Tracheobronchial Hygiene

CRC 330
Cardiorespiratory Care
University of South Alabama
Tracheobronchial Hygiene

- Airway clearance
- CPT
- Directed coughing
- Mechanical insufflation-exsufflation
- Flutter and Acapella devices
- High frequency chest wall oscillation
Airway clearance

Normal Mechanisms
- Mucociliary escalator
- Effective cough
  - irritation
  - inspiration
  - compression
  - expulsion
Abnormal Airway Clearance

- Caused by alterations in
  - Airway patency
  - Mucociliary function
  - Cough reflex
- Unfortunate outcomes
  - full or partial airway obstruction
  - hypoxemia
  - increased WOB
  - air trapping
  - mucus plugging
  - overdistention
  - atelectasis
Ineffective cough

- Anesthesia
- CNS depression
- Narcotic analgesics
- Pain
- N-M dysfunction
- Pulmonary restriction
- Abdominal obstruction

- Abdominal restriction
- Laryngeal nerve damage
- Artificial airway
- Abdominal muscle weakness
- Abdominal surgery
Impaired mucus clearance

<table>
<thead>
<tr>
<th>Diseases affecting: airway patency</th>
<th>Mucus and cilia</th>
<th>cough</th>
</tr>
</thead>
<tbody>
<tr>
<td>FB, tumors, kyphoscoliosis, asthma, COPD, pneumonia</td>
<td>CF, Ciliary dysfunction, bronchiectasis, aspergillosis</td>
<td>MD, ALS, Myasthenia Gravis, Polio, cerebral palsy</td>
</tr>
</tbody>
</table>
Chest Physical Therapy

- Turning and postural drainage
  - Turning the patient
    - Manually or in a kinetic bed
  - Promotes lung expansion and oxygenation
    - Place good lung down
  - Promotes mucus drainage
  - Hold each position for 3-15 minutes
Chest Physical Therapy

**Percussion**
- mechanically or manually clapping the chest wall, increasing the kinetic energy to promote drainage
- no evidence that percussion is superior to drainage alone

**Vibration**
- shaking the chest over the draining area to promote mucus flow
- no conclusive evidence showing superiority over postural drainage
Goals/Indications for CPT

- Turning
  - Reluctance or inability to turn spontaneously
  - Position-related hypoxemia
  - Potential for or presence of atelectasis
  - Presence of an artificial airway
Goals/Indications for CPT

- Postural drainage
  - Difficulty with secretion clearance
  - Atelectasis related to mucus plugging
  - Bronchiectasis, CF, other mucus-producing disease

- Percussion
  - Sputum volume/consistency suggesting necessity
Goals/Indications for CPT

- Prevent postoperative pulmonary complications
  - CPT combined with hyperinflation maneuvers
  - Tailor therapy to patient’s abilities
- Prevent pulmonary complications in patients with neuromuscular disease
  - Low tidal volume/lack of sigh predisposes to atelectasis
Assessing the need for CPT

- presence of excessive sputum production
- ineffective cough
- hx of pulmonary problems treated successfully with CPT
- decreased BS/crackles, suggestive of secretions in airways
- deterioration of vital signs-non specific
- xray showing atelectasis, infiltration, mucus plugging
- deteriorating oxygenation status (PaO₂ or SpO₂)
- Effectiveness of other less aggressive therapy
CPT: Postural Drainage

- Placement of the segmental bronchus in a vertical position relative to gravity
- Efficacy
  - doesn’t facilitate mucociliary clearance in normal subjects
  - doesn’t improve PFT in pts with stable COPD with scant mucus
  - effective in pts who produce > 30 mL sputum/day
  - requires head-down positions > 25°
- adequate systemic and airway hydration is prerequisite
CPT: Postural Drainage

**Technique**

- based on assessment, ID lobes/segments to be drained
- 1 1/2-2 hours after meals or tube feedings
- explain to pt, check tubes/urinal, auscult, check vitals
- bed or tilt-table are elevated 16-18” from horizontal
- maintain position 5-10 minutes, especially if good sputum production
- percuss/vibrate over target lobe/segment if indicated
- monitor for side effects
CPT: Postural Drainage

**Positions**
- posterior basal-pt prone, Trendelenberg
- lateral basal-pt side lying, Trendelenberg
- anterior basal-pt side lying, Trendelenberg
- superior segments- Pt prone, pillow under pelvis
- middle lobe-pt, 45° from supine in Trendelenberg
- lingular segments- pt 45° from supine in Trendelenberg
- anterior upper-pt supine, thighs elevated on pillow
- apical segments-pt upright
- posterior upper-pt upright in chair, leaning forward
UPPER LOBES

ANTERIOR APICAL SEGMENTS
R.U.L. & L.U.L.

POSTERIOR APICAL SEGMENTS
R.U.L. & L.U.L.

ANTERIOR SEGMENTS
R.U.L. & L.U.L.

POSTERIOR SEGMENTS
R.U.L.

(18") TURN FROM PRONE. REST ON RIGHT SIDE. HEAD AND SHOULDERS RAISED, SUPPORTED ON PILLOWS.

L.U.L.

TURN FROM PRONE. REST ON LEFT SIDE, SUPPORT ON PILLOWS.

R.U.L.

LINGULAR SEGMENTS

L.M.L.

TIP BED 12"

TURN FROM SUPINE—REST ON RIGHT SIDE, SUPPORT WITH PILLOWS.

R.M.L.

TIP BED 12"

TURN FROM SUPINE—REST ON LEFT SIDE, SUPPORT WITH PILLOWS.
Figure 10-5. The twelve postural drainage positions
Dependent positioning

- The dependent portion of a lung receives the best ventilation and blood flow
- Placement of the good lung down in unilateral lung disease improves V/Q & PaO₂
- Prone positioning in ARDS improves V/Q, as ARDS often affects dependent segments
CPT: Percussion and Vibration

- **Percussion**
  - efficacy is unproven, may be effective to increase sputum volume, often performed indiscriminately
  - done by cupping the hands and alternately clapping over the draining area
  - cover the area with a thin sheet or towel

- **Vibration**
  - used in conjunction with percussion, during expiration
  - cross the hands on the area percussed, apply pressure and vibrate during a long, slow expiration
Mechanical Percussors

- Less tiresome for the practitioner
- Provide a constant percussion at a higher frequency
- General Physiotherapy percussors
  - with elbow, they percuss
  - without elbow, they vibrate
  - set at a slow frequency
- Patients often prefer this
CPT: Potential problems

- Hemorrhage
- Rib fractures
- Increased ICP
- Hypoxemia
- Impaired cardiac output
- Increased airway resistance
- Dizziness
- Dyspnea
CPT: Assessment of Outcome

- Change in sputum production
- Change in breath sounds
- Patient’s subjective response
- Change in vital signs
- Radiographic changes
- Oxygenation status
- Improved mechanics of ventilation
CPT: Patient monitoring and charting

- Subjective response
- Vital signs
- Breathing pattern and rate
- Sputum/mucus characteristics
- Mentation
- Skin color
- Breath sounds
- Oxygen saturation by pulse oximeter
- Intracranial pressure, if available
CPT

- **Frequency of therapy**
  - ventilated patients should be turned every 2 hours, or placed on a kinetic bed
  - perform CPT q 4-6 hours following bronchodilator therapy, reevaluating every 48 hrs

- **Infection control**
  - standard precautions
  - observe infection control precautions for any given pt
  - disinfect equipment between pts
Directed Cough

- Taught methods of coughing that include the forced expiratory technique (huff cough) and manually assisted cough
- Forced expiratory technique (huff coughing)
  - 1-2 huffs from low-mid lung volumes with glottis open
  - period of controlled relaxed diaphragmatic breathing
  - reinforced by self-compression of the chest by arm adduction
- Manually assisted cough
  - external application of manual pressure to the epigastric region
  - coordinated with forced expiration
Directed Cough: Indications

- Retained secretions in upper airways (if other methods are unsuccessful)
- Atelectasis
- Prophylaxis against PPC
- Routine in CF, bronchiectasis, chronic bronchitis, necrotizing infections, spinal cord injury
- Sputum induction
Directed Cough

- **Contraindications**
  - intracranial aneurism/increased ICP
  - acute myocardial infarction
  - unstable neck or spine injury
  - abdominal problems

- **Complications: those related to coughing**

- **Limitations**
  - not effective in obtunded patients
  - severe obstructive or restrictive disease
  - bypassed upper airway
  - sputum too thick to be eliminated
Directed Cough

- Assessment of outcome
  - sputum production
  - improved pulmonary hygiene
  - observe for patient discomfort or pain
  - breath sounds
  - check volumes, capacities, and flows

- Frequency
  - performed as necessary to keep airways open
  - q 2-4 hours in postop pts
  - as an alternative to CPT, performed 3-4 times daily
Forced Expiratory Technique

**Technique**
- patient directed to inhale to a mid-lung volume
- keep the glottis open exhale abruptly, to cause one or two huffs, as in the previously discussed directed coughing maneuver

**Indication**
- patients in whom exhalation from TLC may cause airway collapse, such as in COPD, bronchiectasis, and cystic fibrosis
Other cough adjuncts

- **Active cycle of breathing**
  - cystic fibrosis
  - patient understanding is imperative
  - not useful on obtunded patients with retained secretions

- **Autogenic drainage**
  - another modification of directed coughing
  - requires careful patient teaching and understanding; has some demonstrated success in cystic fibrosis
## Autogenic Drainage

<table>
<thead>
<tr>
<th>Normal</th>
<th>Phase: 1</th>
<th>Phase: 2</th>
<th>Phase: 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>IRV</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ERV</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FRC</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RV</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(Modified from Hardy KA, Anderson BD: Respir Care Clin North Am 2:323, 1996.)
Mechanical Insufflation-Exsufflation

- Rapid inspiration to 30-50 cm H₂O, equally rapid active expiration/suction to - 30-50 cm H₂O
- Advantage with this technique is the rapid expiration: 7.5 L/sec. expiratory flow, effective for secretion clearance
- Treatment involves 5 in-exsufflations, followed by normal breathing, repeat of the process several times until secretions are mobilized.
- No data regarding the use of this device on acutely-ill patients
Cough-Assist

Amyotrophic lateral sclerosis
Spinal muscular atrophy
Muscular dystrophy
Myasthenia gravis
Spinal cord injuries
Flutter device

- Inside the device is a stainless steel ball in a seat
- As the patient exhales, ball is pushed out of the seat, alternately settling back into the seat throughout expiration
- Oscillatory pressure pattern in the airways, designed to shake secretions loose
- Internal percussion therapy
Flutter

- Therapeutic session consists of two phases
  - Mucus loosening and mobilization phase
  - Mucus elimination phase
  - Specific instructions for each
  - After bronchodilator and PRN

- Indications
  - Difficult airway secretions
Acapella

- Vibratory PEP device, non-gravity dependent
- Housing for the mechanism, a frequency-resistance setting dial on the back of the housing, and a mouthpiece
- Mask may be used
Acapella

- Acapella directs exhaled air through an opening, which is periodically closed by a pivoting cone.
- As air passes through the opening, the cone alternately closes and opens the airflow path.
- Frequencies between 0-30 Hz (cycles/sec), positive pressure throughout the exhalation process: vibratory PEP therapy.
- Adjusting the dial, the frequency of the vibrating pressure waves and the resistance of the opening changes. The higher the frequency of vibrations, the higher the effective resistance will be.
High Frequency Chest Wall Compression

**Device**
- pneumatic vest
- air pulse generator
- air pulse generator is affixed to the vest by two hoses
- frequencies of 5-25 hertz
- Most of each phase must be expiratory to promote secretion clearance

**Research**
- no advantage over CPT, company makes claims
- $$$, therapeutic benefit will have to be proven before the device is widely accepted
- Takes less time, self administered