Supplemental Information
Duke University Medical Center  
Division of Pediatric Pulmonary and Sleep Medicine  

Neuromuscular Weakness Patients  
Exubation Protocol  
12-05-2016

Richard M. Kravitz, MD

CRITERIA FOR EXUBATION INCLUDE:

1. Resolution of any acute process:  
   Afebrile  
   Not receiving Mucoly, hypertonic saline, and/or Pulmozyme  
   Albuterol (if utilized) should be no more often that every 4 hours

2. Chest radiograph is clear of any atelectasis or infiltrates.

3. No supplemental oxygen; SaO2 >94% on room air (or pre-illness baseline).

4. The patient is getting adequate nutrition.  
   Back to baseline (pre-illness) enteral feeding schedule/caloric intake

5. Airway clearance with Cough Assist at a pressure setting of +/- 40 cm H2O every 4 hours.  
   Cough Assist more often than q4 hours is associated with a higher chance of extubation failure.

6. The patient is not requiring suctioning (much) above pre-illness baseline.

7. No respiratory depressant medications (e.g., narcotics, sedatives).  
   Non-sedating anti-anxiolytic medication such as Precedex use may be acceptable

8. Ventilator settings similar to those to be used with NIV-BiPAP ST Mode:  
   General settings: high span with low EPAP and RR ≥ baseline resting rate  
   BiPAP settings will be in the range of:  
   - IPAP 16-20 cm H2O  
   - PEEP 4 cm H2O  
   - Pressure support (delta P) of 12-16 cm H2O  
   - Respiratory rate (based on expected resting respiratory rate):  
     - SMA type 1:  
       - 30 bpm if < 6 months old or 25 bpm if > 6 months old  
     - SMA type 2 / DMD:  
       - Usual respiratory rate  
       - (may need to be somewhat higher at first to rest the patient)

9. Choose an appropriate NIV interface:  
   - Nasal mask or nasal pillows are preferred  
   - Full facemask should be avoided (but may be considered while in the PICU setting)

10. Exubation sequence:  
    - NPO for 6 hours (3 hours for breast milk)  
    - patients with SMA type 1 can get weaker if kept NPO for too long  
    - use ND/NJ or G-tube with Nissen to minimize chances of reflux  
    - Perform Cough Assist with chest PT before exubation  
    - Exubate and initiate BiPAP at settings as described above  
      - Note: BiPAP settings may need to be somewhat higher than what the patient was receiving while on the ventilator  
    - Look for symmetric chest wall / abdominal excursion that:  
      - is in phase (no paradoxical breathing should be present)  
      - demonstrates good chest wall rise  
    - Airway clearance with Cough Assist with chest PT should be done soon after exubation  
      - frequency depends on the clinical situation  
      - should be at least every 2 hours, if not more frequent  
    - Change the interface if the one being utilized is not tolerated or if excessive air leak exists  
      - Continue NIV-BiPAP ST Mode 24 hours a day until stable  
      - wean to while asleep (or back to baseline) over the next few hours to days as tolerated  
    - Continue Cough Assist every 4 hours and as needed  
    - Maintain SaO2 > 94% (preferably without supplemental O2)

SUPPLEMENTAL FIGURE 3
Duke University airway clearance protocol. PRN, as needed; PT, physical therapy.
EQUIPMENT:

1. Cough Assist Set up:
   a. Settings
      i. Inspiratory:
         1. Usually good lung expansion (up to +40 cm H2O)
         2. Over 2-3 seconds
      ii. Expiratory:
         1. Start at -30 cm H2O (can go up to -40 cm H2O)
         2. Over 2 seconds
      iii. Pause:
         1. Pause 1-2 seconds between cycles
   b. Number of cycles
      i. 3 breaths per cycle
      ii. 3-5 cycles per treatment (as tolerated)
   c. Frequency of use:
      i. When well: once to twice per day + PRN
      ii. When ill: as often as needed
         1. Usually every 1-2 hours when an inpatient
         a. Can be up to every 15 minutes
         2. No less than every 4 hours when ill (especially in PICU)
         3. (Have the family help when they are available)
   d. Interfaces:
      i. Face mask
      ii. Mouthpiece
      iii. Endotracheal tube
      iv. Tracheostomy tube

2. Consider bronchodilators:
   a. albuterol or levalbuterol before Cough Assist treatment
   b. ipratropium every 6 hours

3. Consider mucolytic agents:
   a. Dornase-alpha (Pulmozyme) once to twice per day
   b. N-acetylcysteine (Mucomyst) 2-4 times per day

4. Consider airway hydration:
   a. 3%-7% solution every 6 hours
      i. Watch for bronchospasm

5. Consider manual chest PT or the Vest immediately prior to the Cough Assist
   a. may add in postural drainage (Trendelenburg versus multiple positions)

SIGNS OF IMPROVEMENT:

1. Oxygen saturation is improving
   a. Goal of getting back to room air (or pre-illness baseline)

2. Chest film is improving
   a. Goal of having any atelectasis resolve

3. Bronchodilator use is decreasing
   a. Goal of getting back to pre-illness baseline

4. Mucolytics are able to be weaned
   a. Goal of no mucolytic agents

5. Cough Assist use is decreasing
   a. Goal of getting back to pre-illness schedule

SUPPLEMENTAL FIGURE 4
Duke University extubation protocol. BiPAP, bilevel positive airway pressure; EPAP, expiratory positive airway pressure; G-tube, gastrostomy tube; IPAP, inspiratory positive airway pressure; ND, nasoduodenal tube; NIV, noninvasive ventilation; NJ, nasojejunal tube; NPO, nothing by mouth; PEEP, positive end-expiratory pressure; PT, physical therapy; RR, respiratory rate; SMA, spinal muscle atrophy; ST, spontaneously timed.