MULTIPLE CHOICE

1. Which of the following causes of hypoxemia is the result of blood passing through unventilated portions of the lungs?

a. Alveolar hypoventilation

b. Dead space ventilation

c. Intrapulmonary shunting

d. Drug overdose

ANS: C

Hypoxemia is the result of impaired gas exchange and is the hallmark of acute respiratory failure. Hypercapnia may be present, depending on the underlying cause of the problem.
The main causes of hypoxemia are alveolar hypoventilation, ventilation/perfusion (V/Q) mismatching, and intrapulmonary shunting. Intrapulmonary shunting occurs when blood passes through a portion of a lung that is not ventilated. Drug overdose is an extrapulmonary cause that affects the brain.

2. A patient with acute respiratory failure may require a bronchodilator if which of the following occurs?
   
   a. Excessive secretions
   
   b. Bronchospasms
   
   c. Thick secretions
   
   d. Fighting the ventilator

ANS: B

Bronchodilators aid in smooth muscle relaxation and are of particular benefit to patients with airflow limitations. Mucolytics and expectorants are no longer used because they have been found to be of no benefit in this patient population.

3. Supplemental oxygen administration is usually effective in treating hypoxemia related to
   
   a. physiologic shunting.
b. dead space ventilation.

c. hypercapnia with a PaCO$_2$ of 35 mm Hg.

d. ventilation/perfusion mismatching.

ANS: D

Supplemental oxygen administration is effective in treating hypoxemia related to alveolar hypoventilation and ventilation/perfusion mismatching. When intrapulmonary shunting exists, supplemental oxygen alone is ineffective. In this situation, positive pressure is necessary to open collapsed alveoli and facilitate their participation in gas exchange. Positive pressure is delivered via invasive and noninvasive mechanical ventilation. If the patient is also experiencing hypercapnia, the PaCO$_2$ will be greater than 45 mm Hg. In patients with chronically elevated PaCO$_2$ levels, these criteria must be broadened to include a pH less than 7.35.

4. Which of the following nursing interventions should be used to optimize oxygenation and ventilation in the patient with acute respiratory failure?

a. Provide adequate rest and recovery time between procedures.

b. Position the patient with the good lung up.

c. Suction the patient every hour.
d. Avoid hyperventilating the patient.

ANS: A

Providing adequate rest and recovery time between various procedures prevents desaturation and optimizes oxygenation. In acute lung failure, the goal of positioning is to place the least affected area of the patient’s lung in the most dependent position. Patients with unilateral lung disease should be positioned with the healthy lung in a dependent position. Hyperventilate the patient before suctioning; suction patients as needed.

5. A patient has been admitted to the critical care unit with the diagnosis of acute respiratory distress syndrome (ARDS). Arterial blood gases (ABGs) revealed an elevated pH and decreased PaCO₂. The patient is becoming fatigued, and the health care provider orders a repeat ABG. The nurse anticipates the following results

a. elevated pH and decreased PaCO₂

b. elevated pH and elevated PaCO₂

c. decreased pH and decreased PaCO₂

d. decreased pH and elevated PaCO₂

ANS: D
Arterial blood gas analysis reveals a low \( \text{PaO}_2 \) despite increases in supplemental oxygen administration (refractory hypoxemia). Initially, the \( \text{PaCO}_2 \) is low as a result of hyperventilation, but eventually the \( \text{PaCO}_2 \) increases as the patient fatigues. The pH is high initially but decreases as respiratory acidosis develops.

6. Which of the following diagnostic criteria is indicative of ARDS?

   a. Radiologic evidence of bibasilar atelectasis

b. \( \text{PaO}_2/\text{FiO}_2 \) ratio less than or equal to 200 mm Hg

c. Pulmonary artery wedge pressure greater than 18 mm Hg

d. Increased static and dynamic compliance

ANS: B

The Berlin Definition of ARDS is as follows: timing—within 1 week of known clinical insult or new or worsening respiratory symptoms; chest imaging—bilateral opacities not fully explained by effusions, lobar or lung collapse, or nodules; origin of edema—respiratory failure not fully explained by cardiac failure or fluid overload; need objective assessment to exclude hydrostatic edema if no risk factor present; oxygenation—mild (200 mg Hg less than \( \text{PaO}_2/\text{FiO}_2 \) less than or equal to 300 mm Hg with positive end-respiratory airway pressure (PEEP) or constant positive airway pressure greater than or equal to 5 cm \( \text{H}_2\text{O} \)), moderate (100 mg Hg less than \( \text{PaO}_2/\text{FiO}_2 \) less than or equal to 200 mm Hg with PEEP greater than or equal to 5 cm \( \text{H}_2\text{O} \)), or severe (\( \text{PaO}_2/\text{FiO}_2 \) less than or equal to 100 mm Hg with PEEP greater than or equal to 5 cm \( \text{H}_2\text{O} \)). The mortality rate for ARDS is estimated to be 34% to 58%.
7. Which of the following therapeutic measures would be the most effective in treating hypoxemia in the presence of intrapulmonary shunting associated with ARDS?

a. Sedating the patient to blunt noxious stimuli
b. Increasing the FiO₂ on the ventilator
c. Administering positive-end expiratory pressure (PEEP)
d. Restricting fluids to 500 mL per shift

ANS: C

The purpose of using positive-end expiratory pressure (PEEP) in a patient with acute respiratory distress syndrome is to improve oxygenation while reducing FiO₂ to less toxic levels. PEEP has several positive effects on the lungs, including opening collapsed alveoli, stabilizing flooded alveoli, and increasing functional residual capacity. Thus, PEEP decreases intrapulmonary shunting and increases compliance.

8. Patients with left-sided pneumonia may benefit from placing them in which of the following positions?

a. Reverse Trendelenburg
b. Supine
ANS: D

Patients with unilateral lung disease should be positioned with the healthy lung in a dependent position. Because gravity normally facilitates preferential ventilation and perfusion to the dependent areas of the lungs, the best gas exchange would take place in the dependent areas of the lungs. Thus, the goal of positioning is to place the least affected area of the patient’s lung in the most dependent position. Patients with unilateral lung disease should be positioned with the healthy lung in a dependent position.

9. Aspiration can best be prevented by

a. observing the amount given in the tube feeding.

b. assessing the patient’s level of consciousness.

c. encouraging the patient to cough and to breathe deeply.

d. positioning a patient in a semirecumbent position.

ANS: D
Semirecumbency has been shown to decrease the risk of aspiration and inhibit the development of hospital-associated pneumonia.

10. The major hemodynamic consequence of a massive pulmonary embolus is

a. increased systemic vascular resistance leading to left heart failure.

b. pulmonary hypertension leading to right heart failure.

c. portal vein blockage leading to ascites.

d. embolism to the internal carotids leading to a stroke.

ANS: B

The major hemodynamic consequence of a pulmonary embolus is the development of pulmonary hypertension, which is part of the effect of a mechanical obstruction when more than 50% of the vascular bed is occluded. In addition, the mediators released at the injury site and the development of hypoxia cause pulmonary vasoconstriction, which further exacerbates pulmonary hypertension.

11. Which of the following findings confirms the diagnosis of a PE?

a. Low-probability V/Q scan
ANS: C

A definitive diagnosis of a pulmonary embolus requires confirmation by a high-probability V/Q scan, an abnormal pulmonary angiogram or computed tomography scan, or strong clinical suspicion coupled with abnormal findings on lower extremity deep venous thrombosis studies.

12. A pneumothorax greater than 15% requires

a. systemic antibiotics to treat the inflammatory response.

b. an occlusive dressing to equalize lung pressures.

c. interventions to evacuate the air from the pleural space and facilitate re-expansion of the collapsed lung.

d. mechanical ventilation to assist with re-expansion of the collapsed lung.
ANS: C

A pneumothorax greater than 15% requires intervention to evacuate the air from the pleural space and facilitate re-expansion of the collapsed lung. Interventions include aspiration of the air with a needle and placement of a small-bore (12–20 Fr) or large-bore (24–40 Fr) chest tube.

13. A patient was admitted to the critical care unit after a left pneumonectomy. The patient is receiving 40% oxygen via a simple facemask. The morning chest radiography study reveals right lower lobe pneumonia. After eating breakfast, the patient suddenly vomits and aspirates. The first action that should be taken after the patient’s aspiration event is

a. lavaging his airway with normal saline.

b. placing him on his back in a semi-Fowler position.

c. administering manual ventilations with a resuscitation bag.

d. suctioning his airway.

ANS: D

When aspiration is witnessed, emergency treatment should be instituted to secure the airway and minimize pulmonary damage. The patient’s head should be turned to the side, and the oral cavity and upper airway should be suctioned immediately to remove the gastric contents.
14. A patient was admitted to the critical care unit after a left pneumonectomy. The patient is receiving 40% oxygen via a simple facemask. The morning chest radiography study reveals right lower lobe pneumonia. After eating breakfast, the patient suddenly vomits and aspirates. Which test would the nurse expect the health care provider to order to identify the infectious pathogen?

a. CBC with differential

b. Wound culture of surgical site

c. Sputum Gram stain and culture

d. Urine specimen

ANS: C

A sputum Gram stain and culture are done to facilitate the identification of the infectious pathogen. In 50% of cases, though, a causative agent is not identified. A diagnostic bronchoscopy may be needed, particularly if the diagnosis is unclear or current therapy is not working. In addition, a complete blood count with differential, chemistry panel, blood cultures, and arterial blood gas analysis is obtained.

15. A patient was admitted to the critical care unit after a left pneumonectomy. The patient is receiving 40% oxygen via a simple facemask. The morning chest radiography study reveals right lower lobe pneumonia. After eating breakfast, the patient suddenly vomits and aspirates. The single most important measure to prevent the spread of infection between staff and patients is

a. respiratory isolation.
Proper hand hygiene is the single most important measure available to prevent the spread of bacteria from person to person.

16. A patient was admitted to the critical care unit after a left pneumonectomy. The patient is receiving 40% oxygen via a simple facemask. The morning chest radiography study reveals right lower lobe pneumonia. After eating breakfast, the patient suddenly vomits and aspirates. The patient becomes agitated, has decreased level of consciousness, and has an inability to maintain saturation. The nurse expects the next action will include

a. placing the patient on a mechanical ventilator.

b. change in antibiotics to control infection.

c. suctioning and repositioning.

d. administering a sedative to control anxiety.
Nursing interventions include optimizing oxygenation and ventilation, preventing the spread of infection, providing comfort and emotional support, and maintaining surveillance for complications.

17. The two most common causes of hospital-acquired pneumonia in the United States are

- a. Staphylococcus aureus and Pseudomonas aeruginosa
- b. Escherichia coli and Haemophilus influenzae
- c. methicillin-resistant Staphylococcus aureus and Pseudomonas aeruginosa
- d. Klebsiella spp. and Enterobacter spp.

ANS: C

Pathogens that can cause health care–associated pneumonia are similar to those causing both community- and hospital-acquired pneumonia (HAP) with *Pseudomonas aeruginosa* and methicillin-resistant *Staphylococcus aureus* (MRSA) being the most common in the United States. Pathogens that can cause HAP include *Escherichia coli*, *Haemophilus influenzae*, methicillin-sensitive *Staphylococcus aureus*, *Streptococcus pneumoniae*, *P. aeruginosa*, *Acinetobacter baumannii*, MRSA, *Klebsiella* spp., and *Enterobacter* spp.
18. The most common presenting signs and symptoms associated with PEs are

a. tachycardia and tachypnea.

b. hemoptysis and evidence of deep vein thromboses.

c. apprehension and dyspnea.

d. right ventricular failure and fever

ANS: A

The patient with a pulmonary embolism may have any number of presenting signs and symptoms, with the most common being tachycardia and tachypnea. Additional signs and symptoms that may be present include dyspnea, apprehension, increased pulmonic component of the second heart sound (P1), fever, crackles, pleuritic chest pain, cough, evidence of deep vein thrombosis, and hemoptysis. Syncope and hemodynamic instability can occur as a result of right ventricular failure.

Incorrect Answer Reply:

The patient with a pulmonary embolism may have any number of presenting signs and symptoms, with the most common being tachycardia and tachypnea. Additional signs and symptoms that may be present include dyspnea, apprehension, increased pulmonic component of the second heart sound (P1), fever, crackles, pleuritic chest pain, cough, evidence of deep vein thrombosis, and hemoptysis. Syncope and hemodynamic instability can occur as a result of right ventricular failure.

19. Depending on the patient’s risk for the recurrence of PE, a patient may be placed on warfarin for
ANS: C

The patient should remain on warfarin for 3 to 12 months depending on his or her risk for thromboembolic disease.

20. According to the National Association of Medical Direction of Respiratory Care Consensus Panel prolonged mechanical ventilation has been defined as

a. "the need for ≥30 consecutive days of mechanical ventilation for ≥8 hours per day"

b. "the need for ≥15 consecutive days of mechanical ventilation for ≥12 hours per day"

c. "the need for ≥21 consecutive days of mechanical ventilation for ≥6 hours per day"
ANS: C

In 2005, the National Association for Medical Direction of Respiratory Care Consensus Panel recommended that LTMVD (which they referred to as prolonged mechanical ventilation) be defined as —the need for ≥21 consecutive days of mechanical ventilation for ≥6 hours per day.

MULTIPLE RESPONSE

1. Medical management of patient with status asthmaticus that supports oxygenation and ventilation include (Select all that apply.)

   a. oxygen therapy.
   b. bronchodilators.
   c. corticosteroids.
   d. antibiotics.
   e. intubation and mechanical ventilation.
ANS: A, B, C, E

Medical management of a patient with status asthmaticus is directed toward supporting oxygenation and ventilation. Bronchodilators, corticosteroids, oxygen therapy, and intubation and mechanical ventilation are the mainstays of therapy.

2. Nursing management of the patient with acute lung failure includes which of the following interventions? (Select all that apply.)

a. Positioning the patient with the least affected side down

b. Providing adequate rest between treatments

c.Performing percussion and postural drainage every 4 hours

d. Controlling fever

e. Pharmaceutical medications to control anxiety

ANS: A, B, D, E

The goal of positioning is to place the least affected area of the patient’s lung in the most dependent position. Patients with unilateral lung disease should be positioned with the healthy lung in a dependent position. Patients with diffuse lung disease may benefit from being positioned with the right lung down because it is larger and more vascular than the left lung. For patients with alveolar hypoventilation, the goal of positioning is to facilitate ventilation. These patients benefit from nonrecumbent positions such as sitting or a semierect position. In addition, semirecumbency has been shown to decrease the risk of
aspiration and inhibit the development of hospital-associated pneumonia. Frequent repositioning (at least every 2 hours) is beneficial in optimizing the patient’s ventilatory pattern and ventilation/perfusion matching. These include performing procedures only as needed, hyperoxygenating the patient before suctioning, providing adequate rest and recovery time between various procedures, and minimizing oxygen consumption. Interventions to minimize oxygen consumption include limiting the patient’s physical activity, administering sedation to control anxiety, and providing measures to control fever.

3. Psychologic factors that may contribute to long-term mechanical ventilation dependence include (Select all that apply.)

- a. fear.

- b. delirium.

- c. lack of confidence in the ability to breathe.

- d. depression.

- e. trust in the staff so the patient displays a lack of effort.

ANS: A, B, C, D

Psychologic factors contributing to long-term mechanical ventilation dependence include a loss of breathing pattern control (anxiety, fear, dyspnea, pain, ventilator asynchrony, lack of confidence in ability to breathe), lack of motivation and confidence (inadequate trust in staff, depersonalization, hopelessness, powerlessness, depression, inadequate communication), and delirium (sensory overload, sensory deprivation, sleep deprivation, pain medications).
4. Weaning methods that are used in combination with each other include *(Select all that apply.)*

a. SIMV with CPAP.

b. SIMV with PSV.

c. CPAP with PSV.

d. T-piece and PSV.

e. PEEP with CPAP.

ANS: A, B, C, D

A variety of weaning methods are available, but no one method has consistently proven to be superior to the others. These methods include T-tube (T-piece), continuous positive airway pressure (CPAP), pressure support ventilation (PSV), and synchronized intermittent mandatory ventilation (SIMV). One recent multicenter study lends evidence to support the use of PSV for weaning over T-tube or SIMV weaning. Often these weaning methods are used in combination with each other, such as SIMV with PSV, CPAP with PSV, or SIMV with CPAP.