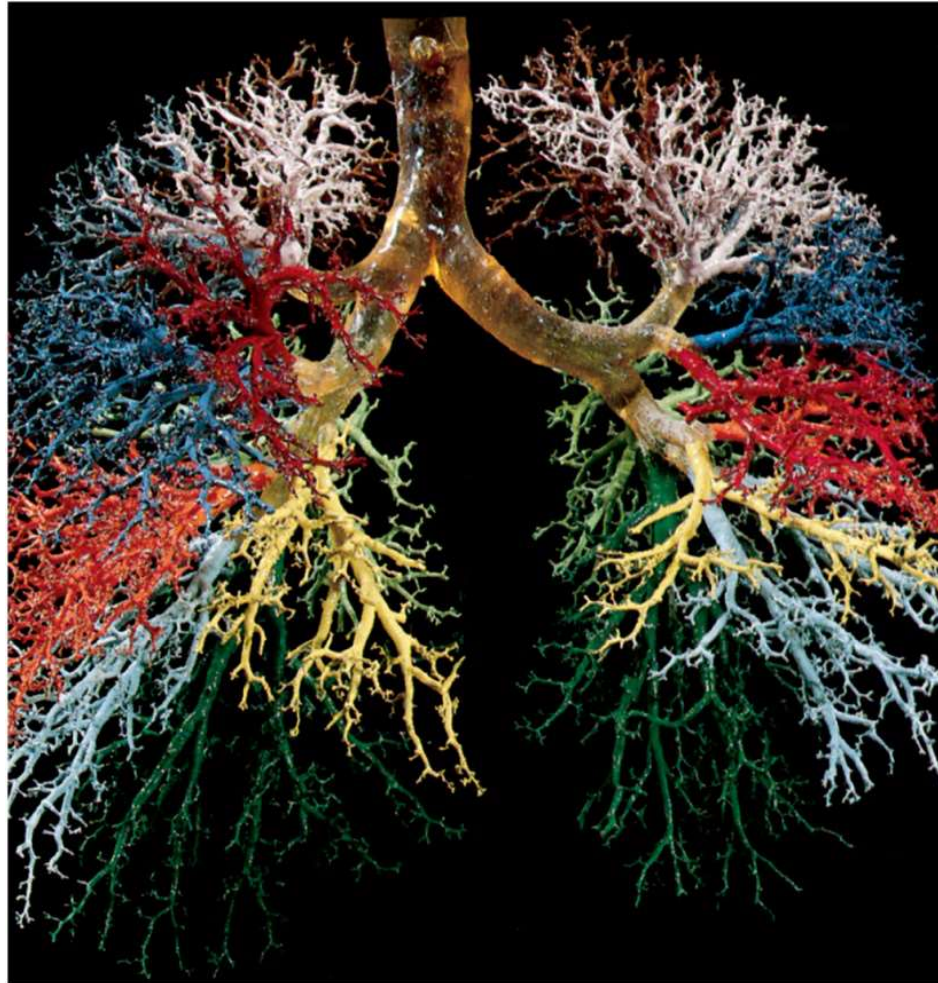


## Chapter 22

# Pathophysiology of the Respiratory System



# Chronic Obstructive Pulmonary Disease

- **COPD** – refers to any disorder in which there is a long-term obstruction of airflow and a substantial reduction in pulmonary ventilation
- major COPDs are **chronic bronchitis** and **emphysema**
  - usually associated with smoking
  - other risk factors include air pollution or occupational exposure to airborne irritants

# Chronic Obstructive Pulmonary Disease

- **chronic bronchitis**

- inflammation and hyperplasia of the bronchial mucosa
- cilia immobilized and reduced in number
- goblet cells enlarge and produce excess mucus
- develop chronic cough to bring up extra mucus with less cilia to move it
- **sputum** formed (mucus and cellular debris)
  - ideal growth media for bacteria
  - incapacitates alveolar macrophages
- leads to chronic infection and bronchial inflammation
- symptoms include dyspnea, hypoxia, cyanosis, and attacks of coughing

# Chronic Obstructive Pulmonary Disease

- **emphysema**
  - alveolar walls break down
    - lung has larger but fewer alveoli
    - much less respiratory membrane for gas exchange
  - lungs fibrotic and less elastic
    - healthy lungs are like a sponge; in emphysema, lungs are more like a rigid balloon
  - air passages collapse
    - obstructs outflow of air
    - air trapped in lungs
  - weaken thoracic muscles
    - spend three to four times the amount of energy just to breathe

# Effects of COPD

- reduces pulmonary compliance and vital capacity
- hypoxemia, hypercapnia, respiratory acidosis
  - hypoxemia stimulates erythropoietin release from kidneys - leads to polycythemia
- **cor pulmonale**
  - hypertrophy and potential failure of right heart due to obstruction of pulmonary circulation

# Smoking and Lung Cancer

- lung cancer accounts for more deaths than any other form of cancer
  - most important cause is smoking (15 carcinogens)
- **squamous-cell carcinoma** (most common)
  - begins with transformation of bronchial epithelium into stratified squamous from ciliated pseudostratified epithelium
  - dividing cells invade bronchial wall, cause bleeding lesions
  - dense swirls of keratin replace functional respiratory tissue

# Lung Cancer

- **adenocarcinoma**

- originates in mucous glands of lamina propria

- **small-cell (oat cell) carcinoma**

- least common, most dangerous

- named for clusters of cells that resemble oat grains

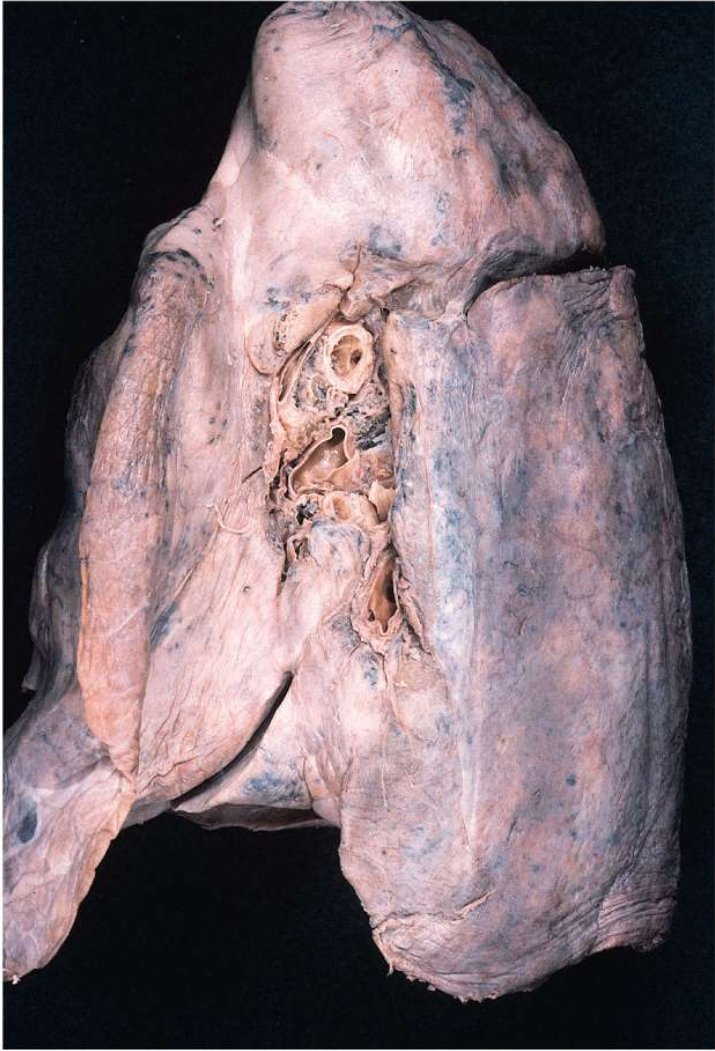
- originates in primary bronchi, invades mediastinum, metastasizes quickly to other organs

# Progression of Lung Cancer

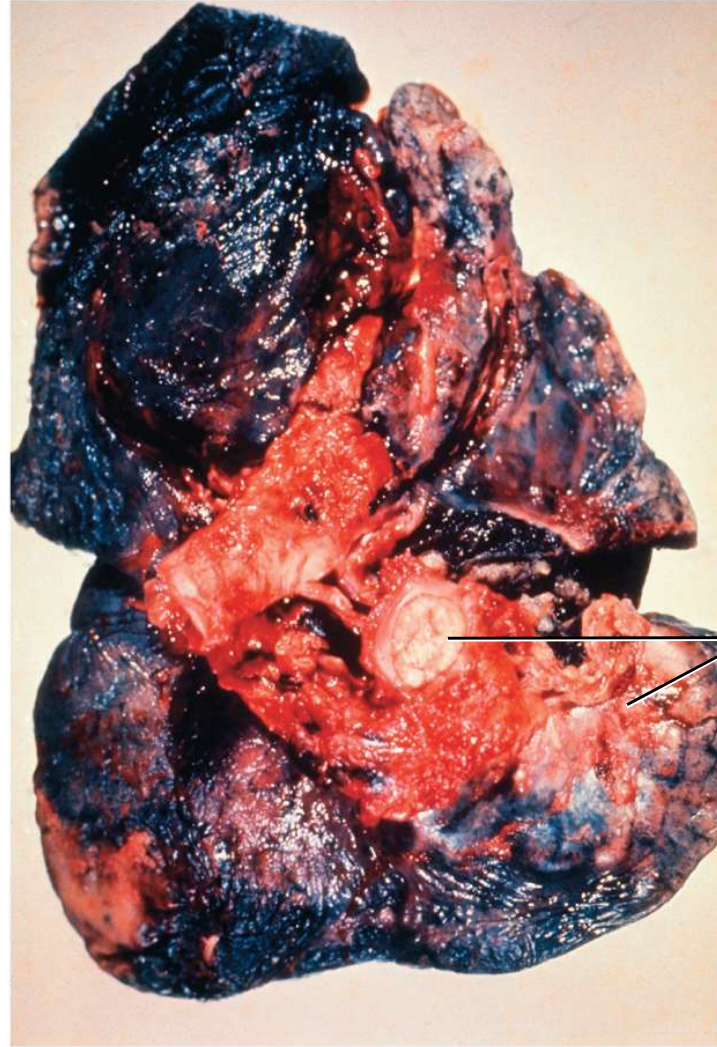
- 90% originate in primary bronchi
- tumor invades bronchial wall, compresses airway; may cause atelectasis
- often first sign is coughing up blood
- metastasis is rapid; usually occurs by time of diagnosis
  - common sites: pericardium, heart, bones, liver, lymph nodes and brain
- prognosis poor after diagnosis
  - only 7% of patients survive 5 years



# Effect of Smoking



(a) Healthy lung, mediastinal surface



(b) Smoker's lung with carcinoma

Tumors

# Pneumothorax

- **pneumothorax** - presence of air in pleural cavity
  - thoracic wall is punctured
  - inspiration sucks air through the wound into the pleural cavity
  - potential space becomes an air filled cavity
  - loss of negative intrapleural pressure allows lungs to recoil and collapse
- **atelectasis** - collapse of part or all of a lung
  - can also result from an airway obstruction

# Carbon Monoxide Poisoning

- **carbon monoxide (CO)** - competes for the O<sub>2</sub> binding sites on the hemoglobin molecule
- colorless, odorless gas in cigarette smoke, engine exhaust, fumes from furnaces and space heaters
- **carboxyhemoglobin** – CO binds to ferrous ion of hemoglobin
  - binds 210 times as tightly as oxygen
  - ties up hemoglobin for a long time
  - non-smokers - less than 1.5% of hemoglobin occupied by CO
  - smokers- 10% in heavy smokers
  - atmospheric concentrations of 0.2% CO is quickly lethal