GUIDELINE

Ventilated Neonate: Nursing Care of

Scope (Staff):	Nursing and Medical Staff
Scope (Area):	NICU KEMH, NICU PCH, NETS WA

Child Safe Organisation Statement of Commitment

CAHS commits to being a child safe organisation by applying the National Principles for Child Safe Organisations. This is a commitment to a strong culture supported by robust policies and procedures to reduce the likelihood of harm to children and young people.

This document should be read in conjunction with this disclaimer

Contents

Aim

To provide guidance on the nursing care and management of a ventilated infant.

Risk

Failure to follow structured and standardised nursing care and management of the ventilated neonate may increase the risk of ventilation acquired complications and the incidence of adverse events.

Key points

- Nursing staff must complete specific ventilation education and training and be deemed competent to care for the ventilated neonate.
- Use this guideline in conjunction with:
  - Ventilation: Conventional
  - High Frequency Jet Ventilation
  - High Frequency Oscillation Ventilation
  - Intubation
- Ventilators differ at KEMH and PCH
  - KEMH – Fabian (Conventional and HFOV)
  - PCH – Draeger VN500 (Conventional and HFOV)
  - HFJV - Bunnell Life Pulse High Frequency Jet Ventilator (both sites)
  - SensorMedics ventilator (HFOV) (both sites)

Complications and Adverse Events associated with mechanical ventilation (MV)

Failure to manage and respond to airway obstructions in infants receiving mechanical ventilation can result in severe adverse outcomes, including brain injury, myocardial injury, airway trauma, and death.

- Infants on MV can deteriorate if rapidly. The **DOPE** acronym is a standardised method for recognising potential causes and responding in a structured order.
- DOPE (Displacement, Obstruction, Pneumothorax, Equipment)
- Refer to Recognising and Responding to Clinical Deterioration Clinical Guideline

Complications and Adverse Events associated with MV

- Ventilator Acquired Pneumonia (VAP)
- Barotrauma
- Chronic Lung Disease
- Pulmonary Interstitial Emphysema (PIE)
- Subglottal Stenosis
- Retinopathy of prematurity
- Unplanned extubation
- Pressure injury/Trauma to the mouth/nose/airway
- Oral aversion
- Obstruction
- Pneumothorax

1. Shift to Shift Nursing Handover

- Document on MR489.00 at the commencement of the shift and when any changes are made:
    - Ventilator mode and settings in red
    - Displayed temperature of the humidifier (circuit temperature)
    - ETT size, type (cuffed/non cuffed), position and integrity of taping (SLAM D), and any measurable leak.
- Check emergency resuscitation equipment is present and working
    - Bag-valve-mask with appropriately sized mask and PEEP valve
    - Suction, tubing and catheter. Suction settings:
        - 50-80 mmHg - infant < 1000 grams.
        - 80-100 mmHg – infant > 1000 grams
    - Location of nearest resuscitation/intubation trolley. See Resuscitation: Equipment and Trolley Checking
    - Chest aspiration emergency kit
    - Neopuff (T-Piece Resuscitaire)
        - PEEP should be set the same as the current PEEP setting on the ventilator
        - PIP should be 30 for term and 25 for preterm infants

2. Ventilator Checks

- Ventilators must be plugged into the Uninterrupted Power Supply (UPS)
- Ventilator circuits should be kept tangle free and separate from IV fluid tubing and monitoring equipment for easy access in the event of an emergency.
- Ventilator circuits and closed suction units are changed as required e.g. if visibly soiled (secretions) or malfunctioning. Ventilators should be stripped, cleaned and set up with new circuits, 6-8hrs post extubation.

- Viral filters must be used for infants with airborne respiratory viral infections. Refer to Appendix 3: Viral Filter Placement

3. ETT Securement and Position

- Secure the ETT immediately after Intubation to prevent dislodgement.
- Medical staff to document the procedure on the Intubation Extubation Record MR493. Perform a chest x-ray after intubation to verify the ETT position and review the lung fields.
- If ETT position requires altering after CXR medical staff to document changes on MR493 and add note in the medical record.
- Nursing staff to inspect and document ETT position and taping integrity HOURLY on MR489.00 (Neobar® or brown tape) and complete Neonatal Endotracheal Tube Nursing Checks (MR489.00) each shift noting any changes made to the ETT taping, reintubation or change in skin integrity.
- Utilise the SLAM D acronym to assist in a standardised assessment method. (Secretions, Length, Attached, Moveable, Done Correctly).
- **Re-taping should be performed as an urgent 2-person procedure if the securement is compromised/loose.** Inform the shift coordinator and medical team prior to re-taping. 1 person MUST be a neonatal trained nurse.
- All **unplanned** extubations **MUST** be entered as a clinical incident in Datix CIMS and in the medical record.

4. Monitoring, Alarm Limits and Settings

- Monitor continuously with alarm limits set and document vital signs and delivered ventilator parameters hourly on MR489.00 -
- Perform blood gases as ordered, including 20-30 minutes after a ventilation parameter change.
- Adjust monitor/ventilator alarms as per tables.

Alarm Limits Settings	
Heart Rate	100-200 for ETT ventilated/CPAP infants
TcPO2	50-90 mmHg
TcPCO2	30-60 mmHg
TCM – temp	44ºC – may be ↓ to 42ºC if infant is <27/40 & fragile skin
TCM – site time	Usually 4 hrs – ↓ 2hrs if <27/40 and <2 wks old/fragile skin
SaO_2 (Half hourly)	Infant <37wks 90–96%, Infant >37wks 93-98% Infant in room air: Upper limit SaO2 100%
Blood Pressure	Mean B/P of 35 - 50 mmHg. Depending on gestation
ETCO2	End Tidal Capnography Monitoring (ETCO2)

Adjust minute volume alarms as follows:
Tidal volume = weight x 4ml
Minute volume = tidal volume x rate
Ideal minute volume is 0.2 – 0.3 L/Kg/min
Upper minute volume alarm:
0.36 L/min x baby's weight
Lower minute volume alarm:
0.16 L/min x baby's weight
Example:
Baby's wight = 1.5 Kg
Upper MV alarm limit = 0.36 L/Kg/min x 1.5 Kg = 0.54 L/min
Lower MV alarm limit = 0.16 L/Kg/min x 1.5 Kg + 0.24 L/min

Factors affecting minute volume	
High MV	**Low MV**
↑ lung compliance	↓ lung compliance
↓airway resistance	↑ airway resistance
↑ frequency	↓ frequency

5. Airway Assessment

- Assess the infant's colour, perfusion, tone, activity, pain/comfort and general appearance at admission, Shift to Shift Handover, and after re-intubation/re-taping, to give a point of reference if the infants condition changes.
- Observe synchrony, adequacy and symmetry of chest expansion
- Auscultate quality of breath sounds and note respiratory rate / effort each hour and if sustained or frequent desaturation or bradycardia.
- Note and document if there is a significant leak around the endotracheal tube. Air leaks may be significant if ventilation cannot be optimised. Notify medical staff and document.

6. ETT Suctioning and ETT Aspirate

- ETT suction is performed to maintain a patent airway and optimise oxygenation and ventilation through the removal of visible airway secretions or audible secretions in the chest or endotracheal tube. Routine suction should be avoided.
- ETT suction may also be needed after clinical deterioration i.e.: decrease in SaO2, bradycardia, altered air entry, chest wall movement, decrease in tidal volume, coarse or decreased breath sounds, deterioration in blood gas values.
- ETT aspirate for MC&S is required routinely for all intubated and ventilated infants each Monday (KEMH only). Complete ETT suctioning for routine MC&S prior to commencement of cares, or repositioning.

  - ETT Aspirate may also be ordered by neonatologist or clinical microbiologist to assist in diagnosis (MC&S or viral studies).

- Adhere to VAP prevention practices when attending to ETT Suction.

Equipment

- Neopuff® with appropriate size mask
- Ballards closed-system suctioning device
- Sodium Chloride 0.9% 10mL – for flushing of catheter post suction.
- 3mL leur slip syringe
- Wall suction settings:
  - 50-80 mmHg - infant < 1000 grams.
  - 80-100 mmHg – infant > 1000 grams

Procedure

ETT suction in stable infants is a 1-person standard aseptic technique. The operator must stand on the side of the ventilator to be able to adjust ventilator settings quickly if necessary.

In unstable infants and all infants on HFO/Jet Ventilation, ETT suctioning is a 2-person standard aseptic technique. The assistant is to stand by the ventilator with the operator on the opposite side.

See CAHS Hand Hygiene and CAHS Aseptic Technique Policies.

ETT Suctioning Steps
1. Perform oropharyngeal suction (if required) prior to ETT suction.
2. Position the infant appropriately prior to commencing. Turning the infant's head from side to side during suction can occlude the jugular vein causing increased intracranial pressure, this practice should be avoided.
3. Routine use of saline is not required unless secretions are thick/tenacious, 0.1-0.2mL N/Saline can be instilled as lavage prior to suction. Clean access port with 2% Chlorhexidine/ Alcohol swab prior to use. Discard saline ampoule and syringe after use.
4. Consider turning off continuous milk feed prior to procedure to reduce the risk of milk aspiration
5. Increase FiO2 by 5-10% prior to suctioning (if appropriate).
6. Open the Ballard suction valve, measure depth required. End of ETT + 5cm. Correct measurement prevents deep suctioning/mucosal damage

ETT Suctioning Steps
7. Insert catheter to the predetermined length, apply suction and support the ETT whilst withdrawing the catheter. This should take no longer than 10 seconds to minimise the risk of cerebral and pulmonary vasoconstriction.
8. Observe the secretions through the secretion viewing window
9. Auscultate the chest; assess the need for further passes of the catheter
10. On completion of suction, apply suction whilst instilling 2mL N/Saline through the access port to flush the catheter.
11. Close Ballard suction valve.
12. Discard gloves and perform hand hygiene
13. Recommence continuous milk feed (if paused)
14. Document the procedure on MR489.00 noting tolerance of procedure and findings.

7. Handling and Positioning

- Plan and coordinate care to coincide with procedures where appropriate e.g. blood sampling, nappy changes, mouth care, repositioning, unless a change in the condition of the infant requiring intervention. Aim for periods of 4-6 hourly between handling to conserve energy for growth and development.
- Positioning of ventilated infants is a two-person procedure. Review ETT position and taping integrity prior to moving the infant. Prioritise re-taping of the if the securement is compromised. Document changes in positioning on the observation chart MR489.00.
- Maintain a neutral thermal environment to promote optimal temperature control.
- Ventilated patients should be nursed on a pressure relieving mattress or sheepskin to assist with pressure area care
- Assess the infant's level of comfort/pain assessment and alert the medical staff if sedation/analgesia is required.

8. Ventilator Acquired Pneumonia (VAP)

Ventilator Acquired Pneumonia is inflammation of the trachea/lung in patients who are or have been mechanically ventilated. It is not present in the patient prior to intubation and most commonly develops 48 hours after ventilation therapy.

This hospital-acquired complication is a significant concern in intensive care units due to its potential to increase patient morbidity, mortality, length of stay and overall healthcare costs. VAP is considered to be the second most common cause of nosocomial infection in neonatal intensive care patients.

VAP Prevention

- Strict hand hygiene is required before and after handling respiratory equipment and staff are to wear gloves and follow standard precautions when handling ventilator condensate, respiratory and or oral secretions. See CAHS Hand Hygiene and CAHS Aseptic Technique Policies.
- Intubation procedure
  - Open all sterile intubation equipment on to a **sterile towel**. Do not place intubation equipment on the bedding and replace if contaminated
  - Use a new ETT with each intubation attempt
- Provide regular oral care with sterile water / maternal colostrum
- Change the ventilator circuit only if visibly soiled or malfunctioning

VAP Prevention Bundle

Elevation of Bed Head
All babies who are clinically able will have the head of the bed elevated as close to 15 - 30º as possible. Bed elevation correlates with significantly less micro-aspiration of stomach contents therefore reducing the risk of aspiration associated pneumonia. Exceptions to this are noted in some neurological conditions and post shunt insertion. Check with the medical team before elevating the bed head.
Oropharyngeal Suction
Oropharyngeal Suctioning is to be done prior to ETT suctioning, ETT strapping, infant cares and repositioning, extubation and re-intubation. Secretions that form in the sub-glottic area are rapidly colonised with pathogenic bacteria. Introduction of oropharyngeal suctioning before repositioning or suctioning of the ETT reduces the risk of aspirating pooled oropharyngeal or nasopharyngeal secretions.
ETT Suctioning
ETT Suctioning should ONLY be done on an as need basis utilising an in-line - suction device. The use of Normal Saline should be avoided if possible as it does not thin or assist in the mobilisation of mucous, can adversely affect arterial and global tissue oxygenation and can dislodge bacterial colonies. If saline is to be used during suctioning and/or flushing of the inline suction set, it should be as single, once only use of saline vials and syringes. Discard vial after use.
Neotech Little Suckers
Neo-tech Little suckers, used for oral and nasal suctioning in the ventilated patient should be changed every 24 hours as per product recommendations. Each patient should have the Neo-tech little suckers labelled with their name and date and time of first use.

Related CAHS internal policies, procedures and guidelines

Cuffed ETT Management

End Tidal CO_2

Extubation: Planned and Unplanned

High Frequency Jet Ventilation

High Frequency Oscillation Ventilation

Intubation

Pneumothorax

Sepsis:Neonatal

Transcutaneous Carbon Dioxide Monitoring

CAHS Hand Hygiene

CAHS Aseptic Technique

References and related external legislation, policies, and guidelines

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Appendix 1: DOPE (Displacement, Obstruction, Pneumothorax, Equipment)

D: Displacement

Clinical presentation:

- Sudden clinical deterioration with decrease in heart rate and SaO2.
- Loss of chest wall movement with ventilation and/or absent or ↓ breath sounds on auscultation.
- Increase in leak noted by ventilator.
- Loss of end tidal CO2 detection.
- Audible cry, gasping, agitation / restlessness
- ↓Perfusion /Cyanosis
- Hypoxemia
- Abdominal distension

Management

- Press urgent assist bell to alert medical team to promptly attend and manage the patient, commence airway support
- Check ETT position – cm at the lips for displacement/dislodgement
- Attach CO2 detector e.g. pedicap to verify
- If dislodgement/extubation is suspected, see Extubation: Planned and Unplanned
- Complete CIMS form: mandatory
- Update parents and clearly document event in medical record

O: Obstruction

The ETT may be in the correct position but obstructed. This could be internal e.g. secretions, blood, an incompletely withdrawn suction catheter or surfactant. A kink in the tube, compression from a fixation device or a displaced ETT at the carina of the trachea can also present as obstruction.

Clinical presentation (suspected)

- Increased WOB.
- Air entry reduced or absent.
- Increasing ventilatory requirements.
- Fluctuation in vital signs falling saturation levels and bradycardia.
- Loss of end tidal CO2 wave form and reading if complete obstruction or a sudden significant rise in etCO2 reading if partial blockage (Note: there may be other causes for a sudden rise in etCO2 e.g. a pneumothorax).

Management

- Attempt ETT suctioning
- Check for kink in ventilator tubing

- Inform medical staff.
- Consider removal of ETT

P: Pneumothorax

Results from the over distension and subsequent rupture of an alveolus. Air then travels up the vascular sheath into the mediastinum and into the pleural cavity.

Clinical Presentation:

- Sudden deterioration in the infant's clinical state
- Marked respiratory distress
- Decreased air entry on the affected side.
- Cyanosis/fall in the oxygen saturations.
- Tracheal deviation to the contralateral side of the pneumothorax.

Management

- Press urgent assist bell to alert medical team to promptly attend and manage the patient, commence airway support
- Transillumination of the chest with an intense beam of light is a useful method of making the diagnosis in an emergency.
- Confirmation by X-ray only if the infant is stable. If the infant is unstable, immediate draining of air is imperative. Refer to Needle Aspiration of the Chest

E: Equipment

Equipment malfunction can cause significant complications and sudden deterioration. These can include but aren't limited to:

- Mechanical failure of ventilator
- Gas supply failure and/or Electrical failure
- Kinked tubing
- User error

Clinical Presentation:

- Sudden deterioration: ↓HR, ↑ PaCO2, ↓BP, ↓SaO2, ↓PaO2 and cyanosis
- Signs of slow deterioration include: ↓ PaO2, ↓↑BP, ↑PaCO2, ↓ SaO2

Management:

- Press urgent assist bell to alert medical team to promptly attend and manage the patient, commence airway support
- Disconnect from the ventilator and neopuff (or bag) manually
- Check for ventilator malfunction, interruption to gas supply
- Check other equipment, lines, tubing etc

Appendix 2: SLAM D – (Secretions, Length, Attached, Moveable, Done Correctly

Structured assessment approach to assessing the integrity and securement of endotracheal taping

S: Secretions

- Are tapes or adhesive soiled in any way by oral or nasal secretions?
- Are tapes visibly wet?
- Has medication or mouthcare moistened the tapes?

L: Length

- Is the endotracheal tube at the correct position as documented and seen on X-ray?

A: Attached

- Is the tape/adhesive fully attached to the patients face?
- Has the comfeel lifted?
- Have the tapes lifted?
- Are the tapes around the ETT secure?

M: Moveable

- Does the ETT move more than 0.5cm in or out?

D: Done Correctly

- Has the correct procedure for securement been done as per the guidelines? Including anchor?
- Has the correct sized neobar been used and attached correctly

Appendix 3: Viral Filter Placement

- Place filter in the expiratory limb
- To be replaced 24hrly or if wet