

UNIT 9 - RESPIRATORY SYSTEM

LECTURE NOTES

9.01 GENERAL FUNCTIONS OF THE RESPIRATORY SYSTEM

- A. Brings oxygenated air to the alveoli
- B. Removes air containing carbon dioxide
- C. Filters, warms, and humidifies the air
- D. Produces sound
- E. Helps with the sense of smell
- F. Assists to regulate the pH within the blood

9.02 THE PASSAGE OF AIR

A. Nose

1. Nares

Also called nostrils, these two openings allow the entrance of air.

2. Nasal Cavity

Lined with mucous and ciliated epithelium, the nasal cavity is where air is warmed, filtered, and humidified. This is where the sense of smell begins.

3. Nasopharynx

Posterior to the nasal cavity, the nasopharynx is part of the throat serving only as a passageway for air.

*** Please note -- some people are mouth breathers and air would not pass through the nose but travels from the mouth to the pharynx.**

B. Pharynx

Known as the throat, this region is shared by both the digestive and respiratory systems. It is subdivided into three sections -- the nasopharynx which serves as a passageway for air only, the oropharynx which serves as a passageway for both air and food, and the laryngopharynx which takes food into the esophagus. The pharynx is composed of muscle lined with mucous membrane.

C. Larynx

The larynx is also known as the voice box. Incoming air from the pharynx enters the larynx through an opening called the glottis. The epiglottis, a cartilage flap-like structure, helps to prevent food from entering the larynx during swallowing. The larynx is composed of cartilage and elastic fibers which form the vocal cords.

D. Trachea

The trachea is known as the windpipe and serves only as a passageway for air. It is composed of smooth muscle and pseudostratified columnar epithelium which contains both mucous-producing goblet cells and cilia to help filter incoming air. The trachea is held open by C-shaped hyaline cartilage rings.

E. Bronchi (singular: bronchus)

The trachea branches within the mediastinum giving way to the primary bronchi and the bronchial tree. The structure of the bronchi is similar to the trachea. As the bronchi branches become smaller and smaller, the amount of cartilage decreases. Bronchi serve as passageways for air.

F. Bronchioles

Bronchioles are smaller air passages which branch from the bronchi. The muscular tubes of the bronchioles have an extremely narrow diameter, around 1 millimeter, and lack cartilage. Changes in the size of bronchioles help to direct the flow of air to various parts of the lungs.

G. Alveolar Ducts

Alveolar ducts are enlarged chambers found at the end of the bronchioles. These very fine passageways which end at the alveolar sacs and connect to the alveoli.

H. Alveoli (singular: alveolus)

The alveoli are small, sac-like structures which serve as the gas exchange surfaces of the lungs. Each lung contains approximately 150 million alveoli, giving the lungs their spongy appearance. Each alveolus is composed of simple squamous epithelium along with macrophages (a type of WBC) to fight infection and surfactant-secreting cells to help prevent their collapse by reducing the surface tension of water. The alveoli are surrounded by a dense network of capillaries allowing for the exchange of oxygen and carbon dioxide between the air and blood.

9.03 THREE REGIONS OF THE PHARYNX

A. Nasopharynx

1. Located behind the nasal cavity extending to the level of the soft palate.
2. Serves as a passageway for air.

B. Oropharynx

1. Located behind the mouth from the level of the soft palate to the level of the hyoid bone.
2. Serves as a passageway for both air and food.

C. Laryngopharynx

1. Located from the hyoid bone to the esophagus.
2. Serves as a passageway for food.

9.04 ANATOMICAL FEATURES ASSOCIATED WITH THE LARYNX

Recall the larynx is the voice box composed of many cartilage structures. This section looks at several features of the larynx.

A. Epiglottis

1. Flap-like cartilage structure located at the back of the tongue near the entrance to the trachea. It is attached to the thyroid cartilage of the larynx.
2. Closes over the glottis during swallowing to help prevent food from entering the larynx.

B. Glottis

1. Slit-like opening between the (true) vocal cords.
2. Serves as a passageway for air.

C. Hyoid Bone

1. Located in the neck between the lower jaw and the larynx. It does not articulate with any other bones, but it is held in a fixed position by muscles and ligaments. It can be felt approximately a finger's width above the anterior prominence of the larynx.
2. Serves as the posterior attachment for the tongue and the muscles which help move the tongue and functions in swallowing.

D. Thyroid Cartilage

1. Is the largest cartilage of the larynx. Nicknamed the Adam's apple, it is bigger in men than in women due to the influence of testosterone.
2. Gives the larynx its characteristic triangular shape while protecting the glottis.

E. Cricoid Cartilage

1. Is a "signet ring" shaped cartilage forming part of the posterior wall and is the most inferiorly placed of all the laryngeal cartilages.
2. Marks the most inferior border of the larynx. (Also serves as a landmark for a tracheotomy).

F. True Vocal Cords

1. The most inferior of the two pairs of horizontal folds in the mucous membrane of the larynx. They contain elastic fibers, which vibrate when air is passed over them.
2. Are responsible for producing sound. Sound can be formed into words by changing the shapes of the pharynx and oral cavity and by using the tongue and the lips.

G. False Vocal Cords

1. The most superior of the two pairs of horizontal folds in the mucous membrane of the larynx. They contain muscle fibers.
2. Help close the glottis during swallowing to prevent food from entering the larynx.

9.05 THE COVERINGS AND GROSS ANATOMICAL FEATURES OF THE LUNGS

The lungs are large spongy structures each found within their own pleural cavity within the thoracic cavity.

A. Apex

The apex is the pointed, superior portion of the lungs which projects above the clavicles.

B. Base

The broad, inferior surface of the lungs which rests on the diaphragm.

C. Lobes

1. The functional units of the lungs.
2. The right lung contains three lobes - the superior, middle, and inferior lobes.
3. The left lung contains two lobes - the superior and inferior lobes.

D. Visceral Pleura

The serous membrane which covers the outer surfaces of the lungs and extends into the fissures separating the lobes.

E. Parietal Pleura

The serous membrane which covers the inner surface of the pleural cavity and extends over the diaphragm and the mediastinum.

F. Pleural Cavity

The mediastinum divides the thoracic cavity into two pleural cavities, each of which contains a lung.

9.06 SITE OF GAS EXCHANGE IN THE LUNGS

A. The alveoli are the primary gas exchange structures.

B. The alveoli are thin-walled (simple squamous epithelium) microscopic air sacs.

C. A capillary network surrounds the alveoli, which brings the blood to the alveoli.

D. Since the blood returning to the lungs contains higher amounts of carbon dioxide than the air in the lungs, carbon dioxide diffuses out of the blood and into the alveoli.

E. Since the blood returning to the lungs contains lower amounts of oxygen than the air in the lungs, oxygen diffuses out of the alveoli and into the blood.

9.07 RESPIRATORY AIR VOLUMES

- A. Tidal Volume (TV)
 - 1. The volume of air moved into or out of the lungs during quiet breathing.
 - 2. The average volume is 500 ccs.
- B. Vital Capacity (VC)
 - 1. The maximum volume of air that can be exhaled after taking the deepest breath possible. $VC = TV + IRV + ERV$
 - 2. The average volume is 4,600 ccs.

9.08 VENTILATION, EXTERNAL RESPIRATION AND INTERNAL RESPIRATION

- A. Ventilation
Ventilation is also known as breathing or the movement of air into and out of the lungs. May also be called pulmonary ventilation.
- B. External Respiration
The process of exchanging gases between the air and the blood.
- C. Internal Respiration
The process of exchanging gases between the blood and the body cells. Oxygen enters the body cells from the blood by diffusion and is used by the body cells for respiration or the production of energy in the form of ATP. Carbon dioxide leaves the body cells by diffusion and enters the blood where it is transported to the alveoli where it will be removed from the body.

9.09 EFFECT OF CARBON DIOXIDE ON RESPIRATION

- A. The medulla oblongata is sensitive to changes in the blood concentration of carbon dioxide and hydrogen ions.
- B. When the concentration of carbon dioxide increases, the respiratory center is stimulated and the rate of breathing is increased.
- C. Carbon dioxide is referred to as the respiratory stimulus.

9.10 DISEASES AND DISORDERS OF THE RESPIRATORY SYSTEM

A. Emphysema

Emphysema is one of the chronic obstructive pulmonary disorders. Emphysema is an irreversible enlargement of the air spaces distal to the terminal bronchioles due to the destruction of the alveolar walls. The result is decreased elastic recoil properties of the lungs. It is the most common cause of death from a respiratory disease in the United States. The number one cause of emphysema is smoking.

Signs and symptoms include dyspnea, malaise, barrel-chest, prolonged expiratory periods with pursed lip breathing, and tachypnea. Treatment includes oxygen therapy, stopping smoking, and breathing techniques to help control the dyspnea.

B. Influenza

Influenza, or flu, is an acute, highly contagious viral infection of the respiratory tract. It occurs sporadically or in epidemics. It tends to affect school children most often, but has its most severe effects on the elderly. Transmission occurs from inhaling infected respiratory droplets or by contact with a contaminated object. The signs and symptoms include fever, chills, headache, malaise, myalgia, rhinorrhea, and a non-productive cough. Treatment usually includes bed rest, fluid intake, and mild analgesics to relieve the pain. There are some antiviral agents which are effective in treating the disease. Flu vaccines given in the fall are generally effective in reducing susceptibility.

C. Lung Cancer

Lung cancer is the most common cause of cancer in the United States. Lung cancer typically develops in the wall or the epithelium of the bronchial tree. The prognosis generally is poor. Lung cancer is attributable to the inhalation of pollutants, especially those found in cigarette smoke. There are no symptoms of lung cancer in the early stages. Later symptoms include dyspnea, hemoptysis, hoarseness, wheezing, and weight loss. Treatment may include surgery, radiation therapy, and/or chemotherapy.

D. Pneumonia

Pneumonia is an acute infection of the lungs which prevents gas exchange. Pneumonia can be caused by viruses, bacteria, or the aspiration of fluid. Treatment depends on the cause, but may include antibiotics for bacterial infections or antimicrobials for viral infections. Treatment also includes humidified oxygen therapy, adequate fluids, bedrest, and analgesics to relieve the pain. Vaccines are available for those who are elderly or have health problems to prevent the onset of pneumonia during the winter months.

E. Sudden Infant Death Syndrome (SIDS)

SIDS is a mystery killer which takes the lives of apparently healthy infants between the ages of four weeks and seven months. The exact cause is unknown but may be related to compression of the carotid artery that occurs when infants sleep on their abdomen. Diagnosis of SIDS requires an autopsy to rule out other disorders.

F. Tuberculosis

Tuberculosis, or TB, is a bacterial infection of the lungs is characterized by pulmonary infiltrates. People who live in crowded conditions or poorly ventilated areas are more likely to be infected. The incidence of TB has risen in the United States due to rising homelessness, drug abuse and HIV infection. The signs and symptoms of TB include fatigue, weakness, anorexia, weight loss, night sweats, and low grade fever. Treatment includes the use of medications that may continue up to one year in order to make sure the bacterial infection has been completely treated.