TRUE/FALSE

1. When a patient fails to ventilate or oxygenate adequately, the problem is caused by pathophysiological factors such as hyperventilation.

   ANS: F PTS: 1 REF: Introduction

2. One of the most common causes of increased airway resistance is COPD.

   ANS: T PTS: 1 REF: Airway Resistance

3. Airway resistance varies directly with the diameter of the airway or ET tube and inversely with the length.

   ANS: F PTS: 1 REF: Airway Resistance

4. Low compliance measurements are usually related to conditions that increase the patient's functional residual capacity and total lung capacity.

   ANS: F PTS: 1 REF: Lung Compliance

5. When looking at the pressure-volume loop, a shift of the slope toward the pressure axis indicates a decrease in compliance.

   ANS: T PTS: 1 REF: Lung Compliance

MULTIPLE CHOICE

1. One of the most frequent uses of mechanical ventilation is for the management of postoperative patients recovering from ____.
   a. apnea and impending respiratory arrest
   b. anesthesia and medications
   c. acute severe asthma and heart failure
   d. acute brain injury and flail chest

   ANS: B PTS: 1 REF: Introduction

2. Normal airway resistance in healthy adults is between 0.5 to ____ cm H_2O/L/sec.
   a. 1.5
   b. 2.0
   c. 2.5
   d. 3.0

   ANS: C PTS: 1 REF: Airway Resistance

3. Based on Poiseuille's Law, the work of breathing increases by factor of ____ when the radius (r) of the airway is reduced by half its original size.
   a. 8-fold
   b. 10-fold
   c. 13-fold
   d. 16-fold

   ANS: D PTS: 1 REF: Airway Resistance

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4. ____ occurs when the patient's minute ventilation cannot keep up with CO_2 production.
   a. Ventilatory failure
   b. Refractory hypoxemia
   c. Oxygenation failure
   d. Deadspace ventilation

   ANS: A PTS: 1 REF: Airway Resistance

5. Which of the following is calculated by C = DV/DP?
   a. oxygenation failure
   b. static compliance
   c. dynamic compliance
   d. lung compliance

   ANS: D PTS: 1 REF: Lung Compliance

6. For critically-ill patients, the dynamic compliance is between 30 and ____ mL/cm H_2O.
   a. 40
   b. 50
   c. 60
   d. 70

   ANS: A PTS: 1 REF: Lung Compliance

7. For critically-ill patients, the static compliance is between 40 and ____ mL/cm H2O.
   a. 50
   b. 60
   c. 70
   d. 80

   ANS: B PTS: 1 REF: Lung Compliance

8. Which of the following is defined as wasted ventilation, or a condition in which ventilation is in excess of perfusion?
   a. ventilatory failure
   b. deadspace ventilation
   c. refractory hypoxemia
   d. oxygenation failure

   ANS: B PTS: 1 REF: Deadspace Ventilation

9. ____ occurs when the ventilated alveoli are not adequately perfused by pulmonary circulation.
   a. Alveolar deadspace
   b. Anatomic deadspace
   c. Physiologic deadspace
   d. Arterial deadspace

   ANS: A PTS: 1 REF: Deadspace Ventilation

10. Hypercapnia, which involves an increase in ____, is the key feature of ventilatory failure.
    a. PCO_2
    b. PIO2
    c. F_IO_2
    d. $PaCO_2$

    ANS: D PTS: 1 REF: Ventilatory Failure

11. Which of the following is the difference between tidal volume and deadspace volume?
    a. minute alveolar ventilation
    b. alveolar volume
    c. (V/Q) ratio
    d. physiologic deadspace

    ANS: B PTS: 1 REF: Ventilatory Failure

12. The gas diffusion coefficient for carbon dioxide is ____ times greater than that for oxygen.
    a. 10
    b. 14
    c. 17
    d. 19

    ANS: D PTS: 1 REF: Ventilatory Failure

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13. The classic physiologic shunt equation ____.
    a. requires only an arterial blood sample
    b. requires an arterial blood sample and a mixed venous blood sample
    c. requires only a venous blood sample
    d. does not require a blood sample

    ANS: B PTS: 1 REF: Ventilatory Failure

14. ____ is reduced oxygen in the body organs and tissues.
    a. Hypoxemia
    b. Tachypnea
    c. Anemia
    d. Hypoxia

    ANS: D PTS: 1 REF: Oxygenation Failure

15. Which of the following is a clinical example of a condition that may lead to ventilatory pump failure?
    a. emphysema
    b. hyperkalemia
    c. pulmonary embolism
    d. COPD

    ANS: B PTS: 1
    REF: Clinical Conditions Leading To Mechanical Ventilation

COMPLETION

1. Regardless of the diagnosis or disease state, patients who require mechanical ventilation generally have developed _____, oxygenation failure, or both.

   ANS: ventilatory failure

   PTS: 1 REF: Introduction

2. In mechanical ventilation, the degree of airway resistance is primarily affected by the length, size, and patency of the airway, endotracheal tube, and _____.

   ANS: ventilator circuit

   PTS: 1 REF: Airway Resistance

3. In a clinical setting, _____ may result if the patient is unable to overcome the airway resistance by increasing the work of breathing.

   ANS: hypoventilation

   PTS: 1 REF: Airway Resistance

4. A(n) _____ bowing of the P-V loop suggests an overall increase in airflow resistance.

   ANS: increased

   PTS: 1 REF: Airway Resistance

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5. In a clinical setting, acute respiratory distress syndrome (ARDS) and _____ are two causes of increased work of breathing.

   ANS: atelectasis

   PTS: 1 REF: Lung Compliance

SHORT ANSWER

1. When a patient fails to ventilate or oxygenate adequately the problem may be caused by one of six major pathophysiological factors. List these factors.

   ANS:
   1. increased airway resistance
   2. changes in lung compliance
   3. hypoventilation
   4. V/Q mismatch
   5. intrapulmonary shunting
   6. diffusion defect

   PTS: 1 REF: Introduction

2. Outline the method used to measure static and dynamic compliance.

   ANS:
   (1) Obtain corrected expired tidal volume.

   (2) Obtain plateau pressure by applying inspiratory hold or occluding the exhalation port at end-inspiration.

   (3) Obtain peak inspiratory pressure.

   (4) Obtain positive end-expiratory pressure (PEEP) level, if any.

   PTS: 1 REF: Lung Compliance

3. Assessment of compliance can be divided into static compliance and dynamic compliance measurements. Explain the relationship and clinical significance of these measurements.

   ANS:
   Static compliance is calculated by dividing the volume by the pressure (i.e., plateau pressure) measured when the flow is momentarily stopped . When airflow is absent, airway resistance becomes a non-factor. static compliance reflects the elastic resistance of the lung and chest wall.

   Dynamic compliance is calculated by dividing the volume by the pressure (i.e. peak inspiratory pressure) measured when airflow is present Since airflow is present, airway resistance becomes a factor in the measurement of dynamic compliance. Dynamic compliance therefore reflects the condition of airway resistance (nonelastic resistance) as well as the elastic properties of the lung and chest wall (elastic resistance).

   PTS: 1 REF: Lung Compliance

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4. Define deadspace ventilation and describe the three different types of deadspace.

   ANS:
   Deadspace ventilation is defined as wasted ventilation or a condition in which ventilation is in excess of perfusion. The conducting airways contribute to about 30% of deadspace ventilation. For a tidal volume of 500 mL, about 150 mL of this volume is wasted since it does not take part in gas exchange. This volume in the conducting airways is called anatomic deadspace and it can be estimated to be about 1 mL/lb of ideal body weight. Alveolar deadspace occurs when the ventilated alveoli are not adequately perfused by pulmonary circulation. Physiologic deadspace is the sum of anatomic and alveolar deadspace volumes.

   PTS: 1 REF: Deadspace Ventilation

5. What are the five mechanisms that lead to the development of ventilatory failure?

   ANS:
   The five mechanisms are:
   (1) hypoventilation, (2) persistent ventilation-perfusion (V/Q) mismatch, (3) persistent intrapulmonary shunting, (4) persistent diffusion defect, and (5) persistent reduction of inspired oxygen tension (PIO2)

   PTS: 1 REF: Ventilatory Failure

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