Introduction

• Breath and breathing is one of easiest vital signs to observe
• Respiration is the process of extracting oxygen from air and expelling carbon dioxide and other wastes

Lesson 20.1 Objectives

• List the anatomical structures of the upper and lower respiratory tracts
• Explain the physiological mechanisms of the respiratory system
• Trace the air-conduction pathway
• Describe mechanisms of breathing, both inspiration and expiration
• Define the terms dyspnea, apnea, hypoxia, anoxia, and vital capacity

Lesson 20.1 Objectives

• Contrast and compare internal and external respiration
• Describe modified respiratory air movements
• Name types of pathological conditions of the respiratory system, giving characteristics and massage considerations of each

Anatomy

• Alveoli
• Bronchi
• Bronchioles
• Larynx
• Lungs
• Nasal Cavity
• Nose
• Pharynx
• Respiratory diaphragm
• Trachea
Physiology

- Exchange of oxygen and carbon dioxide
- Olfaction
  - Sense of smell
- Speech
- Homeostasis

The Respiratory System

Upper Respiratory Tract

- Nose—mostly hyaline and elastic cartilage, but bone in center and bridge
- Nasal cavity—just behind nose, leads to nasal conchae and meatuses
  - Cilia—hairlike projections on outer surface of some cells
  - Goblet cells—produce mucus to moisten air
- Contains openings for the paranasal sinuses

Paranasal Sinuses

- Four sinus cavities
- Named for the bones they are located:
  - Frontal sinus
  - Sphenoidal sinus
  - Ethmoidal sinus
  - Maxillary sinus

Nasal Cavity

Pharynx

- Also called the throat
- Muscular tube about 5 in. long
- Shared by the respiratory and digestive tracts
Pharynx

Upper Respiratory Tract

- Larynx (voice box)—formed by three single and three paired cartilages
  - Two sets of vocal cords—false vocal cords are superior, true vocal cords are inferior
  - Epiglottis—closes trachea during swallowing and is the guardian of the airways

Larynx

Lower Respiratory Tract

- Trachea (windpipe)—tube about 9-10 in. long leading from larynx to upper chest
  - Consists of about 18 half-ring cartilages that allow esophagus to expand into the trachea when food is swallowed
- Bronchi—passageways leading from trachea to lungs
  - Bronchioles—smaller divisions of bronchi

Trachea

Lower Respiratory Tract

- Alveoli—tiny sacs attached to alveolar ducts
  - Alveolar sacs—two or more alveoli that share a common opening
  - Surfactants—phospholipids that assist in gas exchange in the alveoli and contribute to elasticity of pulmonary tissue
Alveoli

Lower Respiratory Tract

- Lungs—spongy, elastic organs that fill most of thoracic cavity and are main organs of respiration
  - External surfaces covered with serous membranes
  - Pleural membrane—encases both lungs and secretes fluid that reduces friction
- Respiratory diaphragm—airtight seal between thoracic and abdominal cavities and is the main muscle of respiration

Lungs

Air-conduction Pathway

- Nose
- Nasal cavity
- Pharynx
- Larynx
- Trachea
- Bronchi
- Bronchioles

Mechanisms of Breathing

- Processes to get oxygen from environment to cells:
  - Breathing
  - External respiration
  - Internal respiration

Breathing

- Also termed pulmonary ventilation
- Muscular contraction and relaxation required to move air in and out
- Two phases:
  - Inspiration or inhalation
  - Expiration or exhalation
Inspiration

- Diaphragm contracts and descends into abdominal cavity to increase size of thoracic cavity
- Sternocleidomastoid, pectoralis minor, and external intercostals contract to raise ribs and chest
- Air is drawn into lungs

Expiration

- Diaphragm relaxes and ascends toward thoracic cavity to decrease its size
- This expels air back into the atmosphere

Breathing

- Adults respire about 15–20 times per minute
- Children breathe twice as fast
- Increase or decrease in body temperature increases or decreases respiration

Breathing

- Vital capacity: total amount of air that can forcibly be inspired or expired from lungs in one breath
- Dyspnea: labored or difficult breathing
- Hypoxia: inadequate oxygen at the cellular level
- Anoxia: lack of oxygen at either locally or systemically
External and Internal Respiration

- Diffusion—tendency of molecules to move from areas of higher concentration to areas of lower concentration
- Two processes:
  - External respiration
  - Internal respiration

External Respiration

- Also called pulmonary respiration
- Gas exchange in lungs between blood and air in alveoli
- O2 diffuses from air, through alveolar wall
- O2 then binds to hemoglobin to be transported to cells throughout the body
- CO2 diffuses from blood into the air, and is then exhaled

Internal Respiration

- Also called tissue respiration
- Gas exchange between blood and tissues
- O2 diffuses from the blood into the cells
- CO2 diffuses from the cells into the blood

Modified Respiratory Air Movements

- Coughing
- Sneezing
- Crying
- Snoring
- Hiccups
- Yawning
- Laughing
- Yawning

Pathological Conditions of the Respiratory System

- Apnea
  - Temporary cessation (≤15 seconds) or absence of breathing
  - Occurs during sleep
Pathological Conditions of the Respiratory System

• Asthma
  – Chronic inflammatory disorder
  – Smooth muscles of smaller bronchi and bronchioles spasm to close
  – Causes labored breathing
  – May be brought on by exercise, stress, infections, or allergens

Pathological Conditions of the Respiratory System

• Bronchitis
  – Inflammation of bronchial mucosa
  – Bronchial tubes swell, extra mucus produced
  – Acute bronchitis caused by upper respiratory tract infection
  – Chronic bronchitis creates copious mucus and productive cough for up to 3 months

Pathological Conditions of the Respiratory System

• Effects of smoking
  – Cigarette smoking eventually destroys alveoli and reduces gas exchange
  – Also destroys respiratory cilia; then body produces excess mucus
  – Smokers tend to be sick more often because excess mucus breeds bacteria
  – Early teen smokers may never develop completely mature lungs

Pathological Conditions of the Respiratory System

• Chronic obstructive pulmonary disease
  – Group of disorders (asthma, emphysema, cystic fibrosis, pneumoconiosis, chronic bronchitis)
  – Characterized by persistent or recurring obstruction of airflow
  – Individual is unable to breathe freely

Pathological Conditions of the Respiratory System

• Common cold
  – Acute inflammation of mucosa of upper respiratory tract
  – Usually confined to nose and throat
  – Symptoms include: coughing, sneezing, watery eyes, nasal congestion and discharge, sore throat, hoarseness
  – May be accompanied by fever and chills

Pathological Conditions of the Respiratory System

• Emphysema
  – Involves overinflation and destruction of alveoli
  – Large air spaces remain filled during expiration
  – Usually leads to labored exhalation
  – Caused by smoking or other air pollution
Pathological Conditions of the Respiratory System

• Hay fever
  – Any allergic reaction of the nasal mucosa
  – Symptoms: sneezing, swelling, mucous discharge, itching and watering of eyes

• Influenza
  – Acute viral infection of respiratory tract
  – 3-day incubation period; lasts 3-10 days
  – Symptoms: inflamed nasal mucosa & pharynx, fever, chills, head & muscle aches

Pathological Conditions of the Respiratory System

• Laryngitis
  – Inflammation of larynx
  – Often results in loss of voice
  – Caused by infections or irritants

• Pleurisy
  – Inflammation of pleural membranes
  – Stabbing pain during breathing

Pathological Conditions of the Respiratory System

• Pneumonia
  – Infection or inflammation of alveoli caused by bacteria
  – Alveoli fill with fluid, dead white cells, pus

Pathological Conditions of the Respiratory System

• Sinusitis
  – Inflammation of paranasal sinuses
  – Swelling of nasal mucosa may obstruct openings from sinuses to nose
  – Causes local tenderness, pain, headaches, fever

Pathological Conditions of the Respiratory System

• Tuberculosis (TB)
  – Chronic lung infection
  – Caused by Mycobacterium tuberculosis bacteria
  – Lungs are primary target but can affect liver, bone marrow, and spleen

Summary

• Main functions of the respiratory system include exchange of gases, homeostasis, olfaction, and production of speech
• Processes of breathing, external respiration, and internal respiration necessary to get oxygen to cells and eliminate gaseous waste
• Main purpose of air movement is to take in oxygen and expel carbon dioxide