UNIVERSITY OF WASHINGTON

MECHANICAL IN-EXSUFFLATION THERAPY PROTOCOL

ADULT APPLICATION

MODE: MECHANICAL IN-EXSUFFLATION THERAPY

I. **APPLICATION**: Mechanical In-Exsufflation (MIE) therapy is a form of cough augmentation, or assist, therapy. It can be an effective means of airway clearance for patients with inadequate cough strength. MIE can be used to clear pulmonary secretions through the upper airway using either a facemask or mouthpiece. MIE can also be used to clear secretions through artificial airways including a tracheostomy tube, tracheostomy stent or open tracheal stoma.

Introduction: The Emerson Cough Assist device is an MIE device that uses adjustable positive and negative pressures with either manual or adjustable automatic timed inspiratory and expiratory cycles to promote airway clearance. MIE is designed to mimic the cough process through hyperinflation with a timed positive pressure cycle followed immediately by a timed negative pressure cycle that produces an increased expiratory flow to remove secretions from the airways.

Indications: Inability to adequately clear pulmonary secretions as a result of:

a. Respiratory neuromuscular weakness
b. Patient's conscious inability to adequately cough

MIE can also provide an alternative to tracheal suctioning with decreased mucosal trauma and improved patient comfort.

Absolute Contraindications: The presence of hemoptysis, pneumothorax, bulbus lung disease, nausea, significant reactive airway disease and recent lobectomy or pneumonectomy.

Relative Contraindications: Therapy immediately following meals, history of pneumothorax, lack of patient cooperation when applying therapy through the upper airway.

II **PROCEDURE**:

A. After assessing the patient and determining that a trial of MIE is appropriate, obtain a physician's order for therapy.

B. Assemble the necessary equipment:

1. Emerson Cough Assist device (manual or manual/automatic)
2. 12 sections of large bore flex tubing
3. 15 X 22mm adaptor

4. high flow micro filter
5. air cushion facemask or mouthpiece

C. MIE Breathing Circuit Assembly:

1. Connect the micro filter to the machine outlet in the lower right corner below the control panel.
2. Connect the large bore corrugated tubing circuit to the filter.
3. Place a 15 X 22mm adaptor on the opposite end of the large bore corrugated tubing circuit. The 15 X 22mm adaptor can be connected directly to the inner cannula barrel of a tracheostomy tube, or to an inline suction catheter to clear secretions in patients with artificial airways.
4. An air cushion facemask can be connected to the 15 X 22mm adaptor and used to clear pulmonary secretions through the upper airway.
   Note: The air cushion facemask must be firmly inflated when applying the mask during therapy to maintain an adequate face seal without traumatizing the bridge of the patient's nose.
5. If the patient is able to maintain an adequate mouth seal with therapy, a mouthpiece may be used in place of the facemask.

D. Mechanical In-Exsufflation Initial Pressure Settings Procedure:

1. Introduce the therapy and the procedure to the patient.
2. Turn the main power switch (located in the lower left below the control panel) on and move the manual/automatic switch (located in the upper left on the control panel) to the manual position.
3. Set the initial exsufflation pressure by occluding the end of the circuit and, while holding the manual control switch in the exhalation position, turn the pressure knob (located below the manual control switch) clockwise while watching the pressure gauge to obtain the desired pressure.
   Note: Initial insufflation pressures can usually be started at 25-35 centimeters of water pressure, (cwp) for pediatric and adult patients.
4. The insufflation pressure is set by turning the inhale pressure knob (located to the right of the manual control switch) clockwise while holding the manual control switch in the inhale position, again with the circuit occluded.
5. Always set the exsufflation pressure before the insufflation pressure. Check both pressures after making the initial settings by toggling the manual control switch to insure that both settings are accurate.
   Note: The exsufflation pressure can be the same as the Insufflation pressure, but is usually set 5-10 cwp higher.

E: **Administering Mechanical In-Exsufflation Through The Upper Airway**:

Assisted cough therapy through the upper airway can be done using either a mouthpiece or air cushion facemask. Maintaining an adequate seal with either interface is necessary to produce effective therapy. In-exsufflation therapy through the upper airway is only effective when bulbar dysfunction does not cause significant glottic obstruction to peak inspiratory and expiratory air-flow.

1. A thorough introduction to this therapy with clear instruction by the caregiver and the cooperation of the patient is necessary for success.
2. To produce effective therapy, the caregiver must coach the patient to maintain a patent airway throughout the entire in-exsufflation cycle.
3. If the patient can produce a “Huff Cough” maneuver, (maintain an open glottis), during the exsufflation cycle, they will allow enough expiratory flow to adequately clear their secretions.
4. It is usually best to manually control the in-exsufflation cycle while coaching the patient in order to coordinate the process.
5. A verbal command should consist of, “Inhale, one thousand one and cough, one thousand one, one thousand two…..”, while manually controlling the inspiratory and expiratory pressure time cycle.
6. Cough cycles can be done individually or in series and pressures are adjusted according to the format described in section D 2 per patient comfort.
7. Insufflation time should be 2-3 seconds followed by an exsufflation time of 2-3 seconds. In-exsufflation cycles can be repeated in series of 5-6 cycles, or with a pause time of 2-4 seconds between cycles.
8. Cycles can be administered either manually or in automatic mode with preset cycle times.
9. Quad cough maneuvers can also be administered in conjunction with exsufflation maneuvers to help promote airway clearance.
10. Hyperinflation breaths using inspiratory pressure cycles with 3 second breath-holds can be used to reduce the potential of atelectasis with in-exsufflation therapy. Insufflation pressures of greater than 45-50 cwp are recommended to produce sufficient hyperinflation.
11. If the patient is not able to maintain an open glottis due to either significant bulbar muscle paralysis, or an inability to follow commands, this therapy will have limited effectiveness if insufficient insufflation and exsufflation flows cannot be produced.
12. A clearing of secretions on repeated therapy, clearing breath sounds, improved oximetry, and patient feedback should be used to determine effectiveness and end of therapy.

F: Administering Mechanical In-Exsufflation Therapy Through An Artificial Airway:

MIE can be used to support airway clearance for tracheostomy patients with improved comfort as compared to tracheal catheter suctioning. MIE may also decrease the frequency of airway clearance therapy through the improved clearance of distal airway secretions. MIE may also decrease the potential for stimulating secretion production as a result of irritation to the tracheal mucosa associated with tracheal suctioning.

1. Provide the patient with an initial introduction and instruction in how MIE therapy is used to clear airway secretions. Although the patient should find MIE to be more comfortable compared to tracheal suctioning, they may need initial reassurance that while the therapy may produce a strange sensation, it will not harm them.
2. If the patient is not mechanically ventilated, place the 15 X 22mm adapter over the inner cannula barrel of the tracheostomy tube and move the control arm, (toggle switch), on the In-Exsufflator device to the inhale position and hold for 2-3 seconds followed by a rapid switch to the exhale position and hold for 2-3 seconds.
3. At the end of 2-3 seconds, remove the 15 X 22mm adapter by rotating it clockwise so as not to remove the inner cannula exsufflation pressure must be maintained while removing the adapter in order to clear the secretions from the tracheostomy tube.
   Note: Timing of the manual insufflation and exsufflation cycles is Easily done by counting, (one thousand one, one thousand two….)
4. In-Exsufflation maneuvers can be done either as a single cycle, but are usually most effective when done in multiple cycles to clear secretions.
5. Hyperinflation/oxygenation therapy can be done in between cycles of in-exsufflation therapy using an AMBU bag.
   Note: Supplemental oxygen should not be bled into the in-exsufflation circuit. The fan motor is not insulated and oxygen supplemental oxygen passing through the fan system during the exsufflation phase is a potential fire hazard.
6. In-exsufflation pressures will often need to be increased in order to produce adequate airway clearance. If after several in-exsufflation cycles airway clearance has not been achieved as determined by auscultation and chest palpation, increase both the insufflation and exsufflation pressures by 5-10 cwp, per patient comfort, as described in section D 2, and trial the therapy again.
7. It is best to increase pressures at the same time and by the same amount in order to achieve adequate airway clearance.
   Note: Titrating inhalation pressures up to 60 CWP and exhalation pressures up to 70 CWP, per patient comfort, may be necessary in

patients with a large body mass. High inhalation pressures may be necessary to provide adequate insufflation volumes.

8. Adequacy and completion of airway clearance therapy can be evaluated by Chest auscultation and palpation, decreased clearance of secretions,
   Oximetry and patient feedback.

G. In-Exsufflation Therapy for Ventilated Tracheostomy Patients:

Note: The same procedure format for non-ventilated tracheostomy patients is followed for ventilated patients, using a closed system including an inline suction catheter.

1. Disconnect the distal, short flex tube from the patient Y or exhalation valve on the breathing circuit and attach the in-exsufflator circuit by the 15 X 22mm adapter.
2. In-exsufflation cycles can be done while maintaining a closed circuit by removing secretions with the inline suction catheter. The inline suction catheter tip should be positioned immediate to but not in the distal end of the tracheostomy tube. Activating suction during the exsufflation phase will clear secretions from the tracheostomy tube without depositing secretions in the breathing circuit. If the patient has no need of supplemental oxygen, they may be comfortably ventilated using timed insufflation cycles in between in-exsufflation cycles. Monitoring chest excursion, breath sounds, oximetry and patient comfort can guide you in using timed insufflation cycles to support the patient's ventilation.
   Note: By experience, inhalation pressures that are sufficient to clear secretions will generally support adequate ventilation using timed insufflation maneuvers only between cough cycles.
3. Patients requiring supplemental oxygen can be hyperinflated and/or oxygenated via AMBU between in-exsufflation cycles.