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RSPT 1410
Bronchial Hygiene Therapy

Cairo: Chapter 7, p. 233-241
Wilkins: Chapter 40, p. 921-946

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Bronchial Hygiene Therapy

- Goals and Indications
  - The primary goal of bronchial hygiene therapy is to help mobilize and remove _____, with the ultimate aim to improve gas exchange and reduce the work of breathing

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Bronchial Hygiene Therapy

- Indications
  - Treating acute conditions
    - _____ secretions
      - chronic conditions that may cause copious secretions
        - » Cystic fibrosis
        - » Bronchiectasis
        - » Ciliary dyskinetic syndromes
        - » Chronic bronchitis

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Bronchial Hygiene Therapy

- Indications
  - Acute _____ with retained secretions
    - Disorders associated with retention of secretions
      - _____ disease
        - » Immobile patients
        - » Postoperative patients
        - » Exacerbations of COPD
      - _____ disease
        - » Cystic fibrosis
        - » Neuromuscular disorders
    - Acute lobar atelectasis
    - V/Q abnormalities caused by _____ lung disease

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Bronchial Hygiene Therapy

- Involves the use of noninvasive airway clearance techniques designed to help mobilize and remove secretions and improve gas exchange
- Traditionally, bronchial hygiene therapy involved postural drainage, percussion, and vibration (PDPV), combined with cough training

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Bronchial Hygiene Therapy

- Over the years, several additional noninvasive clearance methods have been developed to augment or replace this traditional approach
  - These newer techniques include both modified breathing/ coughing routines and mechanical devices designed to augment secretion clearance
- Studies show that when combined with exercise, bronchial hygiene can actually improve lung function in cystic fibrosis (CF) patients

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Bronchial Hygiene Therapy

- Bronchial hygiene therapy can be a valuable component of comprehensive respiratory care *but only if used when indicated*

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Physiology of Airway Clearance

- Normal Clearance
  - requires a _____ airway, a functional mucociliary escalator, and an effective _____
  - Airways normally are kept open by structural support mechanisms and kept clear by proper function of their ciliated mucosa
    - The mucociliary clearance mechanism operates from the _____ down to the respiratory _____
    - Mucus originates from the goblet cells and submucosal glands, although Clara cells and tissue fluid transudation also contribute to airway secretions
    - Mucus is moved via a coordinated _____ of ciliary motion toward the trachea and larynx, where excess secretions can be swallowed or expectorated

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Physiology of Airway Clearance

- The Cough
  - Although essentially a reserve clearance mechanism, the cough is one of the most important protective reflexes
  - By ridding the larger airways of excessive mucus and foreign matter, the cough assists the normal mucociliary clearance and helps ensure airway patency
  - There are four distinct phases to a normal cough:
    - irritation
    - inspiration
    - compression
    - expulsion

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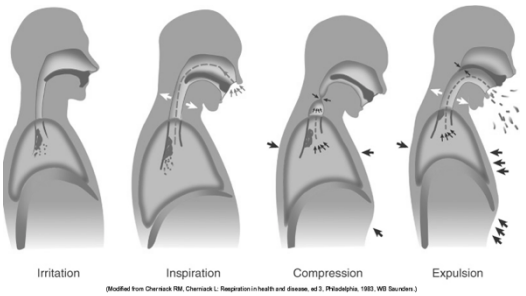

(Modified from Chernack RM, Chernack L: Respiration in health and disease, ed 3, Philadelphia, 1983, WB Saunders.)

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Physiology of Airway Clearance

- The Cough
  - In the initial irritation phase, an abnormal _____ provokes sensory fibers in the airways to send impulses to the brain's medullary cough center
    - This stimulus can be
      - Inflammatory – _____
      - Mechanical – _____
      - Chemical – irritating gases e.g. _____
      - Thermal – _____
  - Once these afferent impulses are received, the cough center generates a reflex stimulation of the respiratory muscles to initiate a deep inspiration (the second phase)
    - 1 to 2 L in the normal adult

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Physiology of Airway Clearance

- The Cough
  - During the third or compression phase, reflex nerve impulses cause glottic closure and a forceful contraction of the expiratory muscles
    - This compression phase is normally about 0.2 second and results in a rapid rise in pleural and alveolar _____ , often in excess of 100 mm Hg
  - At this point the glottis opens, initiating the expulsion phase - with the _____ open, a large pressure gradient between the intrathoracic airways and the atmospheric pressure is exposed

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Physiology of Airway Clearance

- The Cough
  - With the continued contraction of the expiratory muscles, this pressure gradient normally causes a violent, expulsive flow of air from the lungs, with velocities often as high as _____ miles per hour
  - High-velocity gas flow, combined with dynamic airway compression, creates huge _____ that displace mucus from the airway walls into the air stream
  - This causes mucus and foreign material to be expelled from the lower airways to the upper airway, where they can be expectorated or swallowed

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Physiology of Airway Clearance

- Abnormal Clearance
  - Any abnormality that alters airway patency, mucociliary function, strength of the inspiratory or expiratory muscles, or the effectiveness of the cough reflex can impair airway clearance and cause _____
    - In addition, some therapeutic interventions, especially those used in critical care, can result in abnormal clearance
  - Retention of secretions can result in _____ or _____
    - Full obstruction, or mucus plugging, can result in _____ and impaired oxygenation due to shunting
    - By restricting airflow, partial obstruction can increase the work of breathing and lead to air trapping, overdistention, and ventilation/perfusion (V/Q) imbalances

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Physiology of Airway Clearance

- Abnormal Clearance
  - Infectious processes can also cause an _____ response and the release of chemical mediators
    - These chemical mediators can damage the airway epithelium and _____ mucus production
    - All of this results in a worsening airway clearance
  - Compounding these problems may be failure of the cough reflex
    - In patients with retained secretions, interference with any one of the cough's four phases can result in ineffective _____

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Physiology of Airway Clearance

Mechanisms Impairing the Cough Reflex	
Irritation	Anesthesia CNS depression Narcotic-Analgesics
Inspiration	Pain Neuromuscular dysfunction Pulmonary/Abdominal restriction
Compression	Laryngeal nerve damage Artificial airway Abdominal surgery/muscle weakness
Expulsion	Airway compression/obstruction Abdominal muscle weakness Inadequate lung recoil (e.g. emphysema)

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Physiology of Airway Clearance

- Abnormal Clearance
  - Additional factors can impair airway clearance in critically ill patients with _____ airways
    - The tube's presence in the trachea increases mucus secretion, while the tube _____ mechanically blocks the mucociliary escalator
    - Movement of the tube tip and cuff can cause _____ of the tracheal mucosa and further impair mucociliary clearance
    - Endotracheal tubes impair the _____ phase of the cough reflex by preventing closure of the glottis

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Physiology of Airway Clearance

- Abnormal Clearance
  - Although _____ is used to aid secretion clearance, it, too, can cause damage to the airway mucosa and thus impair mucociliary transport
  - Inadequate _____ can cause inspissation of secretions, mucus plugging, and airway obstruction
  - High fractional inspired oxygen concentrations can impair mucociliary clearance, either directly or by causing an acute _____
  - Several common drugs, including some general anesthetics and narcotic-analgesics, can depress mucociliary transport
  - Several _____ commonly seen in critical care are associated with poor secretion clearance

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Bronchial Hygiene

- In Acute Conditions
  - Some of the acute conditions for which bronchial hygiene therapy may be indicated are
    - Acutely ill patients with _____ secretions
    - Patients in acute _____ with clinical signs of retained secretions (audible abnormal breath sounds, deteriorating arterial blood gases, chest radiographic changes)
    - Patients with acute lobar _____
    - Patients with V/Q abnormalities due to lung infiltrates or consolidation

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Bronchial Hygiene

- In Acute Conditions
  - Acute conditions for which bronchial hygiene therapy is probably not helpful include
    - Acute exacerbations of _____
    - Pneumonia without clinically significant sputum production
    - Uncomplicated _____

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Bronchial Hygiene

- In Chronic Conditions
  - Bronchial hygiene therapy has proved effective in aiding secretion clearance and improving pulmonary function in chronic conditions associated with copious sputum production, including
    - CF
    - Bronchiectasis
    - Certain patients with chronic bronchitis
    - In general, sputum production must exceed _____ ml/day for bronchial hygiene therapy to significantly improve secretion removal

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Bronchial Hygiene

- For Prophylaxis
  - Bronchial hygiene therapy has been used as a _____ or prophylactic mode of respiratory care in a variety of patient disorders
  - Current evidence presents a mixed picture regarding the benefits of this approach
  - The best-documented preventive uses of bronchial hygiene therapy include
    - body positioning and patient mobilization to prevent retained secretions in the acutely ill
    - PDPV combined with exercise to maintain lung function in CF
  - Most other prophylactic applications of bronchial hygiene therapy have not proved useful

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Bronchial Hygiene

Techniques

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Chest Physiotherapy

- General Information
  - defined as: the use of manual techniques and postural positions to achieve better _____ to all lung segments and to remove secretions dried or lodged in the respiratory tract
  - aids in the prevention and treatment of respiratory disease and complications
  - includes:
    - postural drainage
    - percussion
    - vibration
    - breathing exercises
    - coughing

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Chest Physiotherapy

- Breathing exercises
  - goals
    - increase input of _____, decrease _____ in lungs
    - decrease the _____
    - remove _____
    - mobilize _____
    - decrease _____

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Chest Physiotherapy

- Breathing exercises
  - uses
    - COPD
    - atelectasis
    - post-op
    - prolonged bed rest

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Chest Physiotherapy

- Types of breathing exercises
  - Diaphragmatic breathing
    - pt. should be made aware that _____ is primary muscle of breathing
    - contraction of the diaphragm causes _____ of dome and expansion of the base of the thorax
    - this increases _____ pressure in the lungs, causing air to flow into lungs (each cm of movement = app. 350 ml of air volume)
    - this exercise strengthens the diaphragm and increases exercise tolerance

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Chest Physiotherapy

Diaphragmatic breathing instruction

- Patient sitting, relaxed
- Therapist's hand(s) placed on abdominal muscles (below xiphoid) or base of ribs
- Slight pressure applied during inspiration
- Firm pressure applied during exhalation

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Chest Physiotherapy

- Types of breathing exercises
  - Pursed lip breathing
    - utilized by _____ pts. (usually unconsciously)
    - pts. exhale against pursed lips, maintaining a _____ pressure in the lungs and allowing a more complete emptying of the lungs before airways collapse
    - when teaching this technique, combine it with diaphragmatic breathing as an expiratory aide

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Chest Physiotherapy

- Types of breathing exercises
  - Segmented breathing exercises
    - similar to diaphragmatic breathing exercises
    - therapist or pt. places hands over area of infiltrates or decreased aeration
    - may be used with postural drainage positions
    - pt. inhales slowly through _____ moving the hand(s) and pauses at peak inspiration
    - pt. exhales through _____

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Chest Physiotherapy

- Types of breathing exercises
  - Segmented breathing exercises
    - variations
      - unilateral or bibasilar expansion (ribs 6, 7 & 8)
      - lateral expansion (ribs 6, 7 & 8 and axilla)
      - apical expansion (below clavicle)
        - » not on COPD pts. - area already developed

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Chest Physiotherapy

Bilateral basal expansion instruction

- Patient sitting, relaxed
- Therapist's hands over area of infiltrate or decreased aeration
- Apply resistance during inspiration

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Chest Physiotherapy

- Coughing
  - aids in removal of secretions and is essential to successful CPT
  - consists of 3 phases
    - inspiration - preferably deeper than normal
    - compression of abdominal muscles against closed glottis
    - forceful expulsion of air

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Chest Physiotherapy

- Coughing
  - to produce effective cough pt. must have
    - adequate _____
    - adequate _____ (PEFR, FEF, MEFR)
    - adequate _____ (negative expiratory pressure)

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Chest Physiotherapy

- Coughing
  - technique
    - several breaths
    - fully expand lungs
    - cough with mouth open
    - best in semi-Fowler's position or side of bed
    - if pt. has recent incisions, allow for pain meds to be given prior to treatment; splint wound with pillow

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Chest Physiotherapy

- Coughing
  - results
    - coughing at high lung volumes aids in clearing secretions down to the _____th or _____th order of airways
    - pts. who are unable to cough may require tracheobronchial aspiration (_____)

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Chest Physiotherapy

- Coughing
  - which pts. can't cough?
    - too weak
    - too much pain
    - large volume of _____
    - excessively thick secretions
    - pts. who are _____ (assisted cough?)
    - pts. with _____ airways
    - babies and some children

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Chest Physiotherapy

- Postural drainage
  - positioning pt. to allow _____ to help drain secretions from specific lung segments
  - indications
    - to help remove secretions in pts. unable to do it on their own
      - pain (trauma, surgery)
      - muscle weakness (age, COPD, infants, young children)
      - inability to generate effective cough (artificial airways, paralysis)

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Chest Physiotherapy

- Postural drainage
  - indications
    - _____ even if pt. can cough, may be overwhelmed
      - » bronchitis
      - » bronchiectasis
      - » cystic fibrosis
    - _____
      - PD can remove secretions and aid in re-expanding the lungs

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Chest Physiotherapy

- Postural drainage
  - indications
    - foreign body removal
    - pts. on _____
      - prophylactic treatment to prevent secretion build-up

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Chest Physiotherapy

- Postural drainage
  - contraindications
    - sudden discomfort, pain or SOB
    - exceeding pt. _____
    - displaced rib fracture
    - hemoptysis (depends on cause)
    - unstable heart rate or blood pressure
    - cardiac dysrhythmias (↓ venous return)

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Chest Physiotherapy

- Postural drainage
  - contraindications
    - no trendelenburg for
      - cerebral aneurysm; recent cranial surgery
      - abdominal distension; obesity; pregnancy
      - recent food consumption; tube feedings
  - anatomy & positions
    - positions are based on _____ structure of the tracheobronchial tree and effects of gravity

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Chest Physiotherapy

- Points to remember
  - children <3 y.o. can be held or laid on your lap, or positioned in bed using pillows
  - do not place pt. close to edge of bed or hang pt. over the edge
  - use pillows to position adults
  - never perform therapy in an awkward position - adjust bed as needed
  - do not encourage _____ in trendelenburg

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Chest Physiotherapy

- Points to remember
  - make sure restraints and bed rails are in place if you leave the pt. and when you are finished
  - lung segments requiring drainage should be determined by chest x-ray and/or auscultation
    - pneumonia CXR = white; BS = _____
    - atelectasis CXR = patchy; BS = _____
  - order of drainage
    - prophylactic - lower then work up
    - treatment - affected lobes, lower then work up

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Chest Physiotherapy

- Points to remember
  - treatment should be modified as needed for each pt. (meals, pain meds, etc.)
  - time per position (pd only) - _____ min. tid-qid

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Chest Physiotherapy

- Percussion
  - indications - same as PD
  - used with PD positions
  - technique
    - place pt. in PD position
    - cover area to be percussed with a towel
    - cup hands with fingers and thumbs closed
    - keep your wrists loose; motion should be from elbow
    - use slow, rhythmic rate (popping sound)

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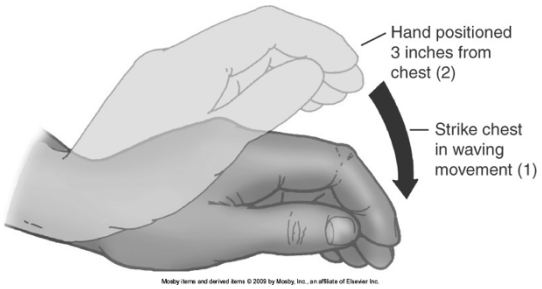

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Chest Physiotherapy

- Percussion
  - should be avoided over:
    - bone (clavicles)
    - spinal column
    - kidneys
    - breasts
    - recent incisions; open wounds
    - chest tubes; drainage tubes

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Chest Physiotherapy

- Percussion
  - Time
    - manual: _____ min/position
    - mechanical: _____ min/position

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Chest Physiotherapy

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Chest Physiotherapy

- Vibration
  - indications same as PD
  - used with percussion and PD
  - technique
    - vibrate during expiration only (pursed lip)
    - place hand on area to be vibrated
    - place other hand over 1st hand
    - vibrate on expiration

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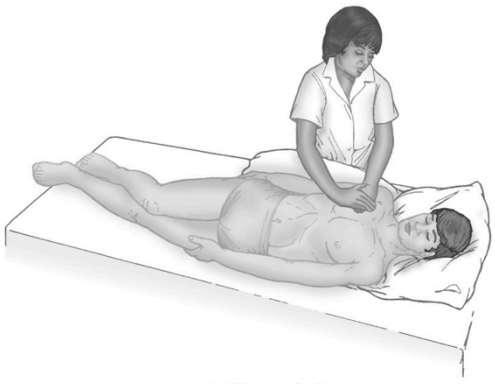

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Chest Physiotherapy

- General points about CPT
  - in most cases, CPT should follow _____ or aerosol therapy
  - for maximum benefit in some diseases (COPD, bronchiectasis, CF), treatments should be 1st thing in the morning & last thing at h.s.

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Chest Physiotherapy

- General points about CPT
  - steps to remember
    1. bronchodilator or aerosol
    2. place pt. in PD position
    3. percussion
    4. vibration
    5. cough
    6. change position
    7. repeat 2-6 until complete

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Chest Physiotherapy

- High-Frequency Compression/Oscillation
  - As applied to airway clearance, oscillation refers to the rapid vibratory movement of small volumes of air back and forth in the respiratory tract
    - At high frequencies (_____to ____Hz), these oscillations act as a physical “mucolytic,” enhancing cough clearance of secretions.
  - There are two general approaches to oscillation
    - External (chest wall) application - often called high-frequency chest wall compression (HFCWC)
    - Airway application
      - Flutter valve
      - Intrapulmonary percussive ventilation (IPV)

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Chest Physiotherapy

- High-Frequency Chest Wall Oscillation
  - High-frequency chest wall oscillation (HFCWO) is accomplished by using a two-part system
    - variable air-pulse generator
    - non-stretch inflatable vest that covers the patient's entire torso
  - Small gas volumes are alternately injected into and withdrawn from the vest by the air-pulse generator at a fast rate, creating an oscillatory motion against the patient's thorax
  - Typically, respiratory therapists perform 30-minute therapy sessions at oscillatory frequencies between ____ -_____Hz between one and six times per day

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Chest Physiotherapy

- High-Frequency Chest Wall Oscillation
  - Compression frequency and flow bias (inspiratory versus expiratory) determine the effectiveness of therapy
    - Animal studies have shown that if the flow bias during treatment is not expiratory, mucus may actually move deeper into the lung
  - Oscillation frequency used affects both patient comfort and efficacy
    - The current recommendation is to individually identify the frequency that produces the optimum results and patient comfort

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Chest Physiotherapy

- High-Frequency Chest Wall Oscillation
  - Clinical studies of HFCWO and HFCWC have demonstrated mixed results
    - When compared with PDPV in patients with CF hospitalized for acute pulmonary exacerbations, HFCWC did not result in better sputum mobilization, pulmonary function, or weight gain

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Chest Physiotherapy

- Airway oscillating devices (AODs)
  - Produce PEP with oscillations in the airway during expiration
    - Believed to work based on the principle of collateral ventilation, which suggests that airflow can occur between adjacent lung segments through the canals of Lambert and through the pores of Kohn
    - Studies have demonstrated it to be as effective as other forms of airway clearance
    - Patients appear to prefer techniques such as PEP that promote independence - important because compliance to airway clearance techniques and exercise is often poor

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Chest Physiotherapy

- Airway oscillating devices (AODs)
  - A popular approach to PEP therapy is the _____
    - Combines the techniques of EPAP with high-frequency oscillations (HFOs) at the airway opening

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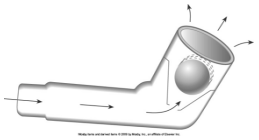
Chest Physiotherapy

Original Flutter valve

- Consists of a pipe-shaped device with a heavy steel ball sitting in an angled "bowl" with a perforated cap
- Actively exhaling into the pipe, creates a PEP of between _____ cm H_2O
- Patients control the pressure by changing their expiratory flows
- Changing the angle of the device alters the oscillations



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Chest Physiotherapy

Acapella

- A valve, looking like a cone in a doughnut, opens under pressure when a user breathes into the device
- The cone lifts out of the doughnut to open the valve and pressure is released
- As the pressure reduces, the flow rate increases, creating a Venturi effect, pulling the cone back into the doughnut
- The cone is mounted on a rocker
- A magnet keeps the valve closed when the device is not in use and allows for adjustment of the resistance

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Chest Physiotherapy

Acapella

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Chest Physiotherapy

Intrapulmonary percussive ventilation

- Uses a pneumatic device to deliver a series of pressurized gas minibursts at rates of 100 to 225 cycles per minute to the respiratory tract, by mouthpiece
  - The duration of each percussive cycle is manually controlled by a thumb button
  - During the cycle, constant PAP is maintained at the airway
  - Also incorporates nebulizer for delivery of aerosol
  - A treatment time of about 20 minutes is recommended

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Chest Physiotherapy Protocol