Clearing The Air On Airway Clearance

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Objectives

- Describe the difference between secretion mobilization and clearance
- Describe different types of airway clearance
- Describe the clinical advantages of mechanical insufflation-exsufflation
1. mobilization
2. removal

Airway clearance
Airway clearance

Techniques design to loosen and mobilize secretions from the lower airway to the upper airway.

- **Mucociliary clearance** (mobilization)
- **Secretion clearance**
- **Cough clearance** (removal)

Techniques that remove secretions from the lungs.
Airway clearance

Mucociliary clearance
(mobilization)
- Oscillation devices
- Positive expiratory pressure

Secretion clearance
- High-frequency chest-wall compression
- Chest physiotherapy

Cough clearance
(removal)
- Suctioning
- CoughAssist MI-E
- Manual assisted cough
- Breathing techniques
Mobilization
Clearance

- Manual assisted cough
- Suction
- CoughAssist mechanical in-exsufflation
Manual assisted cough

- Performed by the respiratory therapist
- Various positions and techniques

Manual assisted cough technique can be combined with the use of CoughAssist
Suction

- Standard of care
- Low cost
- Effective
Suctioning

• Invasive procedure

• Misses left main stem bronchus 90% of the time

• Tracheal trauma, suctioning induced hypoxemia, hypertension, cardiac arrhythmias and raised intracranial pressure have all been associated with suctioning

• Patients have reported that suctioning can be a painful and anxiety provoking procedure

painful
invasive
uncomfortable
hypoxia
infection
tissue trauma
bronchospasm
pulmonary atelectasis
pulmonary bleeding
a better way?
Mechanical Insufflator-exsufflator (M I-E)

- Noninvasive
- Comfortable
- Effective
CoughAssist vs. suctioning

- More effective in clearing secretions and better tolerated than endotracheal suctioning\(^1\)
- Clears airways for longer periods of time than tracheal suctioning\(^1\)
- 89% of patients preferred CA vs. Suction\(^2\)
- 29% more mucus\(^1\)
- 72% patients found it more effective\(^2\)

M I-E

- Mechanical insufflator-exsufflator assists patients in clearing retained secretions by applying a positive pressure to the airway, then rapidly shifting to a negative pressure.

- This rapid shift in pressure produces a high expiratory flow rate from the lungs.

- Proven as effective as a natural cough.
Introduction to M I-E

• The treatment can be delivered via facemask, mouthpiece, or endotracheal or tracheostomy tube

• It is effective for both invasive and non-invasively ventilated patients

• Cleared for adult and pediatric populations
Contraindications

- Bullous emphysema
- Pneumothorax or pneumo-mediastinum
- Acute Lung Injury / Acute Respiratory Distress Syndrome (ARDS)
- Acute pulmonary edema
- Recent barotrauma

*Patients need to be cooperative (unless they have an artificial airway)*
What does M I-E do?

**Non invasive alternative to deep suctioning**
Can be given via facemask, mouthpiece, endotracheal or tracheostomy tube

**Simulates a cough**
By applying a **positive pressure** (deep insufflation) to the airway **followed by a rapid shift to a negative pressure** to produce expiratory flow from the lungs and effectively remove secretions

**Assists patients with clearing of retained secretions**

**Allows Data management**
Peak Cough Flow, Tidal Volume, SpO2 on screen and trend review for long titration and long term follow-up
Indications for use of M I-E

• Neuromuscular disorders
  – ALS
  – Muscular Dystrophy
  – SMA
  – Multiple Sclerosis

• Spinal cord injury

• Tracheostomy

• Low peak cough flows
When should MI-E be instituted

Any patient unable to cough or clear secretions effectively due to reduced peak cough expiratory flow

- **PCF < 160 LPM** (Bach JR et Al, Chest 1996)

PCF < 270 LPM
Initiating M I-E

- For new patients
  - Begin with lower pressures
  - ±10-15 cmH₂O
  - Low inhale flow

- As they become comfortable
  - Progressively increase pressures 5-10 cmH₂O each cough sequence (4-6 breaths)

*Common prescription pressures are generally around ± 35-40 cmH₂O*
M I-E Procedure

- 1 cough cycle is composed of an inspiratory, expiratory and pause phase
- 4-6 cough cycles composes a sequence
- Rest patient 20-30 seconds between sequences
  - Make sure you allow enough time for secretion removal
- A treatment is 4-6 cough sequences
  - Generally performed several times per day
M I-E treatment

Inhale + Exhale + Pause = Cycle

Repeat cycle 4-6 times

Rest 20-30 seconds

Repeat sequence 4-6 times
Clinically proven

- Increase peak cough expiratory flows more than fourfold\(^1\)
- Reduce recurrent respiratory infections in patients with respiratory weakness from neuromuscular disease\(^2, 3\)
- Patients report that it feels “easier to breathe” after the use of CoughAssist\(^3\)
- Improvement in perceived quality of life due to fewer acute illness-related episodes\(^4\)
- Patients prefer MI-E to suctioning for comfort and effectiveness and find it less tiring\(^4\)

Consideration for critical care

In the critical care environment,
- Any patients that behave like restrictive patients from a muscular strength perspective
- Any intubated patients

Specific attention should be brought to the Neuromuscular Diseases Patients, such as:
  – Muscular dystrophy (Duchenne)
  – Myasthenia gravis
  – Poliomyelitis
  – Amyotrophic Lateral Sclerosis (ALS)
  – Spinal Muscular Atrophy (SMA)
Impaired airway clearance in the ICU

- Endotracheal intubation prevents the patient from closing the glottis\(^1\)

- Direct suction clears a small portion of the airway, is ineffective for clearing secretions in the peripheral airways\(^2\)

- Patient dependent upon mucociliary clearance rather than cough clearance

Extubation and airway clearance

• If the lungs are healthy and ventilation can be fully maintained noninvasively, then the only remaining concern is the effective expulsion of airway secretions.$^1$

• Despite the importance of this factor, no ventilator weaning parameter addresses the ability to cough.$^2$

Effects of mechanical insufflation-exsufflation in preventing respiratory failure after extubation: a randomized controlled trial

Miguel Gonclaves, Teresa Honrado, Jao Carlos Winck, Jose Artur Paiva

**Objective:** Assess the efficacy of MI-E in preventing re-intubation for patients in whom acute respiratory failure develops after extubation.
Patients meeting criteria SBT

Control Group
Conventional extubation protocol

Study Group
MI-E extubation protocol

O2, antibiotics, NIV bronchodilators

Plus CoughAssist

Gonclaves M. et al. Effects of mechanical insufflation-exsufflation in preventing respiratory failure after extubation: a randomized controlled trial
# Outcome data

<table>
<thead>
<tr>
<th></th>
<th>Group A (n=40)</th>
<th>Group B (n=35) MIE</th>
</tr>
</thead>
<tbody>
<tr>
<td>NIV application, n (%)</td>
<td>20 (50%)</td>
<td>14 (40%)</td>
</tr>
<tr>
<td>Patients reintubated (n, %)</td>
<td>19 (48%)</td>
<td>6 (17%)</td>
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<tr>
<td>Causes of reintubation (n)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Respiratory pauses with loss of consciousness</td>
<td>0</td>
<td>1</td>
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<tr>
<td>Respiratory distress after 2-h NIV</td>
<td>6</td>
<td>2</td>
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<tr>
<td>Decreasing level of consciousness</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Intolerance to NIV</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Hypotension (systolic BP &lt; 90 mm Hg for &gt; 30 min.)</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Secretion encumbrance associated/severe hypoxemia</td>
<td>9</td>
<td>2</td>
</tr>
<tr>
<td>NIV failure rate, n (%)</td>
<td>13 (65%)</td>
<td>2 (14%)</td>
</tr>
<tr>
<td>Total ICU length of stay</td>
<td>19.3 ± 8.1</td>
<td>16.9 ± 11.1</td>
</tr>
<tr>
<td>Post extubation ICU length of stay</td>
<td>9.8 ± 6.7</td>
<td>3.1 ± 2.5</td>
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M I-E combined with NIV

- Reduce re-intubation rates
- Reduce post-extubation ICU stay

Key points for treating NMD patients

1. Aggressive airway clearance is a key point to manage ARF in NMD

2. Patients with slowly progressive NMD should be extubated directly to NIV combined with assisted coughing.\(^1\)

3. Mechanical insufflation-exsufflation significantly reduces treatment failure in patients with neuromuscular disease, compared conventionally managed with chest physiotherapy alone.\(^2\)

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Challenge the status quo

But, you know... that's the way we've always done it
Bring this technology to your organization

- Improve outcomes
- Reduce ICU days
- Reduce length of stay
- Lower cost of care
- Increase Patient satisfaction
Questions