

# 25 Approach to the Patient in Shock

## REFERENCES

1. McCaig LF, Ly N: National hospital ambulatory medical care survey: 2000 emergency department summary. *Adv Data* 326: 1, 2002.
2. Nawar EW, Niska RW, Xu J: National Hospital Ambulatory Medical Care Survey: 2005 emergency department summary. *Adv Data* 386: 1, 2007.
3. Moscucci M, Bates ER: Cardiogenic shock. *Cardiol Clin* 13: 391, 1995.
4. Angus DC, Linde-Zwirble WT, Lidicker J, et al: Epidemiology of severe sepsis in the United States: analysis of incidence, outcome, and associated costs of care. *Crit Care Med* 29: 1303, 2001.
5. Stevens RD, Bhardwaj A, Kirsch JR, Mirski MA: Critical care and perioperative management in traumatic spinal cord injury. *J Neurosurg Anesthesiol* 15: 215, 2003.
6. Kumar A, Parillo JE: Shock: Classification, Pathophysiology, and Approach to Management in Critical Care Medicine: Principles of Diagnosis and Management in the Adult 3rd ed. Philadelphia, PA, Mosby Inc., p. 379, 2008.
7. Opie LH: Mechanisms of cardiac contraction and relaxation, in Braunwald E, Libby P, Bonow RO, et al: *Heart Disease: A Textbook of Cardiovascular Medicine*, 8th ed. Philadelphia, PA, Saunders Elsevier, p. 530, 2008.
8. Greer CJ, Watts DT: Epinephrine levels in the peripheral blood during irreversible hemorrhagic shock in dogs. *Circ Res* 7: 192, 1959.
9. Thrower WB, Darby TD, Aldinger EE: Acid base derangements and myocardial contractility. *Arch Surg* 82: 56, 1961.
10. Rivers EP, Ander DS, Powell D: Central venous oxygen saturation monitoring in the critically ill patient. *Curr Opin Crit Care* 7: 204, 2001.
11. Karimova A, Pinsky DJ: The endothelial response to oxygen deprivation: biology and clinical implications. *Intensive Care Med* 27: 19, 2001.
12. Rady MY, Rivers EP, Nowak RM: Resuscitation of the critically ill in the ED: responses of blood pressure, heart rate, shock index, central venous oxygen saturation and lactate. *Ann Emerg Med* 14: 218, 1996.
13. Rady MY, Nightingale P, Little RA, et al: Shock index: a re-evaluation in acute circulatory failure. *Resuscitation* 23: 227, 1992.
14. Birkhahn RH, Gaeta TJ, Terry D, et al: Shock index in diagnosing early acute hypovolemia. *Am J Emerg Med* 23: 323, 2005.
15. Nguyen HB, Rivers EP, Havstad S, et al: Critical care in the emergency department: a physiologic assessment and outcome evaluation. *Acad Emerg Med* 7: 1354, 2000.
16. Miller RR, Ely EW: Radiographic measures of intravascular volume status: the role of vascular pedicle width. *Curr Opin Crit Care* 12: 255, 2006.
17. Ely EW, Smith AC, Chiles C, et al: Radiologic determination of intravascular volume status using portable, digital chest radiography: a prospective investigation in 100 patients. *Crit Care Med* 29: 1502, 2001.
18. Jones AE, Tayal VS, Sullivan DM, et al: Randomized controlled trial of immediate versus delayed goal-directed ultrasound to identify the cause of nontraumatic hypotension in emergency department patients. *Crit Care Med* 32: 1703, 2004.
19. Moore CL, Rose GA, Tayal VS, et al: Determination of left ventricular function by emergency physician echocardiography of hypotensive patients. *Acad Emerg Med* 9: 186, 2002.
20. Boldt J: Clinical review: hemodynamic monitoring in the intensive care unit. *Crit Care* 6: 52, 2002.
21. Karakitos D, Labropoulos N, DeGroot E, et al: Real-time ultrasound-guided catheterisation of the internal jugular vein: a prospective comparison with the landmark technique in critical care patients. *Crit Care* 10: R162, 2006.
22. Institute Of Medicine: IOM report: the future of emergency care in the United States health system. *Acad Emerg Med* 13: 1081, 2006.
23. Rivers E, Nguyen B, Havstad S, et al: Early goal-directed therapy in the treatment of severe sepsis and septic shock. *N Engl J Med* 345: 1368, 2001.
24. Sebat F, Musthafa AA, Johnson D, et al: Effect of a rapid response system for patients in shock on time to treatment and mortality during 5 years. *Crit Care Med* 35: 2568, 2007.
25. Monnet X, Rienzo M, Osman D, et al: Passive leg raising predicts fluid responsiveness in critically ill patients. *Crit Care Med* 34: 1402, 2006.
26. Dellinger RP, Levy MM, Carlet JM, et al: Surviving Sepsis Campaign: international guidelines for management of severe sepsis and septic shock: *Crit Care Med* 36: 296, 2008.
27. Dorman T, Breslow MJ, Lipsett PA, et al: Radial artery pressure monitoring underestimates central arterial pressure during vasopressor therapy in critically ill surgical patients. *Crit Care Med* 26: 1646, 1998.
28. Pinsky MR, Payen D: Functional hemodynamic monitoring. *Crit Care* 9: 566, 2005.
29. Richard F, Lopes M, Auler JO: Pulse pressure variation: beyond the fluid management of patients with shock. *Crit Care* 11: 131, 2007.
30. Packman MI, Rackow EC: Optimum left heart filling pressure during fluid resuscitation of patients with hypovolemic and septic shock. *Crit Care Med* 11: 165, 1983.
31. Cuschieri J, Rivers EP, Donnino MW, et al: Central venous-arterial carbon dioxide difference as an indicator of cardiac index. *Intensive Care Med* 31: 818, 2005.
32. Weil MH, Nakagawa Y, Tang W, et al: Sublingual capnometry: a new noninvasive measurement for diagnosis and quantitation of severity of circulatory shock. *Crit Care Med* 27: 1225, 1999.
33. Marik PE: Regional carbon dioxide monitoring to assess the adequacy of tissue perfusion. *Curr Opin Crit Care* 11: 245, 2005.
34. Prentice D, Sona C: Esophageal Doppler monitoring for hemodynamic assessment. *Crit Care Nurs Clin North Am* 18: 189, x, 2006.
35. Skarda DE, Mulier KE, Myers DE, et al: Dynamic near-infrared spectroscopy measurements in patients with severe sepsis. *Shock* 27: 348, 2007.
36. Verdant C, De Backer D: How monitoring of the microcirculation may help us at the bedside. *Curr Opin Crit Care* 11: 240, 2005.
37. Porter JM, Ivatury RR: In search of the optimal end points of resuscitation in trauma patients: a review. *J Trauma* 44: 908, 1998.
38. Jones SE, Stiell IG, Nesbitt LP, et al: Nontraumatic out-of-hospital hypotension predicts inhospital mortality. *Ann Emerg Med* 43: 106, 2004.
39. Rutherford EJ, Morris JA Jr, Reed GW, Hall KS: Base deficit stratifies mortality and determines therapy. *J Trauma* 33: 417, 1992.
40. Lind L: Veno-arterial carbon dioxide and pH gradients and survival in critical illness. *Eur J Clin Invest* 25: 201, 1995.
41. American Thoracic Society: Evidence-based colloid use in the critically ill: American Thoracic Society Consensus Statement. *Am J Respir Crit Care Med* 170: 1247, 2004.
42. Rackow EC, Falk JL, Fein IA, et al: Fluid resuscitation in circulatory shock: a comparison of the cardiorespiratory effects of albumin, hetastarch, and saline solutions in patients with hypovolemic and septic shock. *Crit Care Med* 11: 839, 1983.
43. Vincent JL, Gerlach H: Fluid resuscitation in severe sepsis and septic shock: an evidence-based review. *Crit Care Med* 32: S451, 2004.
44. Finfer S, Bellomo R, Boyce N, et al: A comparison of albumin and saline for fluid resuscitation in the intensive care unit. *N Engl J Med* 350: 2247, 2004.
45. Brunkhorst FM, Engel C, Bloos F, et al: Intensive insulin therapy and pentastarch resuscitation in severe sepsis. *N Engl J Med* 358: 125, 2008.
46. Wiedermann CJ: Systematic review of randomized clinical trials on the use of hydroxyethyl starch for fluid management in sepsis. *BMC Emerg Med* 8: 1, 2008.
47. Sriskandan S, Altmann DM: The immunology of sepsis. *J Pathol* 214: 211, 2008.
48. Vincent JL, Weil MH: Fluid challenge revisited. *Crit Care Med* 34: 1333, 2006.
49. Rivers EP, Kruse JA, Jacobsen G, et al: The influence of early hemodynamic optimization on biomarker patterns of severe sepsis and septic shock. *Crit Care Med* 35: 2016, 2007.
50. Estessoro E, Gonzalez F, Laffaire E, et al: Shock on admission day is the best predictor of prolonged mechanical ventilation in the ICU. *Chest* 127: 598, 2005.
51. Rivers EP: Fluid-management strategies in acute lung injury—liberal, conservative, or both? *N Engl J Med* 354: 2598, 2006.
52. Wiedemann HP, Wheeler AP, Bernard GR, et al: Comparison of two fluid-management strategies in acute lung injury. *N Engl J Med* 354: 2564, 2006.
53. Nguyen HB, Banta JE, Cho TW, et al: Mortality predictions using current physiologic scoring systems in patients meeting criteria for early goal-directed therapy and the severe sepsis resuscitation bundle. *Shock* 30: 23, 2008.
54. American College of Chest Physicians/Society of Critical Care Medicine consensus conference: definitions for sepsis and organ failure and guidelines for the use of innovative therapies in sepsis. *Crit Care Med* 20: 864, 1992.
55. Rivers EP, Blake HC, Dereczky B, et al: Adrenal dysfunction in hemodynamically unstable patients in the emergency department. *Acad Emerg Med* 6: 626, 1999.

## USEFUL WEB RESOURCES

Critical Care Medicine Tutorials (SHOCK)—<http://ccmtutorials.com>, <http://ccmtutorials.com/cvs/index.htm>  
 Critical Care Archives—<http://ccforum.com>