Respiratory System

The respiratory unit focuses on pathophysiologic conditions, which interfere with gas exchange. When problems of gas exchange occur, regardless of the precipitating cause, a hypoxic state is frequently the result. A thorough understanding of hypoxia and the appropriate nursing interventions for the client in a hypoxic state are a high priority.

PHYSIOLOGY OF THE RESPIRATORY SYSTEM

Organs of the Respiratory System
A. Bronchial tree.
   1. Trachea divides below the carina into the right and left main stem bronchi, which extend into the lungs.
   2. The right main stem bronchus is shorter, wider, and straighter than the left; therefore foreign objects are more likely to enter the right side.
   3. Lobar bronchi: three in the right lung and two in the left lung; lobar bronchi subdivide several more times to form segmental and subsegmental bronchi.
   4. Bronchioles: branching from the subsegmental bronchi; no cartilage in the walls. Bronchioles branch into the terminal bronchioles; no mucus glands or cilia.
B. Lungs (organs of respiration).
   1. Lungs are located within the thoracic cavity (Figure 15-1).
   2. Pleura: transparent serous membrane around the lung.
      a. Each lung is sealed within its own compartment by the pleura.
      b. Visceral pleura: adheres to the surface of the lung.
      c. Parietal pleura: covers the inner wall of the chest.
      d. Pleural space: potential space between the visceral and parietal pleura membrane; area between pleural layers contains a small amount of fluid to lubricate and allow for smooth motion of lung tissue during respirations.
   3. Lungs.
      a. Divided into lobes.
         (1) Right lung: three lobes.
         (2) Left lung: two lobes.
      b. Each terminal bronchiole branches into respiratory bronchioles.
   c. The alveolar ducts are located at the end of the respiratory bronchioles.
   d. Alveoli: area of gas exchange; diffusion of oxygen (O₂) and carbon dioxide (CO₂) between the blood and the lungs occurs across the alveolar membrane.
   e. Surfactant is produced in the alveoli; its primary function is to reduce surface tension, which facilitates alveolar expansion and decreases the tendency of alveoli to collapse.
   4. Premature infants frequently have inadequate production of surfactant.
   5. Blood supply to the lungs.
      a. Pulmonary arteries to pulmonary capillaries to alveoli, where exchange of gas occurs.
      b. Bronchial arteries supply the nutrients to the lung tissue and do not participate in gas exchange.

Physiology of Respiration
External respiration is a process by which gas is exchanged between the circulating blood and the inhaled air.
A. Atmospheric pressure: pressure exerted on all body parts by surrounding air.
B. Intrathoracic pressure: pressure within the thoracic cage.
C. Gases flow from an area of high pressure to an area of low pressure; pressure below atmospheric pressure is designated as negative pressure.
D. Inspiration.
   1. Stimulus to the diaphragm and the intercostal muscles by way of the central nervous system.
   2. Diaphragm moves down, and intercostal muscles move outward, thereby increasing the capacity of the thoracic cavity and decreasing intrathoracic pressure to below atmospheric pressure.
   3. Through the airways, the lungs are open to atmospheric pressure; air will flow into the lungs to equalize intrathoracic pressure with atmospheric pressure.
E. Expiration.
   1. Diaphragm and intercostal muscles relax and return to a resting position; therefore lungs recoil and capacity is decreased.
   2. Air will flow out until intrathoracic pressure is again equal to atmospheric pressure.
F. Negative pressure is greater during inspiration; therefore air flows easily into the lungs.
FIGURE 15-1 Respiratory system. (From Lewis SL et al: Medical-surgical nursing: assessment and management of clinical problems, ed 7, St. Louis, 2007, Mosby.)

**Compliance** describes how elastic the lungs are or how easily the lungs can be inflated; when compliance is decreased, the lungs are more difficult to inflate.

**Respiratory volumes.**
1. Tidal volume (VT or TV): amount of air moving in and out of the lungs in one normal breath. Normal = 500 mL (5-10 mL/kg).
2. Vital capacity (VC): amount of air forcibly exhaled in one breath after a maximum inhalation. Normal = 4500 mL.
3. Residual volume (RV): air remaining in the lungs at the end of a forced (maximum) expiration.

**Control of respiration.**
1. Movement of the diaphragm and accessory muscles of respiration is controlled by the respiratory center located in the brainstem (medulla oblongata and pons).
   a. The respiratory center will control respirations by way of the spinal cord and phrenic nerve. The diaphragm is innervated by the phrenic nerve coming from the spinal cord between C-3 and C-5; the intercostal muscles are innervated by nerves from the spinal cord between T-2 and T-11.
   b. Activity of the respiratory center is regulated by chemoreceptors. These receptors respond to changes in the chemical composition of the cerebrospinal fluid (CSF) and the blood (specifically, the Pao2, Paco2, and pH).
2. The medulla contains the central chemoreceptors responsive to changes in CO2 blood levels.
   a. CO2 diffuses into cerebrospinal fluid (CSF), increasing the hydrogen ion concentration of CSF. This has a direct stimulating effect on the chemoreceptors in the medulla.
   b. CO2 saturation of the blood regulates ventilation through its effect on the pH of the CSF and the effects of the CSF on the respiratory center in the medulla.

**NURSING PRIORITY** The primary respiratory stimulus is CO2; when the Paco2 is increased, ventilation is initiated.

3. Carotid and aortic bodies contain the peripheral chemoreceptors for arterial O2 levels.
   a. Primary function is to monitor arterial O2 levels and stimulate the respiratory center when a decrease in PaO2 occurs.
   b. When arterial O2 decreases to below 60 mm Hg, stimulation to breathe is initiated by the chemoreceptors.
   c. In a person whose primary stimulus to breathe is hypoxia, this becomes the mechanism of ventilatory control.

**J. The process of gas exchange.**
1. Ventilation: the process of moving air between the atmosphere and alveoli.
2. Diffusion.
   a. The process of moving O2 and CO2 across the alveolar capillary membrane.
   b. Links the processes of ventilation and perfusion.
   c. Gas diffuses across the alveolar capillary membrane from an area of high concentration to an area of low concentration.
   d. Factors affecting diffusion: surface area of the lung, thickness of the alveolar capillary membrane, characteristics of the gases.

**NURSING PRIORITY** When mucus is retained and pools in the lungs, gas diffusion is decreased; provides a medium for bacteria growth.

3. Perfusion.
   a. The process of linking the venous blood flow to the alveoli.
   b. Dependent on the volume of blood flowing from the right ventricle into and through the pulmonary circulation.

**Oxygen and Carbon Dioxide Transport**
Internal respiration is the exchange of gases between the blood and interstitial fluid. The gases are measured by an analysis of arterial blood (Table 15-1).
A. \( O_2 \)
1. Transformed as a dissolved gas; \( P_{\text{ao}2} \) refers to the partial pressure of \( O_2 \) in arterial blood.
2. \( O_2 \) is primarily transported chemically bound to hemoglobin; when hemoglobin leaves the pulmonary capillary bed, it is usually 95% to 100% saturated with \( O_2 \). It may be referred to as the arterial oxygen saturation (\( \text{Sa}O_2 \)). \( O_2 \) can also be carried (physically dissolved) in the plasma.
3. Oxygenated hemoglobin moves through the arterial system into the cellular capillary bed, where \( O_2 \) is released from the hemoglobin and made available for cellular metabolism.
4. Venous blood contains about 75% \( O_2 \) as it returns to the right side of the heart.
5. \( O_2 \) delivered to the tissue is dependent on cardiac output.

B. \( \text{Oxyhemoglobin dissociation curve} \)
1. Curve shows the affinity of hemoglobin for \( O_2 \) at different \( O_2 \) tensions.
2. \( O_2 \) that remains bound to hemoglobin does not contribute to cellular metabolism.
3. Affinity of hemoglobin refers to the capacity of hemoglobin to bind to \( O_2 \).
4. The affinity of hemoglobin for \( O_2 \) is influenced by many factors, such as hydrogen ion concentration (\( \text{pH} \)), \( \text{CO}_2 \), and body temperature.
   a. Hemoglobin binds tightly together with \( O_2 \) in an alkaline condition.
   b. Hemoglobin releases \( O_2 \) in an acid condition.
   c. As \( \text{CO}_2 \) moves into the serum at the capillary bed, it decreases the \( \text{pH} \) (acidotic), thereby enhancing \( O_2 \) release.
   d. As \( \text{CO}_2 \) moves out of the venous system into the lungs, the \( \text{pH} \) (alkalotic) is increased in the blood, thereby enhancing hemoglobin affinity for \( O_2 \).
   e. In hypothermia, blood picks up \( O_2 \) more readily from the lungs but delivers \( O_2 \) less readily to the tissues; in hyperthermia, the opposite occurs.
5. A decrease in the arterial \( O_2 \) tension (\( P_{\text{ao}2} \)) and a decrease in the saturation of the hemoglobin with oxygen (\( \text{Sa}O_2 \)) results in a state of hypoxemia.

C. Effects of altitude on \( O_2 \) transport.
1. At high levels (above 10,000 feet), there is reduced \( O_2 \) in the atmosphere, resulting in a lower inspired \( O_2 \) pressure and a lower \( P_{\text{ao}2} \). Commercial planes are pressurized to an altitude of 8000 feet.

<table>
<thead>
<tr>
<th>Table 15-1</th>
<th>NORMAL ARTERIAL BLOOD GAS VALUES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acidity index</td>
<td>pH</td>
</tr>
<tr>
<td>Partial pressure of dissolved oxygen</td>
<td>( P_{\text{ao}2} )</td>
</tr>
<tr>
<td>Percentage of hemoglobin saturated with oxygen</td>
<td>( \text{Sa}O_2 )</td>
</tr>
<tr>
<td>Partial pressure of dissolved carbon dioxide</td>
<td>( P_{\text{aco}2} )</td>
</tr>
<tr>
<td>Bicarbonate</td>
<td>( \text{HCO}_3^- )</td>
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</tbody>
</table>

**NURSING PRIORITY**  An \( \text{Sa}O_2 \) below 95% indicates respiratory difficulty.

**NURSING PRIORITY**  Clients who are on oxygen or who have a \( P_{\text{ao}2} \) of less that 72 mm Hg on room air should consult with their physician before planning air travel.

1. Increase in the number of red blood cells or hematocrit from body storage areas, thereby increasing the total hemoglobin-carrying and \( O_2 \)-carrying capacity of the blood.
2. Hyperventilation.
3. Renal erythropoietic factor (erythropoietin) is released, thereby enhancing the production of red blood cells (secondary polycythemia). It takes approximately 4 to 5 days to actually increase red blood cell production.

**ALERT**  Apply knowledge of pathophysiology to monitoring for complications; identify client status based on pathophysiology.

2. Body compensatory mechanisms.
   a. Decrease in \( O_2 \) supply (decrease in cardiac output or inadequate hemoglobin).
   b. Increase in body’s demand.

**System Assessment**

**ALERT**  Monitor changes in the client’s respiratory status. The primary indicators of respiratory disorders are sputum production, cough, dyspnea, hemoptysis, pleuritic chest pain, fatigue, change in voice, and wheezing.

**CHAPTER 15**  Respiratory System

**A. History.**
1. Determine the frequency of upper respiratory problems and/or surgeries involving respiratory problems.
2. Status of immunizations.
   a. Tuberculin (TB) skin test (also known as PPD or Mantoux test).
   b. Pertussis, polio, pneumococcal pneumonia vaccine (Pneumovax).
3. Medications (including OTC, prescriptions, herbs, and vitamins).
4. Lifestyle and occupational environments.
5. Habits: smoking and alcohol intake.
6. Any change in ADLs and activity secondary to respiratory problems.

**B. Physical assessment.**

**ALERT**  Apply knowledge of pathophysiology to monitoring for complications; identify client status based on pathophysiology.

3. Extended exposure to high altitudes will result in an increased vascularization of the lungs, thus increasing the capacity of the blood to carry \( O_2 \).
4. Problem with oxygenation at high altitudes.
   a. Decrease in \( O_2 \) supply (decrease in cardiac output or inadequate hemoglobin).
   b. Increase in body’s demand.

**System Assessment**

**A. History.**
1. Determine the frequency of upper respiratory problems and/or surgeries involving respiratory problems.
2. Status of immunizations.
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   b. Pertussis, polio, pneumococcal pneumonia vaccine (Pneumovax).
3. Medications (including OTC, prescriptions, herbs, and vitamins).
4. Lifestyle and occupational environments.
5. Habits: smoking and alcohol intake.
6. Any change in ADLs and activity secondary to respiratory problems.

**B. Physical assessment.**

**ALERT**  Monitor changes in the client’s respiratory status. The primary indicators of respiratory disorders are sputum production, cough, dyspnea, hemoptysis, pleuritic chest pain, fatigue, change in voice, and wheezing.
1. Initially observe client’s resting position.
   a. Appearance: comfortable or distressed?
   b. Assess client in the sitting position, if possible.
   c. Any dyspnea or respiratory discomfort?
2. Evaluate vital signs.
   a. Appropriate for age level?
   b. Establish database and compare with previous data.
   c. Assess client’s pattern of vital signs; normal vital signs vary greatly from one individual to another (see Table 3-2).

**ALERT** Apply knowledge of client pathophysiology when measuring vital signs; intervene when vital signs are abnormal; interpret data that need to be reported immediately.

3. Assess upper airway passages and patency of the airway.
4. Inspect the neck for symmetry; check to see whether the trachea is in midline and observe for presence of jugular vein distention.
5. Assess the lungs.
   a. Visually evaluate the chest/thorax.
      (1) Do both sides move equally?
      (2) Observe characteristics of respirations and note whether retractions are present (Figure 15-2).
      (3) Note chest wall configuration (barrel chest, kyphoscoliosis, etc.).
   b. Palpate chest for tenderness, masses, and symmetry of motion.
   c. Auscultate breath sounds; begin at lung apices and end at the bases, comparing each area side to side. Breath sounds should be present and equal bilaterally.

![Location of retractions](image)

**FIGURE 15-2** Location of retractions. (From Hockenberry MJ, Wilson D: Wong’s nursing care of infants and children, 8th ed, St. Louis, 2007, Mosby.)

d. Determine presence of tactile fremitus: When client says “ninety-nine,” there should be equal vibrations palpated bilaterally. Over areas of consolidation, there will be an increase in the vibrations.

e. Determine presence of adventitious breath sounds (abnormal额外 breath sounds).
   (1) Crackles: usually heard during inspiration and do not clear with cough; occur when airway contains fluid (previously also known as rales); sounds are not continuous (early cardiac failure, pneumonia, and atelectasis).
   (2) Wheezes: may be heard during inspiration and/or expiration; are caused by air moving through narrowed passages; sound is music-like and continuous.
   (3) Pleural friction rub: heard primarily on inspiration over an area of pleural inflammation; may be described as a grating sound.

6. Assess cough reflex and sputum production.
   a. Is cough associated with pain?
   b. What precipitates coughing episodes?
   c. Is cough productive or nonproductive?
   d. Characteristics of sputum.
      (1) Consistency.
      (2) Amount.
      (3) Color (should be clear or white).
   e. Presence of hemoptysis—duration and amount.

7. Assess for and evaluate dyspnea.
   a. Onset of dyspnea and precipitating causes.
   b. Presence of orthopnea.
   c. Presence of adventitious breath sounds.
   d. Noisy expiration.
   e. Level of tolerance of activity.
   f. Correlate vital signs with dyspnea.
   g. Cyanosis (a very late and unreliable sign of hypoxia).
      (1) For dark-skinned clients, assess the areas that are less pigmented (oral cavity, nail beds, lips, palms).
      (2) Dark-skinned clients may exhibit cyanosis in the skin as a gray hue, rather than blue.
      (3) Prolonged capillary refill time, should be less than 3 seconds.

8. Assess for and evaluate chest pain.
   a. Location of pain.
   b. Character of pain.
   c. Pain associated with cough.
   d. Pain either increased or decreased with breathing.

9. Evaluate fingers for clubbing (characteristic in clients with chronic respiratory disorders).

10. Evaluate pulmonary diagnostics (see Appendix 15-1).
   a. Hemoglobin and hematocrit (presence of polycythemia or anemia).
   b. Electrolyte imbalances.
   c. Arterial blood gases (ABGs).
CHAPTER 15
Respiratory System

RESPIRATORY DISORDERS

Hypoxia

Hypoxia is a condition characterized by an inadequate amount of O₂ available for cellular metabolism.

ALERT Problems with respiratory status occur in all nursing disciplines. Questions may center around nursing priorities and nursing interventions in maintaining an airway and promoting ventilation in the client with respiratory difficulty. The questions may arise from any client situation (e.g., obstetrics, newborn, surgical, etc.).

A. Hypoxia occurs when signs and symptoms occur because of a decrease in PaO₂; hypoxemia occurs when the amount of O₂ in the arterial blood is less than normal.
   1. Decreased O₂ in inspired air.
   2. Disorders causing respiratory obstruction and alveolar hypoventilation.

B. Hypoxia may be caused by inadequate circulation.
   1. Shock.
   2. Cardiac failure.

C. Anemia precipitates hypoxia caused by a decrease in the O₂-carrying capacity of the blood.
   1. Inadequate red blood cell production.
   2. Deficient or abnormal hemoglobin.

Assessment

A. Risk factors/etiology.
   1. Chronic hypoxia.
      a. Chronic obstructive pulmonary disease (COPD).
      b. Cystic fibrosis.
      c. Cancer of the respiratory tract.
      d. Heart failure.
      e. Chronic anemia.
   2. Inflammatory problems affecting alveolar surface area and membrane integrity (e.g., pneumonia, bronchitis).
   3. Acute hypoxia.
      a. Acute respiratory failure.
      b. Sudden airway obstruction.
      c. Conditions affecting pulmonary expansion (e.g., respiratory paralysis).
      d. Conditions causing decreased cardiac output (heart failure, shock, cardiac arrest, etc.).
      e. Hypoventilation (brain attack or stroke, sedation, anesthesia, etc.).

B. Clinical manifestations: underlying respiratory problem, either chronic or acute (Table 15-2).

C. Diagnostics (see Appendix 15-1).

D. Compensatory mechanisms.
   1. Increase in cardiac output (tachycardia).
   2. Increase in extraction of O₂ from capillary blood.
   3. Increase in level of hemoglobin.

E. Complications.
   1. Acute.
      a. Cardiac decompensation.
      b. Progression to chronic hypoxia.

2. Chronic.
   a. CO₂ narcosis (increase in CO₂ content of blood).
   b. Cor pulmonale.
   c. Cardiac failure.

3. Treatment: depends on underlying problem.

NURSING PRIORITY In the client with chronic lung disease who is experiencing severe hypoxia, O₂ should never be withheld for fear of increasing the PaO₂ levels.

Nursing Interventions

Goal: To maintain good pulmonary hygiene and prevent hypoxic episode.

A. Position client to maintain patent airway.
   1. Unconscious client: position on side with the chin extended.
   2. Conscious client: elevate the head of the bed and may position on side as well.

B. Encourage coughing and deep breathing (Box 15-1).

<table>
<thead>
<tr>
<th>Table 15-2</th>
<th>SYMPTOMS OF RESPIRATORY DISTRESS AND HYPOXIA</th>
</tr>
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<tbody>
<tr>
<td>Early Symptoms</td>
<td>Late Symptoms</td>
</tr>
<tr>
<td>Restlessness</td>
<td>Extreme restlessness to stupor</td>
</tr>
<tr>
<td>Tachycardia</td>
<td>Severe dyspnea</td>
</tr>
<tr>
<td>Tachypnea, exertional dyspnea</td>
<td>Slowing of respiratory rate</td>
</tr>
<tr>
<td>Orthopnea, tripod positioning</td>
<td>Bradycardia</td>
</tr>
<tr>
<td>Anxiety, difficulty speaking</td>
<td>Cyanosis (peripheral or central)</td>
</tr>
<tr>
<td>Poor judgment, confusion</td>
<td>Disorientation</td>
</tr>
<tr>
<td>Disorientation</td>
<td></td>
</tr>
</tbody>
</table>

Pediatrics

| Flaring nares (infants) | Mottling, pallor, and cyanosis |
| Substernal, suprasternal, supraclavicular and intercostal retractions (see Figure 15-2) | Sudden increase or sudden decrease in agitation |
| Stridor—expiratory and inspiratory | Inaudible breath sounds |
| Increased agitation | Altered level of consciousness |
| Increased agitation | Inability to cry or to speak |

Box 15-1 EFFECTIVE COUGHING

- Increase activity before coughing: walking or turning from side to side.
- Place client in sitting position, preferably with feet on the floor.
- Client should turn his or her shoulders inward and bend head slightly forward.
- Take a gentle breath in through the nose and breathe out completely.
- Take two deep breaths through the nose and mouth and hold for 5 seconds.
- On the third deep breath, cough to clear secretions.
- Sips of warm liquids (coffee, tea, or water) may stimulate coughing.
- Demonstrate to client how to splint chest or incision during cough to decrease pain.
C. Suction client as needed and as indicated by amount of sputum and ability to cough.
D. Maintain adequate fluid intake to keep secretions liquefied.
E. Encourage exercises and ambulation as indicated by condition.
F. Administer expectorants.
G. Administer O
2 if dyspnea is present.

**NURSING PRIORITY** Administer fluids very cautiously to a client who is having difficulty breathing. Begin with small sips of water to determine whether the client can swallow effectively—thickened liquids are easier to control. Do not begin with fluids that contain any fat (milk) or caloric value because of the increased risk for aspiration.

**Goal:** To implement nursing measures to decrease hypoxia. (Box 15-2).

A. Assess patency of airway (first/highest priority).
   1. Can client speak? If not, initiate emergency procedures (see Appendix 15-3).
   2. If speaking is difficult because of level of hypoxia, place in semi-Fowler's position, begin oxygen, obtain assistance, and remain with client.
   3. If client is coherent and able to speak in sentences, continue with assessment of the problem.
   4. Evaluate amount of secretions and ability to cough; suction and administer O
2 as indicated.
B. Assess use of accessory muscles, presence of retractions.
C. Maintain calm approach, because increasing anxiety will potentiate hypoxia.

**NURSING PRIORITY** Increasing anxiety will accelerate dyspnea in a client who is experiencing severe difficulty breathing.

D. Place adult or older child in a semi-Fowler’s position, if not contraindicated.
E. Place infant in an infant seat or elevate the mattress.

**Box 15-2 OLDER ADULT CARE FOCUS**

Respiratory Care Priorities

- Older adult client may not present with respiratory symptoms, but instead with confusion and disorientation.
- Provide adequate rest periods between activities, such as bathing, going for treatments, eating, etc.
- Increase compliance with medications by scheduling medication administration with routine activities.
- Encourage annual flu shot for individuals over age 65 and determine whether older adult has received pneumococcal vaccination.
- Evaluate client’s response to changes in activity and therapy frequently.
- Administer oxygen with caution; evaluate response to increased levels of oxygen saturation.
- Maintain adequate hydration but use caution because of increased tendency for fluid volume overload.

**NURSING PRIORITY** Position a client experiencing dyspnea with a pillow placed lengthwise behind the back and head. Do not flex the client’s head forward or backward.

F. Assess color and presence of diaphoresis.
G. Evaluate vital signs: Are there significant changes from previous readings?
H. Evaluate for dysrhythmias.
   1. If the client is on a cardiac monitor, check for presence of premature atrial or ventricular contractions.
   2. Evaluate level of tachycardia.
I. Evaluate chest movements: Are they symmetrical?
J. Evaluate anterior and posterior breath sounds.
K. Assess client for chest pain with dyspnea.
L. Notify physician of significant changes in respiratory function.
M. Remain with client experiencing acute dyspnea or hypoxic episodes.
N. Assess response to O
2 therapy.
O. Monitor ABGs and pulse oximetry.

**Pneumothorax**

Air in the pleural space results in the collapse or atelectasis of that portion of the lung. This condition is known as pneumothorax (Figure 15-3).

A. Tension pneumothorax: the development of a pneumothorax that allows excessive buildup of pressure (due to air that cannot escape) in the pleural space, causing a shift in the mediastinum toward the unaffected side.

**NURSING PRIORITY** A tension pneumothorax can very rapidly become an emergency situation. It is much easier to treat the client if the pneumothorax is identified before it begins to exert tension on the mediastinal area.

**FIGURE 15-3** Pneumothorax. (From Zerwekh J, Claborn J: Memory notebook of nursing, vol 2, ed 3, Ingram, Texas, 2007, Nursing Education Consultants.)
Assessment
A. Risk factors/etiology.
   1. Ruptured bleb (spontaneous).
   2. Thoracentesis.
   3. Infection.
   4. Trauma (penetrating or blunt chest injury).
B. Clinical manifestations.
   1. Diminished or absent breath sounds on the affected side.
   2. Dyspnea, hypoxia.
   3. Tachycardia, tachypnea.
   4. Sudden onset of persistent chest pain, pain on affected side when breathing.
   5. Increasing anxiety.
   6. Asymmetrical chest wall expansion.
   8. Possible development of a tension pneumothorax.
      a. Decreased cardiac filling, leading to decreased cardiac output.
      b. Tracheal shift from midline toward unaffected side.
      c. Increasing problems of hypoxia.
C. Diagnostics (see Appendix 15-1).

NURSING PRIORITY When atmospheric pressure is allowed to disrupt the negative pressure in the pleural space, it will cause the lung to collapse. This requires chest tube placement to reestablish negative pressure and reinflate the lung.

Treatment
Placement of chest tubes connected to a water-sealed drainage system (see Appendix 15-4).

Nursing Interventions
Goal: To recognize the problem and prevent a severe hypoxic episode (see Hypoxia, Nursing Interventions).
A. Begin O₂ therapy.
B. Place in semi–Fowler’s position.
C. Notify physician and prepare client for insertion of chest tubes.
Goal: To reinflate lung without complications.
A. Have client cough and deep-breathe every 2 hours.
B. Encourage exercise and ambulation.
C. Establish and maintain water-sealed chest drainage system (see Appendix 15-4).

Open Chest Wound
An open or “sucking” chest wound is frequently caused by a penetrating injury to the chest, such as a gunshot or knife wound. If a chest tube is inadvertently pulled out of the chest, a sucking chest wound may be created.

Assessment
A. Clinical manifestations.
   1. Increase in dyspnea.
   2. A chest wound with evidence of air moving in and out via the wound.
**Treatment**

A. Have the client take a deep breath, hold it, and bear down against a closed glottis. Apply a light occlusive, vented dressing (taped/secured on three sides to allow air to escape) over the wound.

**NURSING PRIORITY** Immediately occlude the chest wound; do not leave the client to go find a dressing. If necessary, place a towel or whatever is at hand over the wound to stop the flow of air.

B. Prepare for insertion of chest tubes to water-sealed drainage system.

C. After covering the wound with a light occlusive dressing, carefully evaluate the client for development of a tension pneumothorax.

**Nursing Interventions**

**Goal:** To prevent problems of hypoxia.

**Goal:** To assess for development of tension pneumothorax.

**Flail Chest**

Flail chest is the loss of stability of the chest wall with respiratory impairment as a result of multiple rib fractures (fractures at two or more points of the ribs involved).

**Assessment**

A. Clinical manifestations.
   1. Paradoxical respiration (Smith’s paradox): the movement of the fractured area (flailed segment) inward during inspiration and outward during expiration, or opposite to the other areas of the chest wall.
   2. Symptoms of hypoxia.

B. Diagnostics.
   1. Chest x-ray film showing multiple rib fractures.
   2. Crepitus of the ribs.

**Treatment**

A. Maintain patent airway.

B. Adequate pain medication to enable client to breathe deeply.

C. O$_2$.

D. Endotracheal intubation with mechanical ventilation for severe respiratory distress (see Appendixes 15-5 and 15-8).

E. Chest tube placement if pneumothorax occurs as a result of puncture of the lung by the fractured rib.

**ALERT** Determine changes in client’s respiratory status.

**Nursing Interventions**

**Goal:** To stabilize the chest wall and prevent complications.

A. Prepare client for endotracheal intubation and mechanical ventilation (see Appendixes 15-5 and 15-8).

B. Assess for symptoms of hypoxia.

C. Assess for symptoms of pneumothorax.

**Pulmonary Embolism**

A pulmonary embolism (PE) is an obstruction of a pulmonary artery, most often the result of an embolism caused by a blood clot (thrombus), air, fat, amniotic fluid, bone marrow, or sepsis. The severity of the problem depends on the size of the embolus.

A. Of the clients that die from PE, the majority die because of failure to diagnose.

B. The majority of pulmonary emboli arise from thrombi in the deep veins of the legs.

C. A pulmonary embolism must originate from the venous circulation, or the right side of the heart.

**Assessment**

A. Common risk factors/etiology.
   1. Conditions or immobility predisposing to venous stasis and/or deep vein thrombosis: surgery within the last 3 months, stroke, spinal cord injury, and history of deep vein thrombosis (DVT).
   3. DVT: the thrombus spontaneously dislodges secondary to jarring of the area—sudden standing, changes in rate of blood flow (Valsalva maneuver, increased BP).

B. Clinical manifestations.
   1. Classic triad of symptoms: dyspnea, chest pain, and hemoptysis occurs in only 20% of clients.
   2. Most common symptoms.
      a. Increased anxiety.
      b. Sudden, unexplained dyspnea.
      c. Tachypnea.
      d. Tachycardia.
   3. Hypotension and syncope.
   4. May result in sudden death if pulmonary embolism is large.

C. Diagnostics (see Appendix 15-1).
   1. Enhanced spiral computed tomography (CT) scan (specific for PE).
   2. D-dimer test is elevated (greater than 250 mcg/L).

**Treatment**

A. Bed rest, semi-Fowler’s position if BP permits.

B. Respiratory support: O$_2$, ventilator, etc.

C. Anticoagulants (heparin, low-molecular-weight heparin, or warfarin) to prevent further thrombus formation.

D. IV access for fluids and medications to maintain blood pressure.

E. Small doses of morphine sulfate may be used to decrease anxiety, alleviate chest pain, or improve tolerance to endotracheal tube.

F. Thrombolytics.

**ALERT** Assess clients for complications caused by immobility. Immobilized clients have an increased risk for development of a pulmonary embolism. Questions require an understanding of principles for prevention of thromboemboli and subsequent embolism formation. It is far easier to prevent the problem than it is to treat the pulmonary embolism.
**Nursing Interventions**

**Goal:** To identify clients at increased risk and prevent and/or decrease venous stasis (see Box 16-2).

**Goal:** To identify problem and implement nursing measures to alleviate hypoxia (see Hypoxia, Nursing Interventions).

**Goal:** To monitor client’s respiratory function and response to treatment.

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**Croup Syndromes**

The term *croup* describes a group of conditions characterized by edema and inflammation of the upper respiratory tract.

A. Acute epiglottitis: a severe infection of the epiglottis, characterized by rapid inflammation and edema of the area; generally occurs in children 2 to 7 years old; may rapidly cause airway obstruction.

1. Cause: most commonly *Haemophilus influenzae*.
2. Clinical manifestations: hypoxia (see Table 15-2).
   a. Rapid, abrupt onset.
   b. Sore throat, difficulty in swallowing.
   c. Inflamed epiglottis.
   d. Symptoms of increasing respiratory tract obstruction.
      1. Characteristic position: sitting with the neck hyperextended (sniffing position) and mouth open (tripod position), drooling.
      2. Inspiratory stridor (crowing).
      3. Suprasternal and substernal retractions.
      4. Increased restlessness and apprehension.
   e. High fever (above 102° F).

---

**NURSING PRIORITY** The absence of spontaneous cough and the presence of drooling and agitation are cardinal signs distinctive of epiglottitis.

3. Treatment.
   a. Endotracheal intubation for obstruction (see Appendix 15-5).
   b. Humidified oxygen.
   c. Antibiotics: IV and then PO.

B. Acute laryngotracheobronchitis (croup): inflammation of the larynx and trachea, most often in children under 5 years.

2. Slow onset, frequently preceded by upper respiratory tract infection.
3. Respiratory distress (see Table 15-2).
   a. Inspiratory stridor when disturbed, progressing to continuous stridor.
   b. Flaring of nares, use of accessory muscles of respiration.
   c. “Seal bark” cough is classic sign.
4. Low-grade fever (usually below 102° F).
5. Signs of impending obstruction.
   a. Retractions (intercostals, suprasternal, and substernal) at rest.
   b. Increased anxiety and restlessness.

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**Alert** Intervene when vital signs are abnormal; position client to prevent complications; interpret client data that need to be reported immediately.

6. Treatment.
   a. Maintain patent airway.
   b. Bronchodilators, racemic epinephrine (for moderate to severe croup) by inhalation.
   c. Cool mist humidification.
   d. No sedatives.
   e. Oxygen.
   f. Corticosteroids, administered intravenously, intramuscularly, or orally.

C. Acute spasmodic laryngitis: mildest form of croup; generally occurs in children 1 to 4 years old.

2. Clinical manifestations.
   a. Characterized by paroxysmal attacks.
   b. Characteristically occurs at night.
   c. Mild respiratory distress (see Table 15-2).
   d. No fever.
   e. After the attack, the child appears well.

3. Treatment.
   a. Child is generally cared for at home.
   c. Cool mist may decrease spasm.

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**Nursing Interventions**

**Goal:** To maintain patent airway in hospitalized child.

A. Tracheotomy set or endotracheal intubation equipment readily available.

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**NURSING PRIORITY** For a child with epiglottitis, do not examine the throat because it may precipitate an airway spasm (laryngospasm).

B. Suction endotracheal tube or tracheotomy only as necessary.

C. Position for comfort; do not force child to lie down.

D. If child is intubated, do not leave unattended.

E. If obstruction is impending, maintain ventilation with a bag-valve mask resuscitator until child can be intubated.

F. If transport is required, allow the child to sit upright in parent’s lap if possible.

**Goal:** To evaluate and maintain adequate ventilation.

A. Assess for increasing hypoxia.

B. Provide humidified O₂; closely evaluate because cyanosis is a late sign of hypoxia.

C. Conserve energy; prevent crying.

D. Monitor pulse oximetry for adequate oxygenation.

**Goal:** To maintain hydration and nutrition.

A. Do not give oral fluids until danger of aspiration is past.
**Goal:** To prevent transmission of organisms.
A. If hospitalized, the child should be placed in a private room, with contact precautions in place (Appendix 6-8).
B. Decrease number of health care personnel in client’s room.
C. Nurses assigned to care for these children should not be assigned the care of other children who are at high risk for respiratory tract infections.
D. Prophylaxis medication with palivizumab (Synagis) for high-risk infants.

**Home Care**
A. Decreased energy level; will tire easily.
B. Small frequent feedings.
C. Teach parents how to assess for respiratory difficulty.
D. Teach parents care implications if child is receiving prophylactic medications (see Appendix 15-2).

**Tonsillitis**
**Assessment**
A. Risk factors/etiology.
2. Increased severity in adults.
B. Clinical manifestations.
1. Edematous, enlarged tonsils; exudate on tonsils.
2. Difficulty swallowing and breathing.
3. Frequently precipitates otitis media.
4. Mouth breathing.
5. Persistent cough, fever.
C. Diagnostics: throat culture for group A beta-hemolytic streptococci (see Appendix 15-1).

**Treatment**
A. Antibiotic for identified organism.
B. Surgery: tonsillectomy for severe repeated episodes of tonsillitis.

**Nursing Interventions**
**Goal:** To promote comfort and healing in home environment.
A. Nonirritating soft or liquid diet.
B. Cool mist vaporizer to maintain moisture in mucous membranes.
C. Throat lozenges, warm gargles to soothe the throat.
D. Antibiotics: important to give child all of the medication prescribed in order to prevent reoccurrence.
E. Analgesics, antipyretic (acetaminophen).

**Bronchiolitis (Respiratory Syncytial Virus)**
Bronchiolitis is an inflammation of the bronchioles; alveoli are usually normal.
A. Respiratory syncytial virus (RSV) infection is most common in winter and spring (November to March), peaks in children 2-5 months old.
B. RSV is transmitted by direct contact with respiratory secretions (Appendix 6-8).
C. RSV is considered the single most important respiratory pathogen of infancy and early childhood.

**Assessment**
A. Cause: usually begins after an upper respiratory tract infection; incubation period of 5-8 days.
B. Reinfection is common; severity tends to decrease with age and repeated infections.
C. Clinical manifestations.
   1. Initial.
      a. Rhinorrhea and low-grade fever commonly occur first.
      b. Coughing, wheezing.
   2. Acute phase.
      a. Lethargic.
      b. Tachypnea, air hunger, retractions.
      c. Increased wheezing and coughing.
      d. Periods of apnea, poor air exchange.
D. Diagnostics: nasal secretions for RSV antigens.

**Treatment**
A. Rest, fluids, and high-humidity environment.
B. **O₂**.
C. Prevention – medication (see Appendix 15-2).

**Nursing Interventions**
**Goal:** To promote effective breathing patterns.
A. Frequent assessment for development of hypoxia (see Table 15-2); close monitoring of **O₂** saturation (oximetry) levels.
B. Increase in respiratory rate and audible crackles in the lungs are indications of cardiac failure and should be reported immediately.
C. Maintain airway via position and removal of secretions.
D. Maintain adequate hydration to facilitate removal of respiratory secretions.
E. Conserve energy; avoid unnecessary procedures, but encourage parents to console and cuddle infant.

**Home Care**
A. Teach parents to recognize symptoms of increasing respiratory problems and when to notify physician.
B. Cool mist may assist to decrease edema and/or spasms of airway.
C. Maintain adequate fluid intake.
D. Immunization with **H. Influenza** type B vaccine.

**Goal:** To promote effective breathing patterns.
A. Frequent assessment for development of hypoxia (see Table 15-2); close monitoring of **O₂** saturation (oximetry) levels.
**Goal:** To provide preoperative nursing measures if surgery is indicated (see Chapter 3).

**Goal:** To maintain patent airway and evaluate for bleeding after tonsillectomy.

A. No fluids until child is fully awake; then cool, clear liquids initially. Avoid brown- or red-colored fluids and milk products.

B. Position child on side or abdomen to facilitate drainage until fully awake; when awake and alert, child may assume position of comfort but needs to remain in bed for the day.

C. Evaluate for frequent or continuous swallowing caused by bleeding; check throat with flashlight for bleeding.

D. Have nasopharyngeal suction equipment available.

E. Monitor for tachycardia, pallor, and increasing restlessness.

F. Apply ice collar to decrease edema.

G. Give oral codeine or acetaminophen for pain; aspirin is contraindicated.

H. Discourage coughing.

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**Etiology.**

1. **Viral:** influenza, parainfluenza, RSV (primarily infants and young children).

2. **Bacterial:** Streptococcus pneumoniae, Mycoplasma pneumoniae, Staphylococcus aureus.

3. **Fungal** (increased risk in immunocompromised clients).

**Clinical manifestations.**

1. Fever, chills.

2. Tachycardia.

3. Tachypnea, dyspnea.


7. Respiratory distress (hypoxia) (see Table 15-2).

8. Diminished breath sounds, wheezing, crackles, tactile fremitus, dullness to percussion.

9. **Pediatrics.**

   a. Feeding difficulty in infants.

   b. Cough nonproductive initially.

   c. Moderate to high fever.

   d. Adventitious breath sounds.

   e. Tachypnea.

   f. Retractions, nasal flaring

---

**Home Care**

A. Child will have sore throat for several days; discourage coughing and excessive activity.

B. Symptoms of bleeding are especially significant on the 5th to 10th postoperative days, when tissue sloughing may occur as a result of healing and/or infection.

C. Maintain adequate hydration; encourage intake of soft foods and nonirritating fluids.

D. A gray membrane on the sides of the throat is normal; should disappear in 1 to 2 weeks.

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**Pneumonia**

Pneumonia is an acute inflammatory process caused by a microbial agent; it involves the lung parenchyma, including the small airways and alveoli.

**Assessment**

A. Predisposing conditions.

1. Chronic upper respiratory tract infection.

2. Prolonged immobility.

3. Smoking.

4. Decreased immunity (disease and/or age).

5. Aspiration of foreign material or gastric contents.


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**Treatment**

A. Antibiotic according to organism identified (see Appendix 6-9).

**ALERT** Administration of medications: do not start antibiotics until a good sputum specimen has been collected. An accurate culture and sensitivity test cannot be done if client has already begun receiving antibiotics.

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**OLDER ADULT PRIORITY** An older adult client may initially present with mental confusion and volume depletion rather than respiratory symptoms and fever.

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**ALERT** Administration of medications: do not start antibiotics until a good sputum specimen has been collected. An accurate culture and sensitivity test cannot be done if client has already begun receiving antibiotics.

B. Respiratory precautions: transmitted via airborne droplets (see Appendix 6-8).

C. Inhalation therapy.

1. Cool O₂ mist.

2. Postural drainage.


D. Chest physical therapy.

**Nursing Interventions**

**Goal:** To prevent occurrence.

A. Encourage mobility and ambulation if possible.

B. Good respiratory hygiene; turn, cough, and deep-breathe.

C. Identify high-risk clients.

D. Encourage pneumococcal vaccine.
**Goal:** To decrease infection and remove secretions to facilitate O₂ and CO₂ exchange.

A. Antibiotics.
B. Have client turn, cough, and deep-breathe.
C. Liquefy secretions.
   1. Adequate hydration (administer PO fluids cautiously to prevent aspiration).
   2. Cool mist inhalation.
D. Evaluate breath sounds and changes in sputum.
E. Position for comfort or place in semi-Fowler’s position.
F. Nursing measures to prevent and evaluate levels of hypoxia (see Hypoxia, Nursing Interventions; also see Table 15-2).
G. Provide adequate pain control measures to facilitate coughing and deep breathing.

**Goal:** To teach client and family how to provide home care when appropriate.

A. Antibiotics.
B. Cool mist humidification.
C. Maintain high oral fluid intake.
D. Antipyretic: acetaminophen.
E. Frequent changes of position.
F. Understand symptoms of increasing respiratory problems and when to notify physician.

### Tuberculosis

TB is a reportable communicable disease that is characterized by pulmonary manifestations.

**Characteristics.**

1. Organism is primarily transmitted through respiratory droplets; it is inhaled and implants on respiratory bronchioles or alveoli; predominately spread by repeated close contact.
2. Latent TB infection (LTBI): a client in good health is frequently able to resist the primary infection and does not have active disease; these clients will continue to harbor the TB organism.
3. The primary site or tubercle may undergo a process of degeneration or caseation; this area can erode into the bronchial tree, and TB organisms are active and present in the sputum, resulting in further spread of the disease.
4. The area may never erode but may calcify and remain dormant after the primary infection. However, the tubercle may contain living organisms that can be reactivated several years later.
5. The majority of people with a primary infection will harbor the TB bacilli in a tubercle in the lungs and will not exhibit any symptoms of an active infection.
6. May occur as an opportunistic infection in clients who are immunocompromised.

### Assessment

**Predisposing conditions.**

1. Frequent close or prolonged contact with infected individual.
2. Debilitating conditions and diseases.
3. Poor nutrition and crowded living conditions.
4. Increasing age.
B. Cause: Mycobacterium tuberculosis, a gram-positive, acid-fast bacillus.
C. Clinical manifestations (up to 20% of clients may be asymptomatic).
   1. Fatigue, malaise.
   2. Anorexia, weight loss.
   3. May have a chronic cough that progresses to more frequent and productive cough.
   4. Low-grade fever and night sweats.
   5. Hemoptysis is associated only with advanced condition.
   6. May present with acute symptoms.
   7. Clients with LTBI will have a positive skin test, but they are asymptomatic.
D. Diagnostics (see Appendix 15-1).

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**NURSING PRIORITY** A positive reaction to a TB skin test means that the person has at some time been infected with the TB bacillus and developed antibodies. It does not mean that the person has an active TB infection.

1. Quantiferon-TB (QFT) rapid diagnostic: blood test to identify presence of antigens; does not take the place of sputum smears and cultures.
2. Bacteriologic studies to identify acid-fast bacilli in the sputum (see Appendix 15-1).

**Complications.**

1. Pleural effusion.
2. Pneumonia.
3. Other organ involvement.

### Treatment

**Chemotherapy** (see Appendix 15-2).

1. Medical regimen involves simultaneous administration of two or more medications; this increases the therapeutic effect of medication and decreases development of resistant bacteria.
2. Sputum cultures are evaluated every 2-4 weeks initially; then monthly after sputum is negative. Sputum cultures should be negative within several weeks of beginning therapy, this depends on the medication regimen and the resistance of the bacteria.
3. Direct observed therapy (DOT): health care personnel provide the medications and observe that client swallows medication; preferred strategy for all clients.
4. Prophylaxis chemotherapy for LTBI.
   a. Close contact with a client with a new diagnosis of TB.
   b. Newly infected client with positive skin test reaction.
   c. Client with positive skin test reaction with conditions that decrease immune response (HIV infection, steroid therapy, chemotherapy).
   d. Isoniazid (INH) most often used for prophylaxis.

**Most often treated on an outpatient basis.**
**Nursing Interventions**

**Goal:** To understand implications of the disease and measures to protect others and maintain own health.

A. Evaluate client’s lifestyle and identify needs regarding compliance with treatment and long-term therapy.

B. Identify community resources available for client.

**ALERT** Identify community/home services that would facilitate a client’s independent living; evaluate client’s support system.

C. Understand medication schedule and importance of maintaining medication regimen.

1. Noncompliance is a major contributor to the development of multidrug resistance and treatment failure.
2. DOT recommended to guarantee compliance; may require client to come to public health clinic for nurse to administer medication.

**ALERT** Evaluate client’s compliance and/or ability to comply with prescribed therapy.

D. Return for sputum checks every 2 to 4 weeks during therapy.

E. Balanced diet and good nutritional status.

F. Avoid excessive fatigue; endurance will increase with treatment.

G. Identify family and close contacts who need to report to the public health department for TB screening.

H. Offer client HIV testing.

**Goal:** To prevent transmission of the disease.

A. When sputum is positive for the organism, implement airborne precautions for hospitalized client (see Appendix 6-8).

B. Home care: teach respiratory precautions.

1. Cover mouth and nose when sneezing or coughing.
2. Practice careful handwashing routine.
3. Wear a mask when in contact with other people.
4. Discard all secretions (nose and mouth) in plastic bags.
5. Reevaluate periodically for active disease or secondary infection.

**NURSING PRIORITY** TB is most likely to be spread by clients who have active, undiagnosed TB.

**Chronic Obstructive Pulmonary Disease**

Also called chronic airflow limitation, chronic obstructive pulmonary disease (COPD) is a group of chronic respiratory disorders characterized by obstruction of airflow.

A. Although each of the disorders (chronic bronchitis, emphysema, and asthma) may occur individually, it is more common for two or more problems to coexist and the symptoms to overlap (most commonly bronchitis and emphysema).

B. Clinical manifestations common to chronic airflow limitation (Figure 15–4).

1. Distended neck veins, ankle edema.
2. Orthopnea or tripod positioning, barrel chest.
3. Prolonged expiratory time, pursed-lip breathing.
4. Diminished breath sounds.
5. Thorax is hyperresonant to percussion.
6. Exertional dyspnea progressing to dyspnea at rest.
7. Increased respiratory rate.

C. As a result of a prolonged increase in Paco2 levels, the normal respiratory center in the medulla is affected; when this occurs, hypoxia will become the primary respiratory stimulus.

D. Emphysema: primarily a problem with the alveoli characterized by a loss of alveolar elasticity, overdistention, and destruction, with severe impairment of gas exchange across the alveolar membrane.

1. Clinical manifestations of emphysema.
   a. Cough is not common.
   b. Sensation of air hunger.
   c. Use of accessory muscles of respiration.
   d. Anorexia with weight loss, thin in appearance.
   e. In general, no cardiac enlargement; cor pulmonale occurs late in disease; decreased PaO2 with activity.
   f. ABGs are often normal until late in disease.
   g. Characteristic tripod position—leaning forward with arms braced on knees.

E. Chronic bronchitis: primarily a problem of the airway characterized by excessive mucus production and impaired ciliary function, which decreases mucus clearance. Client may develop polycythemia as a result of the low PaO2. History of productive cough lasting 3 months for 2 consecutive years.

1. Clinical manifestations of chronic bronchitis.
   a. Excessive, chronic sputum production (generally not discolored unless infection is present).
b. Impaired ventilation, resulting in decreased Pao₂ and symptoms of hypoxia; increased Paco₂ (CO₂ narcosis).
c. Respiratory symptoms: productive cough, exercise intolerance, wheezing, and shortness of breath, progressing to cyanosis.
d. Dependent edema.
e. Generally normal weight or overweight.
f. Cardiac enlargement with cor pulmonale.

**Assessment**

A. Risk factors/etiology.
   1. Cigarette smoking (including passive smoking)—most common cause.
   2. Chronic infections.
   3. Inhaled irritants (from occupational exposure and air pollution).
   4. Alpha₁-antitrypsin deficiency: enzyme deficiency leading to COPD at an early age.
   5. Aging: changes in thoracic cage and respiratory muscles and loss of elastic recoil.

B. Diagnostics: see Appendix 15-1.
   1. Pulmonary function studies show increased residual volume (air trapping).
   2. ABGs (see Table 15-1).
      a. Changes in Paco₂: most often increased in bronchitis.
      b. Low Pao₂ more prominent in clients with bronchitis.
      c. Decompensated condition: decreased Pao₂, increased Paco₂, decreased pH—respiratory acidosis with hypoxia.

C. Complications.
   1. Cor pulmonale (right-side heart failure).
   2. Infections (pneumonia).
   3. Peptic ulcer and gastroesophageal reflux (GERD; see Chapter 18).

**Treatment**

A. Prevention or treatment of respiratory tract infections.
B. Bronchodilators (see Appendix 15-2).
C. Mucolytics and expectorants (see Appendix 15-2).
D. Chest physiotherapy (suctioning, percussion, and postural drainage).
E. Breathing exercises.
F. Exercise to maintain cardiovascular fitness; most common exercise is walking.
G. Low-flow humidified O₂.
H. Corticosteroids (see Appendix 6-7).

**Nursing Interventions**

**Goal:** To improve ventilation.
A. Teach pursed-lip breathing: inhale through the nose and exhale against pursed lips.
B. Avoid activities increasing dyspnea.
C. Humidified O₂ (low flow via nasal cannula at a rate of 1 to 3 L/min) should be used when clients are experiencing exertional or resting hypoxemia.
   1. Monitor for hypercapnia, hypoxia, and acidosis.
   2. A significant increase in Pao₂ may decrease respiratory drive (O₂ toxicity).
   3. Administer O₂ via nasal cannula or Venturi mask (to deliver a more precise FiO₂).
   4. Assess for pressure ulcers on the top of the client’s ears where the elastic holds the mask.

**NURSING PRIORITY** Administer O₂ therapy and evaluate results; the risk for inducing hypoventilation should not prevent the administration of O₂ at low levels to the client with COPD who is experiencing respiratory distress.

D. Assess breath sounds before and after coughing.
E. Avoid cough suppressants.
F. Place client in high-Fowler’s or sitting position.
G. Maintain adequate hydration to facilitate removal of secretions.

**NURSING PRIORITY** The optimum amount of O₂ is the concentration that reverses the hypoxemia without causing adverse effects.

**Goal:** To improve activity tolerance.
A. Balance activities and dyspnea: gradually increase activities; use portable O₂ tank when walking; avoid respiratory irritants.
B. Encourage pursed-lip and diaphragmatic breathing during exercise.
C. Schedule activities after respiratory therapy.
D. Assess for negative responses to activity.

**Goal:** To maintain adequate nutrition.
A. Soft, high-protein, high-calorie diet—especially for underweight clients with emphysema.
B. Postural drainage completed 30 minutes before meals or 3 hours after meals.
C. Good oral hygiene after postural drainage.
D. Small frequent meals; rest before and after meals.
E. Use a bronchodilator before meals.
F. Encourage 3000 mL fluid daily unless contraindicated.

**Home Care**

A. Encourage client and family to verbalize feelings about condition and lifelong restriction of activities.
B. Client teaching.
   1. Include client in active planning for home care.
   2. Instruct client regarding community resources.
   3. Instruct client regarding medication schedule and side effects of prescribed medications.
Asthma is an intermittent, reversible obstructive airway problem. It is characterized by exacerbations and remissions. Between attacks the client is generally asymptomatic. It is a common disorder of childhood but may also cause problems throughout adult life.

A. A chronic inflammatory process producing bronchial wall edema and inflammation, increased mucus secretion, and smooth muscle contraction.

B. Intermittent narrowing of the airway is caused by:
   1. Constriction of the smooth muscles of the bronchi and the bronchioles (bronchospasm).
   2. Excessive mucus production.
   3. Mucosal edema of the respiratory tract.

C. Constriction of the smooth muscle causes significant increase in airway resistance, thereby trapping air in the lungs.

D. Emotional factors are known to play an important role in precipitating childhood asthma attacks.

E. Exercise-induced asthma: initially after exercise there is an improvement in the respiratory status, followed by a significant decline; occurs in the majority of clients; may be worse in cold, dry air and better in warm, moist air.

Assessment

A. Risk factors/etiology.
   1. Hypersensitivity (allergens) and airway inflammation.
   2. Exercise.
   3. Air pollutants and occupational factors.
   4. Pediatric implications.
      a. Reactive airway disease is the term used to describe asthma in children.
      b. General onset before age 3 years.
      c. Children are more likely to have airway obstruction.

B. Diagnostics (see Appendix 15-1).
   2. Increased serum eosinophil count.

C. Clinical manifestations: early-phase reactions occur immediately and last about an hour; late-phase reactions do not begin until 4 to 8 hours after exposure and may last for hours or as long as 2 days, attacks may begin gradually or abruptly.

D. Complications: status asthmaticus is severe asthma unresponsive to initial or conventional treatment.

Treatment

A. Medications (see Appendix 15-2).
   1. Beta2-adrenergic agonists (short-acting and long-acting) administered by nebulizer or metered-dose inhaler.
   2. Antibiotics, if infection is present.
   4. Expectorants.
   5. Inhaled steroids and antiinflammatory drugs to prevent and/or decrease edema.
   6. Supplemental O2 to maintain SaO2 at 90%.

B. Status asthmaticus.
   1. Oxygen.
   2. IV fluids for hydration.
   3. May require intubation and mechanical ventilation (Appendix 15-5).
   4. IV bronchodilators and steroids.

C. Medications to avoid for the client with asthma.
   1. Beta-adrenergic blockers.
   2. Cough suppressants.

Nursing Interventions

See Hypoxia, Nursing Interventions.

Goal: To relieve asthma attacks.

A. Position for comfort: usually high-Fowler’s position or tripod position.

B. Close monitoring of response to O2 therapy: SaO2 levels and changes in respiratory status.

C. Assess response to bronchodilators and aerosol therapy.

D. Carefully monitor ability to take PO fluids; risk for aspiration is increased.

E. Observe for sudden increase or decrease in restlessness, either may indicate an abrupt decrease in oxygenation.

NURSING PRIORITY Determine changes in a client’s respiratory status: the inability to hear wheezing breath sounds in the asthmatic client with acute respiratory distress may be an indication of impending respiratory obstruction.
**Home Care**

A. Assess emotional factors precipitating asthma attacks.
B. Educate client and family regarding identifying and avoiding allergens.
C. Implement therapeutic measures before attack becomes severe.
D. Explain purposes of prescribed medications and how to use them correctly (see Appendix 15-2).
E. Administer bronchodilators before performing postural drainage.
F. Use bronchodilators and warm up before exercise to prevent exercise-induced asthma.
G. Encourage participation in activities according to developmental level.

**Cystic Fibrosis**

Cystic fibrosis is a chromosomal abnormality characterized by a generalized dysfunction of the exocrine glands. The disease primarily affects the lungs, pancreas, and sweat glands.

A. The factor responsible for the multiple clinical manifestations of the disease process is the mechanical obstruction caused by thick mucus secretions.
B. Effects of disease process:
   1. Pulmonary system: bronchial and bronchiolar obstruction by thick mucus, causing atelectasis and reduced area for gas exchange; the thick mucus provides an excellent medium for bacterial growth and secondary respiratory tract infections.
   2. Pancreas: decreased absorption of nutrients caused by the obstruction of pancreatic ducts and lack of adequate enzymes for digestion.

**Assessment**

A. Risk factors/etiology.
   1. Inherited as an autosomal recessive trait.
   2. Most common in Caucasians.
B. Clinical manifestations.
   1. Wide variation in severity and extent of manifestations, as well as period of onset.
   2. Gastrointestinal tract.
      a. May present with meconium ileus in the newborn.
      b. Increased bulk in feces from undigested foods.
      c. Increased fat in stools (steatorrhea); foul-smelling.
      d. Decreased absorption of nutrients: weight loss or failure to thrive.
      e. Increased appetite caused by decreased absorption of nutrients.
      f. Abdominal distention.
      g. Rectal prolapse related to the large bulky stools and loss of supportive tissue around rectum.
   3. Genital tract.
      a. In females the increased viscosity of cervical mucus may lead to decreased fertility due to blockage of sperm.
      b. Males are generally sterile because of blockage or obstruction of the vas deferens.
4. Respiratory tract.
   a. Evidence of respiratory tract involvement generally occurs in early childhood.
   b. Increasing dyspnea, tachypnea.
   c. Paroxysmal, chronic cough.
   d. Pulmonary inflammation: chronic bronchiolitis and bronchitis.
   e. Symptoms of chronic hypoxia: clubbing, barrel chest.
   f. Mucus provides excellent medium for bacteria growth and chronic infections.
5. Excessive salt on the skin: "salty taste when kissed."

C. Diagnostics (see Appendix 15-1).
   1. Sweat chloride test: normal chloride concentration range is less than 40 mEq/L; chloride concentration 40-60 mEq/L is suggestive of a diagnosis of cystic fibrosis.
   2. Pancreatic enzymes: decrease or absence of trypsin and chymotrypsin.
   3. Fat absorption in intestines is impaired.

D. Complications.
   1. Frequent pulmonary infections.
   2. Pneumothorax.
   3. Diabetes secondary to destruction of pancreatic tissue.
   4. Cor pulmonale and respiratory failure are late complications.

**Treatment**

Child is usually cared for at home unless complications are present.

A. Diet: high-calorie, high-protein, fats as tolerated; or decrease in fats, increased salt intake.
B. Fat-soluble vitamins A, D, E, and K in water-soluble forms.
C. Pancreatic enzyme replacement with meals (see Appendix 13-2).
D. Pulmonary therapy.
   1. Physical therapy: postural drainage, breathing exercises.
   2. Aerosol therapy and chest physical therapy (CPT).
   3. Percussion and vibration.
   4. Expectorants (see Appendix 15-2).
E. Antibiotics are given prophylactically and when there is evidence of infection.

**Nursing Interventions**

**Goal:** To promote optimum home care for child (see Chapter 3 for care of chronically ill child).

A. Identify community resources for family.
B. Assist family to identify problems and solutions congruent with their lifestyle.
C. Encourage verbalization regarding impact of child’s problem on the family and the family’s ability to cope with the child at home.
D. When appropriate, teach child about disease and treatment and encourage active participation in planning of care.
E. Assist parents to identify activities to promote normal growth and development.

**Goal:** To maintain nutrition.
A. Minimum restriction of fats; need to increase intake of pancreatic enzyme with increased fat intake.
B. Pancreatic enzymes with meals and snacks.
C. Vitamins A, D, E, and K in water-soluble form.
D. Good oral hygiene after postural drainage.
E. Postural drainage 1 to 2 hours before meals.

**Goal:** To prevent or minimize pulmonary complications.
A. Assist child to mobilize secretions.
   1. CPT: postural drainage, breathing exercises, nebulization treatments.
   2. Encourage active exercises appropriate to child’s capacity and developmental level.
B. Prevent respiratory tract infections.
C. Prevent pneumothorax: no power lifting, intensive isometric exercises, scuba diving.

**Acute Respiratory Distress Syndrome (Adult Respiratory Distress Syndrome)**

Acute respiratory distress syndrome (ARDS) or noncardiogenic pulmonary edema, also referred to as shock lung and white lung, is a condition characterized by increased capillary permeability in the alveolar capillary membrane, resulting in fluid leaking into the interstitial spaces and the alveoli and a decrease in pulmonary compliance.

**Assessment**
A. Risk factors/etiology.
   1. Clients with multiple risk factors are more likely to develop ARDS.
   2. Risk factors.
      b. Indirect lung injury: sepsis (most common), severe massive trauma, acute pancreatitis anaphylaxis, shock.
B. Clinical manifestations.
   1. Tachypnea and dyspnea.
   2. Increasing hypoxia not responding to increased levels of fraction of inspired O₂ (FiO₂) (see Table 15-2).
   3. Refractory hypoxemia.
   4. Tachycardia, adventitious lung sounds.
   5. Profound respiratory distress.
C. Diagnostics: see Appendix 15-1.

**NURSING PRIORITY** It is essential to closely monitor the ABGs in a client with ARDS. A decreasing PaO₂ and increasing difficulty breathing are indications that the client’s condition is deteriorating.

**Treatment**
Care is generally provided in an intensive care setting.
A. Maintain oxygenation.
   1. Oxygen in high levels of concentration.
   2. Endotracheal intubation and mechanical ventilation.
   3. Positive end-expiratory pressure (PEEP): used to decrease the effects of shunting and to improve pulmonary compliance.
B. Hemodynamic pressure monitoring for evidence of cardiac failure. (Appendix 17-5).
C. Treatment of underlying condition.
D. Nutritional support: requires increased calories to meet metabolic demand.

**Nursing Interventions**

**Goal:** To maintain airway patency and improve ventilation.
A. Frequent assessment for increasing respiratory difficulty; anticipate intubation or tracheotomy (see Appendix 15-5).
B. Endotracheal tube or tracheotomy suctioning.
C. Evaluate ABG reports, constant monitoring of SaO₂.
D. Sedate as necessary for client to tolerate the ventilator (see Appendix 15-8).
E. Monitor hemoglobin levels and PaO₂ saturation levels.

**Goal:** To maintain fluid balance.
A. Fluid balance maintained with IV hydration.
B. Evaluate serum electrolyte levels.
C. Strict intake and output, daily weights.

**Goal:** To assess and maintain cardiac output.
A. Assess for dysrhythmias – especially tachy dysrhythmias.
B. Correlate vital signs with other assessment changes.
C. Evaluate cardiac output in relation to fluid intake.
D. Evaluate cardiac output when PEEP is initiated because it will compromise venous return (decreased preload).

**Goal:** To provide emotional support to client and family.
A. Careful repeated explanation of procedures to client and to family.
B. Calm, gentle approach to decrease anxiety.
C. Be available to family at visiting times to explain procedures and equipment.
D. If endotracheal tube or tracheotomy is in place, explain to family and client that speech is only temporarily interrupted.
E. Assist client to maintain communication.
Pulmonary Edema

Pulmonary edema or acute decompensated heart failure (ADHF) is caused by an abnormal accumulation of fluid in the lung, in both the interstitial and alveolar spaces.

A. Origin is most often cardiac: pulmonary congestion occurs when the pulmonary vascular bed receives more blood from the right side of the heart (venous return) than the left side of the heart (cardiac output) can accommodate.
B. Pulmonary edema results from severe impairment in the ability of the left side of the heart to maintain cardiac output, thereby causing an engorgement of the pulmonary vascular bed.

Assessment

A. Risk factors/etiology.
1. Alteration in capillary permeability (inhaled toxins, pneumonia, severe hypoxia).
2. Cardiac myopathy, cardiac failure.
3. Overhydration.
B. Clinical manifestations: hypoxia (see Table 15-2).
1. Decreasing PaO₂.
2. Sudden onset of dyspnea and tachypnea.
3. Severe anxiety, restlessness, irritability.
4. Cool, moist skin.
5. Tachycardia (S₁, S₂ gallop)
6. Severe coughing productive of frothy, blood-tinged sputum.
7. Noisy, wet breath sounds that do not clear with coughing.
8. Dependent edema.

Older Adult Priority Pulmonary edema can occur very rapidly and become a medical emergency.

C. Diagnostics: BNP (B-type natriuretic peptide) levels measured to assess for heart failure (less than 100 pg/mL rules out HF).

Treatment

Condition demands immediate attention; medications are administered intravenously.

A. O₂.
1. O₂ in high concentration.
2. Intubation and mechanical ventilation.
3. Use of bilevel positive airway pressure (BiPAP).
B. Sedation (morphine) or muscle paralyzing agents to allow controlled ventilation: decreases preload/vasoconstriction, as well as decreasing anxiety and pain.
C. Diuretics to reduce the cardiac preload.
D. Dopamine/dobutamine to facilitate myocardial contractility.
E. Medications to increase cardiac contractility and cardiac output (see Appendix 15-2).
F. Vasodilators to decrease afterload.

Nursing Interventions

Goal: To assess and decrease hypoxia (see Hypoxia, Nursing Interventions; also Table 15-2).
Goal: To improve ventilation (Appendixes 15-5, 15-6, 15-7, and 15-8).
A. Place in high-Fowler’s position with legs dependent.
B. Administer high levels of O₂.
C. Evaluate level of hypoxia and dyspnea; may need endotracheal tube intubation and mechanical ventilation.
D. Problem may occur at night, especially in clients who are on bed rest.
E. IV sedatives/narcotics.
1. To decrease anxiety and dyspnea and to decrease pressure in pulmonary capillary bed.
2. Closely observe for respiratory depression.
3. Administer a sedative to decrease anxiety if client has received a muscle paralyzing agent.
4. May be used to assist client to tolerate ventilator.

Older Adult Priority Pulmonary edema is one of the few circumstances in which a client with respiratory distress may be given a narcotic. The fear of not being able to breathe is so strong that the client cannot cooperate. When a sedative/narcotic is administered, the nurse must be ready to support ventilation if respirations become severely depressed.

F. Administer bronchodilators and evaluate client’s response and common side effects.
G. Closely monitor vital signs, pulse oximetry, hemodynamic changes, and cardiac dysrhythmias.
Goal: To reduce circulating volume (preload) and cardiac workload (afterload).
A. Diuretics (see Appendix 16-6).
B. Medications to decrease afterload and increase cardiac output (see Appendix 17-2).
C. Carefully monitor all IV fluids and evaluate tolerance of hydration status.
D. Maintain client in semi- to high Fowler’s position, but allow legs to remain dependent.
Goal: To provide psychologic support and decrease anxiety.
A. Approach client in a calm manner.
B. Explain procedures.
C. Administer sedatives cautiously.
D. Remain with client in acute respiratory distress.
Goal: To prevent recurrence of problem.
A. Recognize early stages.
B. Maintain client in semi-Fowler’s position.
C. Decrease levels of activity.
D. Use extreme caution in administration of fluids and transfusions.

Cancer of the Upper Airway

Oral/pharyngeal cancer is uncontrollable growth of malignant cells that invade and cause damage to areas around the mouth, including the lips, cheeks, gums, tongue, soft and hard palate, the floor of the mouth, tonsils, sinuses, and even the pharynx.
Cancer of the larynx may involve the vocal cords or other areas of the larynx. The majority of lesions are squamous cell carcinomas. If detected early, this type of cancer is curable by surgical resection of the lesion (see Chapter 8).

**Assessment**

A. Risk factors/etiology.
   1. More common in older adult men.
   2. History of tobacco use.

B. Clinical manifestations of oral cancer.
   1. Leukoplakia: whitish or red patch on oral mucosa or tongue (premalignant lesion).
   2. Erythroplasia (erythroplakia): a red velvety patch on the mouth or tongue (premalignant lesion).
   3. A sore in the mouth that bleeds and does not heal.
   4. A lump or thickening in the cheek.
   5. Difficulty chewing or swallowing.

C. Clinical manifestations of laryngeal cancer (may be asymptomatic).
   1. Early changes.
      a. Voice changes, hoarseness.
      b. Persistent unilateral sore throat, difficulty swallowing.
      c. Feeling of foreign body in throat.
      d. Oral leukoplakia.
   2. Late changes.
      a. Pain.
      b. Dysphagia and decreased tongue mobility.
      c. Airway compromise.

D. Diagnostics: direct laryngoscopic examination with biopsy.

**Treatment**

Varies with the extent of the malignancy.

A. Radiation: brachytherapy—placing a radioactive source into or near the area of the tumor; may also be used with external radiation treatments (see Chapter 8).

B. Surgical intervention.
   1. Partial laryngectomy: preserves the normal airway and normal speech mechanism; if a tracheotomy is performed, it is removed after the risk for swelling and airway obstruction has subsided.
   2. Radical neck dissection or total laryngectomy, involves resection of the trachea, a permanent tracheotomy for breathing, and an alternative method of speaking (Figure 15-5).
   3. Depending on location of oral lesions, a glossectomy (removal of the tongue) and/or mandibulectomy (removal of mandible) may be performed; cancers of the oral cavity metastasize early to cervical lymph nodes.

**Complications**

A. Airway obstruction.
B. Hemorrhage.
C. Fistula formation.

**Nursing Interventions**

**Goal:** To prevent oral and laryngeal cancer.

A. Avoid chemical, physical, or thermal trauma to the mouth.

B. Maintain good oral hygiene: regular brushing and flossing.

C. Prevent constant irritation in the mouth; repair dentures or other dental problems.

D. See a doctor for any oral lesion that does not heal in 2 to 3 weeks.

**Goal:** To prepare client for surgery.

A. General preoperative preparation (see Chapter 3).

B. Consult with surgeon as to the anticipated extent of the surgery, determine how airway and nutritional needs will be addressed.
C. Discuss with client the possibility of a temporary tracheotomy or, if anticipated, a permanent tracheotomy.
D. Encourage ventilation of feelings regarding a temporary or permanent loss of voice after surgery, as well as alteration in physical appearance.
E. If total laryngectomy is anticipated, schedule a visit from the speech pathologist or member of the laryngectomy club to reassure client of rehabilitation potential.
F. Establish a method of communication for immediate postoperative period.
G. Discuss nutritional considerations after surgery.

**Goal:** To maintain patent airway after laryngectomy.

A. If tracheotomy is not performed, evaluate for hematoma and increasing edema of the incisional area precipitating respiratory distress.
B. Place in semi-Fowler’s position.
C. Administer humidified O₂ therapy.
D. Closely monitor for respiratory compromise (hypoxia).
E. Monitor vital signs for hemorrhage.
F. Avoid analgesics that depress respiration.
G. Promote good pulmonary hygiene.
H. If tracheostomy is present, suction as indicated (see Appendix 15-6).

**Goal:** To maintain airway; to prevent complications after tracheotomy (see Appendix 15-5).

**Goal:** To promote nutrition postoperatively.

A. Method of nutritional intake depends on the extent of the surgical procedure (see Appendix 18-9 for tube feedings).
B. IV fluids for first 24 hours.
C. Gastrostomy, nasogastric, or nasointestinal tubes may be placed during surgery and used until edema has subsided.
D. Provide good oral hygiene; may need to suction oral cavity if client cannot swallow.
E. Evaluate tolerance of tube feedings; treat nausea quickly to prevent vomiting (see Appendix 18-9).
F. Closely observe for swallowing difficulty with initial oral feedings.
   2. Thicker foods allow more control over swallowing, thin watery fluids should be avoided.
G. For a partial laryngectomy, the possibility of aspiration is a primary concern during the first few days after surgery.

**Alert** Identify clients at high risk for aspiration.

**Goal:** To promote wound healing.

A. Assess pressure dressings and presence of edema formation.
B. Monitor wound suction devices (Hemovac, Jackson-Pratt), drainage should be serosanguineous.
C. Monitor patency of drainage tubes every 3–4 hours, fluid should gradually decrease.
D. If skin flaps were used, the wound is often left uncovered for better visualization of flap and to prevent pressure on area.
E. When drainage tubes are removed, carefully observe area for increased swelling.
F. Type of oral hygiene is indicated by the extent of the procedure.
   1. Mouth irrigations.
   2. Soothing mouth rinses (cool normal saline or nonirritating antiseptic solutions).
   3. If dentures are present, clean mouth well before replacing.
   4. Oral hygiene before and after oral intake.
   5. Avoid using stiff toothbrushes and metal-tipped suction catheters.

**Goal:** To identify resources for speech rehabilitation after laryngectomy.

A. If a partial laryngectomy was done, client should have gradual improvement in voice; client is generally allowed to begin whispering 2 to 3 days after surgery.
B. Follow-up visit from laryngectomy club member.
C. Arrange counseling with speech pathologist.
D. Identify different methods for speech management: esophageal speech, electric/artificial larynx, or tracheoesophageal puncture (closest to normal speech).

**Home Care**

A. Encourage client to begin own suctioning and caring for the tracheostomy before he or she leaves the hospital.
B. Assist the family in obtaining equipment for home use.
   1. System for humidification of air in home environment.
   2. Suction and equipment necessary for tracheostomy care.
C. Care of stoma.
   1. No swimming.
   2. Wear plastic collar over stoma while showering.
   3. Maintain high humidification at night to increase moisture in airway.
   4. Avoid use of aerosol sprays.
D. Nutritional considerations: client cannot smell; taste will also be affected.
E. Client should carry appropriate medical identification.
F. Encourage client to put arm and shoulder on affected side through range of motion exercises to prevent functional disabilities of the shoulder and neck.

**Cancer of the Lung**

Cancer of the lung is a tumor arising from within the lung. It may represent the primary site or may be a metastatic site from a primary lesion elsewhere (see Chapter 8).

**Assessment**

A. Risk factors.
   1. Smoking, including passive smoking.
   2. Occupational exposure to and/or inhalation of carcinogens.
B. Clinical manifestations: nonspecific; appear late in disease.
1. Persistent chronic cough.
2. Cough initially nonproductive; then may become productive of purulent and/or blood-tinged.
3. Dyspnea and wheezing with bronchial obstruction.
4. Recurring fever.
5. Common sites of metastasis.
   a. Liver.
   b. Bones.
   c. Brain.
   d. Lymph nodes: mediastinum.
6. Pain is a late manifestation.
7. Paraneoplastic syndrome: hormone changes, skin changes, neuromuscular and vascular changes; symptoms are controlled with successful treatment of cancer.

C. Diagnostics: bronchoscopy with biopsy.

TREATMENT

Varies with the extent of the malignancy.
A. Radiation: may be used preoperatively to reduce tumor mass.
B. Surgery: treatment of choice early in condition.
   1. Lobectomy: removal of one lobe of the lung.
   3. Lung conserving resection: removal of a small area (wedge) or a segment of the lung.
C. Chemotherapy (Chapter 8).
D. Treatment may involve all three therapies.

NURSING INTERVENTIONS

Goal: To prepare client for surgery.
A. General preoperative preparations (see Chapter 3).
B. Improve quality of ventilation before surgery.
   1. No smoking.
   2. Bronchodilators.
   3. Good pulmonary hygiene.
C. Discuss anticipated activities in the immediate postoperative period.
D. Encourage ventilation of feelings regarding diagnosis and impending surgery.
E. Orient client to the intensive care unit, if indicated.
Goal: To maintain patent airway and promote ventilation after thoracotomy.
A. Removal of secretions from tracheobronchial tree, either by coughing or suctioning.
B. Have client cough frequently, deep-breathe, and use incentive spirometer.
C. Assess vital signs; correlate with quality of respirations.
D. Provide supplemental O₂ as indicated.
E. Control pain so that client can take deep breaths and cough.
F. Do not position the client who has undergone a wedge resection or lobe resection on the affected side for extended periods of time; this will hinder the expansion of the lung remaining on that side. If client is in stable condition, place in semi-Fowler’s position to promote optimum ventilation.

Goal: To maintain normal range of motion and function of the affected shoulder after thoracotomy.
A. Exercises to increase abduction and mobility of the shoulders.
B. Encourage progressive exercises.
Goal: To assist client to understand measures to promote health after thoracotomy.
A. No more smoking; avoid respiratory irritants.
B. Decreased strength is common.
C. Continue activities and exercises.
D. Stop any activity that causes shortness of breath, chest pain, or undue fatigue.
E. Avoid lifting heavy objects until complete healing has occurred.
F. Return for follow-up care as indicated.

NURSING PRIORITY

Postoperative positioning of the client who has had thoracic surgery is important to remember, especially the client who has undergone pneumonectomy.

Goal: To assess and support cardiac function after thoracotomy.
A. Monitor for dysrhythmias; assess adequacy of cardiac output.
B. Evaluate urine output.
C. Administer fluids and transfusions with extreme caution; client’s condition is very conducive to development of fluid overload.
D. Evaluate hydration and electrolyte status.

Goal: To maintain patent airway and promote ventilation after thoracotomy.
A. Removal of secretions from tracheobronchial tree, either by coughing or suctioning.
B. Have client cough frequently, deep-breathe, and use incentive spirometer.
C. Assess vital signs; correlate with quality of respirations.
D. Provide supplemental O₂ as indicated.
E. Control pain so that client can take deep breaths and cough.
F. Do not position the client who has undergone a wedge resection or lobe resection on the affected side for extended periods of time; this will hinder the expansion of the lung remaining on that side. If client is in stable condition, place in semi-Fowler’s position to promote optimum ventilation.

Goal: To maintain normal range of motion and function of the affected shoulder after thoracotomy.
A. Exercises to increase abduction and mobility of the shoulders.
B. Encourage progressive exercises.
Goal: To assist client to understand measures to promote health after thoracotomy.
A. No more smoking; avoid respiratory irritants.
B. Decreased strength is common.
C. Continue activities and exercises.
D. Stop any activity that causes shortness of breath, chest pain, or undue fatigue.
E. Avoid lifting heavy objects until complete healing has occurred.
F. Return for follow-up care as indicated.
CHAPTER 15  Respiratory System

Appendix 15-1  PULMONARY DIAGNOSTICS

X-Ray Studies
Chest X-Ray Film
An x-ray film of the lungs and chest wall; no specific care is required before or after x-ray study.

Bronchoscopy
Provides for direct visualization of larynx, trachea, and bronchi; client generally receives nothing by mouth (NPO status) for 6 hours before the exam; preoperative medication is given, and the client’s upper airway is anesthetized topically.

Nursing Implications
1. After the exam, evaluate the client for return of gag reflex. Maintain client’s NPO status until return of gag reflex.
2. Bronchial biopsy may be done to obtain cells for cytologic exam; observe client for development of pneumothorax.

Pulmonary Angiography
Contrast material is injected into the pulmonary arteries; the angiography permits visualization of the pulmonary vasculature; definitive diagnosis for pulmonary emboli. Client should be well hydrated prior to procedure.

Contraindications: (1) dye or shellfish allergies, (2) unstable condition, (3) uncooperative client, (4) pregnancy.

Magnetic Resonance Imaging (MRI)
See Appendix 20-1.

Computerized Axial Tomography (CAT Scan)
See Appendix 20-1.

Pathology: Lab Studies
Sputum Studies
Sputum specimen should come from deep in the lungs and not be contaminated with excessive amounts of saliva. Client should be instructed to rinse mouth out with water before collection to decrease contamination.

Culture and Sensitivity Test: Performed to determine presence of pathogenic bacteria; also to determine which antibiotic the specific organism is sensitive to. Should be done before antimicrobial therapy is started.

Acid-Fast Bacilli: Sputum collection and analysis when tuberculosis (TB) is suspected; morning sputum may contain a higher concentration of organisms.

Cytologic Exam: Tumors in pulmonary system may slough cells into the sputum.

Blood Work
D-dimer: Blood test to identify degradation of fibrin; degradation products not commonly found in healthy clients. Elevated in thromboembolism and in DIC. Normal is less than 250 mcg/L.

Pulmonary Function Studies
Studies may be done: (1) to evaluate pulmonary function before surgery; (2) to evaluate response to bronchodilator therapy; (3) to differentiate diagnosis of pulmonary disease; and (4) to determine the cause of dyspnea.

Client must be alert and cooperative; client should not be sedated. Study is done in the pulmonary function laboratory; client directed to breathe into a cylinder from which a computer interprets and records data in specific values. Client should not smoke (for 12 hours) or use bronchodilating medications (for 6 hours) before the test.

Pulse Oximetry
Measurement is made by placing a sensor on the finger or earlobe; a beam of light passes through the tissue and measures the amount of oxygen-saturated hemoglobin. If probe is placed on the finger, any nail polish should be removed. Provides a method for continuously evaluating the oxygen saturation levels (SpO2). It is noninvasive, and there are no pre- or postoximetry preparations. Readings may be incorrect if severe vasoconstriction has occurred or if PaO2 is below 70%. Normal range is 95% or higher.

Nursing Implications
1. Pulse oximetry should be used:
   a. For the client who is on supplemental oxygen and is at increased risk for desaturation.
   b. For the chronically ill client who has a tracheotomy or is on mechanical ventilation for chronic respiratory problems.
   c. For the client who has a critical or unstable airway.
2. Pulse oximetry is not recommended to monitor oxygen saturation:
   a. For clients experiencing problems with hypovolemia or decreased blood flow to extremities.
   b. To evaluate respiratory status when ventilator changes are made.
   c. To monitor progress of client on high levels of oxygen.
   d. During cardiopulmonary resuscitation.

Arterial Blood Gas Studies
Measurement of the pH and partial pressures of dissolved gases (oxygen, carbon dioxide) of the arterial blood; requires approximately 3 mL of arterial blood, obtained through an arterial puncture. If client’s oxygen concentration or ventilatory settings have been changed, or if a client has been suctioned, blood should not be drawn for at least 30 minutes (see Table 15-1). Perform Allen’s test to assess collateral circulation before arterial puncture. Pressure should be maintained at the puncture site for a minimum of 5 minutes. The arterial blood sample should be tightly sealed and placed on ice.

Allen’s Test: Hold client’s hand, palm up. While occluding both the radial and ulnar arteries, have the client clench and unclench his or her hand several times; the hand will become pale. While continuing to apply pressure to the radial artery, release pressure on ulnar artery. Brisk color return (5-7 seconds) to the hand should occur with the radial artery still occluded. If color does not return, then ulnar artery does not provide adequate blood flow, and cannulation or puncture of radial artery should not be done.

Thoracentesis
Withdrawal of fluid from the pleural cavity; used for diagnostic and therapeutic purposes.

Nursing Implications
1. Explain procedure to client.
2. Position client.
   a. Preferably, client should sit on the side of the bed with the arms and head over the bedside table.
   b. If client is unable to assume sitting position, place on affected side with the head of the bed slightly elevated. Area containing fluid collection should be dependent.
   c. If client has a malignancy, cytotoxic drugs may be infused into the pleural space.
3. Support and reassure the client during the procedure.
4. After the procedure, position the client on his or her side with puncture side up (or in semi-Fowler’s position) and monitor respiratory status and breath sounds for possible pneumothorax.
**Mantoux Skin Test**

Mantoux test, or purified protein derivative (PPD) test, is a method of tuberculin skin testing. PPD is injected intradermally in the forearm. Results are read in 48 to 72 hours. A positive reaction means the individual has been exposed to *M. tuberculosis* recently or in the past and has developed antibodies (sensitized). It does not differentiate between active or latent infection. It may take 2 to 12 weeks after exposure for sensitivity and a positive skin test reaction to develop.

**Nursing Implications**

1. Intradermal injection: A small (25-gauge) needle is used to inject 0.1 mL of PPD under the skin. The needle is inserted bevel up; a raised area or “wheal” (6–10 mm) will form under the skin.
2. The most common area for injection is the inside surface of the forearm.
3. Do not aspirate; do not massage area.
4. The client should be given specific directions to return, or plans should be made to read the test in 48 to 72 hours.
5. Interpretation: The area of induration (only the part of the reaction that can be felt; induration may not be visible) is measured, not the area of erythema or inflammation.
   
   - An induration of 5 mm or more is a positive reaction in immunosuppressed clients, IV drug users, and persons who have been recently exposed to active TB.
   - An induration of 10 mm is a positive reaction for persons who are at increased risk for infection. This includes IV drug users, clients with chronic medical conditions, children under 4 years of age, institutionalized clients, clients in long-term care facilities, and health care workers.
   - An induration of 15 mm is a positive reaction for members of the general population who do not meet any of the other criteria.
6. A chest x-ray film, prophylactic medication, and medical follow-up are used to determine whether TB is dormant or active or whether the person was exposed and has an adequate immune response. It is also important to determine when and where the person came in contact with the TB bacillus.

**Nuclear Medicine**

**Lung Scan: (V/Q Scan)**

A procedure to determine defects in blood perfusion in the lung; particularly useful in the client believed to have a pulmonary embolus or a ventilation/perfusion problem. For the perfusion component, a radioactive dye is injected or is inhaled, and the specific uptake is recorded on x-ray film. For the ventilation component, the client breathes the tracer element through a face mask with a mouthpiece. The ventilation component requires the client's cooperation. Client is not sedated or on dietary restrictions for the exam.

**Bronchodilators**

Relax smooth muscle of the bronchi, promoting bronchodilation and reducing airway resistance; also inhibit the release of histamine.

**General Nursing Implications**

- Metered-dose inhalers (MDIs): Hand-held pressurized devices that deliver a measured dose of drug with each “puff.” When two “puffs” are needed, 1 minute should elapse between the two “puffs.” A spacer may be used to increase the delivery of the medication.
- Dry powder inhalers (DPIs) deliver more medication to lungs and do not require coordination as with an MDI; medication is delivered as a dry powder directly to the lungs; 1 minute should elapse between “puffs.”
- Bronchodilators: Beta₂ agonists and theophylline are given with caution to the client with cardiac disease, because tachydysrhythmias and chest pain may occur.
- Aerosol delivery systems have fewer side effects and are more effective.

**MEDICATIONS**

<table>
<thead>
<tr>
<th>Epinephrine (Adrenaline): subQ, IV</th>
<th>( 1^\text{st} \text{ class} ) of \ \text{Bronchodilators}</th>
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<tbody>
<tr>
<td><strong>SIDE EFFECTS</strong></td>
<td><strong>NURSING IMPLICATIONS</strong></td>
</tr>
<tr>
<td>Headache</td>
<td>1. Do not administer to clients with hypertension or dysrhythmias.</td>
</tr>
<tr>
<td>Dizziness</td>
<td>2. Primarily used to treat acute asthma attacks and anaphylactic reactions.</td>
</tr>
<tr>
<td>Hypertension</td>
<td>3. With racemic epinephrine, results should be observed in less than 2 hours.</td>
</tr>
<tr>
<td>Tremors</td>
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<tr>
<td>Dysrhythmias</td>
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<thead>
<tr>
<th>Theophylline (Theodur): PO, rectal, IV</th>
<th>Tachycardia</th>
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<tbody>
<tr>
<td>Aminophylline: IV</td>
<td>Hypotension</td>
</tr>
<tr>
<td></td>
<td>Nausea/vomiting</td>
</tr>
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<td></td>
<td>Seizures</td>
</tr>
</tbody>
</table>

1. Theophylline blood levels should be determined for long-term use; therapeutic levels are between 10 and 20 mcg/mL; levels above 20 mcg/mL are toxic.
2. IV administration may cause rapid changes in vital signs.
3. Considered to be a third-line drug for use with asthma.
## Respiratory System

### Medications and Nursing Implications

**MEDICATIONS** | **SIDE EFFECTS** | **NURSING IMPLICATIONS**
---|---|---

**NURSING PRIORITY** Monitor blood levels of medications.

#### Rapid-Acting Control

**Beta₂ Agonists**
- **Albuterol** *(Proventil, Ventolin)*: MDI, DPI, PO, aerosol
- **Terbutaline** *(Brethine)*: aerosol, PO
- **Pirbuterol** *(Maxair)*: MDI
- **Levalbuterol** *(Xopenex)*: nebulizer
- **Metaproterenol** *(Alupent)*: nebulizer, MDI

<table>
<thead>
<tr>
<th></th>
<th>Tachycardia, tremors, and angina can occur but are rare with inhaled preparations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Used for short-term relief of acute reversible airway problems.</td>
</tr>
<tr>
<td>2.</td>
<td>Not used on continuous basis in absence of symptoms.</td>
</tr>
<tr>
<td>3.</td>
<td>Client teaching regarding proper use of MDI and/or DPI.</td>
</tr>
</tbody>
</table>

#### Anticholinergics

- **Ipratropium bromide** *(Atrovent)*: aerosol, MDI

<table>
<thead>
<tr>
<th></th>
<th>Nasal drying and irritation. Minimal systemic effects.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Nasal spray may be used for clients with allergic rhinitis and asthma.</td>
</tr>
<tr>
<td>2.</td>
<td>MDI used to decrease bronchospasm associated with COPD.</td>
</tr>
<tr>
<td>3.</td>
<td>Therapeutic effects begin within 30 seconds.</td>
</tr>
</tbody>
</table>

#### Long-Acting Control

**Beta₂ Agonists**
- **Salmeterol** *(Serevent)*: DPI

<table>
<thead>
<tr>
<th></th>
<th>Headache, cough, tremors, dizziness.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Administered two times daily (q 12 hours).</td>
</tr>
<tr>
<td>2.</td>
<td>Not used for short-term relief; effects begin slowly and last for up to 12 hours.</td>
</tr>
</tbody>
</table>

**Corticosteroids**
- **Beclomethasone** *(Beclovent, Vanceril)*: MDI
- **Triamcinolone acetonide** *(Azmacort)*: MDI
- **Fluticasone** *(Flovent)*: MDI

<table>
<thead>
<tr>
<th></th>
<th>Oropharyngeal candidiasis, hoarseness, throat irritation, bad taste, cough, minimal side effects.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Works well with seasonal and exercise-induced asthma.</td>
</tr>
<tr>
<td>2.</td>
<td>Prophylactic use decreases number and severity of attacks.</td>
</tr>
<tr>
<td>3.</td>
<td>May be used with beta₂ agonist.</td>
</tr>
<tr>
<td>4.</td>
<td>Gargle after each dose and use a spacer to decrease candidiasis.</td>
</tr>
</tbody>
</table>

#### Nonsteroidal Antiinflammatory Drugs

- **Cromolyn sodium** *(Intal)*: MDI

<table>
<thead>
<tr>
<th></th>
<th>Inhalation: cough, dry mouth, throat irritation, and bad taste</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Prophylactic use decreases number and severity of attacks.</td>
</tr>
<tr>
<td>2.</td>
<td>Prevents bronchoconstriction before exposure to known precipitant (e.g., exercise).</td>
</tr>
<tr>
<td>3.</td>
<td>Not for an acute attack.</td>
</tr>
</tbody>
</table>

- **Nedocromil sodium** *(Tilade)*: MDI

<table>
<thead>
<tr>
<th></th>
<th>Unpleasant taste</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Given to children over 6 years old.</td>
</tr>
<tr>
<td>2.</td>
<td>Maximal effects develop within 24 hours.</td>
</tr>
<tr>
<td>3.</td>
<td>Does not treat an acute asthmatic attack.</td>
</tr>
</tbody>
</table>

#### Leukotriene Modifiers

- **Montelukast** *(Singular)*: PO
- **Zafirlukast** *(Accolate)*: PO

<table>
<thead>
<tr>
<th></th>
<th>Headache, GI disturbance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Once daily dose in the evening.</td>
</tr>
<tr>
<td>2.</td>
<td>Administer within 1 hour before or 2 hours after eating.</td>
</tr>
</tbody>
</table>

**Antitubercular** Broad-spectrum antibiotic specific to TB bacilli.

**General Nursing Implications**
- Client is not contagious when sputum culture is negative for three consecutive cultures.
- Use airborne respiratory precautions when sputum is positive for bacilli.
- Treatment includes combination of medications for about 6 to 12 months.
- Monitor liver function studies for clients receiving combination therapy.
- After initial therapy, medications may be administered once daily or on a twice-weekly schedule.
- Teach clients they should not stop taking the medications when they begin to feel better.
— Advise clients to return to the doctor if they notice any yellowing of the skin or eyes or begin to experience pain or swelling in joints, especially the big toe.
— Medication regimens always contain at least 2 medications to which the infection is sensitive; inadequate treatment is primary cause of increased incidence.

**MEDICATIONS**

**Isoniazid (INH): PO, IM**

**SIDE EFFECTS**
- Peripheral neuritis
- Hypersensitivity
- Hepatotoxicity
- Gastric irritation

**NURSING IMPLICATIONS**
1. Administer with (pyridoxine) vitamin B₆ to prevent peripheral neuritis.
2. Primary medication used in prophylactic treatment of TB.

**Rifampin (Rifadin): PO**

**Rifapentine (Priftin): PO**
(a derivative of rifampin)

**SIDE EFFECTS**
- Hepatotoxicity—hepatitis
- Hypersensitivity
- Gastric upset

**NURSING IMPLICATIONS**
1. May negate the effectiveness of birth control pills and warfarin.
2. May turn body secretions orange: urine, perspiration, tears—can stain soft contacts.

**Ethambutol (Myambutol): PO**

**SIDE EFFECTS**
- Optic neuritis
- Allergic reactions—dermatitis, pruritus
- Gastric upset

**NURSING IMPLICATIONS**
1. Give with food if GI problems occur.
2. Observe for vision changes.

**Pyrazinamide (PZA)**

**Pyrazinamide, Tebrazid: PO**

**SIDE EFFECTS**
- Hepatotoxicity
- Increased uric acid levels

**NURSING IMPLICATIONS**
1. May take with food to reduce GI upset.

**Rifabutin (Mycobutin): PO**

**SIDE EFFECTS**
- Rash, GI disturbances
- Hepatotoxicity

**NURSING IMPLICATIONS**
1. May turn body secretions orange: urine, perspiration, tears—can stain soft contacts.
2. Use with caution in pregnancy.

**Nasal Decongestants**

Produce decongestion by acting on sympathetic nerve endings to produce constriction of dilated arterioles.

**Phenylephrine hydrochloride**
(Neosynephrine): intranasal

**Oxymetazoline (Afrin): nasal spray**

**Pseudoephedrine (Sudafed): PO, nasal aerosol spray**

**SIDE EFFECTS**
- Large dose will cause CNS stimulation, anxiety, insomnia, increased blood pressure, and tachycardia.

**NURSING IMPLICATIONS**
1. With intranasal preparations, rebound congestion may occur.
2. Not recommended for children under 6 years old.

**ALERT** Evaluate client’s use of home remedies and OTC medications.

3. Medications are frequently found in OTC combination decongestants.
4. Caution clients with high blood pressure to check with their health care provider before using.

**Antihistamine**
Blocks histamine release at H₁ receptors (see Appendix 7-2).

**Expectorant**
Stimulates removal of respiratory secretions; reduces the viscosity of the mucus.

**Guaifenesin (Robitussin, Mucinex): PO**

**SIDE EFFECTS**
- Nausea
- GI upset

**NURSING IMPLICATIONS**
1. Increase fluid intake for effectiveness.

**Antivirals**
Used for treatment of severe respiratory syncytial virus (RSV) in hospitalized children.

**Ribavirin (Virazole): aerosol**

**SIDE EFFECTS**
- Anemia, increased respiratory problems

**NURSING IMPLICATIONS**
1. Should not be used for infants receiving mechanical ventilation.
2. Carefully monitor respiratory status of infant.
3. Used on hospitalized infant.
4. Pregnant nurses should not have direct contact with medication (pregnancy category X).
Appendix 15-2  RESPIRATORY MEDICATIONS—cont’d

<table>
<thead>
<tr>
<th>MEDICATIONS</th>
<th>SIDE EFFECTS</th>
<th>NURSING IMPLICATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prophylaxis: RSV</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| Palivizumab (Synagis): IM | Hypersensitivity | 1. IM injections required once a month; pain and erythema at injection site (very expensive).  
2. Dosing for high-risk infants and children should begin in late fall (November) and continue through early spring (April). |

GNS, Central nervous system; GI, gastrointestinal; IM, intramuscularly; IV, intravenously; OTC, over-the-counter; PO, by mouth (orally); subQ, subcutaneously; TB, tuberculosis; UTI, urinary tract infection.

Appendix 15-3  SUDDEN AIRWAY OBSTRUCTION

⚠️ NURSING PRIORITY The procedure to remove airway obstruction is not effective in the child with epiglottitis or sudden airway obstruction caused by inflammation of the upper airways.

Goal: To identify foreign body airway obstruction.

1. If the victim can speak or cry, there is probably adequate air exchange.
2. If the victim cannot speak or cry but is conscious, proceed to implement abdominal thrusts to clear the obstructed airway.
3. If the victim is unconscious:
   a. Call for help; dial 911/announce code blue, etc.
   b. Place client supine.
   c. Open airway using head-tilt/chin-lift method.
   d. Observe for presence of foreign body; perform finger sweep and remove if visible.
   e. Maintain open airway; if there is no evidence of breathing, deliver two effective breaths (breaths that cause visible chest rise) either mouth-to-mouth or mouth-to-nose and mouth resuscitation.
   f. If effective breaths cannot be delivered, reposition head, reopen airway, and attempt to ventilate victim again.
   g. If still unable to ventilate, initiate procedure for relieving obstructed airway.

ALERT Identify and intervene in life-threatening situations; evaluate and document client’s response to emergency procedures.

Goal: To clear obstructed airway—infant (conscious and unconscious).

1. Conscious: Perform Heimlich (abdominal thrusts) maneuver (chest thrusts if pregnant or obese) until obstruction is removed or client becomes unconscious.

   a. Stand behind client and wrap arms around waist.
   b. Make a fist and place thumb side against client’s abdomen; place fist midline, just above the umbilicus, and below the xiphoid.
   c. Place other hand over fist and press into client’s abdomen using quick upward thrusts.
   d. Repeat upward thrusts until foreign body is dislodged or client becomes unconscious.
   e. When client becomes unconscious, evaluate for presence of foreign body in the airway, remove if identified and attempt to ventilate.

2. Unconscious: Evaluate airway. Open airway and attempt to ventilate; if unable to ventilate, then proceed with steps for removal of foreign body.
   a. Position client supine, kneel astride the client’s thighs; with the heel of the hand, apply forceful upward thrust to the abdomen well below the xiphoid and above the umbilicus.
   b. Administer five abdominal thrusts, return to the client’s head, open the airway, and assess for breathing; if absent, provide two effective breaths.

   🎵 PEDIATRIC PRIORITY Do not do a blind sweep of the infant or child’s mouth; the foreign body should be visualized before you attempt to sweep the mouth.

Goal: To clear obstructed airway—adult and child (conscious and unconscious).

1. Conscious: Perform Heimlich (abdominal thrusts) maneuver (chest thrusts if pregnant or obese) until obstruction is removed or client becomes unconscious.
CHAPTER 15  Respiratory System

Appendix 15-4  WATER-SEaled CHEST DRAINAGE

Purposes
1. To remove air and/or fluid from the pleural cavity.
2. To restore negative pressure in the pleural cavity and promote reexpansion of the lung.

Principle of Water-Sealed Chest Drainage
The water seal (or dry seal on some equipment) serves as a one-way valve; it prevents air, under atmospheric pressure, from reentering the pleural cavity. On inspiration, air and fluid leave the pleural cavity via the chest tube; the water or dry seal keeps the air and fluid from reentering (Figure 15-6).

NURSING PRIORITY  There must be a seal (either water or dry seal) between the client and the atmospheric pressure.

Equipment
Three-chamber disposable chest drainage system: A molded plastic system that provides a collection chamber, a water-sealed chamber, and a suction-control chamber. When suction is applied, there should be a continuous, gentle bubbling in the water in the suction-control chamber (see Figure 15-7).

Two-chamber disposable chest drainage system: A molded plastic system that provides a water-sealed chamber where atmospheric pressure is prevented from going into client’s pleural cavity via a one-way valve. The second chamber serves as a collection chamber.

Nursing Implications
Assessment
1. Evaluate for hypoxia.
2. Evaluate character of respirations.
3. Assess for symmetrical chest wall expansion.
4. Evaluate breath sounds bilaterally.
5. Palpate around insertion site for subcutaneous emphysema.

Intervention
1. Perform range of motion of the affected arm and shoulder.
2. Encourage coughing and deep breathing every 2 hours.
3. Encourage ambulation if appropriate.


FIGURE 15-7  Water-sealed chest drainage. (From Potter PA, Perry AG: Fundamentals of nursing, ed 7, St. Louis, 2009, Mosby.)
Appendix 15-4 WATER-SEALED CHEST DRAINAGE—cont’d

4. Administer pain medications as indicated.
5. Place in low Fowler’s or semi-Fowler’s position.

Observe Drainage System for Proper Functioning
1. Water level in tubing from the client should fluctuate (tidal): rise on inspiration and fall on expiration. The opposite occurs with positive-pressure mechanical ventilation.
2. Continuous bubbling should not occur in the fluid where water seal is maintained; continuous bubbling indicates an air leak; continuous bubbling should occur only in the system that maintains a third chamber for suction control.
3. Initial bubbling may occur in the water-sealed chamber with coughing or with deep respiration as air is moved out of the pleural cavity.

Maintain Water-Sealed System
1. Keep all drainage equipment below level of client’s chest.
2. Evaluate for dependent loops in the tubing; this increases resistance to drainage. All extra tubing should be coiled in the bed and flow in a straight line to the system.
3. Tape all connections.
4. Note characteristics and amount of drainage. Mark level on the drainage system as needed and every 8 hours.
5. Vigorous “milking” or stripping chest tubes is controversial. Stripping should not be done routinely on clients because it increases pleural pressures.
6. Change collection chamber when it is approximately half full. Institution policy determines whether the nurse can change the collection chamber.
7. Do not clamp chest tubes during transport.

Alert Monitor effective functioning of therapeutic devices; determine whether chest drainage is functioning properly; adjust tubes to promote drainage; identify abnormal chest tube drainage; evaluate for achievement of goal of chest tubes; assess and intervene when unexpected responses to therapy occur.

Chest Tube Removal
1. Criteria for removal of the tube:
   a. Minimum or less than 50 mL drainage per day.
   b. Fluctuations stop in the water-seal chamber.
   d. Client had good breath sounds and is breathing comfortably.
2. Procedure.
   a. Provide pain relief about 30 minutes before procedure.
   b. Generally, the physician will want the client in a low Fowler’s or semi-Fowler’s position, unless contraindicated.
   c. The physician will ask the client to exhale and hold it or to exhale and bear down (a Valsalva maneuver). Either of these procedures will increase the intrathoracic pressure and prevent air from entering the pleural space.
   d. With the client holding his or her breath, the physician will quickly remove the tube and place an occlusive bandage over the area; the client can then breathe normally.
   e. Assess the client’s tolerance of the procedure; a chest x-ray film should be obtained to determine that the lungs remain fully expanded.

Appendix 15-5 ARTIFICIAL AIRWAYS

Endotracheal Intubation Placement of an endotracheal (ET) tube through the mouth or nose into the trachea (Figure 15-8).

Purpose
To provide an immediate airway; to maintain a patent airway; to facilitate removal of secretions and provide method for artificial ventilation.

Nursing Interventions
1. Provide warm, humidified oxygen.
2. Establish method of communication because the client cannot speak; child is unable to cry.
3. Maintain safety measures.
   a. Prevent client from accidentally removing tube: soft hand restraints, mittens, etc.
   b. Secure ET tube to the face.
   c. Child with an ET tube requires constant attendance.
4. As soon as tube is inserted, assess symmetry of chest expansion and bilateral breath sounds. Assess for presence of bilateral breath sounds every 2 hours. If tube slips farther into the trachea, it may pass into the right main stem bronchus, obliterating the left main stem bronchus. Determine placement by checking breath sounds.
5. Cuff must remain inflated if client is on a volume ventilator. If the client has adequate spontaneous respiration and is not on a ventilator, the cuff may be left deflated.


6. Minimal occluding volume (MOV) should be used when inflating the cuff to prevent aspiration or to maintain mechanical ventilation. This is accomplished by placing a stethoscope over the trachea or by listening to the client’s breath sounds to
determine when air stops moving past the cuff. A safe pressure on the cuff is 20 to 25 mm Hg.
7. Provide frequent oral hygiene; assess for pressure areas on the nose or the mouth.
8. Client’s nothing-by-mouth (NPO) status is maintained as long as tube is in place.
9. Suction as indicated (see Appendix 15-6).

**Tracheostomy** A surgical opening in the trachea (Figure 15-9).

**Purpose**
To maintain airway over an extended period of time; to facilitate removal of secretions.

**Nursing Interventions**

**Initially After Tracheostomy**
1. Provide warm, humidified oxygen.
2. Small amount of bleeding around the tube is expected.
3. Observe for pulsations of the tube; it may be resting on the innominate artery; notify physician of observation.
4. Maintain frequent contact and communication with client and provide reassurance.

**Maintenance of Tracheostomy**
1. Provide warm, humidified oxygen.
2. Establish method of communication because client cannot speak; child is unable to cry.
3. Maintain safety measures.
   a. Secure tracheal tube to the client’s neck.
   b. Use safety measures to prevent client from dislodging tube: soft restraints, trach ties, etc.
   c. Prevent clothing or bed covers from occluding area of tracheal opening.
   d. Child with a tracheostomy requires continuous attendance.
4. Assess for symmetrical expansion of chest wall and bilateral breath sounds.
5. Provide frequent oral hygiene; turn every 2 hours.
6. Inflate tracheostomy cuff during tube feedings or feedings by mouth (minimal occluding pressure).
7. Cuff must remain inflated if client is on a ventilator. If the client has adequate spontaneous respiration, the cuff may be left deflated.
8. Suction as indicated (see Appendix 15-6).

**ALERT** Provide tracheostomy care as necessary/appropriate.

---


9. IP tracheal tube has an obturator, it should be taped to the head of the bed. If the tracheostomy tube is accidentally removed, the obturator will be necessary for replacing the tube.
10. A fenestrated tracheostomy tube can be adapted so that air will flow throughout normal passages; frequently used when client is beginning to be weaned from the ventilator. If client has respiratory difficulty when the inner cannula is removed, immediately reinsert the cannula to provide a tracheal airway. The tube can also be plugged so that client can speak or cough through normal airway. Make sure the cuff is deflated before plugging the tracheostomy.
11. Establish means of communication; keep call light within easy reach of client.
12. If the client accidentally removes the tube, use the obturator to attempt to replace the tube in the tracheal opening. If unable to replace tracheotomy tube, hold the opening open with a hemostat until physician is available to replace the tube.

**ALERT** Provide tracheostomy care as necessary/appropriate.
### SUCTIONING THROUGH ARTIFICIAL AIRWAYS

**NURSING PRIORITY** Suctioning the endotracheal tube or the tracheostomy is done to remove excess secretions and to maintain patent airway. Suctioning should always be done before a cuff is deflated.

1. Determine that the client needs to be suctioned.
   a. Auscultate lungs to detect presence of secretions.
   b. Observe to see whether client is experiencing immediate difficulty with removal of secretions.
2. Explain procedure if client is not familiar with it, or simply indicate you are going to assist with the removal of the secretions.
3. All equipment introduced into the trachea or the ET tube must be sterile.
4. Attach the suction catheter to the suction source while maintaining sterile technique.
5. If client is not in immediate danger of airway occlusion, hyperoxigenate with 100% O₂ for three to four hyperinflations.
6. Gently insert sterile catheter into the opening without applying suction. Insert catheter to the point of slight resistance; then pull catheter back 1 to 2 cm.
7. Apply intermittent suction as the catheter is gently rotated and withdrawn.
8. Each suctioning pass should not exceed 10 to 15 seconds in duration.
9. Reconnect client to oxygen source and evaluate whether one suctioning episode was sufficient to remove secretions.
10. Hyperoxigenate client for 1 to 5 minutes after suctioning; assess vital signs and O₂ saturation—values should return to normal or to the previous levels before suctioning.
11. Avoid suctioning client before drawing blood for determination of arterial blood gas values. Client should be allowed to stabilize for approximately 30 minutes before blood is drawn.
12. Monitor oximetry while suctioning; if oximetry does not come back to normal level immediately after suctioning, do not attempt to suction client again; replace oxygen and or ventilatory connection and continue to monitor closely.

### Complications of Suctioning

1. Hypoxia: If possible, preoxygenate with high percentage of O₂ before and after suctioning.
2. Dysrhythmias: Limit suctioning to 10 to 15 seconds; monitor rhythm during suctioning; if bradycardia or tachycardia develops, discontinue suctioning immediately.
3. Bronchospasm: Try to time the suctioning with client’s own cycle; insert tube during inspiration.
4. Airway trauma: Maintain suction level below 120 mm Hg.
5. Infection: Use sterile technique; assess the color and quantity of sputum suctioned.
6. Atelectasis: Use suction catheters that are approximately one-third or less of the diameter of tube.

**ALERT** Intervene to improve respiratory status; suction client’s respiratory tract (oral, nasal, tracheostomy, and ET tube).

### OXYGEN

**Goal:** The goal of oxygen therapy is to maintain an optimum level of oxygenation at the lowest effective level of fraction of inspired oxygen (Fio₂).

**Methods of Administration**

Oxygen is measured in liters per minute flow (LPM): a range of 2 to 8 LPM is the most common order.

1. **Low-flow systems:** nasal cannula, standard mask, nonrebreather mask.
2. **High-flow systems:** Venturi mask, nebulizer mask, and ventilators. Oxygen is measured as Fio₂ in concentrations from 24% to 100%: 10 LPM oxygen flow is required to obtain accurate percentage flow.

**Humidification**

1. Adds water vapor to inspired gas.
2. Prevents drying and irritation of respiratory membranes.
3. Loosens thick secretions, allowing them to be more easily removed.

**Indications for Oxygen Administration**

1. A decrease in oxygen in the arterial blood (hypoxemia).
2. An increase in the work of breathing.
3. To decrease the cardiac workload.

**Oxygen Safety in Administration**

1. Properly ground all electrical equipment.
2. Do not permit any smoking by anyone in the area.
3. Use water-based, not oil-based, lubricants.
4. Use oxygen with caution in clients with chronic airway disease; most often administered via mask or nasal cannula at 2 to 4 LPM, unless client is in severe distress.
5. Oxygen supports combustion but is not explosive.

**Oxygen Toxicity** A medically induced condition produced by inhalation of high concentrations of oxygen over a prolonged period of time. Toxicity is directly related to concentration of oxygen, duration of therapy, and degree of lung disease present.

1. Tracheal irritation and cough.
2. Dyspnea and increasing cough.
3. Decrease in vital capacity.
4. The PaO₂ continues to decrease, even with an increasing Fio₂.
5. Atelectasis.
Ventilators Deliver air at a predetermined tidal volume. The ventilator delivers the volume of air within safe ranges of pressure. A pressure limit is set, and an alarm will sound if the tidal volume cannot be delivered within the set pressure limits. The intrathoracic pressure is increased with the ventilator; this decreases the venous blood return (preload) to the right side of the heart and subsequently decreases cardiac output.

Patterns of Ventilation
1. Assist control (AC): The client may initiate the cycle with inspiration.
2. Continuous mandatory ventilation (CMV): The machine controls rate and volume of the client’s ventilatory cycle.
3. Intermittent mandatory ventilation (IMV)/synchronized intermittent mandatory ventilation (SIMV): Delivers ventilation at inspiratory phase of client’s spontaneous ventilation; may be used for weaning from ventilator.
4. Positive end-expiratory pressure (PEEP): Maintains positive pressure at alveolar level at end of expiration to facilitate the diffusion of oxygen. PEEP will increase the intrathoracic pressure, thus further decreasing the venous return and causing a decrease in blood pressure. **Indications for use:** Acute respiratory distress syndrome (ARDS); clients unable to maintain patent airway; neuromuscular diseases causing respiratory failure.
5. Continuous positive airway pressure (CPAP): Used to augment the functional residual capacity (FRC) during spontaneous breathing. Used to wean clients from ventilators and may be administered by face mask. Client or infant must have spontaneous respirations.

** ALERT** Identify changes in respiratory status and intervene to improve respiratory status; assess client for unexpected response to therapy.

Nursing Implications
1. All alarms should be set and checked each shift, especially low pressure and low exhaled volume.
2. A bag-valve mask resuscitator is placed in the client’s room in case of mechanical failure of equipment.
3. Central venous pressure (CVP) and pulmonary artery pressure readings will be affected by the ventilator; readings should be determined in a consistent manner.
4. Ventilator setting for fraction of inspired oxygen (FiO₂), tidal volume, respiratory rate, pattern of control (AC/IMV, etc.), and PEEP should be checked and charted in the nurses’ notes.
5. Assess client’s tolerance of the ventilator; intravenous medications such as propofol (Diprivan) and fentanyl are frequently used. If changes, weaning, or removal of the ventilator are anticipated, do not medicate the client.
6. The client frequently experiences a high level of anxiety and fear. Explain equipment and alarms to the client and to the family. Maintain a calm, reassuring approach to the client.
7. When ventilator changes are made, carefully assess the client’s response (pulse oximetry, vital signs).
8. Never allow the condensation in the tubing to flow back into fluid reservoir.

**COMMON VENTILATOR ALARMS**
1. High pressure alarm: Sounds when tidal volume cannot be delivered at set pressure limit. **Nursing Care:** Increased secretions—suction; client biting tube—place oral airway; coughing and increased anxiety—administer sedative.
2. Low pressure alarm: Sounds when the machine cannot deliver the tidal volume because of a leak or break in the system. **Nursing Care:** Disconnection—check all connections for break in system; client stops breathing on the SIMV mode—evaluate client’s tolerance; tracheostomy or endotracheal (ET) tube cuff is leaking—check for air escaping around cuff, may need to replace tracheostomy tube if cuff is ruptured.

**WEANING FROM VENTILATORS**
May be done via SIMV, or T-piece on ET or tracheotomy with heated mist and oxygen, or by pressure support ventilation from the ventilator. During weaning it is imperative for the nurse to maintain close observation for increasing dyspnea and hypoxia. If client experiences dyspnea, he or she should be returned to the ventilator at whatever parameters were being used, and the doctor should be notified; anticipate drawing blood for determination of arterial blood gas values.

**ALERT** Identify changes in respiratory status and intervene to improve respiratory status; assess client for unexpected response to therapy.

**NURSING PRIORITY** Focus on the client not on the ventilator. In case of problems with the ventilator, assess the client; if adequate ventilation is not being achieved, take client off the ventilator, maintain respirations via a bag-valve mask resuscitator, and call for assistance.
Sputum Specimen Collection This test analyzes sputum samples (material expectorated from client’s lungs and bronchi during deep coughing) to diagnose respiratory disease, identify the cause of pulmonary infections, identify abnormal lung cells, and assist in managing pulmonary disease.

Nursing Implications
1. Sputum for culture and sensitivity should be collected as soon as possible to facilitate identification of bacteria and treatment.
2. Specimens for cytology and for acid-fast bacilli for TB diagnostics should be collected in the morning when bacteria and cells are most concentrated.
3. No mouthwash should be used before collection of specimen; have client rinse his mouth with water or brush his teeth with water, but do not use toothpaste.
4. Aerosol mist will assist in decreasing thickness of sputum and increasing effectiveness of coughing.
5. Maintain strict asepsis and standard precautions in collecting and transporting specimen; use sterile specimen collection container.
6. Acid-fast bacillus: Sputum collection should be done on three consecutive days.
7. Culture and sensitivity: Initial specimen should be obtained before antibiotics are administered.

Clinical Tips for Problem Solving
If client experiences pain while coughing:
• Support painful area with roll pillows to minimize pain and discomfort.
• Encourage client to take several deep breaths before beginning. This assists in triggering the cough reflex and aerates the lungs (see Box 15-1).
If client is unable to produce sputum specimen:
• Attempt procedure early in the morning, when mucus production is greatest.
• Notify physician to obtain orders for a bronchodilator or nebulization therapy.
Study Questions  Respiratory System

1. On the first postoperative day after a right lower lobe (RLL) lobectomy, the client deep-breathes and coughs but has difficulty raising mucus. What nursing observation would indicate the client is not adequately clearing secretions?
   1. Chest x-ray film showing right-sided pleural fluid
   2. A few scattered crackles on RLL on auscultation
   3. Increase in Paco₂ from 35 to 45 mm Hg
   4. Decrease in forced vital capacity

2. What nursing observation indicates the cuff on an endotracheal tube is leaking?
   1. An increase in peak pressure on the ventilator
   2. Client is able to speak.
   3. Increased swallowing efforts by client
   4. Increased crackles (rales) over left lung field

3. The client with COPD is to be discharged home while receiving continuous oxygen at a rate of 2 L/min via cannula. What information does the nurse provide to the client and his wife regarding the use of oxygen at home?
   1. Because of his need for oxygen, the client will have to limit activity at home.
   2. The use of oxygen will eliminate the client’s shortness of breath.
   3. Precautions are necessary because oxygen can spontaneously ignite and explode.
   4. Use oxygen during activity to relieve the strain on the client’s heart.

4. The nurse is caring for a client who is experiencing an acute asthma attack. He is dyspneic and experiencing orthopnea; his pulse rate is 120 beats/min. In what order will the nurse provide care to this client? Number the following options in the order in which they will be performed, with 1 being the first action and 4 being the last action.
   1. _____ Administer humidified oxygen.
   2. _____ Place in semi-Fowler’s position.
   3. _____ Provide nebulizer treatment with bronchodilator.
   4. _____ Discuss factors that precipitate attack.

5. The wife of a client with COPD is worried about caring for her husband at home. Which statement by the nurse provides the most valid information?
   1. “You should avoid emotional situations that increase his shortness of breath.”
   2. “Help your husband arrange activities so that he does as little walking as possible.”
   3. “Arrange a schedule so your husband does all necessary activities before noon; then he can rest during the afternoon and evening.”
   4. “Your husband will be more short of breath when he walks, but that will not hurt him.”

6. Which statement correctly describes suctioning through an endotracheal tube?
   1. The catheter is inserted into the endotracheal tube; intermittent suction is applied until no further secretions are retrieved; the catheter is then withdrawn.
   2. The catheter is inserted through the nose, and the upper airway is suctioned; the catheter is then removed from the upper airway and inserted into the endotracheal tube to suction the lower airway.
   3. With suction applied, the catheter is inserted into the endotracheal tube; when resistance is met, the catheter is slowly withdrawn.
   4. The catheter is inserted into the endotracheal tube to a point of resistance, and intermittent suction is applied during withdrawal.

7. While a client’s wife is visiting, she observes the client’s chest drainage system and begins to nervously question the nurse regarding the amount of bloody drainage in the system. What is the best response from the nurse?
   1. “Your husband has been really sick; this must be a very difficult time. Let’s sit down and talk about it.”
   2. “I have checked all of the equipment and it is working fine; you do not need to worry about it.”
   3. “The system is draining collected fluid from around the lungs. The drainage is expected and does not mean that he is bleeding.”
   4. “The chest tube is draining the secretions from his chest; it is important for him to deep-breathe frequently.”

8. The nurse is caring for an infant who is experiencing respiratory distress and being treated with continuous positive airway pressure (CPAP). The nurse knows that for this treatment to be most effective, the infant must be:
   1. Intubated with respiration maintained by controlled ventilation
   2. Able to breathe spontaneously
   3. Frequently stimulated to maintain respiratory rate
   4. Suctioned frequently to maintain alveolar ventilation

9. The nurse is assessing a client who is on a ventilator and has an endotracheal tube in place. What data confirm that the tube has migrated too far into the trachea?
   1. Decreased breath sounds are heard over the left side of the chest.
   2. Increased rhonchi are present at the lung bases bilaterally.
   3. Client is able to speak and coughs excessively.
   4. Ventilator pressure alarm continues to sound.
10. A 6-year-old client is admitted to the postoperative recovery area after a tonsillectomy. In what position will the nurse place the client?
   1. Semi-Fowler's position, with the head turned to the side.
   2. Prone position, with the head of the bed slightly elevated.
   3. On the back, with the head turned to the right side.
   4. On the abdomen, with the head turned to the side.

11. A child's mother and father are both carriers of the cystic fibrosis gene. What is the genetic basis for the possibility of this child having cystic fibrosis?
   1. One of every four offspring will have cystic fibrosis.
   2. The probability of a child having the condition is 25% with each pregnancy.
   3. Because the mother and father are both positive for the gene, all of the children will be carriers.
   4. Cystic fibrosis is inherited as an autosomal dominant trait, and all children will be carriers.

12. The nurse understands clamping a chest tube may cause what problem?
   1. Atelectasis.
   2. Tension pneumothorax.
   3. Bacterial infections in the pleural cavity.
   4. Decrease in the rate and depth of respirations.

13. On auscultation, the nurse hears wheezing in a client with asthma. Considering the pathophysiology of asthma, what would the nurse identify as the primary cause of this type of lung sound?
   1. Increased inspiratory pressure in the upper airways.
   2. Dilatation of the respiratory bronchioles and increased mucus.
   3. Movement of air through narrowed airways.
   4. Increased pulmonary compliance.

14. What finding on the nursing assessment would be associated with a diagnosis of pneumonia?
   1. Diminished breath sounds.
   2. Accessory use of thoracic muscles.
   3. Hematemesis in the morning.
   4. Dry hacking cough at night.

15. The nurse is monitoring a client who is experiencing an acute asthma attack. What observations would indicate an improvement in the client's condition?
   1. Respiratory rate of 18 breaths/min.
   2. Pulse oximetry of 88%.
   3. Pulse rate of 110 beats/min.
   4. Productive cough with rapid breathing.

16. Clients with COPD usually receive low-dose oxygen via nasal cannula. The nurse understands that which problem may occur if the client receives too much oxygen?
   1. Hyperventilation.
   2. Tachypnea.
   3. Hypoventilation or apnea.
   4. Increased snoring.

17. A client has a diagnosis of right-sided empyema. Thoracentesis is to be performed in the client’s room. The nurse will place the client in what position for this procedure?
   1. Prone position with feet elevated.
   2. Sitting with upper torso over bedside table.
   3. Lying on left side with right knee bent.
   4. Semi-Fowler's position with lower torso flat.

18. For a client with COPD, what is the main risk factor for pulmonary infection?
   1. Fluid imbalance with pitting edema.
   2. Pooling of respiratory secretions.
   3. Decreased fluid intake and loss of body weight.
   4. Decreased anterior-posterior diameter of the chest.

19. A client has a history of atherosclerotic heart disease with a sustained increase in his blood pressure. What side effect may occur and is important to discuss with this client before he uses an over-the-counter decongestant?
   1. Urinary frequency and diuresis.
   2. Bradycardia and diarrhea.
   3. Vasoconstriction and increased arterial pressure.
   4. Headache and dysrhythmias.

20. What symptoms would the nurse expect to observe in a 19-month-old client with a diagnosis of laryngotraacheobronchitis (LTB)?
   1. Stridor on inspiration.
   2. Expiratory wheezing.
   3. Paroxysmal coughing.
   4. Hemoptysis.

Answers and rationales to these questions are in the section at the end of the book titled Chapter Study Questions: Answers and Rationales.