MAQUET SERVO-N VENTILATOR- NURSING CARE FOR INVASIVE MODE

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INTRODUCTION

Neurally Adjusted Ventilatory Assist (NAVA) is a mode of mechanical ventilation intended for use in spontaneously breathing patients. As with all ventilation it is important to manage the machine and the patient with skill to ensure effective ventilation is delivered.

1. AIM

- To ensure neonates are given appropriate and safe support on the ventilator.

2. PATIENT

- Neonates

3. STAFF

- Medical and nursing staff

4. EQUIPMENT

- Maquet SERVO-n Ventilator- set up and ready to use (Refer to Maquet Servo-n set up protocol)

5. CLINICAL PRACTICE

1. Airway management
   a. ETT:
      i. Ensure the ETT is patent at all times. Suction using inline suction PRN using the guide in the table below. Keep spare suction catheters near to the baby also in case of inline suction failure. As a guide the suction catheter size should be twice that of the ETT size (eg. Size 3.0 mm ETT= 6 Fr suction catheter). Use short 10 Fr suction catheters to suction the mouth and nose (R 1). All secretions should be documented on the observation chart including amount, viscosity, colour and smell (R 2)

ETT SIZE	INSERTION DEPTH
2.0mm	Green, 16cms
2.5mm	Purple, 17cms
3.0mm	Double Red, 20cms
3.5mm	Double Yellow, 22cms
4.0mm	Double Black, 23cms

      ii. Ensure the ETT is secure at all times. Check taping is secure. Re-tape PRN with the help of another nurse. Inform medical staff if re-taping is required. Check tube placement at the beginning of your shift and with each turn/movement of the patient.

      iii. To calculate approximate ETT length use the formula below.
      Oral: Weight +6cms, **Nasal**: Weight +7cms.
      Or use the following "Neonatology Calculator" link on the NCC website:
      http://www.seslhd.health.nsw.gov.au/RHW/Newborn_Care/useful_links.asp
      Measure tube length in relation to the documented length on the observation chart using a tape measure (R 3)

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b. Chest X-Ray: All patients receiving invasive ventilation via an ETT should have a chest x-ray taken post intubation. ETT should be positioned between T1 and T3. Chest x-ray may then be used PRN and is not done routinely in this unit (R 4).

c. Air entry: Chest should be auscultated at the beginning of shifts, with cares, with suctioning, repositioning and as required (R 5).
d. The term 'DOPE' can be used to troubleshoot ETT problems: D=Displacement, O= Obstruction, P= Pneumothorax, E= Equipment failure.

2. Ventilation
    a. Check ventilation settings at the beginning of the shift and ensure they match those documented. Assess whether patient is adequately ventilated and that you understand the method being used. If you do not, seek advice/assistance from senior nursing staff, team leader, medical team or the education team (R 6).
    b. Consider the need for blood gas analysis (R 7).
    c. Ensure patient comfort (eg. analgesia, nesting, comfort holding, non-nutritive sucking).
    d. Change the disposable filter every 48 hours.
    e. Change the circuit weekly.
    f. Wipe down the ventilator daily with neutral detergent.
    g. Internal expiratory block only needs to be changed at the end of treatment when it has been used on an infected patient (eg. MRSA, Serratia, RSV). At all other times it can be reused as long as the additional disposable filter has been in situ for the duration of the treatment (R 8).

3. EDi catheter management
    a. Before an EDi catheter is passed use the calculation tool to assess size and length of tube and the length that it should be passed to. To find this on the screen touch NAVA and then calculation tool. Work through the steps on the screen. The ECG has tall P and QRS waves in the top leads and no P waves in the bottom leads. Correct placement means the P waves are pronounced on the top row of ECG, become less pronounced on the middle two rows (where the purple signal should be) until there is no P wave and dampened QRS waves on the bottom ECG row.
    If the signal is in the bottom portion of the screen this means the catheter is too HIGH. If it is at the top then too LOW. The arrow next to the chart will indicate the movement that needs to occur. If the EDi needs to move down then the arrow will indicate as so, vice versa for up.
    b. Catheters should be changed weekly (R 9) but if they fall out before the 7 day change they can be cleaned and re-inserted.

4. Observations
    All ventilated patients should be on continuous monitoring (R 10).

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5. Troubleshooting

Problem/ alarm	Response
EDi Catheter won't aspirate	Aspirating the EDi catheter may collapse the bore and this may be why no aspirate is obtained. They are, however, designed to be aspirated and so gentle adjustment should allow aspiration in the case of aspirate measurement. Positioning for all other feeds and gastric medication administration can be determined using the EDi catheter positioning screen.
EDi Catheter blocked	Due to the addition of an electrical wire/probe the EDi catheter has a smaller diameter lumen than the usual NG tube. This means that it can become blocked by thick viscous medications or thickened feeds. In this case it may be necessary to pass a second NG/OGT for the administration of these products.
Excessive leak	A leak of up to 60% is compensated for by the machine to 100% effectiveness. A leak up to 80% is compensated for by the machine up to 50% effectiveness. Leaks >80% cannot be guaranteed to deliver effective ventilation in invasive modes.
No patient effort	Ensure EDi is correctly positioned, if so then patient may be apnoeic in which case the backup rate will begin. Consider reducing the apnoea time if patient is not adequately supported in back up mode.
Gaseous Distension	Because of the smaller lumen and difficulty in aspiration, often there may be air trapping in the gut. In this case, it may be necessary to pass a second NG/OGT for aspiration of gas and gastric contents

6. Pain and Comfort
   Ensure patient is comfortable. Non-pharmacological (non-nutritive sucking, comfort holding and nesting) or pharmacological (sucrose, morphine, fentanyl, midazolam). Kangaroo care should be encouraged for ventilated babies.

7. Cares
   Cares can be conducted using individual assessment but generally 8 hourly. Resite skin probes 4-6 hourly. Observe for signs of skin breakdown from pressure sores.

8. Weighing and Procedures
   Patients can still be weighed whilst ventilated either on the Giraffe internal scales or the outside scales. Procedures can still be conducted in the crib. Both need to take care to ensure a stable and secure airway and need to be assessed on an individualised basis.

6. DOCUMENTATION

- Integrated Clinical Notes
- Observation Chart

7. EDUCATIONAL NOTES

- **EDi**
  Electrical Activity of the Diaphragm, measured in microvolts. It can be thought of as a respiratory vital sign. When the respiratory centre in the brain is stimulated it sends a signal via the phrenic nerve to the diaphragm muscle to stimulate contraction and subsequent respiration. When the

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muscle is stimulated it produces an electrical signal. The EDi Catheter reads this specific electrical signal in the diaphragm and we, the practitioners, are then able to assess how much or how little signal is being sent to the diaphragm to stimulate breathing. Maquet SERVO-n ventilator displays EDi as peak and minimum. EDi peak (also called EDi max) represents neural respiratory effort and is responsible for the size and duration of the breath. EDi min represents the spontaneous tonic (or baseline or resting) activity of the diaphragm in between the inspirations, which prevents de-recruitment (collapse) of lungs (alveoli) during expiration. Normal EDi Peak is 5-15. If EDi peak is >15, this means, a stronger signal is sent from brain to diaphragm to increase the size of the breath. This can be seen clinically as baby working harder with more inspiratory recessions. This means more ventilator support (more NAVA in case of NAVA mode) is required. If EDi peak is <5, this means weak signal is sent from brain to lungs indicating baby requires less support. Normal EDi min is probably <3. If EDi min is consistently ≥3, consider increasing PEEP to reduce the tonic activity of the diaphragm and to maintain FRC.

- **EDi Trigger**
  EDi trigger the minimum increase in electrical activity that triggers the ventilator. EDi trigger is usually set at 0.5microvaults and when the EDi reaches 0.5, NAVA is triggered to assist with the breath. If the EDi trigger is set too low, the ventilator responds to small EDi signals and converts them into small breaths. This prevents neonate from going into backup ventilation and may result in under-ventilation.

- **NAVA Level**
  Neurally Adjusted Ventilatory Assist. The NAVA supports the baby's breathing by responding to the electrical signal (EDi). If the NAVA level is set at 1.0 it will provide 1.0cm/H_2O for every microvolt detected. For example if NAVA is set at 1 and Edi Peak is recorded as 20, ventilator generates PIP of about 20 cm H_2O for that breath. When the EDi reaches a peak the breath and PIP will be held.
  The neonate determines the peak inspiratory pressure, inspiratory and expiratory times for each breath and respiratory rate.

- **Apnoea Time**
  This determines the amount of time the neonate can be apnoeic before ventilating in the backup mode. Although apnoea is typically defined as no respiratory effort for 20 seconds, it will be too long for small preterm infant to be apnoeic for 20 seconds before breath is given. Apnoea time is the maximum time the neonate will be without any ventilation. This is generally set at 1-5 seconds. Apnoea time of 5 seconds generally guarantees a minimum breaths of 12 breaths per minute. After 5 seconds of apnoea, neonate goes into back-up ventilation at the back-up rate. The next EDI signal will restart the 5 second apnoea timer again. Apnoea time can be reduced down to 1 second (minimum rate of 60 breaths/min). A neonate who remains apnoeic will ventilate at the pre-set backup rate in a pressure controlled mode. If the neonate is apnoeic and desaturating consider shortening the apnoea time and ensuring back up ventilation settings are suitable for individual neonate.

- **PRVC**
  <u>Pressure Regulated Volume Controlled (similar to PCAC+VG or SIPPV+VG).</u>
  Combines pressure and volume controls by delivering a pre-set volume, with a decelerating inspiratory flow, at a pre-set rate. Maintains the lowest possible constant pressure on inspiration to achieve a set volume. Inspiratory pressure will not exceed 5cm/H2O below the upper pressure limit (alarm limit).

ALERT: The alarm function is not only an alert that the ventilator is reaching a top pressure it is also a <u>regulation</u> of the pressure. Therefore to increase pressure delivery the alarm limit must be

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This is similar to the P Max function in the Drager VN500 Ventilators.
PEEP, Ti. Slope and trigger are set. All breaths are synchronised and the patient's own breaths are supported.

- **PC**
  Pressure control. (PCAC without VG)
  Pre-set inspiratory pressure is delivered at a pre-set respiratory rate, synchronised with the baby's breathing.PEEP, Slope, Ti, Trigger, Paw are all set. All breaths are synchronised and the patient's own breaths are supported.

- **SIMV (PRVC)**
  Synchronised Intermittent Mandatory Ventilation + Pressure Regulated Volume Controlled (similar to SIMV+VG)
  Combines pressure and volume controls by delivering a pre-set volume with a decelerating inspiratory flow at a pre-set rate. Maintains the lowest possible constant pressure on inspiration to achieve a set volume. Inspiratory pressure will not exceed 5cm/H2O below the upper pressure limit (alarm limit). This is similar to the PMax function on the Draeger VN500 Ventilator. PEEP, Ti. Slope and trigger are set. All breaths are synchronised, patients own breaths are unsupported.

- **SIMV (PC)**
  Synchronised Intermittent Mandatory Ventilation + Pressure Control (similar to SIMV without VG)
  Delivers a constant pressure over a pre-set Ti at a pre-set rate. Uses a decelerating flow. Volume delivery will change with lung compliance and resistance and is not regulated. All beaths are synchronised, patients own breaths are unsupported.

- **PS**
  Pressure Support
  Provides ventilator support for the patient's own breaths using a preset pressure with a decelerating flow.
  Turn PS to zero to ensure patients own breaths are unsupported in SIMV modes.

- **Invasive NAVA**
  Edi triggers breaths, pressures, volumes, Ti, Slope and adjust based on the neural signal read from the diaphragm. If there is no signal/ patient effort the ventilator will go into a back-up pressure controlled mode (PC).

8. RELATED POLICIES/PROCEDURES/CLINICAL PRACTICE LOP

- Maquet SERVO-n set up.
- NAVA Clinical Guidelines

9. RISK RATING

- Low

10. NATIONAL STANDARD

- CC – Comprehensive Care

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11. REFERENCES

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12. ABBREVIATIONS AND DEFINITIONS OF TERMS

ETT	Endo tracheal Tube	PIP	Peak inspiratory pressure
ICU	Intensive Care Unit	PRN	As necessary
MRSA	Methicillin Resistant Staphylococcus Areus	RSV	Respiratory Syncytial Virus
NCC	Newborn Care Centre	SIPPV	Synchroniseed Intermittent Positive Pressure Ventilation
NG	Naso gastric	Ti	Inspiratory Time
OG	Orogastric	VG	Volume Guarantee

13. RATIONALES

Rationale 1	To maintain airway patency and to minimise trauma to the mucosal areas.
Rationale 2	To observe for respiratory infections
Rationale 3	To prevent accidental extubation.
Rationale 4	To ensure correct tube positioning and chest expansion whilst not exposing patient to excessive radiation.
Rationale 5	To suction PRN and observe for dislodgement of secretions or ETT
Rationale 6	As a standard safety check and for the purposes of nursing observation
Rationale 7	To ensure adequate ventilatory support
Rationale 8	In accordance with infection control protocol
Rationale 9	To prevent infections.
Rationale 10	To observe and record patients physiological status

14. AUTHOR:

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