



Oxygenation

Learning Objectives:

After completing this lecture, the students will be able to:

1. Explain the structure and function of the respiratory system.
2. Explain the role and function of the respiratory system in transporting oxygen and carbon dioxide to and from body tissues.
3. Describe the mechanisms for respiratory regulation.
4. Identify factors influencing oxygenation.
5. Identify conditions that can alter respiratory function.
6. Assess the client's ventilatory, and oxygenation status.
7. Identify nursing care interventions that promote oxygenation.

Oxygenation:

The delivery of oxygen to the body's tissues and cells is called **oxygenation**. **Respiration** is a process of gas exchange, it's necessary to supply cells with O_2 for metabolism and to remove CO_2 . The mechanisms of respiration require an integration of factors involving ⁽¹⁾ *nervous system*, ⁽²⁾ *chemoreceptors in cardiovascular system*, as well as ⁽³⁾ *the respiratory system*.

The respiratory system provides the essential first process in this integrated system, that is movement and transfer of gases between the atmosphere and the blood. Impaired function of the system can significantly affect our ability to breathe, transport gases, and participate in everyday activities. Clients with compromised oxygenation status need careful assessment and thoughtful nursing care to achieve an adequate and comfortable level of oxygenation function.

Glossary:

- ◆ **Eupnea:** normal respiration its quiet, rhythmic, and effortless.
- ◆ **Tachypnea:** rapid respiration; it is seen e.g., with fevers, metabolic acidosis.
- ◆ **Bradypnea:** abnormally slow respiration; which may be seen in clients who have taken drugs such as sedatives, who have metabolic alkalosis, or who have IICP (e.g., from brain injuries)
- ◆ **Apnea:** absence of breathing.
- ◆ **Orthopnea:** inability to breathe easily only with stand or sitting position.
- ◆ **Dyspnea or shortness of breath (SOB):** difficulty breathing.
- ◆ **Exertional dyspnea:** Difficulty breathing with activity.

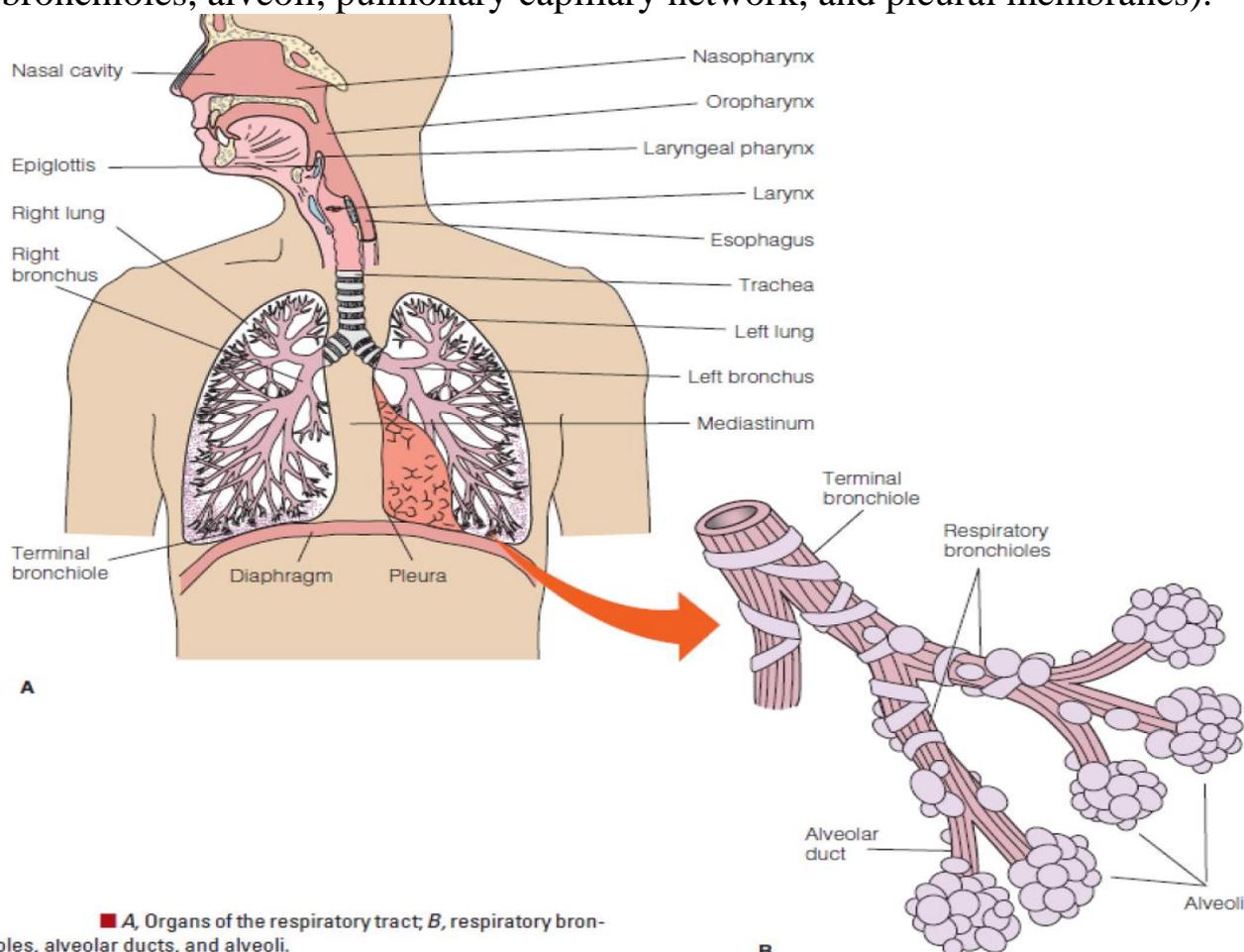
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- ◆ **Hypoventilation:** inadequate alveolar ventilation, may be caused by either slow or shallow breathing, or both. It may occur because of diseases of the respiratory muscles, drugs, or anesthesia.
- ◆ **Hyperventilation:** increased movement of air into and out of the lungs.
- ◆ **Pneumothorax:** Air or gas in the pleural cavity.
- ◆ **Hemothorax:** Accumulation of blood in the pleural space.
- ◆ **Pleural effusion:** Excessive fluid in the pleural space.
- ◆ **Oxygen saturation:** amount of oxygen combined with hemoglobin.
- ◆ **Hypoxemia:** reduced oxygen levels in the blood.
- ◆ **Hypoxia:** insufficient oxygen in the body tissues.
- ◆ **Anoxia:** without oxygen.
- ◆ **Hypercapnia or hypercarbia:** increased blood levels of CO₂.
- ◆ **Cyanosis:** bluish discoloration of the skin, nail beds, and mucous membranes due to reduced hemoglobin-oxygen saturation.

Overview of anatomical and physiological of breathing:

The respiratory system is divided structurally into:

1. Upper respiratory system (the mouth, nose, pharynx, and larynx).
2. Lower respiratory system (the trachea, and lungs with the bronchi, bronchioles, alveoli, pulmonary capillary network, and pleural membranes).





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Physiology of Oxygenation:

Involves four components, include:

1. **Pulmonary ventilation or (breathing):**

The movement of air into the lungs (*inspiration or inhalation*) and out of the lungs (*expiration or exhalation*) for the purpose of delivering fresh air into the lung's alveoli. **The rate and depth of ventilation are adjusted in response to changes in the concentrations of:**

- Hydrogen ion (pH) in the body's fluids. A decrease in the body's fluids pH will stimulate faster and deeper ventilation.
- CO₂ in the body's fluids, an increase in CO₂ in the blood will stimulate faster and deeper ventilation.
- Blood O₂ concentration.

Adequate ventilation depends on several factors:

- Open and clear airways (cough reflex and ciliary action keep airway open and clear).
- An intact CNS and respiratory center (*respiratory center located in medulla oblongata and pons in the brainstem*).
- An intact thoracic cavity capable of expanding and contracting.
- Adequate pulmonary compliance and recoil. (Expansion and recoil of the lungs occurs passively in response to changes in pressures within the thoracic cavity and the lungs themselves).

2. **Alveolar-capillary gas exchange:** involve the diffusion of O₂ and CO₂ between the alveoli and the pulmonary capillaries, it's also referred to as *oxygen uptake* or *external respiration*.

3. **Transport of O₂ and CO₂:** involves the transport of the respiratory gases between the tissue and the lungs. O₂ needs to be transported from the lungs to the tissues, and CO₂ must be transported from the tissue back to the lungs.

Factors affect the rate of O₂ transport from the lungs to the tissues include:

- Cardiac output: any pathologic condition that decreases cardiac output diminishes the amount of O₂ delivered to the tissues.
 - Number of erythrocytes and blood hematocrit (Hct):
 - ◆ Excessive increases in the blood Hct raise the blood viscosity reducing the cardiac output and reducing the O₂ transport.
 - ◆ Excessive reduction in the blood Hct reducing the O₂ transport.
 - Exercise: increased cardiac output and to increased use of O₂ by the cells.
4. **Systemic diffusion:** O₂ diffuses from the blood to the tissues, while CO₂ moves from the tissues to the blood; It is referred to as *internal respiration*.



Factors affecting oxygenation:

1. **Age:** Oxygenation status can be influenced by age.
2. **Environmental factor:** Heat, cold and air pollution affect oxygenation. Clients who are exposed to dust, animal dander, or toxic chemicals in the home or workplace are at increased risk for alterations in oxygenation. Smokers and those exposed to second-hand smoke should be questioned as to the type, amount and number of years of exposure.
3. **Lifestyle Factors:** lifestyle factors can affect a client's oxygenation status:
 - ❖ Physical exercise or activity increases the rate and depth of respirations.
 - ❖ Occupations predispose individual to lung disease.
4. **Disease Processes:** Oxygenation alterations can often be traced to disease states related to alterations in ventilation, alveolar gas exchange, oxygen uptake, or circulation. Many disease states may affect oxygenation, including COPD, atelectasis, atherosclerosis, heart failure, and anemia.
5. **Medications:** a variety of medications can decrease rate and depth of respirations. The most common medications are; sedative-hypnotics and anti-anxiety drugs e.g., diazepam; and narcotics such as morphine.
6. **Stress:** the sympathetic nervous system is stimulated and epinephrine is released during stress and causes the bronchioles to dilate.

Alteration in respiratory function:

- A. **Conditions affecting airway patency:** A completely or partially obstruction of the airway, can occur anywhere along the upper or lower respiratory passageways as a result of the presence of foreign body, or accumulation of mucus or inflammatory exudates.
 - ✓ Partial obstruction of the upper airway is indicated by a low-pitched snoring sound during inhalation.
 - ✓ Complete obstruction of the upper airway is indicated by extreme inspiratory effort that produces no chest movement and an inability to cough or speak
 - ✓ Lower airway obstruction is not always as easy to observe.
 - ✓ Stridor, a harsh, high-pitched sound, may be heard during inspiration.
- B. **Conditions affecting movement of air into and out of the lungs:** condition affecting the rate, volume, rhythm, and relative ease or effort of respiration. **example;** dyspnea, orthopnea, tachypnea, bradypnea, and apnea.
- C. **Conditions affecting diffusion of O² and CO₂ between alveoli and pulmonary capillaries:** e.g., pulmonary edema, atelectasis, and anemia.
- D. **Conditions affecting the transport of oxygen and carbon dioxide via the blood to and from the tissue cells:** Conditions that decrease cardiac output such as heart failure or hypovolemia, affect tissue oxygenation, and the body's ability to compensate for hypoxemia.