

Sepsis: Review Questions

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QUESTIONS

Choose the single best answer for each question.

Questions 1 and 2 refer to the following case.

A 70-year-old man presents to the emergency department with a 2-day history of fever, chills, cough, and right-sided pleuritic chest pain. On the day of admission, the patient's family noted that he was more lethargic and dizzy and was falling frequently. The patient's vital signs are: temperature, 101.5°F; heart rate, 120 bpm; respiratory rate, 30 breaths/min; blood pressure, 70/35 mm Hg; and oxygen saturation as measured by pulse oximetry, 80% without oxygen supplementation. A chest radiograph shows a right lower lobe infiltrate.

- This patient's condition can best be defined as which of the following?**
 - Multi-organ dysfunction syndrome (MODS)
 - Sepsis
 - Septic shock
 - Severe sepsis
 - Systemic inflammatory response syndrome (SIRS)
- What is the first step in the initial management of this patient?**
 - Antibiotic therapy
 - β -Blocker therapy to control heart rate
 - Intravenous (IV) fluid resuscitation
 - Supplemental oxygen and airway management
 - Vasopressor therapy with dopamine
- A 40-year-old man with a history of IV drug use presents with cellulitis with multiple abscesses of the right upper extremity. His current weight is 70 kg (lean body weight). He rapidly develops worsening respiratory distress and hypotension and ultimately requires intubation and mechanical ventilation. Blood gas analysis shows a pH of 7.23, P_{aCO_2} of 58 torr, P_{aO_2} of 60 torr, and an oxygen saturation of 88%. His ventilator settings are assist-control mode with a tidal volume of 420 mL, respiratory rate of 16 breaths/min, positive end-expiratory pressure (PEEP) of 5 cm H_2O , and F_{iO_2} of 70%. His plateau pressure on the ventilator is 29 cm H_2O . A chest radiograph shows bilateral interstitial infiltrates, and a 2-dimensional echocardiogram demonstrates normal left ventricular function. What ventilator adjustments should be made?**
 - Change the ventilator mode to synchronized intermittent mandatory ventilation
 - Increase PEEP
 - Increase respiratory rate to 24 breaths/min
 - Increase tidal volume to 600 mL
 - Leave the ventilator settings unchanged
- Which of the following patients is an ideal candidate for noninvasive positive pressure ventilation (NIPPV)?**
 - A 30-year-old comatose woman suspected of drug overdose
 - A 55-year-old man with acute anterior wall myocardial infarction with cardiogenic shock and recurrent ventricular arrhythmias
 - A 60-year-old man with peritonitis requiring 2 vasopressors
 - A 65-year-old patient with a massive stroke and inability to protect airway
 - A 70-year-old alert patient with respiratory failure due to chronic obstructive pulmonary disease exacerbation
- Which of the following is an indication for using corticosteroids in septic shock?**
 - Acute respiratory distress syndrome (ARDS)
 - Necrotizing pneumonia
 - Peritonitis
 - Sepsis responding well to fluid resuscitation
 - Vasopressor-dependent septic shock

(turn page for answers)

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ANSWERS AND EXPLANATIONS

1. **(D) Severe sepsis.** The patient fulfills criteria for severe sepsis, defined as sepsis with evidence of organ dysfunction, hypoperfusion, or hypotension. SIRS is defined as an inflammatory response to insult manifested by 2 of the following: temperature greater than 38°C (100.4°F) or less than 36°C (96.8°F), heart rate greater than 90 bpm, respiratory rate greater than 20 breaths/min, and white blood cell count greater than $12 \times 10^3/\mu\text{L}$, less than $4 \times 10^3/\mu\text{L}$, or 10% bands. A diagnosis of sepsis is given if infection is present in addition to meeting criteria for SIRS. Septic shock includes sepsis-induced hypotension (despite fluid resuscitation) along with evidence of hypoperfusion. MODS is the presence of altered organ function such that hemostasis cannot be maintained without intervention.¹ This patient's lack of fluid resuscitation classifies him as having severe sepsis rather than septic shock.
2. **(D) Supplemental oxygen and airway management.** The initial evaluation of any critically ill patient in shock should include assessing and establishing an airway, evaluating breathing (which includes consideration of mechanical ventilator support), and restoring adequate circulation.² Adequate oxygenation should be ensured with a goal of achieving an arterial oxygen saturation of 90% or greater.
3. **(B) Increase PEEP.** The largest trial of a volume- and pressure-limited strategy showed a 9% decrease in all-cause mortality in patients ventilated with tidal volumes of 6 mL/kg of estimated lean body weight as compared with a tidal volume of 12 mL/kg (target plateau pressure, < 30 cm H₂O).³ Based on the results of this study, a strategy of using low tidal volume and high PEEP is recommended for mechanical ventilation of acute lung injury/ARDS patients.
4. **(E) A 70-year-old alert patient with respiratory failure due to chronic obstructive pulmonary disease exacerbation.** NIPPV can be considered in carefully selected patients with sepsis. Patients with shock, altered mental status, or increased airway secretions should not be treated with NIPPV.⁴ Studies regarding the use of NIPPV in patients with sepsis-induced acute lung injury/ARDS are limited. In our experience, patients with normal mental status who are likely to recover within 48 to 72 hours seem to be good candidates for NIPPV.
5. **(E) Vasopressor-dependent septic shock.** An inappropriate cortisol response is not uncommon in patients with septic shock. Low-dose IV corticosteroids (hydrocortisone 200–300 mg/day) are recommended

in patients with vasopressor-dependent septic shock.⁵ However, steroids should not be used in the absence of vasopressor requirement. Higher doses of corticosteroids have been shown to be harmful in severe sepsis.⁶ The use of adrenal function tests to guide decisions on corticosteroid therapy is considered a reasonable approach.⁷ An absolute incremental increase of 9 µg/dL at 30 or 60 minutes after administration of 250 µg of corticotropin was found as the best cutoff value to distinguish between adequate adrenal response (responders) and relative adrenal insufficiency (nonresponders).⁸ Another approach is to use IV dexamethasone 4 mg every 6 hours until a low-dose corticotropin stimulation test can be performed; dexamethasone does not interfere with the cortisol assay but will interfere with adrenal axis response. Corticosteroids may then be continued in nonresponders and discontinued in responders.⁹

REFERENCES

1. Bone RC, Balk RA, Cerra FB, et al. Definition for sepsis and organ failure and guidelines for the use of innovative therapies in sepsis. The ACCP/SCCM Consensus Conference Committee. American College of Chest Physicians/Society of Critical Care Medicine. *Chest* 1992;101:1644–55.
2. Holmes CL, Walley KR. The evaluation and management of shock. *Clin Chest Med* 2003;24:775–89.
3. Ventilation with lower tidal volumes as compared with traditional tidal volumes for acute lung injury and the acute respiratory distress syndrome. The Acute Respiratory Distress Syndrome Network. *N Engl J Med* 2000; 342:1301–8.
4. Hilbert G, Gruson D, Vargas F, et al. Noninvasive ventilation in immunosuppressed patients with pulmonary infiltrates, fever, and acute respiratory failure. *N Engl J Med* 2001;344:481–7.
5. Rivers EP, Gaspari M, Saad GA, et al. Adrenal insufficiency in high-risk surgical ICU patients. *Chest* 2001; 119:889–96.
6. Bone RC, Fisher CJ, Clemmer TP. A controlled clinical trial of high-dose methylprednisolone in the treatment of severe sepsis and septic shock. *N Engl J Med* 1987;317:653–8.
7. Keh D, Sprung CL. Use of corticosteroid therapy in patients with sepsis and septic shock: an evidence-based review. *Crit Care Med* 2004;32(11 Suppl):S527–33.
8. Annane D, Sebille V, Troche G, et al. A 3-level prognostic classification in septic shock based on cortisol levels and cortisol response to corticotropin. *JAMA* 2000; 283:1038–45.
9. Annane D. Cortisol replacement for severe sepsis and septic shock: what should I do? *Crit Care* 2002;6:190–1.