Clinical Guideline: Nursing Management of a Baby on NCPAP, BiPAP and SiPAP

Draft version 5.0

Authors:

EOE Neonatal Benchmarking Group	Sara Wayte Deputy Sister, NICU, NNUH

For use in: EOE Neonatal Units
Guidance specific to the care of neonatal patients

Used by: For use in neonatal units in the East of England

Key Words: CPAP, Positive Pressure, NCPAP, BIPAP

Date of Ratification: **November 2022**

Review due: **November 2024** (or earlier in the light of new evidence)

Registration No: **NEO-ODN-2022-13**

Approved by:

Neonatal Clinical Oversight Group	
Clinical Lead Matthew James	

1. Scope

For use in neonatal units in the East of England.

2. Purpose

To inform registered practitioners of the safe preparation and evidence-based care of a baby requiring Nasal Continuous Positive Airway Pressure (NCPAP).

3. Background

There are increasing numbers of low birthweight and premature infants surviving with conditions such as chronic lung disease or bronchopulmonary dysplasia due to complications of assisted mechanical ventilation and other factors. NCPAP has been used as an alternative respiratory treatment to mechanical ventilation and prevent and manage lung disease in preterm infants for almost over half a century.[1]

Many infants admitted to the neonatal unit are in need of respiratory support. NCPAP reduces the need for ventilation by increasing inspiratory and expiratory pressure reducing airway resistance.[2] The majority of babies are preferential nose breathers, which facilitates the use of NCPAP.

The anatomy of premature infants places them at a much higher risk for respiratory complications. Their chest wall is very compliant and they are unable to generate enough volume to maintain their own functional residual capacity (FRC) independently, placing them at risk for extrathoracic airway collapse because of the increase in negative pressure. The premature infant's alveoli are unable to remain open and tend to collapse with diaphragmatic distention, increasing atelectasis, and decreasing tidal volumes.[3]

4. NCPAP

The physiological goal of NCPAP is to improve gas exchange in the baby. Many infants who are experiencing respiratory distress tend to have asynchronous breathing, creating a see-saw motion between their chest and their abdomen. When NCPAP is applied, it decreases the compliance of the chest wall and allows for synchronous breathing, resulting in decreased effort of breathing, improved gas exchange and improved cardiac function. NCPAP increases the FRC by exceeding the closing capacity of the lungs, which stabilizes and prevents the collapse of alveoli. It also provides a splint to the chest wall and airway, resulting in increased lung volumes, recruitment of atelectatic alveoli, and prevention of further atelectasis. With the correct amount of NCPAP, the exchange of carbon dioxide and oxygen occurs optimally at the cellular level.[3]

a) Benefits of NCPAP

Respiratory:

- Decreases the incidence of long-term lung complications such as chronic lung disease

- Avoids the trauma, inflammatory response and volu/barotrauma associated

with mechanical ventilation

• Decreases alveolar oedema

• Increases tidal volume

• Decreases airway resistance and therefore both work of breathing and oxygen demand

• Increases lung recruitment and helps prevent atelectasis

• Decreases V/Q mismatching improving gas exchange

• Supports the work of breathing without mandatory breaths allowing the infant a more 'normal' breathing pattern

• Decreases the incidence of pneumothorax

Development/growth:

• Facilitates skin to skin contact

• Allows for oral stimulation and sucking, improves neurocognitive outcomes when compared with mechanical ventilation

• Maintains functional reserve capacity and reduces upper/lower airway resistance improving tolerance of caregiving and handling

• Improves growth.

Financial:

• Fewer hospital days and decreased hospital costs [4]

b) Types

There are many different varieties of NCPAP, each having advantages and disadvantages.

NCPAP

Nasal Continuous Positive Airway Pressure (NCPAP) is the application of positive pressure to the airway of the spontaneously breathing infant through the respiratory cycle.[7] In practice, NCPAP consists of a controlled flow of humidified medical air and or oxygen gases (measured in cm H_20) through a flow driver to circulate the gas through a NCPAP circuit to the larynx or nose. To gain a lower or higher pressure, the flow of gas can be altered.

NCPAP and apnoea

NCPAP with added advantage of apnoea monitoring, via a sensor attached to abdomen. The apnoea alarm is triggered when no breaths detected within set time-out period.

BIPAP (Triggered)

BIPAP is often used to provide additional support in patients failing on NCPAP as a rescue prior to, or instead of intubation by providing two alternating background positive pressure levels, a set respiratory rate and provide a higher mean airway pressure (MAP). This leads to changes in the infants functional residual capacity (FRC) allowing for tiny breathes from the small change in pressure.[8]

The possible benefits for this mode include helping to prevent atelectasis and stimulate spontaneous breathes compared to NCPAP. The set respiratory rate is not synchronised with the infants breathing.

SiPAP

SiPAP provides synchronised respiratory support in the same way as BiPAP, however synchronises with the babies own respiratory efforts.

Bubble CPAP

Bubble NCPAP is created as humidified air flows at the rate of 6-10 L/min from the gas source passes the nasal prongs to the expiratory limb, and into the water. The amount of NCPAP that is administered is determined by the depth of the expiratory tubing: 1 cm is equivalent to 1 cm H_2O pressure. It appears to generate oscillations in the premature infant's chest, which mimic the vibrations of the high-frequency oscillator.[4] It can also be modified and made mobile, allowing it to be placed on the neonate in the delivery room, thereby optimizing its use. It is unique in that it has no audible alarms, so greater vigilance is needed to ensure that there is a proper connection, position, pressure delivery and respiratory support. However, the produced PEEP is not able to be measured.

c) Indications for NCPAP

• Significant signs of respiratory distress: increased work of breathing through tachypnoea, expiratory grunting, intercostal recession, sternal recession and nasal flaring, cyanosis/increased oxygen requirements (i.e. FiO2 >30% or 1lt/min on nasal cannula oxygen), deteriorating blood gases (i.e. pH <7.25 with evidence of CO2 retention).[6]

• Following delivery and resuscitation, consider NCPAP as the initial method of breathing support after delivery in spontaneously breathing pretem/term infants. [5]

• Apnoea and bradycardia of prematurity

• Atelectasis shown on x-ray

• Pulmonary oedema

• Non-Invasive support prior to intubation[1]

• Post extubation

• Transient Tachypnoea of the Newborn (TTN)

• Tracheo-malacia or other abnormality of the lower airways.

d) Contra-indications

• Known pneumothorax

• Facial and nasal abnormalities e.g., bilateral choanal atresia, cleft palate, tracheoesophageal atresia.

• Diaphragmatic hernia.

• Unrepaired gastroschisis.[6]

• Larger babies often do not tolerate application of NCPAP devices well, resulting in restlessness and labile oxygen requirement

e) Complications

• Abdominal distension increasing risk of risk of feed intolerance.[6]

• False pressure readings due to: an obstruction of nasal prongs, poor fixation, kinking, blockage from mucous plugging or increased resistance created by turbulent air flow through the prongs, artificially maintaining air pressure.

• Inadequate gas flow causing fluctuating baseline pressures, resulting in increased respiratory effort by the infant.

• Excessive flow preventing incomplete exhalation inadvertently increasing PEEP levels resulting in over-distension and increased work of breathing.

• Nasal irritation, septal distortion, pressure necrosis, nasal mucosal damage secondary to inadequate humidification or poor fixation of nasal prongs.[6]

• Skin irritation of the head and neck from improperly secured bonnets.

• Lung over-distension causing air leak syndromes i.e., pneumothorax.

• Equipment failure including leaks, tubing blockages, alarm failures, incorrect calibration.

5. Equipment

Infants should be nursed in a safe environment. There should be access to suction, oxygen and resuscitation equipment at the bedside, that is regularly checked with each shift.

• NCPAP machine with cables, NCPAP tubing and humidifier chamber that are clean and well maintained.

• Bag/Bottle of sterile water.

• Correctly sized hat using head circumference and manufacturers sizing tool.

• Correctly sized prongs/mask/fixings/straps using manufacturers sizing tool.

• Monitoring equipment to detect heart-rate, saturations, respirations and blood pressure.

• Observation chart.

• Gastric tube, skin protection and fixings.

6. Process

Consideration should be given to NCPAP as primary mode of respiratory support for transfer between delivery and NICU.[2] The decision to commence NCPAP must be medically led from delivery onwards.

1. Inform parents of need to commence NCPAP and signpost to information and document if circumstances permit.
2. Measure head circumference to determine correct hat/head gear size, using manufacturers sizing tool as per manufacturer's guidance.

3. As per manufacturers guidance, use the sizing tool included within the NCPAP tubing, to measure the nares for correct prong/mask size:-

   • Prongs should fill the nares completely without stretching the skin.

   • Use the **biggest** possible size to ensure optimum seal and closest septum gap to maintain comfort and skin integrity.

   • It may be necessary to choose a smaller nares size to accommodate septum gap.

   • To confirm size place the prongs in the infants' nostrils (briefly), prior to attaching to the nasal tubing.

4. Attach the prongs to the nasal tubing
5. Ensure machine is plugged in and gases connected and turn on.
6. Attach/open sterile bag of water for humidification unit and turn on. Humidification is delivered to the infant at 37°c.
7. Attach NCPAP to the baby, using appropriate fixings as per manufacturer's instructions avoiding excessive pressure on the nose, cheeks and base of neck.
8. Following medical direction, increase flow to achieve required pressures within manufacturer's guidelines.
9. Check NCPAP sounds can be heard in the lungs by auscultation with a stethoscope.
10. Measure and pass an orogastric tube (OGT); record size, length and position of gastric tube in accordance with unit guideline.
11. Place an open syringe onto the end of the OGT and leave open to the air to allow release of excess air in the stomach.
12. Record observations of heart rate, respirations, saturations, FIO2, humidity, pressures and flow hourly.
13. Visually check position of CPAP hourly to detect dislodgement
14. Monitor blood pressure as clinical condition dictates, at least 12hrly.
15. Aspirate OGT 4-6hrly or more frequently if clinically indicated.
16. Assess and score skin condition as per unit guidelines.
17. Check nasal septum, nares, bridge of nose, cheeks and forehead hourly to reduce the risk of septal damage. Ensure that there is no unnecessary pressure from tubing.
18. Remove headgear/hats once per shift to inspect head for skin integrity and pressure areas. Change between mask/prongs to help alleviate damage.
19. Record hourly whether mask or prong and alternate use as per unit guideline. Ensure that there is no unnecessary pressure from tubing.
20. Report deviations to medical staff and the Nurse in Charge so a blood gas can considered. Document in notes..
21. Check air entry with position changes/cares or with any increases in oxygen requirements or respiration rates
22. Observe for secretions and need for oral/nasal suctioning.
23. Give mouth care as needed in line with mouth care assessment tool and document
24. Assess pain score as per network guidelines and act accordingly. Document actions taken.

25. Follow developmental care guidelines to make sure of correct positioning for the neonate with positional aides to reduce any stress that the NCPAP might create. Document using Comfort scale and act accordingly.
26. In accordance with blood gases, overall condition and medical decision, appropriately adjust NCPAP respiratory support.
27. NCPAP hats sizing must be checked weekly and hat/ size changed accordingly.
28. NCPAP tubing must be changed every 7 days or in line with hospital infection control guidelines and clearly documented within the notes
29. Any NCPAP equipment not in use must be decontaminated and tubing discarded.

7. Family Centred Care

Maintain a family centred approach to care that incorporates psychological, spiritual and social support.[6]

Keep parents educated and informed of progress on NCPAP, through verbal and written information, which is documented in the patient record. Involve parents in the decision making of their baby, encouraging any questions.

If baby is settled, encourage opportunities and support parents to provide care for their infant including routine cares, containment holding, kangaroo care and/or cuddles.

8. Audit

Audit will be in line with East of England Benchmarking group activity and consequent action planning using infant's charts and care plans to assess quality outcomes and guideline adherence. Poor scores may necessitate more frequent audits to ensure progress is being made.

9. References

- 1. Garg, S. and Sinha, S. (2013) Non-Invasive Ventilation in Premature infants: based on evidence or habit. *Journal of Clinical Neonatology.* Vol 2: 4. p155-159
- 2.NICE Pathways (2019) Specialist neonatal Respiratory care in preterm babies overview
- 3. Sweet, D.G; Carnielli,V.;Greisen, G.; Hallman, M.; Ozek, E.: Plavka, R.; Saugstad, O.D.; Simeoni, U.; Speer, C.P.; Vento, M. and Halliday, H.L. (2013) European consensus guidelines on the management of neonatal respiratory distress syndrome in preterm infants--2013 update. Neonatology, 103(4) pg353-68. doi: 10.1159/000349928.
- 4. Guay, J.M; Carvi, D.; Raines, D.A. and Luce, W.A. (2018) Care of the Neonate on Nasal Continuous Positive Airway Pressure: a bedside guide. *Neonatal Network.* Vol 37:1. P24-32.
- 5. Fawke, J. *et al* (2021) Newborn resuscitation and support of transition of infants at birth Guidelines | Resuscitation Council UK
- 6. Ferrara, L. *et al* (2017) Effect of Nasal continuous Positive Airway Pressure on the pharyngeal swallow in neonates. *Journal of Perinatology,* Vol 37. P398-403.
- 7, Lavelle, J. and McCoy, R. (2013) UHL Neonatal Guideline: CPAP Nursing Care.
- 8. Pan, A et al (2021) Bi-Level Nasal Positive airway pressure (BiPAP) vs Nasal Continuous Airway Pressure (CPAP) for preterm infants with birthweight less than 1500g and respiratory distress syndrome following INSURE treatment: a 2 centre randomised control trial. *Current Medical Science* vol 41 (3) p542-547.

East of England Neonatal Benchmarking Group

Benchmark: Nasal Continuous Positive Airway Pressure

Score relates to practice in (unit):	
Scored by:	**Date scored:**
Statement: Nasal continuous positive airway pressure (NCPAP) is a well established and effective respiratory support used n newborn infants with mild respiratory distress syndrome, apnoea or after extubation NCPAP has a number of physiological benefits, including: ● airway stabilisation ● stabilised diaphragm and chest wall ● increased lung volumes ● reduced obstructive apnoea ● decreased airway resistance ● decreased respiratory effort NCPAP reduces the need for/length of ventilation and the failure of extubation following ventilation in neonates with respiratory distress syndrome which potentially reduces the incidence of Chronic Lung Disease.	
Standards: Careful observation will decrease the chances of trauma related to NCPAP therapy. Regular ongoing assessments are instrumental in the success or failure of the infant on CPAP.	
Patient Group: Any infant cared for in a neonatal unit that requires respiratory support from NCPAP	
Definition: An application of continuous positive pressure throughout the respiratory cycle which can be delivered using prongs or mask	
Indicators/Information that highlight concerns which may Trigger the need for benchmark activity: An increasing trend in nasal trauma.	
Criteria for scoring: A maximum of 6 infants nursed on CPAP will be assessed visually and their documentation reviewed within a four week period.	

Key Factors		**Individual scores**	**Possible total**
F1	There is an evidence-based guideline to support clinical practice.		**3**
F2	Aspects of care		**11**
F3	Staff education		**4**
F4	Parent/carer education and involvement		**2**
	Overall Score		**20**

Factor 1: There is an evidence-based guideline to support clinical practice
Evidence based practice guidelines ensure that care delivered to the infant is of the highest standard.
Clinical guidelines are systematically developed statements to assist practitioner and patient decisions about appropriate healthcare for specific circumstances, statements about different aspects of the patients' condition and the care to be given.

Factor 2: Aspects of Care
In order to minimise the risk of potential damage caused by the CPAP interface, each time the system is set up it should be measured correctly and set up to not cause any pressure on the nares or septum.

Factor 3: Staff Education

The ongoing care of the infant on NCPAP is primarily the responsibility of the registered nurse, who will ensure its safe and effective delivery. They should also be able to troubleshoot any problems and prevent complications.

Factor 4: Parent/Caregiver Education and Involvement
Parents are educated about the role of CPAP for their neonate and they are supported in providing care for them.

Benchmarking Score Sheet: NCPAP

Key factors & criteria	Notes 1	Notes 2	Notes 3	Notes 4	Notes 5	Notes 6
1.There is an evidence-based guideline to support clinical practice a) The guideline is evidence-based and referenced b) The guideline is reviewed regularly according to trust policy. c) The guideline is supported and used by the multidisciplinary team.						
2. Patient Care There is either documented/observed/discussed with staff evidence that: a) Selection of hat/headgear and prong/mask is according to manufacturer's instructions and is regularly measured whilst the system is in use to allow for growth changes and these measurements are documented according to the plan of care. b) The patient interface is checked for efficacy of seal, with the mask/prongs are correctly positioned for optimal delivery and the target pressure is delivered. c) The hat is placed so that the front is just over the eyebrows, the back extends to the base of the neck and the ears are completely covered. The lateral straps provide equal gentle tension according to manufacturer's instructions. d) Inspections of the nares/bridge of nose/cheeks and forehead to identify early signs of pressure and findings documented. e) Removal of the patient interface for detailed inspection and relief of pressure on the nares as well as cleaning of the nasal area. f) The infant should be positioned in such a way as to not add tension onto the patient interface (e.g. lateral supported position) with the use of positioning aids g) An orogastric tube is in situ to permit venting of gas from the stomach and aspirate 4 hourly. h) There is a regular assessment of respiratory effort that is recorded on the patient chart. i) Nasopharyngeal suction is administered as required to maintain a clear airway and reduce the work of breathing. j) The humidifier is set to deliver 37^0C to maximise the water saturation of the gas. k) The circuit is changed every 7 days or according to manufacturer's guidelines or trust policy.						

3. Staff education a) Evidence based educational resources on the use of NCPAP available for staff. b) Staff are instructed in use of equipment. c) Staff are competent in the use of NCPAP with an awareness of potential adverse effects and the actions needed to avert them. d) Manufacturers trouble shooting information about CPAP equipment is available on the unit for staff to access as required.						
4. Parents (either documented or through discussion with parents). a) There is evidence that parents have been signposted to information on NCPAP. b) Parents are supported to provide care for their infant whilst being cared for on CPAP.						

Statements to justify scores/local action plans:

East of England Neonatal ODN
(Hosted by Cambridge University Hospitals)

Exceptional Circumstances Form

Form to be completed in the **exceptional** circumstances that the Trust is not able to follow ODN approved guidelines.

Details of person completing the form:	
Title:	Organisation:
First name:	Email contact address:
Surname:	Telephone contact number:
Title of document to be excepted from:	
Rationale why Trust is unable to adhere to the document:	
Signature of speciality Clinical Lead: Date:	Signature of Trust Nursing / Medical Director: Date:
Hard Copy Received by ODN (date and sign):	Date acknowledgement receipt sent out:

Please email form to: mandybaker6@nhs.net requesting receipt.
Send hard signed copy to: Mandy Baker
EOE ODN Executive Administrator
Box 93
Cambridge University Hospital
Hills Road
Cambridge CB2 0QQ