Respiratory Disorders

Bio 375
Pathophysiology

General Manifestations of Respiratory Disease

- Sneezing is a reflex response to irritation in the upper respiratory tract and is associated with inflammation or foreign material in the nasal passages.
- Coughing may result from irritation due to nasal discharge dripping into the oropharynx or from inflammation or foreign material in the lower respiratory tract or from inhaled irritants like tobacco smoke.

Infectious Diseases: Upper Respiratory Tract Infections

- Common cold (Infectious rhinitis) is caused by a viral infection of the upper respiratory tract.
- The most common pathogen is rhinovirus, although there are more than 100 causative agents so it is difficult to develop immunity.
- Children acquire more colds than adults.
Common cold is spread through respiratory droplets:
- Directly inhaled
- Spread by secretions on hands or contaminated objects

Highly infectious because:
- Shed in large numbers from the infected nasal mucosa during the first days
- They can survive several hours outside the body

Influenza (Flu)

Influenza is a viral infection that may affect both the upper and lower respiratory tracts.

There are three types of flu virus:
- Type A (the most common)
- Type B
- Type C

The viruses mutate constantly preventing effective immune defense

Flu differs from the common cold in that it usually has a sudden, acute onset with fever, fatigue and aching pains in the body.
- It may also cause a viral pneumonia
- A mild case of flu may be complicated by secondary problems like bacterial pneumonia

Prevention by vaccination recommended
Pneumonia

- Pneumonia may develop as a primary acute infection in the lungs, or it may be secondary to another respiratory or systemic condition.
- Pathogens may:
  - Enter the lungs directly by inhalation
  - Be resident bacteria spreading along the mucosa
  - Occur by aspiration of secretions
  - Occasionally be blood borne

Classifications of Pneumonias

- Several methods available based on:
  - Causative agent:
    - Virus
    - Bacterium
    - Fungus
  - Anatomic location of the infection:
    - Diffuse and patchy throughout both lungs
    - Lobar (restricted to one lobe)

Complications of Viral Respiratory Infection
Bronchopneumonia: See patches of consolidation

Lobar pneumonia
Lower lobe is Uniformly consolidated

- Pathologic changes
  - Viral usually involves changes in the interstitial fluid or alveolar septae
  - Bacterial usually alveoli inflamed and filled with exudate
- Epidemiologic data
  - Nosocomial (hospital acquired) usually bacterial and in those with less resistance
  - Community acquired (may be bacterial or viral)

<table>
<thead>
<tr>
<th>Types of Pneumonia</th>
<th>Lobar Pneumonia</th>
<th>Bronchopneumonia</th>
<th>Interstitial Pneumonia (Primary Alveolitis)</th>
<th>Pneumonia, PAP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distribution</td>
<td>All of one or two lobes</td>
<td>Multiple patches</td>
<td>Cryptogenic | Pathogenesis</td>
<td></td>
</tr>
<tr>
<td>Cause</td>
<td>Pneumococcal pneumonia</td>
<td>Multiple bacteria</td>
<td>Infiltration of interstitium and alveoli causing consolidation</td>
<td></td>
</tr>
<tr>
<td>Pathology</td>
<td>Inflammation and exudate in alveoli, often with abscesses or infection</td>
<td>Exudate in alveoli</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Onset</td>
<td>Sudden and acute</td>
<td>Variable</td>
<td>Variable</td>
<td></td>
</tr>
<tr>
<td>Signs</td>
<td>Fever, cough</td>
<td>Variable | Variable</td>
<td></td>
<td></td>
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<td>| | | |</td>
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</tbody>
</table>

- Types of pneumonia in the table:
Lung Cancer

- Lungs are a common site for both primary and secondary cancers.
- Primary lung cancer is a major cause of death; relationship between lung cancer and cigarette smoking well documented (80-90% of lung cancer patients have smoked).
- Metastases develop frequently in the lungs because the venous return and lymphatics bring tumor cells from distant sites in the body to the heart, then into the pulmonary circulation.
- The prognosis for lung cancer remains poor! (15% survival rate at 5 years after diagnosis).

Spiral CT scans have been found to identify tiny curable lung cancers. In a recent study, spiral CT scans of 32,000 men and women found 484 cancers. 85% of them in the earliest stages when prompt removal can be curative. In patients whose lungs cancers are removed at this early stage, the survival rate is 92% for a 10 year period.

Anyone at high risk for lung cancer should have a spiral CT scan every year.

Pathophysiology of Lung Cancer

- Bronchogenic carcinoma (from bronchial epithelium) is the most common type of malignant lung tumor.
- Several subgroups occur:
  - Squamous cell carcinoma
  - Adenocarcinoma
  - Small-cell (oat cell) carcinoma
  - Large-cell carcinoma
First change in lung is usually metaplasia, a change in the epithelial tissue, associated with smoking or chronic irritation.

- The loss of normal protective, ciliated, pseudostratified epithelium leaves the lung tissue more vulnerable to irritants and inflammation from smoking.
- Various chemicals in smoke are carcinogenic and act as initiators and promoters.

Dysplasia or carcinoma *in situ* then develops.

- Staging of lung cancer is based on tumor size, node involvement and metastases.
- Common sites for metastases from the lung include brain, bone and liver.
- Smoking is the major factor in development of lung cancer, but, since not all smokers develop lung cancer, there are probably genetic factors involved as well.
- Exposure to industrial carcinogens like silica, asbestos and vinyl chloride are also risk factors.

In many cases, lung cancer has already metastasized prior to diagnosis.

- Treatment involves surgical resection of localized lesion.
- Chemotherapy and radiation may be used in conjunction with surgery.
- Prognosis is poor unless the tumor is in a very early stage of development.
Asthma

- Asthma is a disease that involves periodic episodes of severe but reversible bronchial obstruction in persons with hypersensitive or hyperresponsive airways
- Repeated attacks of acute asthma may lead to irreversible damage to the lungs
- Acute attacks may be superimposed on a chronic condition

Types of Asthma

- Extrinsic asthma involves acute episodes triggered by a type I hypersensitivity reaction to an inhaled antigen (involves IgE antibodies)
  - Often a familial history of other allergic conditions and onset is common in children
  - Some patients no longer have attacks after adolescence
- Intrinsic asthma has its onset in adults
  - Stimuli for triggering attack include respiratory infections, exposure to cold, exercise, drugs such as aspirin, stress and inhalation of irritants like cigarette smoke

Chronic Obstructive Pulmonary Disease (COPD)

- COPD is a group of common chronic respiratory disorders characterized by progressive tissue degeneration and obstruction in the airways of the lungs
- They are debilitating conditions that affect the persons ability to work and function independently
- Examples include, emphysema, chronic bronchitis and chronic asthma
COPD causes irreversible and progressive damage to the lungs. Eventually, respiratory failure may result because of severe hypoxia or hypercapnia. In many patients COPD leads to development of cor pulmonale, right sided congestive heart failure.

Pathophysiology of Emphysema

- The significant change in emphysema is the destruction of the alveolar walls and septae, which leads to large, permanently inflated alveolar air spaces.

- Several factors contribute to the destruction of tissue in the alveoli:
  - Some people have a genetic deficiency of alpha1-antitrypsin, a protein normally present in tissues that inhibits the action of proteases released during inflammation by neutrophils.
- Cigarette smoke increases the number of neutrophils and the activity of proteases that destroy lung tissue
- Certain pathogenic bacteria also can release proteases that damage lung tissue

Changes in ventilation and perfusion that occur in COPD

<table>
<thead>
<tr>
<th>Chain Obstructive Lung Disease</th>
<th>Disease Characteristics</th>
<th>Clinical Symptoms</th>
<th>Airflow—Lung Function</th>
</tr>
</thead>
</table>
| Pathology                     | Destruction of alveolar walls, loss of elasticity, impaired exchange, poor air flow, hypoxemia | Dyspnea, chronic cough, sputum, frequent infections, cough and dyspnea, wheezing | Diffusion, bronchial 
  obstruction, increased 
  respiratory resistance, 
  hypoxemia, cough, 
  sputum, frequent 
  infections, dyspnea, 
  wheezing |
| Pathophysiology               | Increased mucous glands and secretion, inflammation, and infection, obstruction | Dyspnea, chronic cough, sputum, frequent infections, cough and dyspnea, wheezing | Diffusion, bronchial 
  obstruction, increased 
  respiratory resistance, 
  hypoxemia, cough, 
  sputum, frequent 
  infections, dyspnea, 
  wheezing |
Changes in chronic asthma

Pulmonary Edema

- Pulmonary edema refers to fluid collecting in the alveoli and interstitial area.
- Many conditions can lead to this condition which reduces the amount of oxygen diffusing into the blood, interferes with lung expansion and reduced oxygenation of the blood.

Etiology of Pulmonary Edema

- Can be caused by left sided congestive heart failure.
- Hypoproteinemia due to kidney or liver disease where serum albumin levels are low.
- Inflammation of the lungs with increased capillary permeability develops due to inhalation of toxic gases or in association with tumors.
- Blocked lymphatic drainage in the lungs may cause edema with tumors or fibrosis.
Pulmonary edema in association with left sided congestive heart failure

A pulmonary embolus is a blood clot or other material that obstructs the pulmonary artery or a branch of it, blocking blood flow through lung tissue.

Most pulmonary emboli are thrombi or blood clots originating from the leg veins.