

Administration of nasal CPAP in non-tertiary level 2 nurseries

Neonatal Services Advisory Committee (NSAC) - Victoria



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Introduction

The purpose of this document is to provide guidelines for staff in Level 2 nurseries located in hospitals without a Neonatal Intensive Care Unit (NICU), who undertake nasal continuous positive airway pressure (NCPAP) beyond a stabilization procedure. This document was not designed to encourage Level 2 units to undertake this procedure. An ad hoc working group with broad representation was established by the clinical subcommittee of NSAC (CSNSAC) to develop draft guidelines in response to concerns from Level 2 nursery staff about this procedure. The draft guidelines were discussed and modified by the clinical subcommittee, NSAC and other stakeholders. This draft incorporates changes agreed to at the NSAC meetings held on 20 August 2002 and 25 March 2003.

Background

The use of NCPAP in Level 2 Victorian nurseries as a definitive treatment to reduce the need for transfer to a tertiary centre is uncommon and heterogeneous. Medical and nursing staff in tertiary neonatal centres regard NCPAP as an intensive care practice and resource it accordingly. It is not surprising that it is rare outside tertiary hospitals to find circumstances where suitable medical, nursing and equipment resources coincide to permit the safe and efficient delivery of this form of respiratory support.

There is extensive experience in the use of NCPAP in tertiary units. The pitfalls and difficulties involved in its use, together with the complications and expected clinical course under a variety of circumstances, are well understood. Although NCPAP is a relatively simple and effective therapy for respiratory distress syndrome, it is resource intensive, particularly in relation to the requirement for skilled nursing care.

Consensus opinion

It is the view of NSAC (supported by a number of tertiary and Level 2 medical and nursing staff), that NCPAP should not be undertaken in non-tertiary Level 2 nurseries unless it is in accordance with these guidelines. This belief is based on the current distribution of resources, the experience of Level 2 and Level 3 staff with the procedure, and safety issues.

Clinical guidelines

The guidelines cover four main areas:

1. A clinical protocol that encompasses indications and contraindications, technique of administration, assessment of success/failure, weaning and discontinuation, complications, and monitoring requirements;
 2. Medical resources;
 3. Nursing resources; and
 4. Equipment.
- There needs to be clear communication links with tertiary units. Each baby should be discussed with a Neonatologist prior to commencement of NCPAP and on a daily basis thereafter. For continuity, this may be a Neonatologist at a specific tertiary unit or it may be a Newborn Emergency Transport Service (NETS) Consultant.
 - Hospitals should have a clear policy on the use of NCPAP. This requires input from hospital management as well as clinical staff.
 - The document does not aim to describe the total care associated with a sick baby, although it does include some discussion on some aspects of care that are relevant to NCPAP, for example, IV fluid therapy.

Indications for NCPAP in level 2 nurseries

Babies should meet all of the following:

- Birthweight >1499g and gestation >32 weeks;
- Less than 24 hours old (the use of rescue NCPAP in a 2-3 day old baby with progressive respiratory failure is not infrequently followed by the need for rescue endotracheal intubation and aggressive mechanical ventilation);
- Clinical signs of respiratory distress;
- Oxygen requirement >30% and <50%; and
- A chest x-ray consistent with respiratory distress syndrome or transient tachypnoea.

Resource limitations meant some units have sought to identify a subgroup of babies who require more prolonged NCPAP or are at a higher risk of needing endotracheal ventilation. These units would transfer these babies early, rather than commence NCPAP with the purpose of avoiding transfer. The Barwon Region Paediatric group have found such babies to have the following characteristics:

Premature baby >32 weeks gestation and >1499g with early onset moderate respiratory distress syndrome who has:

- An increasing oxygen requirement that exceeds 35% in the first 12 hours
- Grunting respiration
- A chest x-ray consistent with respiratory distress syndrome

Contraindications

- Birthweight less than 1500g
- Gestation <33 weeks
- More than 24 hours old
- Insufficient medical or nursing resources
- $FiO_2 >50\%$
- Hypercarbia ($pCO_2 >50-55\text{mmHg}$) with respiratory acidosis ($pH < 7.28$)
- Apnoea (babies >1499g and >32 weeks gestation rarely have uncomplicated apnoea of prematurity as a reason to require NCPAP)

Technique for administration of NCPAP

There are a number of techniques available to deliver NCPAP. The commonest modes of delivery in Melbourne NICUs are the single prong technique, and various binasal prong techniques including Hudson prongs and the Infant flow driver. The specific details of nursing care required for these babies, such as positioning of the prong(s), maintenance of a clear nasal airway, ensuring the mouth is closed, etcetera, should be developed in consultation with a Level 3 unit.

Single prong refers to a cut down endotracheal tube that is placed in one or other nostril. In some units the distal end of the tube is sited 2½-3cm from the external nasal opening, whilst in other units the tube is advanced through to the naso-pharynx under direct vision. The tube is secured in the same fashion as for a naso-tracheal tube.

Hudson prongs are short, wider tubes that extend approximately ½-1cm into the nostrils. They have a specific fixation method and are quite challenging to manage from a nursing perspective.

It would be a substantial challenge to master the techniques required to correctly apply CPAP using Hudson prongs in nurseries where the technique is utilized fewer than 5–10 times per year. It is therefore recommended for simplicity, that the single nasal prong technique be used. There is now published evidence to support the use of Hudson prongs over single nasal prong in babies under 1250g. There have been no trials undertaken in larger babies comparing delivery methods.

The simplest delivery system for units that have a mechanical ventilator is outlined in Appendix A. Cheaper and equally effective CPAP generating systems are now widely available. Many of these are in use in tertiary units in Melbourne. Potential users should liaise with these units for further information.

The recommended level of NCPAP is 5-7cm H₂O.

The course of babies on NCPAP

Babies with respiratory distress on whom NCPAP is initiated are usually tachypnoeic, grunting and require mild to moderate inspired oxygen concentrations.

Signs of a positive response to NCPAP include:

- A reduction in the respiratory rate
- Stabilization or reduction in FiO₂
- Resolution of grunting
- Reduction in the degree of sternal and intercostal recession

Failure of NCPAP is judged by:

- An FiO₂ rising to above 0.5
- Respiratory acidosis – pH < 7.28 with a rising p_aCO₂ > 50mmHg
- Development of recurrent apnoea requiring stimulation
- Development of spontaneous episodes of significant desaturation (<90% for >20secs)
- Worsening sternal and intercostal recession/grunt/tachypnoea
- Agitation not relieved by simple measures (comforting, paracetamol)
- Development of a pneumothorax

All of the above require immediate consultation with a Neonatologist to discuss further management and retrieval.

Babies who require NCPAP for acute respiratory indications in the first 24 hours after birth, are kept nil by mouth until their respiratory rate is $<70/\text{min}$, the oxygen requirement is $<30\%$ and their work of breathing has improved significantly. Maintenance IV fluids are therefore required. If feeds cannot be commenced by 96 hours due to ongoing respiratory distress, parenteral nutrition will be required.

Some babies become quite agitated when on NCPAP. Narcotic analgesics should not be administered to babies on NCPAP because of the risk of respiratory depression. Simple analgesics such as paracetamol are appropriate.

Once a baby's respiratory rate falls below $70/\text{min}$, the FiO_2 is <0.3 and the baby is breathing with less effort, the CPAP should be reduced by $1\text{cm H}_2\text{O}$ every 6 hours until at $5\text{cm H}_2\text{O}$. A trial off is undertaken once the baby is stable for 6-12 hours on a CPAP of $5\text{cm H}_2\text{O}$ in an $\text{FiO}_2 < 0.3$ with a respiratory rate <70 . It is not uncommon to see a mild increase in respiratory rate as well as an increase in inspired oxygen concentration (for example, 25% to 35%) in the first hour after discontinuation of CPAP. This weaning strategy is pragmatic rather than exclusive.

Complications

- Pneumothorax
- Agitation
- Continued deterioration
- Nasal trauma (ulceration of the septum)

Monitoring

- CPAP system - tube(s) in the nose, nasal airway clear, mouth closed, neck slightly extended
- Continuous pulse oximetry
- Indwelling arterial line for intermittent blood gas estimation and continuous blood pressure monitoring is recommended for all babies where the FiO_2 is >0.4
- Standard cardiorespiratory monitoring including blood pressure
- Transcutaneous O_2 and CO_2 monitoring if available
- Regular inspection and assessment of the ventilatory circuit and equipment

Medical resources

Consultant Paediatricians involved in the administration of NCPAP should be:

- Experienced in the management of babies receiving NCPAP;
- Familiar with the indications and contraindications for NCPAP;
- Familiar with the expected course of babies supported on NCPAP; and
- Technically competent in the management of tension pneumothorax, and in the procedure of endotracheal intubation and delivery of mechanical ventilation

While most of these criteria may fall within the scope of regional and rural Consultant Paediatricians, it was agreed that standards of accreditation in relation to the prolonged administration of respiratory support should be developed. Regular participation in professional development activities within a tertiary NICU is essential.

Most Level 2 centres do not have 24-hour on-site medical staff expert in the resuscitation of the sick newborn who acutely deteriorates. The committee believes that where a baby is on NCPAP, such in-house expertise is essential, particularly to manage the baby who collapses or suddenly deteriorates.

Nursing staff

The availability of appropriately trained nursing staff is critical. Not only do staff need to be available when NCPAP is initiated, but there needs to be a guaranteed availability for the predicted duration of NCPAP. For the average baby, this would mean at least 48–72 hours.

Consideration needs to be given to the needs of other babies in the nursery. In addition, the most experienced nurse will generally be assigned to the baby on NCPAP, thereby reducing the available support to more junior nurses in the nursery.

It was felt that no nursery at present could provide such a guarantee 365 days a year. Therefore, in the absence of increased nursing resources, each case would need to be addressed individually. Centres where there is enthusiasm to use this therapy, recognize that a number of babies may have to be transferred out primarily because of lack of nursing resources. Given the difficulty in recruiting appropriately trained neonatal nurses to tertiary units, it is difficult to see how nursing resources could be adequately boosted in Level 2 units, even if increased funding was made available.

Nursing staff were most concerned that there were clear guidelines within their nursery detailing the indications and contraindications for NCPAP, as well as detailed guidelines on weaning and ceasing NCPAP.

Equipment

The equipment required, both specific and supportive, is similar to that used for stabilization prior to transfer of babies needing respiratory support. A complete list is provided in the Appendix A.

General issues

A number of points were made in relation to the long-term use of NCPAP in Level 2 nurseries:

- On a case by case basis, there needs to be agreement between senior medical and senior nursing staff that suitable resources are available for the predicted duration of the therapy.
- The availability of medical and nursing staff with recent experience in a NICU was considered important.
- Criteria for accreditation should be developed for both nursing and medical staff.
- The nurse to patient ratio should be 1:1.
- There should be appropriate pathology and radiology back up, both in-hours and after-hours.
- A detailed in-service education package should be developed that includes:
 - principles of NCPAP;
 - specific nursing management;
 - prong(s) care;
 - prevention, diagnosis and management of blocked prong(s);
 - strapping and changing prong(s);
 - understanding and problem solving in relation to equipment associated with delivery of NCPAP; and
 - review of specific procedures in relation to complications, for example pneumothorax
- Exchange programs that allow Level 2 nursing and medical staff exposure to the tertiary unit environment are essential.
- Units are encouraged to undertake research and quality improvement activities in this area.
- Standardised data collection and audit is essential.

Appendix A

Equipment required for the administration of nasal continuous positive airway pressure (NCPAP) in level 2 hospitals

Thermal maintenance

- Resuscitaire with servo controlled radiant heater
or
- Incubator

Mechanical ventilator system

- Continuous flow mechanical ventilator set in the CPAP mode with high and low pressure, loss of power and gas alarms
- Humidifying chamber
- Sterile water (bottle or bag and feed set)
- Ventilator tubing
- Temperature probe for the circuit
- Air and oxygen outlets
- Alternatives include "bubbly bottle" systems or the Infant flow driver

Monitoring equipment

- Cardio-respiratory monitor
- Pulse oximeter
- Transcutaneous monitor (if available)
- Non-invasive blood pressure monitor
- Equipment for invasive blood pressure monitoring
- Equipment for collecting arterial blood gases
- Transilluminator for rapid diagnosis of pneumothorax

Equipment for inserting a modified endotracheal tube (ETT)

- ETT (cut to 5cm mark) size 3.0mm for infants ≤ 2 kg
3.5mm for infants > 2 kg
(Hudson cannula or a CPAP Driver are other methods of NCPAP administration)
- Cotton tie
- Clean scissors
- 2 'sleek' tape (or similar) trousers
- 1 elastoplast tape slit longitudinally in middle for nose and tube
- Cotton swab sticks
- Benzoin Compound Tincture
- Suction apparatus
- Fg 5 and 8 suction catheters
- Lubricant
- Laerdal bag / Neopuff and face mask
- Intubation equipment

Equipment for gastric decompression

- Fg 8 orogastric tube
- Cotton tie
- Strapping eg. Blendaderm cut to a trouser
- Container to collect gastric drainage
- 10mL syringe

Resuscitation equipment

To be kept at the bedside at all times:

- Suction apparatus
- Suction catheters Fg 5, 6 and 8
- Intubation equipment
- Hand ventilation system and face mask (Laerdal, Neopuff or anaesthetic bag)
- Thoracentesis equipment: 21 gauge butterfly needle
 - 3 way stopcock
 - 10 or 20mL syringe
 - alcohol swab
 - sterile cotton swab
- Equipment for inserting an intercostal catheter (see *Stabilization and Transport of Newborn Infants and At-Risk Pregnancies* 1998, Melbourne: NETS page 53)

Documentation

- Observation chart with provision for recording in addition to vital signs:
 1. FiO₂
 2. CPAP
 3. Gas flow rate
 4. Water level in humidifying chamber
 5. Humidifier and circuit temperature