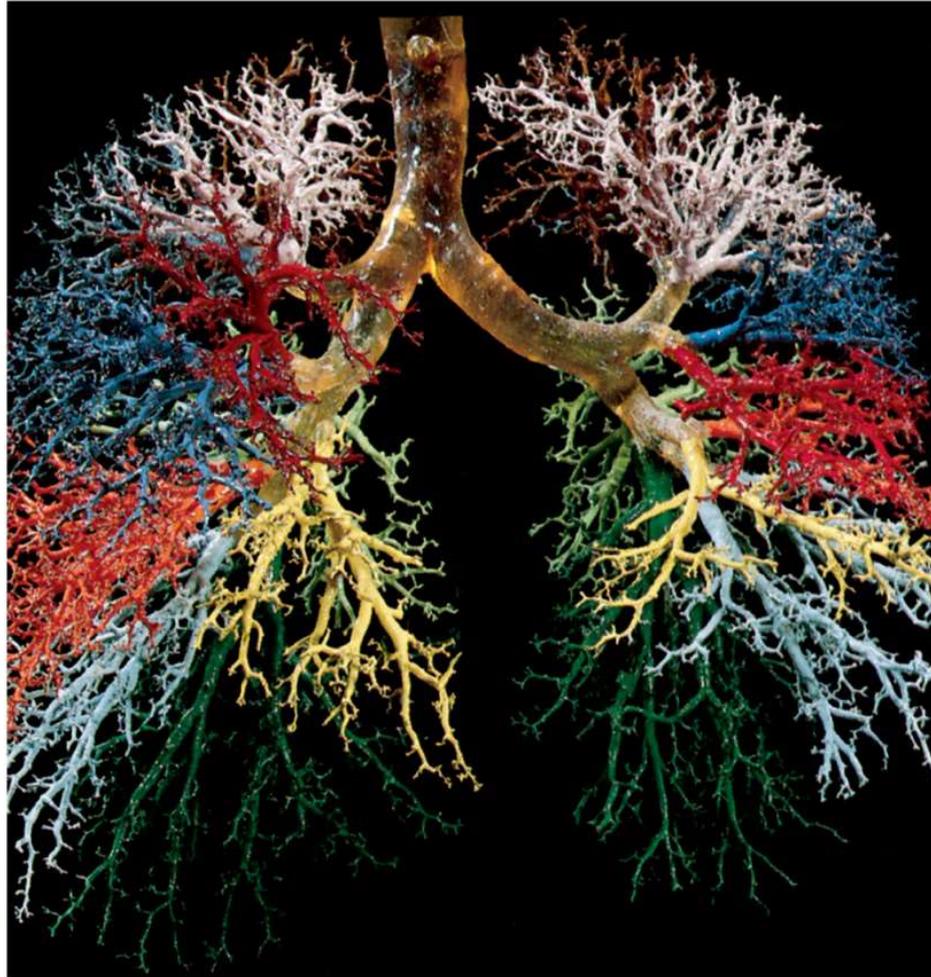


Chapter 22

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

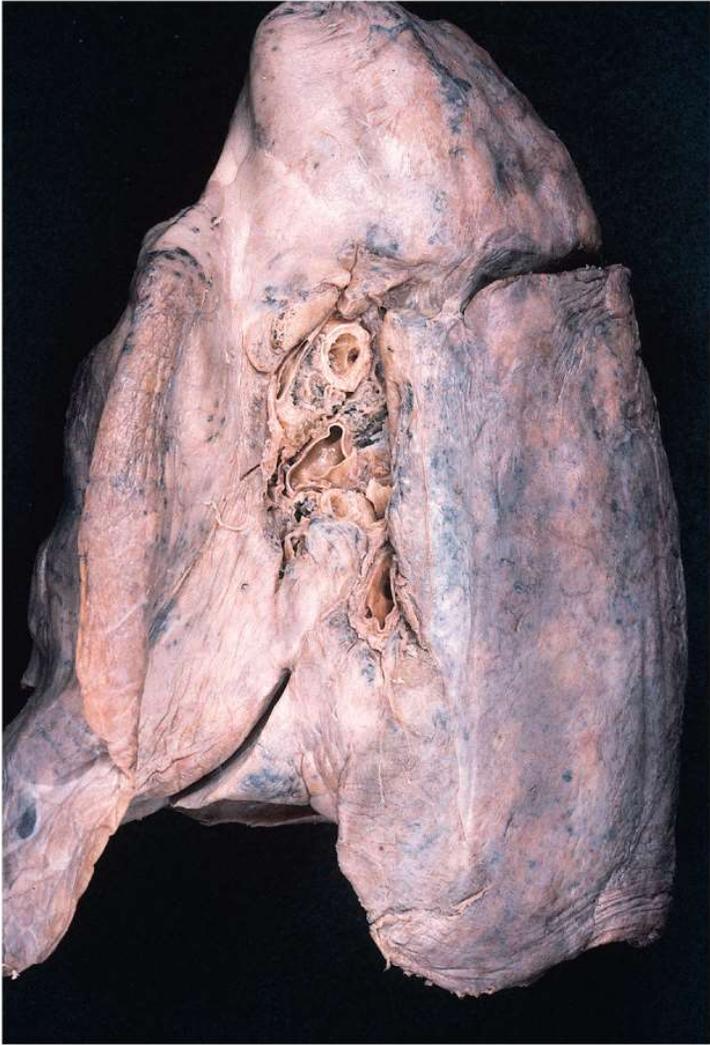
Lung Cancer

- **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

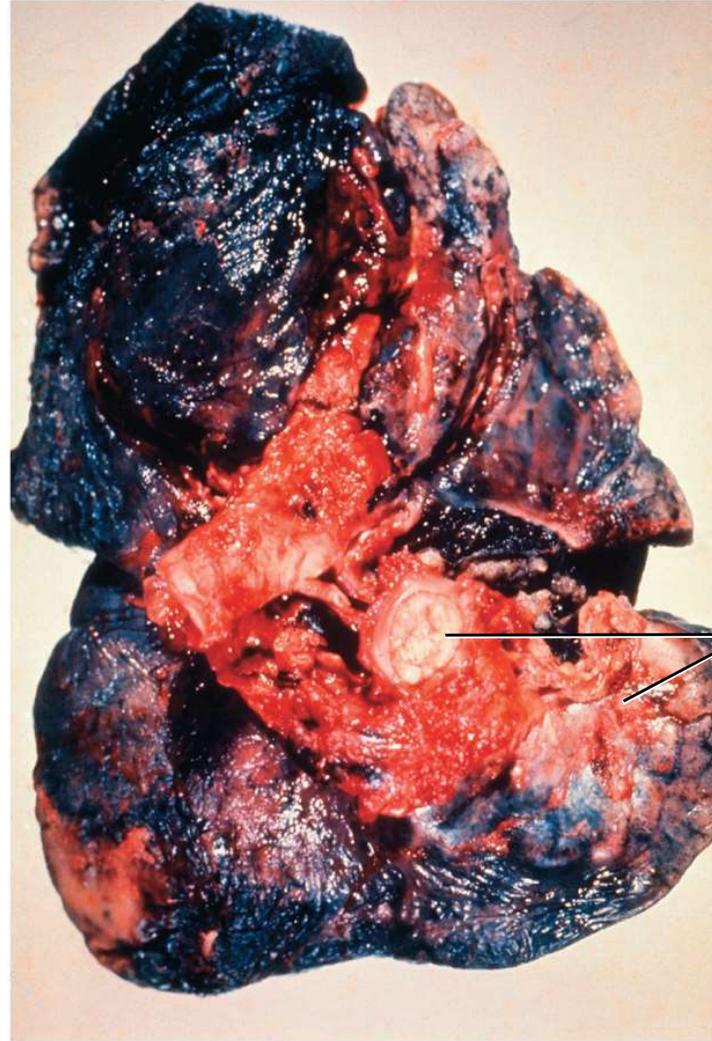
Progression of Lung Cancer

- 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 O₂ 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