Care of Ventilated Infant in Newborn Intensive Care Unit (NICU)

Procedure Responsibilities and Authorisation

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Procedure Review History

Version	Updated by	Date Updated	Description of Changes
4	Chad Pagdanganan	July 2017	3-yearly update
3	Joyce Mok	2014	Update
2	Joyce Mok	2010	Update

Care of Ventilated Infant in Newborn Intensive Care Unit (NICU)

1. Overview

1.1 Purpose

To provide safe assisted ventilation which facilitates optimum gas exchange to correct hypoxemia, maintain adequate alveolar performance and decrease work of breathing.

1.2 Scope

For neonates

1.3 Patient Group

Neonates and infants in NICU

1.4 Definitions

Acrocyanosis	A condition marked by bluish or purple colouring of the hands and feet, caused by slow circulation.
Mechanical Ventilation	A type of respiratory support that uses mechanical assistance via endotracheal (ET) tube/tracheostomy for infants with respiratory failure, pulmonary insufficiency, need for surfactant administration, severe apnoea and bradycardia episodes cardiovascular support, neurologic disorder, chemical or medical respiratory depression, and pre/post-surgery. The main goal of mechanical ventilation is to provide adequate oxygenation and ventilation with the most minimal ventilation possible.
Neonatal Emergency Medication Sheet (NEMS)	The emergency medication chart for each infant in Level 3 in which dosages of resuscitation and intubation drugs are pre-calculated based on infant's birth weight or current weight.
Medical staff	The medical staff in NICU includes CNS (Clinical Nurse Specialist), NNP (Nurse Practitioner Neonatology), Registrar and Paediatrician.

2. Clinical Management

2.1 Competency required

Registered nurse who has completed Level 3 (Intensive Care) ventilator orientation

2.2 Equipment

- Ventilator & gas source
- Sterile water
- Emergency equipment
  - Suction equipment
  - Emergency trolley
  - Neonatal Emergency Medication Sheet (NEMS)
  - Neopuff™ + appropriately sized mask
  - Anaesthetic bag + pressure gauge (in each Emergency trolley or by the bedside as needed)
  - Stethoscope

2.3 Procedure

Preparations

- Explain procedure to baby's parents and family to allay their fears and anxiety.
- Ensure that the emergency equipment is functioning and always readily available. Check the emergency trolley each shift, and after use and replace used items.
- Ensure NEMS is available and current

Care of the ET tube

a) Position of the ET tube

- Apply duoderm as a base tape to protect the infant's skin before securing the ET tube at the correct position
- Use sleek tape for nasal tube or Elastoplast for oral tube.
- After confirming the ET tube by x-ray, document the length of ET tube at the nares/lips, on NICU intubation chart.
- Cut the end of the tube with appropriate length to reduce dead space.
- Calculate the length of the suction catheter and document on the NICU intubation chart.
- Refer to the infant's intubation chart to note the length of the ET tube in case the ET tube dislodge.
- Observe for any evidence of ET tube slipping, moving in and out, or tape loosening.
- Request medical staff to re-tape as necessary to prevent accidental dislodgement or extubation.

- Closely observe the position of the ET tube, e.g. more than 1cm from its desired position may indicate extubation or placement in the right main-stem bronchus.
- Position the infant in a supine/lateral/prone position depending on clinical condition of the infant, with the head in a neutral midline position.
- Be aware that the tube moves with the chin and can move several centimetres with head flexion/extension.
- Use a neck roll or folded flannel to support the ET tube to avoid the tube to be dragged.
- Two nurses are required when turning the infant, or lifting for an x-ray.

b) Maintain patent airway

- Position the infants with head in neutral midline position
- Maintain airway humidification, and record temperature of inspired gas as shown on the temperature panel on the humidifier, which is pre-set achieve 36.7 ºC.
- Provide the correct humidification temperature to prevent complications due to under/over humidification, and to maintain the integrity of the airway mucociliary function.
- Leave the gastric tube on free drainage if baby is nil by mouth and aspirate every four hours to relieve gaseous distension of the abdomen and to assess gastric contents.

c) Suctioning of the ET tube

- Check suction equipment at the beginning of each shift.
- Suctioning is not a routine practice; the need to suction should be assessed on an individual basis.
- The amount of secretions will be disease related, e.g. infants with early stage of respiratory distress syndrome (RDS) and those with most types of congenital heart disease will have minimal mucous and will require less suctioning in the initial 1-2 days.
- Delay ET suction for 60 minutes post administration of Curosurf, if possible, to ensure absorption of the surfactant.
- Criteria for suctioning includes:
  - Evidence of secretions (audible/visible)
  - Changes in vital signs
  - Changes in oxygenation SpO_2 or pCO_2
  - Restlessness, irritable and agitated
  - Decrease air entry
  - Radiological change such as lung consolidation
- Stop continuous feeding before suctioning.

- Use saline lavage as indicated because saline can cause deterioration if used in excess.
- NB: Loose secretions may not need saline.
- Some infants may require an increased fraction of inspired oxygen ($Fi0_2$) before and after suctioning to maintain SpO_2 and prevent hypoxia. However, hyperoxygenation is not a routine practice for every infant.
- In-line suction catheter is used to allow ventilation to continue because the use of in-line suction catheter is associated with a decreased risk of infection and smaller changes in the cerebral blood flow.
- Change in-line suction catheter every 24 hours
- Use of infant's NICU intubation chart to ensure correct measurement of the length of suction catheter. Suction catheter should not advance further than the distance of the ET tube.
- Ensure suction pressure is set at 80-100mmHg.
- Limit each suctioning duration to 5-10 seconds. The suction catheter should be withdrawn slowly at a consistent speed until the black mark on the catheter appears in the viewing window. It should not be pulled straight out in one quick motion.

Rationale: To reduce the risk of complications such as hypoxia, bradycardia, barotraumas, changes in blood pressure, alternations in cerebral blood flow, intraventricular haemorrhage, tracheal damage, atelectasis, infection, and pneumothorax.

Note: Occasionally if very thick secretions cannot be cleared with in-line suction two person open suction procedure may be required. The assisting nurse will disconnect the infant from the ventilator and instil lavage if indicated, reconnects briefly. The nurse then uses suction catheter to suction down ET tube using the predetermined length to clear secretions. The infants may need to be bagged in between suctioning.

d) Monitoring and documentation

- Document and report any changes on the infant's condition to the medical staff
- Observe the general state of the infant
  - Awake, crying if ventilated
  - Assess infant's pain and sedation status using Neonatal Pain Agitation and Sedation Scale (N-PASS)
- Colour: Pallor, Cyanosis, Jaundice

  Note: Acrocyanosis is a normal finding among new born infants
- Mouth and nose

- Secretions: amount colour, and consistency

- Respiratory status
  - Is the baby comfortable while breathing?
  - Signs of respiratory distress: retractions, nasal flaring or indrawing.
  - Respiratory rate
  - Chest movement: symmetrical?
  - With accidental extubation, chest movement may not be seen or may be decreased
- Listen to breath sounds

Rationale:

- To determine differences in the left and right lung fields, e.g. suspecting pneumothorax.
- To detect any slipping of the ET tube into the right bronchus
- To ensure ET tube is in the correct position after repositioning of the infant
- To assess effectiveness of intervention, e.g. after suctioning
- Bilateral and equal air entry on auscultation?
- Fine course crackles?
- Abnormal sounds?

e) Continuous monitoring and hourly recording

i) Cardiorespiratory monitor

ii) Continuous blood pressure (BP) if arterial line is available, or cuff BP as ordered by the medical staff, e.g. 1-4 hourly

iii) SpO_2 monitoring

iv) Alarm limits set approximately according to the infant's gestational age and age.

f) Blood gas measurement

i) Measure blood gas (arterial/capillary) 2-4 hourly as indicated, or 20-60 minutes after change of ventilator settings or after administration of volume, e.g. 0.9% sodium chloride

ii) Arterial blood gas is more reliable in obtaining an accurate pO_2 value. When arterial line is not available, capillary samples are useful for measuring pCO_2 and pH values.

g) Adjusting FiO_2 level:

When adjusting FiO_2, make small changes at a time, e.g. 5-10%, and allow time for the infant to respond to reduce the risk of fluctuation of FiO_2 to cerebral and retinal blood flow.

h) Care of infants with peripheral arterial line (PAL) or umbilical arterial catheter (UAC) as per NICU procedures

i) Alarms must be turned on all the time to detect complications, e.g. haemorrhage, disconnections, occlusions or deterioration

ii) Observe hourly the colour and perfusion of the toes/fingers distal to the insertion site of PAL, skin breakdown, and infiltration of the site.

iii) Observe the perfusion and colour of buttocks during nappy change for baby who has UAC insitu and more frequently if change is noted in the perfusion or colour of the lower limbs

iv) Calibrate (i.e. zero) the transducer at every shift to ensure proper functioning of the arterial line/UAC

i) Monitor temperature:

i) Check and record the infant's axillary temperature 4-hourly or more often as required, e.g. 1-2 hourly, to detect temperature instability.

ii) Record and report if peripheral temperature <35 ºC.

Monitor any changes in the peripheral temperature as per NICU procedure. Changes in peripheral temperature may be due to handling, significant event or deterioration of infant's condition resulted in reduced cardiac output and poor peripheral perfusion.

iii) Check and record infant's BP, core temperature, incubator/radiant warmer setting, position of the temperature probes to ensure correct probe positioning and accurate measurement.

j) Maintain accurate fluid balance record

i) Measure urine volume, e.g. urine output is poor if <1ml/kg/hr.

ii) Record bowel motion including amount and characteristics.

iii) Monitor blood sugar level (BSL) and lactate

k) Provide developmental supportive care according to Lippincott procedures.

Rationale:

i) To facilitate neurological development, minimise stress and pain

ii) To maximise infant's ability to cope with and recover from clinical procedures.

l) Preventive measures:

i) Reduce handling time where possible by evaluating all aspects of care.

ii) Group cares based on the infant's condition and tolerance to handling

iii) Facilitate family-centred care by negotiating care with the parents according to stability and clinical condition of the infant.

iv) Teach parents about the signs and symptoms of infant stress and comfort measures that they can provide.

v) Apply cue based cares - wait for the baby to wake or demonstrate need then perform grouped care.

vi) Provide pain relief, e.g. give dextrose gel prior to invasive procedure to reduce pain responses.

vii) Reduce external stimuli from lighting and noise levels.

viii) Use positioning aids, e.g. nesting, to provide containment and maintain infant in a flexion position.

ix) Use skin barrier, e.g. duoderm to protect skin.

x) Document infant's behavioural cues.

m) Behavioural measures:

i) Use facilitated tucking to position infants during painful procedure: hand swaddling technique that holds the infant's extremities fixed and contained close to the trunk.

ii) If appropriate and safe to perform, provide parents to have skin-to-skin cuddling with their infant who is a stable ventilated infant with no umbilical arterial line.

Rationale:

To promote infant's physiological stability and temperature control and to enhance maternal hormonal response that facilitates breastfeeding.

n) Sedation:

i) Administer sedation as prescribed, e.g. fentanyl, morphine, midazolam, or bolus dose of phenobarbitone.

ii) Monitor BP continuously or hourly cuff BP for infant receiving morphine due to the potential adverse neurologic outcomes that may exist in ventilated infants who receives morphine and has hypotension. Report any changes in BP to medical staff.

iii) Observe and record the effectiveness of sedation, e.g. vital signs within normal range, infant is settled and not fighting against the ventilator, and stable oxygen saturation and FiO_2.

iv) Observe for side effects of medication:

a) Fentanyl: Adverse effects include respiratory depression, chest wall rigidity, dependence, and urinary retention.

b) Morphine: Adverse effects include respiratory depression, hypotension, bradycardia, transient hypertonia, ileus, delayed gastric emptying, urinary retention, dependence and seizures.

o) Emergency management: Use Neopuff™ with blender or the manual breath button for bagging.

Rationale:

Bagging the infants with the Neopuff ™

i) Allows the delivery of controlled inspiratory pressure during Intermittent Positive Pressure Ventilation (IPPV).

ii) Bagging of infant using manual breath button delivers IPPV at current ventilator setting.

2.4 Potential Complications

ET tube dislodgement or extubation

Observe for signs of extubation

- Sudden deterioration like apnoea, bradycardia, and desaturations.
- Audible crying
- Decreased chest movement
- Breath sounds in the abdomen upon auscultation
- Change in skin colour- cyanosis
- Abdominal distension

Hypoxia

Bradycardia

Barotraumas

Changes in blood pressure

Alternations in cerebral blood flow

Intraventricular haemorrhage

Tracheal damage

Atelectasis

Infection

Pneumothorax

3. Evidence Base

3.1 References

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- Clinical Practice Committee (2015). Suctioning: Endotracheal Suctioning. *Newborn Services Clinical.* Retrieved on Oct 19, 2017 from http://www.adhb.govt.nz/newborn/Guidelines/Respiratory/Suction/SuctionETT.htm

3.2 Associated Waikato DHB Documents

- NICU Drug Manual
- NICU Nursing Procedure: Arterial lines: Nursing management and sampling and removal (1638)
- NICU Nursing Procedure: Arterial Line: Catheterisation and setup of Umbilical (UAC), peripheral arterial (PAL) Catheter in NICU (1637)
- NICU Nursing Procedure: Peripheral temperature monitoring (2895)
- NICU Nursing Procedure: Neonatal pain and sedation: Assessment and nursing management (1684)
- Lippincott Procedures: Skin-to-skin contact, initiating intubated patient, neonatal
- Lippincott Procedures: Skin-to-skin contact, terminating an encounter, intubated patient, neonatal
- Lippincott Procedures: Developmental support, neonatal
- Lippincott Procedures: Endotracheal suctioning, intubated patient, neonatal