Physical Exam & Associated Pathology
Part V – Respiratory System

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The Respiratory System

- Lungs, fissures, and lobes
  - Anteriorly, the apex of each lung is above 2 cm to 4 cm of the clavicle. The lower border of the lung is at the 6th rib at the midclavicular line and the 8th rib at the midaxillary line. The lower border of the lung lies at the level of T10. On inspiration, it descends further down the back.

- The trachea and bronchi
  - Breath sounds over the trachea and bronchi have a different quality than breath sounds over the lung parenchyma. The trachea bifurcates the sternal angle anteriorly and the T4 spinous process from the back.

- Serous membranes
  - Visceral: lines the outer lungs
  - Pleural: lines the inner surface
  - The pleural space is the potential space between visceral and parietal pleurae.

- Signs and symptoms
  - Chest pain
  - Shortness of breath (dyspnea)
  - Wheezing
  - Cough
    - Blood-streaked sputum (hemoptysis) - infection, cancer, cardiovascular disease

- Chest pain
  - Cardiovascular
  - Bronchitis
  - Pneumonia
  - Costochondritis, herpes zoster
  - Reflux esophagitis, esophageal spasm
  - Cervical arthritis
  - Biliary colic
  - Gastritis
The Respiratory System (con’t)

- **Shortness of breath and wheezing**
  - Dyspnea: A nonpainful, ‘shortness of breath’. Assess for cardiac or pulmonary disease.
  - Wheezing indicates a partial airway obstruction from secretions, tissue inflammation, or a foreign body.

- **Chronic bronchitis**
  - Mucus production causing airway obstruction

- **Chronic obstructive pulmonary disease (COPD)**
  - Chronic obstruction of airways

- **Asthma**
  - Inflammation of bronchi and bronchoconstriction

- **Diffuse interstitial lung diseases** (such as tuberculosis, sarcoidosis, widespread neoplasms, asbestosis, and idiopathic pulmonary fibrosis)
  - Abnormal and widespread infiltration of cells, fluid, and collagen into interstitial spaces between alveoli

- **Pneumonia**
  - Inflammation of lung parenchyma from the respiratory bronchioles to the alveoli

- **Spontaneous pneumothorax**
  - Leakage of air into pleural space through blebs (blisters) on visceral pleura, which results in partial or complete collapse of the lung
  - Sudden onset of dyspnea

- **Acute pulmonary embolism**
  - Sudden occlusion of all or part of pulmonary arterial tree by a blood clot that usually originates in deep veins of the legs or pelvis
  - Sudden onset of dyspnea
• Cough
  
  o A reflex response to stimuli that irritate receptors in the larynx, trachea, or large bronchi, however, other causes include inflammation of the respiratory mucosa and pressure or tension in the air passages from a tumor or enlarged lymph nodes. It may also be cardiovascular in origin.

  o Duration of the cough is important:
    
    - **Acute**: lasting less than 3 weeks
    - **Subacute**: 3 to 8 weeks
    - **Chronic**: more than 8 weeks

  o Most common causes of chronic cough
    
    - ACE inhibitor
    - Asthma
    - Chronic bronchitis
    - GERD
    - Postnasal drip syndrome

• Auscultation

  Auscultate along the posterior and anterior surface of the chest at the midclavicular lines and the anterior and posterior axillary lines. Listen for one full breath cycle (inspiration/expiration)

  o Breath sounds (lung sounds)
    
    - **Vesicular**: Soft and low pitched; heard through inspiration, and continue without pause through expiration. Heard over most of the lungs.
    - **Bronchovesicular**: Inspiratory and expiratory sounds about equal in length through the breath cycle. Heard between shoulder blades and at the first and second intercostals spaces.
    - **Bronchial**: Louder and higher in pitch, with a short silence between inspiratory and expiratory sounds. Expiratory sounds last longer than inspiratory sounds. Heard over the manubrium.

  o Adventitious (added) sounds
    
    - Adventitious sounds are additional sounds that are added to the normal breath sounds.
Chest Disorders and Auscultation

- **Chronic Bronchitis**
  - The bronchi are chronically inflamed and a productive cough is present. Airway obstruction may develop
  - Adventitious Sounds: None; or scattered coarse crackles in early inspiration and perhaps expiration; or wheezes and rhonchi

- **Consolidation**
  - Alveoli fill with fluid or blood cells, as in pneumonia, pulmonary edema; or pulmonary hemorrhage.
  - Adventitious Sound: Late inspiratory crackles over the involved area

- **Chronic obstructive pulmonary disease (COPD)**
  - Slowly progressive disorder in which the distal air spaces enlarge and lungs become hyperinflated. Chronic bronchitis is often associated.
  - Adventitious Sounds: None, or the crackles, wheezes, and rhonchi of associated chronic bronchitis

- **Asthma**
  - Widespread narrowing of the tracheobronchial tree diminishes air flow to a fluctuating degree. During attacks, air flow decreases further and lungs hyperinflate
  - Adventitious Sounds: Wheezes possibly crackles
Spirometry

- Pulmonary Function Testing (PFT): Assessing the lungs at it relates to:
  - How much air volume can be moved in and out of the lungs
  - How fast the air can be moved in and out of the lungs
  - Stiffness of the lungs and chest wall
  - How the lungs respond to physical therapy

- PFT is used for:
  - Screening for the presence of obstructive and restrictive diseases
  - Documenting the progression of pulmonary disease – restrictive or obstructive
  - Documenting the effectiveness of therapeutic intervention

- Normal values are based on the following:
  - Age
  - Gender
  - Body height and size
  - Race

- Obstructed airflow (not getting air out)
  - The patency is estimated by measuring the flow of air as the patient exhales as hard and fast as possible. Flow through the tubular passageways of the lung can be reduced for a number of reasons:
    1. Narrowing of the airways due to bronchial smooth muscle contraction as is the case in asthma
    2. Narrowing of the airways due to inflammation and swelling of bronchial mucosa
    3. Material inside the bronchial passageways physically obstructing the flow of air (i.e. mucus plugging)
    4. Destruction of lung tissue with the loss of elasticity; hence the loss of the external support of airways; emphysema
    5. External compression of the airways by tumors and trauma

- Restricted airflow (not getting air in)

  Conditions associated with restrictive airflow:
  - Sarcoidosis
  - Tuberculosis
  - Pneumonia
  - Ankylosing spondylitis
  - Gross obesity
  - Generalized weakness – malnutrition
  - Muscular dystrophy
  - ALS (Amyotrophic Lateral Sclerosis)
Spirometry (con’t)

- **Forced Vital Capacity (FVC)**
  - FVC is the amount of air that can be maximally and forcibly expelled from the lungs after a maximal inhalation. In obstructive disease, the amount of air in the lungs will not be readily exhaled because of physical obstruction and airway collapse during exhalation.
  - In obstructive diseases, the lung’s air volume will be more slowly expelled and will be a smaller volume over the time course of the FVC test than would be expected in a healthy individual.
  - In restrictive lung disease, the FVC will be smaller because the amount of air that can be forcefully inhaled or exhaled is smaller to start with because of disease.
  - Since FVC will be smaller in obstructive and restrictive disorders, FVC alone cannot be used to diagnose obstructive and restrictive disorders by itself.

- **Forced Expiratory Volume in One Second (FEV1)**
  - FEV1 is the amount of air that is forcefully exhaled in the first second of the FVC test.
  - Generally, healthy individuals are able to expel 75% - 80% of their vital capacity in the first second of the FVC test, therefore FEV1 is a pulmonary function value that is highly diagnostic of obstructive disease (i.e. if an individual’s FEV1 is low compared to the predicted FEV1 in the normal population, the individual may have an obstructive lung disease.
  - FEV1 is also expressed as a ratio or percentage of the FVC and is written as %FEV1 or FEV1/FVC.
  - If a display of a low FEV1 is low, the presence of obstructive pathologies should be suspected.
  - In restrictive lung disease:
    - The FEV1 and the FVC will be lower than predicted normal values
    - Because both of these values may equally be affected, the %FEV1 may well be calculated to be between 85% - 100% normal.
    - Look closely at %FEV1 when FEV1 and FVC are low and if the %FEV1 is 85% or greater, then restrictive pathology should be suspected.

- Normal PFT Outcomes: .85% of predicted values
- Mild Disease: >65% but <85% of predicted values
- Moderate Disease: >50% but <65% of predicted values
- Severe Disease: <50% of predicted values
### Sample PFT: Obstructive Disease

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<th></th>
<th>Predicted Value</th>
<th>Measured Value</th>
<th>%</th>
</tr>
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<tr>
<td>FVC</td>
<td>6.0 L</td>
<td>4.0 L</td>
<td>67%</td>
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<tr>
<td>FEV1</td>
<td>5.0 L</td>
<td>2.0 L</td>
<td>40%</td>
</tr>
<tr>
<td>FEV1/FVC</td>
<td>83%</td>
<td>50%</td>
<td>60%</td>
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### Sample PFT: Restrictive Disease

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<th>Predicted Value</th>
<th>Measured Value</th>
<th>%</th>
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<tbody>
<tr>
<td>FVC</td>
<td>5.6 L</td>
<td>4.4 L</td>
<td>78%</td>
</tr>
<tr>
<td>FEV1</td>
<td>4.9 L</td>
<td>3.5 L</td>
<td>72%</td>
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<td>FEV1/FVC</td>
<td>84%</td>
<td>79%</td>
<td>94%</td>
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References:

All reference material is listed at the conclusion of the Physical Examination and Associated Pathology lessons.