Pulmonary Disease in the Intensive Care Unit: Review Questions

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QUESTIONS

Choose the single best answer for each question.

1. A patient is receiving supportive therapy in the intensive care unit for acute respiratory distress syndrome (ARDS). On the eighth day of treatment, a bronchoscopic directed protected specimen brushing is performed to evaluate a new infiltrate. Which of the following microorganisms is NOT likely to be isolated?

A) *Haemophilus influenzae*
B) *Klebsiella pneumoniae*
C) *Prevotella melaninogenica*
D) *Pseudomonas aeruginosa*
E) *Staphylococcus aureus*

2. A 24-year-old man with asthma is intubated for respiratory failure. The patient is sedated with lorazepam and paralyzed with doxacurium. The initial ventilator settings are as follows: assist/control mode rate, 12 breaths/min; tidal volume, 700 mL; inspiratory flow rate, 90 L/min; positive end-expiratory pressure (PEEP), 0 cm H_2O. As the peak airway pressure reaches 53 cm H_2O, the flow rate is reduced to 60 L/min with a decrease in the peak airway pressure to 42 cm H_2O. Thirty minutes later, the patient's blood pressure has decreased from 140/75 to 70/45 mm Hg. Auscultation reveals diminished breath sounds bilaterally with both inspiratory and expiratory rhonchi. Which of the following is the most appropriate next step?

A) Administer a 500-mL bolus of lactated Ringer's solution intravenously
B) Further decrease the inspiratory flow rate
C) Increase the PEEP to 10 cm H_2O
D) Insert bilateral chest tubes
E) Reduce the respiratory rate

3. Which of the following best describes the appearance of a pneumothorax on a radiograph taken with the patient in the supine position?

A) Apical capping
B) Apical hyperlucency
C) Deep sulcus sign
D) Increased radiolucency of the lung fields
E) Multiple vertical lucency sign

4. A patient with ARDS develops refractory hypoxemia despite attempts at various modes of mechanical ventilation. The patient is finally turned and ventilated in the prone position. The PaO_2 increases significantly with a fall in the pulmonary admixture ratio. Which of the following best explains the improvement in oxygenation?

A) Change in regional diaphragmatic movement
B) Increased functional residual capacity
C) Increased mobilization of secretions
D) Increased perfusion to the nondependent ventral lung regions
E) Increased ventilation to the nondependent ventral lung regions

(turn page for answers)

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EXPLANATION OF ANSWERS

1. **(A) *Haemophilus influenzae*.** Although *Streptococcus pneumoniae* and *H. influenzae* may be recovered during the first few days of a patient's stay in the intensive care unit, they are rarely isolated thereafter. *Staphylococcus aureus* is the pathogen most frequently isolated from lower respiratory tract samples of patients with ventilator-associated pneumonia (VAP). Other commonly isolated pathogens include *Pseudomonas aeruginosa*, *Enterobacter* species, *Klebsiella* species, *Acinetobacter baumannii*, *Proteus* species, and *Escherichia coli*. *Prevotella melaninogenica* is among the most common anaerobic organisms isolated. Although anaerobic bacteria are frequently isolated from the oropharynx, and microaspiration has been demonstrated to be the predominant mechanism of VAP, the role of anaerobic bacteria in VAP is unclear, with many studies reporting a low incidence of anaerobic bacteria in VAP. Isolation of anaerobic bacteria requires adequate transport conditions and specific growth media. With these measures, anaerobic bacteria have been isolated in up to 25% of patients with VAP.
2. **(E) Reduce the respiratory rate.** This patient most likely has severe air trapping with significant auto–positive end-expiratory pressure (PEEP)/intrinsic PEEP (iPEEP). iPEEP will reduce venous return and therefore also cardiac output and blood pressure. The resistance to expiration may result in significant iPEEP with hemodynamic compromise. The iPEEP and/or the exhaled tidal volumes must be measured in all patients to avoid significant air trapping. A low inspiratory-expiratory ratio (long expiration) should always be used. Permissive hypoventilation may be required in patients with severe airway obstruction. Extrinsic PEEP should be avoided in asthmatic patients because it has not been shown to increase alveolar ventilation; it may also increase air trapping. iPEEP can be diminished by either decreasing the ventilator rate or increasing the flow. The latter step, however, may increase the peak airway pressure. The low dynamic compliance results in high airway pressures with attendant risk of barotrauma.
3. **(C) Deep sulcus sign.** When a patient is in the supine position, the classic radiographic findings of a pneumothorax may not be present. In this position, the most superior (ie, the highest) portion of the thorax is near the lung bases. Because pneumothorax air rises to the highest location in the chest, the lung bases should be closely scrutinized for the following signs: (1) clear visualization of the diaphragm anteriorly creating a "double" appearance of the diaphragm; (2) a deep costophrenic angle (deep sulcus sign); (3) an unusually distinct cardiac apex and pericardial fat tags; and (4) increased radiolucency of the upper abdominal quadrants.
4. **(E) Increased ventilation to the nondependent ventral lung regions.** Despite the involvement of all lung fields on a frontal chest radiograph, computed tomography in patients with acute respiratory distress syndrome has demonstrated preferential distribution of alveolar consolidation in the dependent lung areas. It might be assumed that the improvement in oxygenation when the patient was turned to the prone position is a consequence of increasing perfusion to better-ventilated lung regions. However, Gattinoni and colleagues[1] have demonstrated that the lung densities redistribute rapidly from the dorsal to ventral regions when a patient is turned prone, suggesting that ventilation redistribution is the main factor influencing oxygenation in the prone position, rather than perfusion redistribution. In the supine position, dorsal lung regions are below closing volume at end-inhalation. However, in the prone position, the transpulmonary pressure may exceed the airway opening pressure in the dorsal lung regions, thereby recruiting previously unventilated lung units.

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SUGGESTED READINGS

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