Pulmonary Techniques

“Chest Physical Therapy”

Anatomy Review

• Respiratory System
  – Upper Tract
    • Functions
      – Warm moisten and filter inspired air
      – Bacteria is trapped by nasal mucosa

• Respiratory System
  – Middle Tract
    • Trachea

• Respiratory System
  – Lower Tract
    • L & R main bronchi
      – Smaller bronchi
        • Alveolar bronchi
        • Alveoli
        • Lobules
Anatomy Review

• Respiratory System
  – Pulmonary Circulation
    • Lungs
      – Receive blood to be oxygenated via the pulmonary arteries
      – Returns the oxygenated blood to the heart via the pulmonary veins

Anatomy Review

• Respiratory System
  – Primary Functions
    • Respiration
    • Respiratory Defense System
    • Acid-Base balance

Ventilation & Respiration

• Ventilation: describes only the movement of air. Air is inspired through the nose or mouth, through all of the conducting airways until it reaches the distal respiratory unit (alveoli).
Ventilation & Respiration

- **Respiration**: a term used to describe the gas exchange within the body.
  - Oxygen is provided to the body tissues and carbon dioxide has been removed
- **Muscles of Ventilation**:
  - 1. diaphragm
  - 2. scalenes
  - 3. intercostals
  - 4. upper traps, SCM, pec minor/major, subclavious

2 Main Categories of Pulmonary Pathology

- **RESTRICTIVE**: INABILITY OF THE LUNGS TO FULLY EXPAND
  - RESULTS FROM EXTRAPULMONARY RESTRICTION
- **OBSTRUCTIVE**: CONDITIONS WHICH OBSTRUCT THE FLOW OF AIR IN THE RESPIRATORY TRACT
  - AFFECTS VENTILATION
  - AFFECTS GAS EXCHANGE

RESTRICTIVE

- TUMOR
- INTERSTITIAL PULMONARY FIBROSIS
- BRONCHOPULMONARY DYSPLASIA
- ADVANCED AGE
- TRAUMA OR SURGERY
- SCLERODERMA
- ANKYLOSING SPONDYLITIS
- POSTURAL DEFORMITIES (SCOLIOSIS)
- SCI, CP, MUSCULAR DYSTrophy, PARKINSON’S
- PLEURAL DISEASE
- OBESITY OR ASCITES
**OBSTRUCTIVE**

- PERIPHERAL AIRWAY DISEASE
- CHRONIC BRONCHITIS
- EMPHYSEMA
- ASTHMA
- BRONCHIECTASIS
- CYSTIC FIBROSIS
- BRONCHOPULMONARY DYSPLASIA

**Chronic Lung Diseases**

- COPD (Chronic Obstructive Pulmonary Disease)
  - Chronic Bronchitis
  - Emphysema
- Asthma
- CF (Cystic Fibrosis)

**COPD**

- The most common chronic pulmonary disorder
- Afflicting 10-15% of adults over age 55
- COPD is characterized by progressive airflow obstruction
- The pulmonary components that comprise COPD are chronic bronchitis & emphysema
Chronic Bronchitis

• Defined as chronic cough & expectoration (when other specific causes of cough are excluded), which persists for at least a 3 month period for at least 2 consecutive years

Emphysema

• Defined as abnormal enlargement of the distal respiratory unit and destructive changes of the alveolar walls without fibrosis

COPD - overview

• Chronic bronchitis and emphysema can coexist and their clinical signs and symptoms overlap
• This is why the term COPD is useful in the clinical setting to describe the combination of these 2 disorders
COPD Etiology

- The major causal agent in COPD: chronic inflammation caused by irritation of inhaled cigarette smoke

Clinical Presentation of COPD

- Chronic cough, expectoration, & exertional dyspnea
- Anterior-posterior diameter of chest increases (kyphosis)
- May hearing wheezing & crackles
- Hypertrophy of accessory muscles of ventilation
- Pursed-lip breathing
- Cyanosis
- Digital clubbing
Asthma - overview

- Increased reactivity of the tracheobronchial tree in the presence of various stimuli
- Episodic attacks of wheezing & dyspnea that improve either spontaneously or with medical intervention & are interspersed with periods that are symptom free
- Widespread narrowing of airways resulting in bronchospasm

Asthma Etiology

- Affects 14-15 million in the US
- Exact mechanism of airway hyperactivity is unknown
- The airways of these patients are sensitive to allergens, infections, irritants, cold, emotional stress, exercise, and chemicals

Clinical Presentation of Asthma

- Varying degrees of wheezing & dyspnea
- During acute exacerbation
  - Chest held in expanded position
  - Hyperinflation of the lungs
  - Accessory muscles of ventilation are used
  - Expiratory wheezing
Cystic Fibrosis - overview

- A hereditary disease (recessive gene)
- Incidence of disease white children 1 in 2000 births, carrier rate 1 in 20; less common in African-American population (1 in 17,000) and rare in Asian population
- Disease characterized by exocrine gland dysfunction
- In 1995, mean survival age was 30, respiratory failure = most common cause of death

Other Pulmonary Pathologies

- Bronchiectasis
- Cor Pulmonale
- Tuberculosis

Bronchiectasis

- A progressive obstructive lung disease that produces abnormal dilation of a bronchus
- An irreversible condition usually associated with chronic infections, aspiration, CF, or immune system impairment
- Symptoms: consistent productive cough, hemoptysis, weight loss, anemia, crackles, wheezes, loud breath sounds
Cor Pulmonale

- Considered a medical emergency
- Sudden dilation of the right ventricle of the heart due to a pulmonary embolus
- Right sided heart failure will occur if condition is not treated
- Clinical symptoms: chronic cough, chest pain, distal swelling (bilateral), dyspnea, fatigue, weakness

Tuberculosis (TB)

- A bacterial infection transmitted in an airborne fashion (cough, sneeze, speak)
- Primarily involves the lungs, but can occur in kidneys, lymph nodes, meninges
- Lesions in lung can be seen with X-ray
- Clinical symptoms: fatigue, weight loss, loss of appetite, low-grade fever, productive cough, chest discomfort, dyspnea
- Treatment: medication, immunization recommended for children

Medical Management of Pulmonary Disease

- Pharmacological Management
- Surgical Management
- Physical Therapy
Pharmacological Management

- Maintenance of Airway Patency
  - Beta-Adrenergic Agonists
  - Anti-cholinergics
  - Corticosteroids
  - Supplemental Oxygen

Surgical Management

- Surgical resection of giant bullae to remove abnormally dilated, nonfunctional lung tissue to decompress the adjacent functional lung tissue
- Pneumonectomy: removal of 20-30% of nonfunctional lung
- Lung transplantation for end-stage pulmonary disease

Physical Therapy Management

- **Breathing re-education**
  - Diaphragmatic breathing
  - Pursed-lip breathing
- **Patient education**
  - Cessation of smoking
  - Energy conservation
- **Exercise**
  - Ventilatory muscle training
  - Aerobic
  - Trunk & UE
- **Secretion Removal**
- **Positioning**
- **Relaxation Techniques**
Breathing Re-education

- **Breathing Re-education**
  - Performed to increase ventilation & improve oxygenation, thereby relieving dyspnea

- **Diaphragmatic Breathing**

Breathing Re-education cont

- **Pursed-Lip Breathing**
  - Often used spontaneously by pts with COPD, but may need to be taught
  - Have patient sit comfortably with hand on mid-abdominal muscles
  - Patient inhales slowly through the nose, & then lets the air escape gently through the lips WITHOUT any use of abdominal muscles

Patient Education

- **Smoking Cessation**
  - Special focus on the effects of smoking and smoking cessation should be included in pulmonary rehab
  - We can help guide the patient in their efforts to quit, not to provide the actual service

- **Energy Conservation**
  - Teaching the patient techniques to reduce the demands of the activities that they must perform
  - See handout
Exercise

• **Ventilatory Muscle Training**
  – Use of a resistive breathing device specifically designed to improve respiratory muscle function
  – Consists of a mouthpiece & chamber with adjustable resistance settings (progressively narrower airways)

• **Aerobic Exercise**
  – Any form of aerobic exercise serves as a stimulus to increase respiratory muscle strength & endurance
  – Must include warm-up and cool-down periods

Exercise continued

• **Trunk & UE exercise:**
  – Any exercise that affects the shoulders or trunk will help to mobilize the chest
  – **Seated exercise examples:**
    • pt exhales while bending forward to touch floor, inhales and extends up raising arms in a V overhead
    • hands hold opposite forearms & resting on top of head, patient rotates trunk left and right

Secretion Removal

• **Postural (or Bronchial) Drainage**
• **Manual Techniques**
  – Percussion
  – Vibration
  – Shaking
• **Coughing**
• **Assisted Coughing**
• **Suctioning**
Postural Drainage

• Positioning the patient according to bronchopulmonary anatomy, so that a particular lung segment is placed with its bronchus perpendicular to the floor.
• This will facilitate drainage of secretions from the periphery into the major airways, which can then be removed with coughing.

Precautions for use of Trendelenberg Position

• Circulatory
  — Pulmonary edema
  — Congestive heart failure
  — HTN
• Abdominal
  — Obesity, abdominal distention, hiatal hernia, nausea, recent food consumption
• Shortness of breath made worse by the trendelenberg position

Precautions for use of side-lying position

• Vascular
  — Axillofemoral bypass graft
• Musculoskeletal
  — Arthritis
  — recent rib fracture
  — shoulder bursitis, or tendonitis
Postural Drainage continued

• See handout for specific postural drainage positions
• Each position held for 5-20 minutes
• Have the patient cough (or suction them) before changing positions
• Limit the total treatment time to 30-40 minutes if treating more than one lung segment
• Can apply manual techniques while the patient is in this position

Manual Techniques

• **Percussion:**
  – A treatment technique which consists of rhythmically and alternately striking the chest wall over specific lung segments with cupped hands to mechanically jar and dislodge retained secretions
  – [http://www.youtube.com/watch?v=nqWvOlJ0c6Q](http://www.youtube.com/watch?v=nqWvOlJ0c6Q)

Manual Techniques continued

• **Percussion continued:**
  – Perform with the patient in the appropriate postural drainage position
  – The force should be adjusted for each patient & should be comfortable
  – Can be performed over a layer of thin cloth (hospital gown)
  – 2-5 minutes per lung segment, & followed by vibration, coughing or suctioning
**Percussion Precautions**

- Rib fractures
- Low platelet count
- Osteoporosis
- Unstable CV status
- Recent spinal fusion
- Fresh burns, open wounds, skin infection
- Pulmonary embolism
- For those whom percussion is contraindicated, vibration can be used

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**Manual Techniques continued**

- **Vibration:**
  - Vibration consists of chest compression with manual vibration produced by PTA tensing all muscles in the UE in co-contraction
  - Performed during exhalation only for 6-8 breaths

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**Manual Techniques continued**

- **Shaking**
  - Similar to vibration except that it consists of gentle thrusts in and out rather than vibration
  - Performed on exhalation only
Coughing

• The primary means of clearing the first 6-7 generations of airways of excess secretions
• Common causes of ineffective cough: weakness, paralysis, incoordination of ventilatory muscles, pain, COPD, and depression of CNS.
• The result is retained secretions and bronchial obstruction

Coughing

• There are various coughing techniques
• Here are two:
  – **Double cough**: following a deep inspiration, the pt performs 2 coughs in 1 breath, the second is usually more forceful than the first
  – **Huffing**: pt takes a deep inspiration & then air is forcefully exhaled as in coughing except that the mouth is kept open

Assisted Coughing

• There are various assisted coughing techniques,
• Here are two:
  – **Heimlich-Type Assist**: in supine or sidelying; place heel of one hand inferior to xiphoid; pt takes a deep breath & holds it. As you instruct the pt to cough, you apply a quick push up & in under the diaphragm with the heel of your hand
  – **Rocking**: in quadruped, pt rocks all the way forward while looking up & taking a deep breath, then coughs with a flexed head while rocking backward to the heels.
Suctioning

- Indicated when pts are unable to clear secretions by coughing
- Invasive procedure
- Significant risk
- Must be performed with caution

Patient Positioning

- Positioning to relieve dyspnea
  - Positions that support the UE (leaning forward) are recommended to increase the mechanical efficiency of accessory muscles
  - Leaning forward also increases intra-abdominal pressure & pushes the diaphragm up into the thorax for a more optimal position for contraction
  - See handout

Pulmonary Assessment

- Physical Therapy Assessment
  - Vital Signs
  - Observation
  - Palpation
  - Auscultation
  - MMT
- Medical Assessment
  - Pulmonary function testing
  - Arterial blood gases (ABGs)
# Pulmonary Assessment: PT

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<tr>
<th><strong>Vital Signs</strong></th>
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<tbody>
<tr>
<td>• Temperature</td>
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<td>• Resting BP</td>
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<td>• Resting HR</td>
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<td>• Resting RR</td>
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<th><strong>Observation</strong></th>
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<tr>
<td>• Breathing pattern</td>
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<tr>
<td>• Inhaling/exhaling through nose? Mouth?</td>
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<tr>
<td>• Ease of respiration</td>
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<tr>
<td>• Posture</td>
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<tr>
<td>• Use of accessory muscles of ventilation</td>
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<tr>
<td>• Size &amp; shape of thorax</td>
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<td>• Nail bed color and presence/absence of digital clubbing</td>
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<th><strong>Palpation</strong> for mediastinal shift</th>
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<td>• Trachea positioning</td>
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<td>• Moves toward the affected side</td>
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<th><strong>Palpation</strong> for Fremitus</th>
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<td>• Place palms (or hypothenar eminences) lightly on symmetrical areas of back. Patient says &quot;99.&quot; The intensity of vibrations detected in each hand is compared as you move your hands over several areas</td>
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<td>• Under normal conditions, equal vibrations of moderate intensity are perceived</td>
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<td>• Increased fremitus with increased density (less air) in lung tissue, decreased/absent when there is fluid or air in the pleural space</td>
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Pulmonary Assessment

• **Auscultation**
  – Listening over the chest wall to the airways as gas enters and exits the lungs

Normal Auscultation

• Patient inspires fully through an open mouth, then exhales quietly
  – Inhalation and the beginning of exhalation normally produces a soft rustling sound
  – The end of exhalation is silent

Auscultation: Breath sounds

• Vesicular breath sounds
  – Normal, soft, low-pitched sounds heard over more distal airways primarily during inspiration
  – During expiration, the soft sound is diminished and only heard during the beginning
**Breath Sounds**

- Bronchial breath sounds
  - Abnormal breath sounds when heard in locations that vesicular sounds are normally present. (pneumonia may produce this)
- Decreased or diminished breath sounds
  - A less audible sound may indicate severe congestion, emphysema or hypoventilation
- Absent breath sounds
  - May indicate pneumothorax or lung collapse

**Adventitious Breath Sounds**

- **Crackles**: (used to be called rales) sound like the rustling of cellophane, like “bubbles” or “pops”
- **Wheezes**: more musical in nature, like stretching the neck of an inflated balloon, high-pitched
- **Rhonchi**: low-pitched, occur with ins & exp
- **Stridor**: very high-pitched wheeze. If heard without a stethoscope = emergency

**MMT**

- Patient with pulmonary disease may have weakness
  - In ventilatory muscles
  - Peripheral muscles due to long term steroid use
Pulmonary Assessment:  
Pulmonary Function Testing

- Lung Volumes & Capacities
  - Total Lung Capacity (TLC)
  - Tidal Volume (TV)
  - Inspiratory Reserve Volume (IRV)
  - Expiratory Reserve Volume (ERV)
  - Residual Volume (RV)
  - Inspiratory Capacity (IC)
  - Functional Residual Capacity (FRC)
  - Vital Capacity (VC)

Pulmonary Assessment:  
Arterial Blood Gases (ABGs)

- Blood gases helps us to determine the effectiveness of alveolar ventilation
- Values are expressed as partial pressures of the gas

Questions???