Inspiratory Muscle Training to Enhance Recovery from Mechanical Ventilation

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Objectives

• Describe mechanical ventilation and the weaning process
• Describe the different techniques of IMT
• Review current research regarding IMT
• Explain the clinical relevance of IMT
What is Mechanical Ventilation?

• Machine that delivers oxygen & expels CO2 for individuals who cannot breathe on their own

• Time on ventilation should be 2.6 – 7.9 days but depends on
  – Overall strength of breathing muscles
  – Condition of lungs prior to mechanical ventilation
  – Patient characteristics
Complications of Ventilation

- Inspiratory muscle weakness
  - After 18-69 hours on ventilation proteolysis and atrophy occur
  - Failure to wean from ventilation
  - Increased airway resistance/reduced lung compliance
  - Ventilator-induced diaphragmatic dysfunction
- Airway trauma
- Infections
- Pneumothorax
- Critical illness myopathy/polyneuropathy
- Longer ICU stay – increase cost
- Mortality
Weaning

• Process of decreasing mechanical ventilation to allow the patient to breathe on their own
• 70% of ICU patients able to successfully wean off ventilators in first attempt
• Process takes 40-50% of total time on mechanical ventilation
Failure of Weaning

• Can lead to:
  – Increased risk of inspiratory muscle weakness
  – Critical illness myopathy/polyneuropathy
  – Infection
  – Airway trauma
What is IMT?

- Targets diaphragm and accessory inspiratory muscles
- Increases muscle strength and endurance
- Facilitates weaning
- Different techniques of IMT
IMT Techniques

• Resistive flow training
• Isocapnic/normocapnic hyperpnoea
• Inspiratory threshold pressure training *
• Adjustment of ventilator sensitivity
• Controlled diaphragmatic breathing*
• Incentive spirometry
<table>
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<tr>
<th>Study</th>
<th>Design</th>
<th>Description</th>
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| Caruso et al (2005)   | RCT    | Intubated due to acute respiratory failure or decreased consciousness       | Adjustment of ventilator trigger sensitivity to 20% of initial MIP  
5 min x twice daily x 7 d/wk x until weaned  
Duration increased by 5 min each session, max 30 min  
Pressure increased by 10% of initial MIP, max 40% MIP  
Stopped if adverse signs | No training |
|                       |        | Receiving controlled ventilation or PS for ≥ 72 hr                        |                                                                                               |         |
|                       |        | Exp: n = 20  
Completed n = 12 (8 male)  
Age (yr) = 67 (SD 10)  
APACHE II = 23 (SD 6)  
Con: n = 20  
Completed n = 13 (9 male)  
Age (yr) = 66 (SD 17)  
APACHE II = 24 (SD 7) |         |
| Condessa et al (2013) | RCT    | Intubated via endotracheal tube due to acute respiratory failure from trauma, medical or surgical causes | Threshold device at 40% MIP in supine 45 deg up  
10 breaths x 5 sets x twice daily x 7 d/wk x until weaned  
Pressure increased 10% of initial MIP daily, as tolerated  
Stopped if adverse signs  
Supplemental oxygen if needed | No training |
|                       |        | Starting PS after ≥ 48 hr controlled ventilation                           |                                                                                               |         |
|                       |        | Exp: n = 45 (23 male)  
Age (yr) = 64 (SD 17)  
APACHE II = 23 (8)  
Con: n = 47 (28 male)  
Age (yr) = 65 (SD 15)  
APACHE II = 23 (8) |         |
Protocol

• Typically high intensity, short duration
• Threshold devices:
  – 3-5 sets of 6-10 breaths, 2 times per day
• Adjustment ventilator sensitivity:
  – Set to 20% of initial MIP
  – Completed for 5 minutes, 2 times per day, 5-7 days per week.
  – Duration increased 5 minutes each session
  – Pressure increased 10% each session
• STOPPED if adverse signs are observed
Current Research on IMT

• Outcomes of IMT programs
  – Increase QOL and inspiratory strength in individuals weaning off of mechanical ventilation
  – Decreased weaning time and increased maximal inspiratory pressure in individuals over the age of 16
  – Threshold pressure training or adjustments in ventilator sensitivity resulted in increased respiratory muscle strength when weaning patients off of a mechanical ventilator
Indicators for IMT

• Use of mechanical ventilator
• Reduced respiratory muscle strength
• Fatigue of diaphragm and accessory muscles
• Reduced respiratory muscle pump capacity
• Ventilator-induced diaphragmatic dysfunction
• Decreased respiratory muscle endurance
• To reduce weaning time
When to Begin IMT

• When patient is no longer sedated
• Patients condition has stabilized to where it is safe to begin the weaning process
Clinical Relevance

• Important for PT’s to understand proper IMT techniques
• When to implement IMT
• Affects the type and length of therapy
• Pt education
  – Compliance: decreases risk of pulmonary complications
Conclusion

- There are many complications from prolonged ventilation
- IMT is a technique that can help increase the strength and endurance of respiratory musculature
- Protocols and techniques of IMT should be based on patient characteristics
References