Non Invasive Ventilation

Introduction:

Respiratory distress syndrome (RDS) is a significant problem for premature infants. Mechanical ventilation may injure the lungs or exacerbate any underlying condition that led to the need for mechanical ventilation. Ventilator-induced lung injury may be associated with alveolar structural damage, pulmonary oedema, inflammation, and fibrosis. Mechanisms of lung injury include high airway pressure (barotrauma), large gas volumes (volutrauma), alveolar collapse and re-expansion (atelectrauma), and increased inflammation (bio trauma).

Given the above; alternatives to mechanical ventilation are welcomed. There are various modes of non-invasive ventilation: Nasal continuous positive airways pressure (nCPAP), Bi-level positive airway pressure (BiPAP)/Nasal Intermittent Positive Pressure Ventilation (NIPPV) and High flow nasal cannula (HFNC).

CPAP is known to be effective as a primary mode of respiratory support in preterm infants with RDS and in preventing extubation failure after a period of ventilation. Small studies suggest that BiPAP (two alternating levels of CPAP with a background rate) is superior to CPAP in preventing extubation failure, and managing apnoea of prematurity but not as a primary mode of respiratory support in preterm infants. Long term studies to assess safety and effectiveness are yet to report on BiPAP.

HFNC have been used in the adult and paediatric populations for a long time; although adopted more recently into neonatal units. Ease of use and greater access to the baby's face promoting bonding and feeding make HFNC an attractive option for respiratory support. However, the safety and efficacy of HFNC has not yet been demonstrated.

BiPAP

This is also known as Bi-Level CPAP, which provides two levels of positive airway pressure during the respiratory cycle (higher during inspiration and lower during expiration) at a set respiratory rate or back up rate. It is thought that BiPAP helps to recruit alveoli, increase the functional residual capacity and subsequently decrease work of breathing. Studies have shown that BiPAP helps to reduce length of respiratory support, and length of oxygen dependency in preterm infants after extubation.

Indications: Increased work of breathing

1. Apnoea of prematurity
2. Post extubation in infants <28 weeks
3. Failure with CPAP

Start with expiratory pressures of 4cm and inspiratory pressures at least 4cm higher and a respiratory rate of 30-40 per minute.

If recurrent or persistent apnoea, increasing oxygen requirement, increased work of breathing or acidosis; reassess to rule out other causes of deterioration e.g. sepsis, pneumothorax, exhaustion. Consider if intubation necessary.

While there are no published trials on weaning from BiPAP, it is reasonable to adjust settings as in a ventilator and wean pressure, backup rate or FiO2 as appropriate. Consider switching to nCPAP if infant is stable.

CPAP

This method provides constant pressure throughout the respiratory cycle in a spontaneously breathing infant. This continuous distending pressure provided by nasal CPAP is thought to improve oxygenation by stabilising residual lung volume in infants with respiratory distress syndrome and prevents collapse of alveoli during expiration.
Indications:

1. Increased work of breathing
2. Apnoea of prematurity
3. Post extubation in infants ≥28 weeks
4. Term or near term babies with respiratory distress

Start at 4-5cm of H₂O and increase as required. Maximum pressures of 8cm of H₂O.

Weaning: Controversy exists regarding the best methods of weaning CPAP. Evidence from small studies support complete cessation of CPAP support rather than the gradual weaning method by demonstrating a shorter weaning time and CPAP duration.

If recurrent or persistent apnea, increasing oxygen requirement, increased work of breathing or acidosis occurs; reassess to rule out other causes of deterioration e.g. sepsis, pneumothorax, exhaustion. Escalate therapy to BiPAP and/or consider if intubation is necessary.

The use of high levels of positive end-expiratory pressure (PEEP) may be associated with a higher incidence of pneumothorax. Other risks include nasal trauma and abdominal distension.

High Flow Nasal Cannula

This is the delivery of humidified, heated and blended oxygen/air at flow rates between 1-6L/min in neonates. It allows nasal leak which washes out CO₂ from the nasopharyngeal dead space and provides mild distending airway pressure. It can be used as a method of non-invasive ventilation in infants with:

- Parenchymal lung disease
- Apnoea of prematurity
- Infants slow to wean off CPAP
- Infants with nasal trauma from CPAP
- Infants >28 weeks gestation

Nasal prongs to only occupy around 50% of nares space to allow for nasal leak. Start with a flow rate of 4-6L/min, maximum flow rates is 6L/min. Aim to wean by 1L/min every 24 hours if FiO₂ is <30%; ideally, Oxygen requirement to be less than 40% when weaning. Some babies will take longer to wean eg those with severe CLD or pulmonary hypoplasia. Change to low flow oxygen once flow down to 2L/min and FiO₂ <30%. Allow clinical condition to dictate when gases are required, there is no need for “routine daily” gases.

If recurrent or persistent apnoea, increasing oxygen requirement, increased work of breathing or acidosis; reassess to rule out other causes of deterioration e.g. sepsis, pneumothorax, exhaustion. Change to BiPAP, CPAP and/or consider intubation as indicated.

Studies suggest that nasal high flow may have similar efficacy to nasal CPAP. However, there is paucity of evidence for early preterm infants.

References:

6. Nasal intermittent positive ventilation (NIPPV) versus nasal continuous positive airway pressures for apnea of prematurity 2008 the Cochrane collaboration. P Davis

Solabomi Alalade, Malli Chakraborty, Sybil Barr June 2014, to be reviewed June 2017.