AIRWAY CLEARANCE TECHNIQUES FOR CHRONIC LUNG DISEASE

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Conflicts

- I have no conflicts to declare.
Outline

- Benefits of Airway Clearance Techniques
- Modified Postural Drainage
- The Research
- Huffing vs Coughing
- Equal Pressure Point
- Active Cycle of Breathing
- Autogenic Drainage
- Oscillating PEP Devices
- Thoracic Mobility Exercises
- Exercise and Lifestyle Considerations
Who Benefits from ACTs?

- COPD with secretions (> 30 ml/day)
- Bronchiectasis
- Cystic Fibrosis and other ciliary dysfunction
- Sub-acute Asthma with secretions
- Post-op or chronic Atelectasis
What are ACTs?

• Efficient Airway Clearance Techniques should get up the most sputum in the shortest time with the least energy expended.
• Usually done by patient themselves
• Includes: Forced Expiratory Technique, Active Cycle of Breathing, Autogenic Drainage, Oscillating PEP Therapy, Exercise
• Also: PEP Devices, High Frequency Chest Wall Oscillation, Intra-pulmonary Percussor Ventilator, Inhalation Therapy
Where and When?

ANYTIME!
ANYWHERE!
Why?

- Traditional postural drainage and percussion (conventional chest physiotherapy) causes:
  - Discomfort
  - GERD (gastro-esophageal reflux disease)
  - Oxygen desaturation
  - Shortness of breath
  - Headaches and sinus pain
  - Dependence on caregiver
  - Repetitive strain injuries in caregivers
...But...

- Modified postural drainage (ie: NO tipping) can still be useful for some populations.
- Gravity does indeed have an effect on mucous.
- In adults, there is increased ventilation in the dependant lung!
- To be effective, the positions (alternate side-lying) must be maintained for several minutes and accompanied by deep breathing exercises.
THE RESEARCH

- 29 studies (475 participants total)\(^1\)
- Only small, poor quality studies
- ACTs were as effective as conventional chest physiotherapy (no better, no worse!)
- In 10 studies, patients preferred self-administered techniques.

The Research

- Systematic Review of 26 articles looking at ACTs in COPD¹.

- Articles with solid evidence are scarce.

- ACTs such as Active Cycle of Breathing, Forced Expiratory Techniques and Autogenic Drainage can be effective in COPD.

The Research

• Few studies. Poorly controlled

• ACTs safe to use in COPD.

• ACTs during acute COPD exacerbations may reduce the likelihood of requiring mechanical assistance, may reduce the time it is needed and may reduce length of hospital stay.

• ACTs in stable COPD may improve quality of life measures but appear to have no effect on exacerbations or hospitalizations.

How Do ACTs work?

- Postural Drainage & Percussion relies on gravity and positioning to move mucous.

- Airway Clearance Techniques rely on airflow and ventilation to move mucous but only work if airflow is behind the mucous.
Physiology 101 – Shear Force

- Air moving over a thick layer of mucous creates a shear force on the liquid layer
- When the shear force is greater than the surface tension in the mucous layer, the mucous will begin to move
- Mucous flow is higher when the airflow is higher
Physiology - Equal Pressure Point

- Pleural pressure ($P_{pl}$) + Elastic Recoil (ER) = Alveolar pressure ($P_{a}$)

- With Forced Expiratory Technique, Pleural pressure and Elastic Recoil are positive pressures

- Alveolar pressure drops as you move up airways due to airway resistance

- Equal Pressure Point is when Pleural pressure exceeds Alveolar pressure and airway compresses
Altering Point of Airway Compression

- Small breath in
- Medium breath in
- Deep breath in
COUGHING vs HUFFING

- Coughing causes tracheal collapse.
- Adults have more bronchial wall instability therefore risk of more collapse.
- People with COPD have more collapsible airways
- Repeated coughing causes fatigue and can cause discomfort.

Save coughing for the final secretion evacuation phase.
Forced Expiratory Technique or Huffing

- Inspire from low to medium to high lung volumes. Low volume huff moves peripheral secretions. High volume huff clears larger, proximal airways.

- Long or short expiration?
  - Prolonged for chronic conditions with collapsible airways.
  - Short/fast for acute or post-op (non-collapsible airways
Huffing

- Mouth stays open (drop the jaw).
- Glottis stays open.
- Do one or two huffs at a time. (More could cause bronchospasm.)
- Practice with cardboard tubing or “fogging up glass.”
Huffing Practice

- Practice huffing with cardboard tubes
- Try small versus large breaths through cardboard tube.
- Try short versus long expirations
  - Small (low volume) breath $\rightarrow$ deeper/peripheral airways
  - Large (high volume) breath $\rightarrow$ larger/proximal airways
Active Cycle of Breathing

- Three parts
  - Breathing control = tidal volume breathing in a relaxed state using the diaphragm (and accessory muscles if needed).
  - Thoracic Expansion = Inspiration to TLC (total lung capacity), 3 second breath hold*, relaxed expiration *avoid if hyperinflated
  - Forced Expiration Technique (huffing)
Active Cycle of Breathing
Active Cycle of Breathing Practice

- Now it’s your turn to teach this to the person sitting beside you...
Autogenic Drainage

- Works by moving mucous by adapting and changing the breathing type and level
- Can only be done in the range of Vital Capacity, therefore difficult for COPD patients who have lost much of their VC.
- To find out where secretions are, take a deep breath in and exhale through mouth. If mucous audible at beginning, then secretions are in upper airways. If sounds are at the end, secretions are in the lower airways.
Autogenic Drainage – Inhalation

- Low airflow through nose
- Breath hold for 3-4” with glottis open, if possible, for better filling
- 8-12 breathing cycles (3 or 4 at each volume level)
Autogenic Drainage - Exhalation

- Through open upper airways (nose or mouth)
- High flow velocity
- Avoid wheezing, which indicated compression of airways.
- Feel and hear the mucous move or else it is breathing exercise
Autogenic Drainage

- Start at low lung volumes (ERV) to unstick secretions
- Breath in middle-low volumes (TV) to move secretions
- Breath in high volumes (VC) to evacuate secretions
- In each phase, hold each breath 2 to 3 seconds
- Huff or cough
Autogenic Drainage Practice

Now try teaching the person beside you!
Oscillating Positive Expiratory Pressure

- PEP creates positive intrabronchial pressure, allowing air to move behind obstructed airways (collateral filling)
- PEP splints the airways open to allow increased expiratory flow and mobilization of secretions.
- Oscillations are thought to liquefy secretions and may aid muco-ciliary action
Contraindications/Precautions to Oscillating PEP

- Pneumothorax
- Haemoptysis – stop for 24hrs.
- Recent facial or extensive dental surgery
- Severe cardiovascular insult or disease
- Post lung transplant or post lobectomy – interferes with healing
- Severe nausea or vomiting
Types of Oscillating PEP

- Flutter
- Acapella
- Cornet
- Quake
- Flute
- DIY style: “Straw in glass” technique
Flutter vs Acapella

- Flutter gravity dependent, therefore must be used in upright position
- Flutter effectiveness depends on tilt of device; Acapella not affected by tilt
- Adjustable PEP (5 more PEP, 1 more oscillation) on Acapella, as well as 2 styles, depending on expiratory flow rate
- Price? Ease of care?
DIY Oscillating PEP

- 10 to 15 cm of water in cup
- Large straw which reaches down to bottom of cup
- Inhale through nose and hold breath 2 to 3 seconds
- Exhale in a relaxed manner through straw
- Repeat 10 to 20 breaths
- Huff or cough

Try practicing DIY Oscillating Pep!
Thoracic Mobility Exercises

- To improve control/coordination of breathing and increase ribcage mobility.
- Increasing levels of difficulty for varying levels of patient mobility (MSK considerations)
- Examples: Shoulder shrugs, lateral costal breathing with/without lateral flexion, trunk flex/ext, arm circles, chest press, trunk rotation in sitting or standing
Exercise

- Loosen mucous with mixture of endurance training, muscle strengthening and stretching
- Exercise in various positions – sitting, standing, supine, prone, side-lying – because gravity influences ventilation
- Increased ventilation opens up plugged or collapsed airways
Exercise

- Some may need to use ACT before exercises if too SOB.
- For others, exercise is all the ACT they need!
- Trampoline – jumping or jogging – proven to be effective and good for compliance.
Lifestyle Considerations

- Education – importance of early recognition and treatment of infections
- Importance of adequate hydration to control viscosity of secretions and keep cilia moving
- Importance of healthy diet to bolster immune system and to maintain/achieve healthy weight
- Smoking cessation
- Stress /tension reduction; ergonomics; pacing
- Potential use of mucolytic agents
Thank You!