
 - Neuromuscular disease



What conditions might benefit from CPT??

- Minimal to no benefit
 - Acute asthma
 - Bronchiolitis
 - Respiratory failure without atelectasis
 - Prevention of post-extubation atelectasis in neonates
 - Prevention of atelectasis following surgery
 - Undrained pleural collections



Indications for CPT

“indications or contraindications for or against chest physiotherapy should never be formulated on the basis of diagnostic entities but should rather stem from a detailed analysis of the prevailing individual pathophysiology.”

Indications for CPT

- ↑ and/or retention of secretions
 - Impacting on lung mechanics and/or gaseous exchange
 - Potential for further complications
- Acute lung/ lobar collapse due to mucus plugging
- Decreased mobility (general/trunk)
- Potential postural deformities
- Poor exercise tolerance

Contraindications and precautions

- severely ill, unstable child
- coagulopathy (plt <100 with care, no Rx if plt < 50)
- pulmonary haemorrhage
- pulmonary oedema
- raised intracranial pressure
- pulmonary hypertension
- very premature infants

Respiratory assessment of infant and child

Careful assessment is essential to identify problems requiring physiotherapy intervention

Medical notes: information can be extracted from medical notes relating to present and past medical history: when assessing a neonate history of pregnancy, labour and delivery are relevant

Discussion with relevant carers: discussion with medical staff, nursing staff and carer is essential information should be obtained about

1. Stability of child condition .
2. How well infant tolerates handling.
3. Child is fed via oral nasogastric or intra venous route and timing of last feed .

Examination:

- Clinical signs of respiratory distress should be noted
- high -ve intrathoracic pressure during inspiration pulls the soft compliant chest wall in ward .
- Nasal flaring is sign of respiratory distress it is in response to decrease air way resistance .
- Tachypnoea respiratory rate >60.
- Grunting occur when an infant expired against partially closed glottis. This is automatic response to increase functional residual capacity.

- Stridor is heard in presence of narrowing of upper trachea or larynx this is due to collapse of floppy tracheal wall or inhaled foreign body it is heard during inspiration .

- Cyanosis .
- Auscultation .
- Neck extension in respiratory distress to reduce air way resistance

- Head bobbing occurs when infant uses accessory muscle of respiration .
- Pallor is sign of hypoxemia or anemia .
- Reductance to feed is due to tachypnea .
- Alteration in level of consciousness may be due to neurological deficit or as a result of opiate analgesia or due to hypoxia it is accompanied by inability to feed or cry. Irritability and restlessness indicate hypoxia.

Other relevant observation :

1. It is important to note muscle tone b/c hypotonic child have increased difficulty with breathing coughing and expectoration while hypertonia is associated with difficulty in clearing secretion .
2. Abdominal distention can cause or exacerbate respiratory distress b/c diaphragm is placed at mechanical disadvantage.

CPT Modalities

- "...in the case of young children with respiratory disease, we have few effective therapies, and when [you think] your only tool is a hammer, everything starts to look like a nail.
- "...patients have respiratory difficulties from a variety of causes, but we have one hammer, so we try it on everybody."



Physiotherapy in the PICU



Physiotherapy


Clear secretions	Muscle strengthening	stretching
Reexpand collapsed lobes	Thoracic mobility	Splinting
Weaning	Movement reeducation	Positioning
	Improve ex tolerance	
	Developmental stimulation	

Positioning

Clear secretions

Reexpand collapsed lobes

- Use gravity to move secretions from peripheral → proximal airways
- Positions used: supine, prone, side lying and sitting



- It is used to optimize respiratory function
- supine position is least beneficial while prone positioning improve respiratory function, decrease gastroesophageal reflex and reduce energy expenditure
- Pattern of regional ventilation differ in infants as it is distributed to uppermost regions of lungs so care should be taken during positioning
- Spontaneously breathing newborn infants are better oxygenated when tilted slightly head up and show a drop in PaO₂ if placed flat or tilted head down

Mobilisation

Clear secretions

Reexpand collapsed lobes

Weaning

- Improve thoracic mobility
- **Improve lung volumes**
- Assist secretion clearance
- Improve exercise tolerance and muscle strength
- Increase cardiovascular fitness
- Prevent postural deformities
- Bone ossification
- Bladder and bowel function
- Psychological benefits!




Mobilisation

Clear secretions

Reexpand collapsed lobes

Weaning



MANUAL VENTILATION

it involves disconnection of patient from mechanical ventilation to provide temporary manual ventilation
Special consideration should be applied in preterm infants whose lung tissue is easily damaged by high inflation

Pressures and in children with hyper inflated lungs in whom there is greater risk of pneumothorax
For infants 500ml bags and for older children 1L bags should be used

they may be valved or open ended so expulsion of excess pressure is controlled by operators fingers

In pediatric patients manual ventilation is used to achieve following:

Hyperinflation: a long inspiration with an inspiratory pause followed by rapid release of bag
Aim of this technique is to recruit lung units by improving collateral ventilation and increasing lung volume. in acute respiratory distress the portion of recruitable lung may be extremely variable

Following hyperinflation a high expiratory flow assist in mobilizing secretions towards central airways

Hyperoxygenation: It is used before suction in order to reduce suction induced hypoxia or pulmonary hypertension

Hyperventilation: it is used to reduce carbon dioxide in patients with head injury so that physiotherapy can be undertaken safely

In patients with large cardiac shunt hyperventilation is contraindicated

Breathing exercises

Clear secretions

Reexpand collapsed lobes

Weaning

- Deep breathing exercises
- Localised expansion techniques
- Active Cycle of Breathing Technique
- Autogenic drainage

It is possible to encourage children to deep breathe from about 2 years of age by using games such as bubbles, incentive spirometers

Laughing is very effective means of lung expansion in infants



Chest manipulations

Clear secretions

Reexpand collapsed lobes

- Mucus liquifies on agitation
- Mechanical energy transmitted through chest wall with percussion/vibes
- Liquid secretions moved centrally by gravity / cough / Forced Expiratory Technique



Chest percussion :

Vibration and shaking it increases peak expiratory flow to move secretion toward large air ways. Chest wall vibration are used more frequently in ventilated children than percussion b/c glottis is open by endotracheal tube facilitating rapid expiratory flow.

Suctioning

Clear secretions

- ▣ Needed in patients with artificial airway or ineffective cough.
- ▣ Complications include
 - hypoxia
 - arrhythmia's
 - mucosal trauma
 - pneumothorax
 - ↑ ICP
 - bacteraemia
 - loss of ciliary function
 - atelectasis



Suctioning

Clear secretions

- ▣ Some complications can be prevented/minimised by
 - Adequate sedation and analgesia / paralysis
 - Preoxygenating
 - Using correct sized catheter
 - reducing suction pressures
 - Limiting depth of insertion
 - Correct technique
 - Only suctioning when indicated
 - No routine use of saline
 - Humidification



Case examples

Haemodynamically unstable child with isolated RUL collapse and hypoxia.

- Should you refer for CPT?

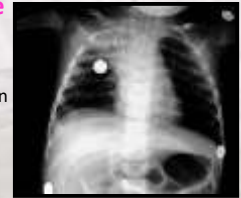


Case examples

Haemodynamically unstable child with RUL collapse

- **Ask** – how much does RUL impact on oxygenation?
- **Answer** – NOT MUCH!
- If this is the only focal problem, CPT risks >>> **benefits**

- **DO NOT TREAT!**



Case examples

Haemodynamically unstable child with R lung collapse

- **Ask** – is the collapse causing significant hypoxia?
- **IF YES** potential benefits of CPT >> risks
- **IF NO** wait until more stable before treating
- **TAKE NECESSARY PRECAUTIONS**
- **TRIAL OF TREATMENT**



Case examples

Child with raised ICP

- CPT and suction causes \uparrow ICP



Case examples

Child with raised ICP

Type of treatment

- Depends on ICP, other injuries, general condition.
- Ensure adequate sedation, analgesia and/or paralysis
 - Painful stimuli and stress increase metabolic demands, BP and ICP
- **Monitor ICP, BP, HR**
- Keep Rx to minimum
- Supine may be best position with head up.

Chest Physiotherapy

- Potential benefits for specific patients
- Careful clinical and radiological assessment
- Determine risk:benefit for each patient
- Holistic approach.

- **RESEARCH NEEDED!**

“In the meantime, those involved in the management of pediatric respiratory disorders should avoid the unnecessary distress to both the child and family of useless treatment and the potentially serious consequences of inappropriate intervention”