Chapter 39
Oxygenation
Factors Essential to Normal Functioning of the Respiratory System

- Integrity of the airway system to transport air to and from lungs
- Properly functioning alveolar system in lungs
  - Oxygenate venous blood
  - Remove carbon dioxide from blood
- Properly functioning cardiovascular and hematological system
  - Carry nutrients and wastes to and from body cells
Upper Airway

- Function—warm, filter, humidify inspired air
- Components
  - Nose
  - Pharynx
  - Larynx
  - Epiglottis
Lower Airway

- Functions—conduction of air, mucociliary clearance, production of pulmonary surfactant
- Components
  - Trachea
  - Right and left mainstem bronchi
  - Segmental bronchi
  - Terminal bronchioles
Anatomy of the Lungs

- Main organs of respiration
- Extend from the base of diaphragm to the apex above first rib
- The right lung has three lobes; left lung has two
- The lungs are composed of elastic tissue (alveoli, surfactant, pleura)
The Organs of the Respiratory Tract
Pulmonary Ventilation

- Inspiration—the active phase of ventilation
  - Involves movement of muscles and thorax to bring air into the lungs
- Expiration—the passive phase of ventilation
  - Movement of air out of the lungs
Process of Ventilation

- The diaphragm contracts and descends, lengthening the thoracic cavity
- The external intercostal muscles contract, lifting the ribs upward and outward
- The sternum is pushed forward, enlarging the chest from front to back
- Increased lung volume and decreased intrapulmonic pressure allow air to move from an area of greater pressure (outside lungs) to lesser pressure (inside lungs)
- The relaxation of these structures results in expiration
Gas Exchange

- Refers to the intake of oxygen and release of carbon dioxide
- Made possible by respiration and perfusion
- Occurs via diffusion (movement of oxygen and carbon dioxide between the air and blood)
Question

Which one of the following respiratory organs is the site of gas exchange?

A. Mediastinum
B. Parietal pleura
C. Alveoli
D. Diaphragm
Answer: C. Alveoli

Rationale:

At the end of the terminal bronchioles, there are clusters of alveoli that are the site of gas exchange. The wall of each alveolus is made of a single-cell layer of squamous epithelium. This thin wall allows for exchange of gasses within the capillaries covering the alveoli.
Four Factors Influencing Diffusion of Gases in the Lungs

- Change in surface area available
- Thickening of alveolar-capillary membrane
- Partial pressure
- Solubility and molecular weight of the gas
Transport of Respiratory Gases

- Oxygen is carried in the body via plasma and red blood cells.
- Most oxygen (97%) is carried by red blood cells in the form of oxyhemoglobin.
- Hemoglobin also carries carbon dioxide in the form of carboxyhemoglobin.
- Internal respiration between the circulating blood and tissue cells must occur.
Tell whether the following statement is true or false.

Pulmonary ventilation is the process by which oxygenated capillary blood passes through body tissues.

A. True

B. False
Answer: B. False

Perfusion is the process by which oxygenated capillary blood passes through body tissues.
Cardiovascular System

• Vital for exchange of gases

• Composed of the heart and the blood vessels
  - The heart is a cone shaped, muscular pump, divided into four hollow chambers

  • The upper chambers, the atria (singular, atrium), receive blood from the veins (the superior and inferior vena cava and the left and right pulmonary veins)

  • The lower chambers, the ventricles, force blood out of the heart through the arteries (the left and right pulmonary arteries and the aorta)
Respiratory Activity in the Infant

- Lungs are transformed from fluid-filled structures to air-filled organs.
- The infant’s chest is small, airways are short, and aspiration is a potential problem.
- Respiratory rate is rapid and respiratory activity is primarily abdominal.
- Synthetic surfactant can be given to the infant to reopen alveoli.
- Crackles heard at the end of deep respiration are normal.
Respiratory Activity in the Child

- Some subcutaneous fat is deposited on the chest wall making landmarks less prominent.
- Eustachian tubes, bronchi, and bronchioles are elongated and less angular.
- The average number of routine colds and infections decreases until children enter daycare or school.
- Good hand hygiene and tissue etiquette are encouraged.
- By end of late childhood, the immune system protects from most infections.
Respiratory Functioning in the Older Adult

- Bony landmarks are more prominent due to loss of subcutaneous fat.
- Kyphosis contributes to appearance of leaning forward.
- Barrel chest deformity may result in increased anteroposterior diameter.
- Tissues and airways become more rigid; diaphragm moves less efficiently.
- Older adults have an increased risk for disease, especially pneumonia.
Factors Affecting Respiratory Functioning

- Levels of health
- Developmental considerations
- Medications
- Lifestyle
- Environment
- Psychological health
Guidelines for Obtaining a Nursing History

- Determine why the patient needs nursing care.
- Determine what kind of care is needed to maintain a sufficient intake of air.
- Identify current or potential health deviations.
- Identify actions performed by the patient for meeting respiratory needs.
- Make use of aids to improve intake of air and effects on patient’s lifestyle and relationship with others.
Sounds Heard Upon Percussion of Chest Wall

- **Resonance**—loud, hollow low-pitched sound heard over normal lungs
- **Hyperresonance**—loud, low booming sound heard over emphysematous lungs
- **Flatness**—detected over bone or heavy muscle
- **Dullness**—with medium pitch and intensity heard over the liver
- **Tympany**—high-pitched, loud, drum-like sound produced over the stomach
Breath Sounds

- Vesicular—low-pitched soft sound during expiration heard over most of lungs
- Bronchial—high-pitched and longer, heard primarily over trachea
- Bronchovesicular—medium pitch and sound during expiration, heard over upper anterior chest and intercostal area
Tell whether the following statement is true or false.

Wheezes are continuous, musical sounds, produced as air passes through airways constricted by swelling, narrowing, secretions, or tumors.

A. True
B. False
Answer

Answer: A. True

Wheezes are continuous, musical sounds, produced as air passes through airways constricted by swelling, narrowing, secretions, or tumors.
Abnormal (Adventitious) Lung Sounds

- **Crackles**—intermittent sounds occurring when air moves through airways that contain fluid
  - Classified as fine, medium, or coarse

- **Wheeze**s—continuous sounds heard on expiration and sometimes on inspiration as air passes through airways constricted by swelling, secretions, or tumors
  - Classified as sibilant or sonorous
Common Diagnostic Methods

- Arterial blood gas and pH analysis
- Cytologic study
- Endoscopic studies
- Skin tests
- Radiography
- Lung scan
Values Measured from Pulmonary Function Tests

- Vital Capacity (VC)
- Forced Expiratory Vital Capacity (FEVC)
- Forced Inspiratory Vial Capacity (FIVC)
- Forced Expiratory Volume (FEV)
- Total Lung capacity (TLC)
- Residual Volume (RV)
- Peak Expiratory Flow Rate (PEFR)
Question

Which one of the following lung values is the amount of air contained within the lungs at maximum inspiration?

A. Vital capacity
B. Total lung capacity
C. Residual volume
D. Peak expiratory flow rate
Answer

Answer: B. Total lung capacity

Rationale:

Total lung capacity is the amount of air contained within the lungs at maximum inspiration.

Vital capacity is the amount of air displaced by maximal exhalation.

Residual volume is the amount of air left in the lungs at maximal expiration.

Peak expiratory flow rate is the maximum flow attained during the forced expiratory maneuver.
Nursing Interventions Promoting Adequate Respiratory Functioning

- Teaching about a pollution-free environment
- Promoting optimal function
- Promoting proper breathing
- Managing chest tubes
- Promoting and controlling coughing
- Promoting comfort
- Meeting respiratory needs with medications
Promoting Proper Breathing

- Deep breathing
- Using incentive spirometry
- Pursed-lip breathing
- Abdominal or diaphragmatic breathing
Managing Chest Tubes

- Assist with insertion and removal of chest tube.
- Monitor the patient’s respiratory status and vital signs.
- Check the dressing.
- Maintain the patency and integrity of the drainage system.
Types of Cough Medications

- Cough suppressants
- Expectorants
- Lozenges
The Cough Mechanism

A

B

C
Promoting Comfort

- Positioning
- Maintaining adequate fluid intake
- Providing humidified air
- Performing chest physiotherapy
- Maintaining good nutrition
Administering Inhaled Medications

- Bronchodilators—open narrowed airways
- Mucolytic agents—liquefy or loosen thick secretions
- Corticosteroids—reduce inflammation in airways
Question

Tell whether the following statement is true or false.
A meter-dosed inhaler delivers a controlled dose of medication with each compression of the canister.

A. True
B. False
Question

Answer: A. True

A meter-dosed inhaler delivers a controlled dose of medication with each compression of the canister.
Types of Inhalers

- Nebulizers—disperse fine particles of medication into deeper passages of respiratory tract where absorption occurs
- Metered-dose inhalers—deliver controlled dose of medication with each compression of the canister
- Dry powder inhalers—activated by the patient’s inspiration
Oxygen Delivery Systems

- Nasal cannula
- Nasal catheter
- Transtracheal catheter
- Simple mask
- Partial rebreather mask
- Nonrebreather mask
- Venturi mask
- Tent
Precautions for Oxygen Administration

- Avoid open flames in patient’s room.
- Place no smoking signs in conspicuous places.
- Check to see electrical equipment in room is in good working order.
- Avoid wearing and using synthetic fabrics (builds up static electricity).
- Avoid using oils in the area (ignite spontaneously in oxygen).
Type of Artificial Airways

- Oropharyngeal and nasopharyngeal airway
- Endotracheal tube
- Tracheostomy tube
Two Types of Tracheostomy Sets: Cuffless and Cuffed
Administering Cardiopulmonary Resuscitation (ABCs)

- **Airway**—tip the head and check for breathing
- **Breathing**—if victim is not breathing spontaneously, give two breaths lasting 1.5 to 2 seconds
- **Circulation**—check the pulse; if victim has no pulse, initiate chest compressions
Planning: Expected Outcomes

- Demonstrate improved gas exchange in lungs by absence of cyanosis or chest pain and a pulse oximetry reading >95%.
- Relate the causative factors and demonstrate adaptive method of coping.
- Preserve pulmonary function by maintaining an optimal level of activity.
- Demonstrate self-care behaviors that provide relief from symptoms and prevent further problems.