NON-INVASIVE RESPIRATORY SUPPORT AFTER FIRST HOUR OF LIFE

Indication for use
- Treatment for surfactant deficient lung disease.
- Means of weaning and extubating earlier from mechanical ventilation.
- Treatment for recurrent apnoeas and bradycardias in premature infants.
- Other causes of respiratory distress.

General considerations

Newborns ≥ 35 weeks:
- Use HHFNC (Optiflow®) 8 l/min or Infant-Flow device, 5 - 6 cm H\textsubscript{2}O, FiO\textsubscript{2} < 0.6, wean as appropriate.

Preterm newborns < 35 weeks:
- Follow algorithm as indicated.

Newborns with chronic lung disease:
- Newborns might not require HHFNC/CPAP support despite high O\textsubscript{2} requirements.

Monitoring:
- Review aims as indicated on algorithm hourly for the first 3 hours, then 3 hourly for the next 6 hours, then 6 hourly for the next 63 h of life until newborn is 72 h old. Expand review time thereafter.

Practice

Equipment
- Stand with Air/Oxygen Blender or Infant Flow Box.
- Humidification device – Fisher & Paykel humidifier, chamber and sterile water bag.
- Bubble CPAP tubing and generator or Infant Flow tubing.
- Appropriately sized bonnet/head gear, prongs and chin strap.
- Ensure appropriate resuscitation equipment is available at the cot side.

Preparation/Set up for Bubble CPAP
- Measure infant’s head for the bonnet/head gear and chin strap, using tape measure. Select correct size bonnet (4 sizes available), head gear (3 sizes available) and chin strap (4 sizes available). Ensure the bonnet/head gear is a snug fit. The bonnet should cover the infant’s ears and the front edge of the bonnet should sit just above the eyebrows. The bonnet may be tied at the top, although this can sometimes drag the bonnet upwards.
- Set up bubble CPAP circuit as per manufacturer’s instructions (user guide, product catalogue and images are available at http://www.fphcare.com/neonatal/respiratory.asp). Ensure humidification chamber is connected to water for inhalation bag. The bag should be at least 50 cm above the chamber.
- Check the CPAP circuit is free from leaks by using the “elbow” connection provided and turning on the flow. You should see bubbling in the CPAP generator. Turn on the humidifier to allow the gas to warm.
- Choose the correct nasal prong size (9 sizes available) by using the prong sizing “caterpillar” guide provided and attach the prongs to the nasal tubing. It is advisable to select prongs that are snug to ensure that the prongs sit at least 1 mm away from the nares and do not rub. Using prongs that are too small means that there will be increased movement of the prongs and the resulting friction can cause nasal trauma. Prongs should fill the nares without stretching the skin.
- Connect nasal tubing to the rest of the CPAP circuit (you will need to remove the "elbow" to do this) ensuring that the blue tubing meets blue tubing and white meets white.
- Select the desired CPAP pressure and flow. As a rule, it is useful to select 1 lpm of flow for 1 cmH\(_2\)O pressure. This system allows you to deliver between 3 - 10 cmH\(_2\)O pressure and the recommended flow range for this system is 4 - 10 lpm.
- With the infant in a supine position, insert the prongs into the infant’s nostrils ensuring that they sit proud of the nares, by at least 1 mm. The bridge between the prongs should not press against the septum or the philtrum. Careful attention to sizing, fixation and position is the key to preventing tissue damage.
- Align the clear portion of the nasal tubing so that it is parallel to the infant’s face. Slide the grey foam block so that it lies midway along the tubing and centrally on the blue Velcro band at the front of the bonnet. Individual strips of foam may be removed from the block, as necessary, to ensure that the tubing is parallel to the face. These foam strips should be kept, in case they are required for positioning at a later stage. Secure the nasal tubing by using the blue central Velcro strap to tightly anchor the grey foam block.
- Once the grey block is secure and the prongs are in the nose, secure each side strap. The blue plastic bar should only be gently curved and not under great tension. These side straps should not press into the infant’s cheeks. When the infant is lying with their head to one side, the side fixation strap on the side of the head that the infant will be lying on should be tightened further and the opposite one loosened. This will help to ensure the prongs do not twist out of position when the infant’s head is turned to one side.
- Apply the correct size chin strap to minimise air leaks via the mouth. The Velcro portion should connect at the top of the infant’s crown (see picture on the leaflet provided with box of chin straps). A pacifier may also be used to assist with the reduction of air leaks via the mouth, providing parental consent is obtained for the use of a pacifier.
- Position infant comfortably and check position of CPAP circuit and interface.
- Consider extending the collapsible portion of the nasal tubing fully to form a “Z” shape, to ensure that the CPAP circuit is kept below the level of the nasal tubing.
- Always ensure the weight of the tubing is not pulling on the infant’s nares.
- Condensation reduces the effectiveness of CPAP, increases noise and reduces gas flow to the infant. Any condensation should be promptly drained from the expiratory tubing into the CPAP generator overflow tank.

**Preparation/Set up for Infant Flow CPAP**

- The head should be measured prior to application of the hat. The colour indicator on the tape should correspond with the hat colour. Sizing does not always correspond to the head size of the baby. It may be up to 2 sizes smaller. If the correct size is unavailable, it is better to choose the next size up rather than down for the baby’s comfort.
- The CPAP circuit contains a prong measuring device: Place the measurement device against the baby’s nares and choose the closest fitting size. Three sizes are available, small, medium and large. It is better to choose a smaller size to avoid pressure on the nares. A prong which is too small size will increase the work of breathing and give inadequate pressure support. Once you have chosen the correct size this should be attached to the flow device.
- Prong should be gently applied to the baby’s nose. This should be a snug, not tight fit. There should be no blanching of the rim of the nose. A small amount of sodium chloride may aid insertion into the nostrils. Do not use creams or petroleum on the nose as these will soften the skin and increase skin breakdown. The prongs should not rest on the philtrum. This will cause undue pressure and decrease the integrity of the skin. If the baby’s nose is becoming sore you can leave the expiratory hose outside the Velcro strap this will take pressure away from the nose.
- There is a mask CPAP available to ‘rest’ the babies’ nose particularly (not for routine use), if this is becoming sore or it is difficult to maintain the CPAP pressure without pulling the straps tighter.
- The hat ties should not be pulled tightly, this will increase the likelihood of pressure marks along the cheeks and ears, it will also cause the nasal septum to deviate or become sore. Do not place gauze under the tie straps as this will affect seal of CPAP. It may be better to go up a size on prongs If you are getting inadequate seal. You can apply Duoderm H or T shaped patch to ease pressure.

**Optimising NCPAP treatment**

**Aim to deliver the best possible NCPAP with minimal handling:**
- Nurse prone (this can be done with a UAC/UVC in situ and regular checks) or side to side with gentle neck extension (change position 3 - 6 hrly).
- Position at 30° head up, flexed body position, supported by appropriate nesting and use of boundaries (according to developmental care guidelines).
- Ensure the nose has been cleared (suctioned carefully & thoroughly).
- Ensure hats and prongs are the right size and in the nose at all times.
- Ensure the mouth is closed.
- Ensure desired CPAP pressure is being delivered through continuous assessment to ensure that there is an ongoing slow gentle bubbling and generation of pressure.
- Keep any loss of CPAP pressure to a minimum, ensure CPAP device is well fitted and positioned at all times.
- An oro-gastric tube should be sited to prevent abdominal distension and this should be connected to a syringe without the plunger to allow removal of air from the stomach. Due to oral secretions, the oro-gastric tube is prone to slipping. The position should be monitored carefully and adjusted, as necessary, on a regular basis. The tube should be aspirated to remove air 4 - 6 hourly, as abdominal distension can impact on lung volume and the work of breathing.
- Check equipment at regular intervals (at least hourly with observations), ensure good humidity and water level at all times, particularly if secretions are thick. You may get rainout in the tubing if incubator temperature and humidity are very low, this will affect pressure delivery to the baby. The baby will also get flooding of water down the tube which may cause apnoea or desaturation. Excess water from tubing will need to be emptied. Humidifier and tubing should be changed on a weekly basis and marked changed in the notes.
- A cold baby may be due to no water in the humidification chamber, through giving cold gases to the infant.

**Additional support measures**
- Chest x-ray on admission
- Insert IV cannula and take a sample for a capillary/venous blood gas. If possible delay other invasive procedures for the first 3 h of life.
- Insert UVC and UAC in all preterm infants < 26 weeks or if very sick, i.e. ventilated or arterial hypotension.
• Insert UVC or longline, no UAC in all preterm infants 26 - < 30 weeks.
• NO UVC/UAC, insert primary longline in all infants ≥ 30 weeks if not on sufficient feeds by day 5 of life (60 % of total fluid requirement).
• Do not attempt longline insertion if UVC in correct position for a maximum of 14 days or until 100 ml/kg/d enteral feeds achieved.
• Start prophylactic antibiotics in all preterm infants < 35 weeks.
• Start prophylactic caffeine in all preterm infants < 30 weeks, otherwise only if clinically indicated.
• Consider prophylactic indomethacin (see PDA guideline).

**Ongoing cares**

• Don’t remove prongs for > 2 – 3 min in the first 48 hours of life or post extubation.
• General cares 12 hourly (8 hourly if required more often).
• Suction (nasal and oro-pharyngeal) (8 Fr) 3 - 4 hourly initially and in symptomatic infants, then 6 hourly. Suction catheter should fit comfortably. If secretions are very dry instillation of normal saline 1 drop per nostril may aid secretion removal or catheter insertion. Universal precautions should be taken when suctioning. Fleck of blood may indicate mucosa is dry or there is trauma.
• Avoid septal injury (pressure on nasal septum). With each care, at least, the skin around the nose, nares, septum and surrounding area should be inspected for signs of redness, bleeding, crusting, excoriation and any narrowing of the passages 4 hourly. With bubble CPAP the bridge between the prongs should never press against the septum or the philtrum. Careful attention to sizing, fixation and position is the key to preventing tissue damage
• Regular mouth-care as required to avoid the build up of thick secretions on the lips and in the mouth. Avoid oil based creams on or around the nostrils/lips when using CPAP due to risk of burns to skin and nasal mucosa.
• No cuddle until after 48 hours of life or post extubation.
• Explain to parents rationale for minimal handling and teach containment handling.
• If baby becomes agitated try one of the following:
  1. suction nasopharynx
  2. aspirate excess gastric air
  3. offer a pacifier
  4. contain infant with swaddling and nesting
  5. hands off (allow to settle)
  6. consider low dose of analgesia for invasive procedures
• At least weekly documented change of CPAP circuit. The bonnet, chin strap and prongs may need to be changed more frequently if soiled or ill fitting. The size of the bonnet, prongs and chin strap should be reviewed at least once a shift.

**Failure of NCPAP (increasing oxygen requirement, pCO2, apnoeas or bradycardias)**

• Check pressure is being maintained.
• Check prongs have not become displaced.
• Check prongs are correct size.
• Check prongs are not blocked through excess secretions.
• Check hose has not become disconnected and other causes for leaks.
• The baby may have an inadequate seal, a chin strap should be considered to improve pressure delivery, taking care not to apply it too tightly which can occlude the airway.
• Consider other causes for respiratory deterioration apart from prematurity (eg: pneumothorax, diaphragmatic hernia, pulmonary hypoplasia, pneumonia, congenital lung anomaly, infections, anaemia, neuromuscular problem, medication).
### Low Flow Nasal Cannula

**Estimated Inspired Oxygen Concentration**

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