# 8. Respiratory pathology

# Respiratory system

## Structure and function [Figs. 8-1, 8-3]

- Upper respiratory tract
  - structure
    - nasal cavity, sinuses, nasopharynx,
    - oral cavity, oropharynx
  - function
    - filter, warm, humidify air
- Lower respiratory tract
  - structure
    - larynx, trachea
    - lungs (right and left)
  - function
    - air exchange
    - speech
- Branching of airways into smaller ducts
  - bronchi → bronchioles → alveolar ducts → alveoli
- Air exchange occurs in most distal spaces (alveoli)
  - diffusion barrier [Fig. 8-3]
    - alveolar pneumocyte, common basement membrane, endothelial cell
- Respiratory defense mechanisms
  - mucus, mucocilliary escalator
  - alveolar macrophages
  - cough/ sneeze reflexes
- Pulmonary circulation
  - dual blood supply

# Respiratory pathology

## Overview

- Infections
- Obstructive airway diseases
- Restrictive airway diseases
- Miscellaneous disorders
- Neoplasms

## Infections of the upper respiratory tract

- Common cold, sore throat, “Flu”
  - viral infection of upper respiratory tract with classic symptoms
  - rhinovirus, parainfluenza viruses
  - self limited, symptomatic relief
- Strep throat
  - a bacterial infection caused by streptococcus A
  - diagnosed by identifying the bacteria, antibiotic therapy
- Mononucleosis
  - a viral infection caused by EBV with enlarged nodes, sore throat
- Diphtheria
  - a bacterial infection of the throat with formation of a membrane

# Respiratory pathology

## Infections, middle respiratory tract [Fig. 8-5]

- Croup (3mo -3yo)
  - acute viral infection of the larynx in children younger than 3 yo
  - barking cough
  - due to parainfluenza virus
- Acute epiglottitis (3yo-7yo)
  - acute bacterial infection of the epiglottis due to H. influenzae B
  - may be life threatening due to swelling and closure of airway
  - immunization
- Bronchiolitis (< 2yo)
  - inflammation of bronchi and bronchioles due to viral infection
  - usually due to Respiratory Syncitial Virus

## Pneumonia [Fig. 8-7]

- Inflammation/ infection of the lungs
- Typical pneumonia
  - infection affecting the air spaces characterized by a cough that produces sputum (productive cough)
  - Lobar pneumonia is widespread involvement (lobe of lung)
  - Bronchopneumonia is more limited involvement
- Atypical (interstitial) pneumonia
  - infection affecting the interstitial lung tissue characterized by a non-productive cough

### Typical pneumonias

- Causative agents depend on where infection acquired
  - community acquired
    - usual bacteria are streptococcus, hemophilus, staphylococcus
  - hospital acquired
    - usual bacteria are gram negatives
  - fungi, parasites and viruses may also cause pneumonia
    - travel history is important re possible exposure
    - immunocompromised individuals susceptible to unusual organisms
- Routes of infection
  - inhalational
  - hematogenous

### Atypical pneumonias

- Mycoplasma pneumoniae
  - commonest atypical pneumonia
  - common in young adults
  - may develop extra-pulmonary features
- Legionella pneumophilia
  - cause of Legionnaire's disease
  - prominent non-respiratory symptoms
  - uncommon, source is standing water

### Complications of pneumonia [Fig. 8-9]

- Pleuritis: inflammation of the pleural lining
- Pyothorax: pus in the pleural cavity
- Empyema: loculated areas of pus in the pleural cavity
- Abscess
- Bronchiectasis
- Chronic lung disease

# Respiratory pathology

## Pneumonia [Fig. 8-7]

Diagnosis

- symptoms
  - fever, chills, rigors
  - dyspnea, cough
  - mucopurulent discharge
- chest x-ray, bacterial cultures of sputum, CBC & differential, arterial blood gas

Treatment

- antibiotics

## Tuberculosis [Figs. 8-10, 8-11]

- Chronic respiratory infection due to bacteruium called Mycobacteria tuberculosis (Mtb)
- Mtb causes granulomatous reaction with caseous necrosis
- Initial primary infection
  - Ghon complex consists of lung lesion and enlarged hilar nodes
    - M. tb bacteria isolated within the granulomas preventing spread
  - uncommonly primary infection may progress
- Secondary tuberculosis
  - reactivation or reinfection
  - tissue destruction, extrapulmonary spread
- Diagnosis
  - non-specific symptoms
  - demonstrate presence of bacteria in sputum
    - acid fast stain (Ziehl-Nielsen)
    - DNA probes
  - important because if present must isolate patient
- Treatment
  - multi-drug regimen
  - treatment continues for many months
  - drug resistant strains arising

# Obstructive airway diseases

- Group of respiratory diseases characterized by symptoms of obstructed airways (↓ flow rate, air trapping)
- Major diseases:
  - Asthma
  - Chronic obstructive pulmonary disease
    - emphysema
    - chronic bronchitis
  - Bronchiectasis
  - Cystic fibrosis

# Respiratory pathology

## Chronic obstructive pulmonary disease

- Chronic bronchitis
  - disease diagnosed clinically as production of excessive sputum for at least 3 months during 2 consecutive years
  - smoking is most common cause
  - obstruction is due to narrowing of airways caused by thickened mucosal lining and increased mucus
- Emphysema [Fig. 8-13]
  - destruction and dilation of distal air spaces
  - centrilobular emphysema (widening of air spaces in center of a lobule)
    - most common form of emphysema, usually secondary to smoking
  - panlobular emphysema (widening of all air spaces in a lobule)
    - secondary to deficiency of α-1 anti-trypsin (inactivates proteases)
- Clinical features [Fig. 8-14]
  - pink puffer
    - patients with predominant emphysema
    - destruction of lung tissue results in overinflation (barrel chest)
    - use of accessory muscles of respiration
    - hyperventilate to keep blood oxygenated ("puffer")
  - blue bloater
    - patients with predominant chronic bronchitis
    - hypoxemia results in cyanosis "blue"
    - frequently obese ("bloater")
    - pulmonary hypertension with resulting right ventricular hypertrophy
  - usually a combination

## Bronchiectasis [Fig. 8-12]

- Permanent dilatation of a bronchus due to destruction of the wall
- Increased susceptibility to infections
- Causes of bronchiectasis include
  - obstruction (foreign body, tumor)
  - infection (TB, measles, pneumonia)
  - impaired defense mechanisms (cystic fibrosis)

## Asthma

- Asthma is a respiratory disease characterized by increased reactivity of smooth muscle in airways (reactive airway disease)
- Extrinsic asthma
  - attacks precipitated by exposure to triggering allergens
    - Type I Hypersensitivity reaction
  - associated with other atopic diseases (eczema, hay fever, allergies)
- Intrinsic asthma
  - attacks precipitated by non-immune mechanisms
    - exercise, stress, infections, temperature, aspirin
- Pathogenesis [Figs. 8-15, 8-16]
  - stimuli trigger inflammation with release of mediators
    - smooth muscle contraction (bronchi constriction)
    - leaky vessels
    - mucus plugs
- Status asthmaticus
  - severe unremitting asthma attack not responsive to bronchodilators
- Treatment
  - treat acute attacks with bronchodilators, prevent chronic inflammation with steroids

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## Restrictive lung diseases

- Group of respiratory diseases characterized by symptoms of restrictive lung function (↓ lung volume, ↓ compliance)
- Major diseases
  - hypersensitivity pneumonitis
  - pneumoconioses
  - sarcoidosis
- Inflammatory process in alveolar walls with fibrosis
- Honeycomb lung is common end stage appearance

## Hypersensitivity pneumonitis

- Respiratory disease due to disordered immune reaction to various inhaled antigens [Fig. 8-18]
- Exposure is usually work or hobby related
- Allergens include moldy hay, pigeon droppings, etc.
  - farmer's lung
  - pigeon fancier's lung
- Acute form (Type III reaction)
- Chronic form (Type IV reaction)
- Treatment is avoidance of the allergen

## Pneumoconioses

- Respiratory disease due to inhalation of inorganic dusts
- Exposure often occurs at work
- Severity depends on amount, duration and type of dust
- Examples
  - Coal-worker's lung
    - inhalation of coal and silica particles in miners
  - Silicosis
    - inhalation of silica particles by sand blasters, miners, stone cutters
  - Asbestosis
    - inhalation of asbestos particles by shipyard workers, insulation
    - nb. also develop pleural plaques, lung cancer, mesothelioma
- Treatment is avoidance of the dust

## Sarcoidosis [Fig. 8-17]

- Multisystemic disease of unknown etiology characterized by non-caseating granulomas in various organs
- May involve any organ
  - typically lungs, lymph nodes, liver
- Diagnosis
  - biopsy of affected tissue
- Treatment
  - no specific treatment
  - steroids

# Respiratory pathology

## Drowning

- Third leading cause of accidental deaths
- Types of drowning
  - wet drowning (90 %)
    - aspirated water enters the respiratory tract with resulting anoxia
    - sea water results in more pronounced pulmonary edema
  - dry drowning (10%)
    - reflex laryngospasm with closure of glottis resulting in anoxia
    - no water in the lungs
- Outcome depends on speed of rescue/ resuscitation

## Adult respiratory distress syndrome (ARDS)

- Clinical condition characterized by acute respiratory failure that does not respond to oxygen
- Various causes
  - aspiration, drowning, sepsis, shock, etc.
- Injury to lung causes leaky capillaries
  - fluid enters the air spaces and interstitial space from the capillaries
- High mortality (50%)

## Miscellaneous terms

- Atelectasis [Fig. 8-22]
  - term used to describe incomplete expansion of alveoli
  - causes
    - deficiency of surfactant
    - compression of alveoli by external mass
    - resorption of air distal to obstruction
  - usually reversible
- Dyspnea
  - term used to describe subjective feeling of shortness of breath

## Neoplasms

- Laryngeal carcinoma
  - linked to smoking, alcohol
  - squamous cell carcinomas
  - symptoms includehoarseness, loss of voice

# Respiratory pathology

## Lung cancer [Fig. 8-26]

- Statistics
  - number one cause of deaths due to cancer (male and female)
  - second most common malignancy (male and female)
- Risk factors
  - cigarette smoking
  - asbestos exposure
  - radiation
  - arsenic, chromium
  - genetic factors
- Lung is also a common site for metastatic tumors
- Adenocarcinoma
  - most common primary lung malignancy (>35%)
  - equal frequency in smokers and non-smokers
  - usually peripheral, solitary nodule
- Squamous cell carcinoma (30%)
  - usually smokers
  - typically more centrally located
- Small cell carcinoma (20%)
  - usually smokers
  - often early spread
  - paraneoplastic syndromes common

## Pleural disease

- Review of terms
  - pneumothorax [Fig. 8-28]
    - entry of air into the pleural cavity with collapse of the lung
  - pleural effusion
    - accumulation of fluid in the pleural cavity
  - pleuritis
    - inflammation of the pleura typically secondary to pneumonia
- Pleural tumors
  - mesothelioma is a malignant neoplasm of mesothelial cells
  - associated with asbestos exposure