



HEALTH HOLDING

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<b>Department:</b>	Neonatal Intensive Care Unit (NICU)		
<b>Document:</b>	Multidisciplinary Policy and Procedure		
<b>Title:</b>	Weaning Off Ventilator and Extubation of Neonate		
<b>Applies To:</b>	All NICU Staff and Respiratory Therapists		
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## 1. PURPOSE:

- 1.1 To determine the optimal time and best strategy for successful weaning and extubation of ventilated premature infants.
- 1.2 To avoid prolonged ventilation and premature unsuccessful extubation followed by re-intubation because both are associated with poor outcomes.

## 2. DEFINITIONS:

- 2.1 **Weaning** it can be defined as the gradual reduction in respiratory support, assigning a spontaneous breathing time to let the patient take responsibility for an acceptable gas exchange.
- 2.2 **Extubation** it is the removal of the endotracheal tube. This point coincides with the determination that the patient is able to maintain an effective gas exchange without ventilator support or with minimal additional support.

## 3. POLICY:

- 3.1 The disconnection of a patient from mechanical ventilator is continuous process that involves:
  - 3.1.1 Active weaning of the ventilator settings.
  - 3.1.2 Evaluation of extubation readiness.
  - 3.1.3 Adequate supervision and provision of non-invasive support following disconnection as Required.
- 3.2 Gradually reduce ventilator support until the settings are judged to be low enough to remove support.
- 3.3 Assess the risk factors for extubation failure before extubation.
- 3.4 Close post extubation observation is mandatory.
- 3.5 Provide appropriate post extubation adjunctive therapy.

## 4. PROCEDURE:

- 4.1 **Before Extubation:**
  - 4.1.1 Complete physical examination.
  - 4.1.2 Ensure spontaneous breathing clinically, and if required by placing infant for few minutes on CPAP and observing his respiratory rate, SpO<sub>2</sub> and heart rate before extubation.
  - 4.1.3 Obtain blood gases.
  - 4.1.4 If required, get a chest X-Ray.
  - 4.1.5 Load with caffeine citrate if it had not been initiated previously.
  - 4.1.6 Sedation has been discontinued for enough time.
  - 4.1.7 Ensure acceptable haematocrit.
  - 4.1.8 May consider short burst of low dose corticosteroids for infants who:
    - 4.1.8.1 Were intubated for prolonged periods.
    - 4.1.8.2 Have a history of traumatic or multiple endotracheal intubations.
    - 4.1.8.3 Previously failed extubation because of subglottic edema.
  - 4.1.9 Keep NPO for at least 6 hours, reassess and may resume post-extubation.



- 4.2 Try extubation if infant is tolerating the minimal settings, using low PIP and the following is achieved for at least 12 hours or earlier self-extubation:
  - 4.2.1 For birth weight < 1000 g: MAP < 7 cm H<sub>2</sub>O and FiO<sub>2</sub> < 30%
  - 4.2.2 For birth weight > 1000 g: MAP < 8 cm H<sub>2</sub>O and FiO<sub>2</sub> < 30%
  - 4.2.3 SIMV/PS: PIP < 16 cm H<sub>2</sub>O, PEEP < 5 cm H<sub>2</sub>O, Rate < 20, FiO<sub>2</sub> < 30-35%,
  - 4.2.4 Tidal volume < 4.0 mL/kg (5 mL/kg if < 700 g or > 2 weeks of age)
- 4.3 **Note that:** infants who remain ventilator dependent for extended periods have increased tidal volume requirement over time, as a result of increasing anatomic dead space, referred to as acquired tracheomegaly, and increased physiologic dead space with the development of chronic lung disease and more heterogeneous lung aeration. In general, tidal volume should not be reduced below 4 mL/kg and in some infants not below 4 mL/kg during the weaning process to avoid excessive work of breathing.
- 4.4 Post-extubation management:
  - 4.4.1 Connect to nasal CPAP or humidified high-flow nasal cannula.
  - 4.4.2 Parameters of Nasal CPAP if used:
    - 4.4.2.1 Frequency ~15-25/ minute
    - 4.4.2.2 PIP increase to 2-4 > MV setting (adjust PIP for effective aeration per auscultation),
    - 4.4.2.3 PEEP < 6.
    - 4.4.2.4 Flow 8-10 L,
    - 4.4.2.5 FiO<sub>2</sub> adjusted to maintain SpO<sub>2</sub> of 91-95%.
  - 4.4.3 Wean from CPAP if:
    - 4.4.3.1 PEEP less than 5 cm of H<sub>2</sub>O.
    - 4.4.3.2 Oxygen requirement less than 25% and not increasing to maintain SpO<sub>2</sub> at 91-95%.
    - 4.4.3.3 Respiratory rate less than 60 with no retractions.
    - 4.4.3.4 No significant apnea.
    - 4.4.3.5 Normal blood gas.
  - 4.4.4 Nebulized racemic epinephrine:
    - 4.4.4.1 Use for management of upper airway obstruction post-extubation (which usually manifests as stridor and increased work of breathing).
    - 4.4.4.2 May give adrenaline nebulization: 0.5 mL/kg 1:1000 (1 mg/mL) diluted to 6 mL of saline
  - 4.4.5 Consider Re-intubation if:
    - 4.4.5.1 Severe apnea requiring positive pressure ventilation, or multiple episodes of apnea: > 6 times within 6 hours.
    - 4.4.5.2 Hypoxemia: FiO<sub>2</sub> > 50% to maintain SpO<sub>2</sub> > 90%.
    - 4.4.5.3 Hypercapnia: PCO<sub>2</sub> > 60 with pH < 7.25.
    - 4.4.5.4 Excessive work of breathing with severe retractions.
  - 4.4.6 Post-extubation assessment:
    - 4.4.6.1 Closely observe for vital signs, any signs of increasing respiratory distress e.g. tachypnea, increased work of breathing, color changes, desaturations requiring an increase in oxygen or CPAP or stridor which may indicate upper airway obstruction.
    - 4.4.6.2 Obtain blood gases in 15-30 minutes and adjust management accordingly to maintain gases within normal limits.
    - 4.4.6.3 Chest X-Ray if indicated.
    - 4.4.6.4 Assess for resuming feeding.
    - 4.4.6.5 Assigned physician will document the extubation parameters, time, the used non-invasive ventilation support, tolerance of the infant and any events on the progress notes of the patient's medical record.
    - 4.4.6.6 The assigned nurse will document: the time of extubation and vital signs on the flow sheet and whether the extubation was to room air, oxygen or CPAP, tolerance of the infant and any other events on the nurse's progress notes.
  - 4.4.7 Extubation failure:
    - 4.4.7.1 Consider and assess for risk factors for extubation failure that includes:
      - 4.4.7.1.1 Lower Gestational Age (< 26 weeks).
      - 4.4.7.1.2 Prolonged ventilation (> 10-14 days).
      - 4.4.7.1.3 History of previous extubation failure.

- 4.4.7.1.4 Use of sedatives (e.g. morphine, fentanyl).
- 4.4.7.1.5 Multiple reintubations: upper airway problems.
- 4.4.7.1.6 Evidence of residual lung injury: bronchopulmonary dysplasia (BPD), pulmonary interstitial emphysema.
- 4.4.7.1.7 Extubation from high ventilatory settings.
- 4.4.7.1.8 Extubation from high FiO<sub>2</sub>.
- 4.4.7.1.9 Hemodynamically significant patent ductus arteriosus (PDA).
- 4.4.7.2 Causes of weaning and extubation failure:
  - 4.4.7.2.1 Increased Respiratory load.
  - 4.4.7.2.2 Decreased respiratory capacity.

## **5. MATERIAL AND EQUIPMENT:**

- 5.1 Resuscitation bag with appropriate size face mask.
- 5.2 Stocked and checked resuscitation trolley in patient room.
- 5.3 Wall suction unit working and appropriate size suction catheters.
- 5.4 Stethoscope to check for clear and equal air entry.
- 5.5 If not extubating straight to room air ensure further equipment is ready to be used i.e. prong/mask CPAP, high flow nasal cannula or low flow nasal prong oxygen.
- 5.6 A moist and a dry face washer when tapes and Duoderm are removed
- 5.7 Cardio respiratory and oxygen saturation monitoring.

## **6. RESPONSIBILITIES:**

- 6.1 Physician
- 6.2 All NICU Staffs
- 6.3 Respiratory Therapist

## **7. APPENDICES:**









N/A

## **8. REFERENCES:**

- 8.1 Shalish W et al., When and How to Extubate Premature Infants from Mechanical Ventilation. Curr Pediatr Rep (2014) 2: 18-25.
- 8.2 Sant 'Anna GM et al., Weaning Infants from Mechanical Ventilation. Clinical Perinatology 39 (2012) 543-562
- 8.3 Nebulized racemic epinephrine for extubation of newborn infants. Cochrane Database of Systematic Reviews 2010.



## 9. APPROVALS:

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