

## 1.23 SEPSIS AND SHOCK

### Introduction

Early recognition and treatment of sepsis and shock is imperative to improve the outcomes of critically ill neonates and children. In adults, sepsis is defined as life-threatening organ dysfunction caused by a dysregulated host response to infection. In children, the definition of sepsis focuses on the presence of systemic inflammatory response criteria in the context of suspected or proven infection. Early recognition of clinical findings associated with sepsis is necessary to appropriately intervene and prevent progression to shock. Shock can be categorized as distributive (as in sepsis), hypovolemic, cardiogenic, or obstructive. Ultimately, shock results from inadequate tissue perfusion to support metabolic demands, which may be caused by an inadequate supply of oxygen to the tissues or an increased demand of the tissues for oxygen. As a result, cellular hypoxia, anaerobic metabolism, and dysregulation result in irreversible cell damage and death. Pediatric hospitalists often encounter children with all forms of shock and should be adept at recognition and management to improve patient outcomes.

### Knowledge

Pediatric hospitalists should be able to:

- Describe the components of tissue oxygen delivery, focusing on elements of the oxygen delivery equation, including cardiac output and oxygen content of the blood.
- Discuss the pathophysiology of tissue hypoxia, including hypoxemia, anemia, and ischemia.
- Identify vital sign and laboratory criteria that constitute sepsis in children.
- Discuss potential causes of sepsis, including bacterial, viral, fungal, parasitic, and rickettsial infections.
- Describe common diseases and conditions associated with the four forms of shock.
- Describe the role of empiric antibiotic therapy, including when antibiotics should be initiated and when to choose specific antibiotics and/or antivirals.
- Compare and contrast the presenting signs and symptoms of the four forms of shock, attending to differences in heart rate, blood pressure, pulses and peripheral perfusion, mental status, and urine output.
- Discuss compensatory mechanisms of early shock including increased heart rate, stroke volume, and vascular smooth muscle tone.
- List indications for chronotropic, inotropic, and blood pressure support, including the mechanisms of action for each class of medications.
- Identify the commonly performed diagnostic studies (such as laboratory, radiographic, and others) which aid in determining the extent or form of shock, including venous lactate, mixed venous saturation, urine output, chest radiograph, and others.
- Summarize the approach toward stabilization of each form of shock.

### Skills

Pediatric hospitalists should be able to:

- Perform an initial rapid assessment using Pediatric Advanced Life Support skills.
- Identify early signs of sepsis and shock from a focused history, physical examination, and initial diagnostic studies.
- Initiate appropriate and timely interventions based on the form of shock.
- Order and correctly interpret results of common studies to determine the cause of sepsis and extent of shock, such as complete blood count, chemistries, blood gas, venous lactate, mixed venous saturation, radiographs, and others.
- Select the appropriate empiric antibiotic regimen.
- Order appropriate monitoring and correctly interpret monitoring data.
- Identify cardiomegaly and other signs of congestive heart failure on physical exam and chest radiograph.
- Facilitate effective transfer to a tertiary care center or intensive care setting when appropriate.

### Attitudes

Pediatric hospitalists should be able to:

- Realize the importance of effective communication with emergency room and intensive care staff to assign the appropriate level of care for patients with sepsis and shock.
- Acknowledge the value of listening effectively and responding to concerns of the family/caregivers and healthcare providers regarding changes in physiologic parameters, including vital signs, mental status, physical examination, and urine output.
- Recognize the value of providing support and education to the family/caregivers on the nuances and complexities of the various forms of shock and the importance of careful monitoring and evaluation.

### Systems Organization and Improvement

In order to improve efficiency and quality within their organizations, pediatric hospitalists should:

- Work with hospital administration, staff, subspecialists, and other services to educate healthcare providers on the importance of early recognition of sepsis and shock to prevent complications, including end-organ failure and death.
- Lead, coordinate, or participate in educational programs, including those involving simulation, to acquire the skills needed for appropriate recognition and intervention for children in sepsis and shock.
- Lead, coordinate, or participate in the development and implementation of trigger tools and rapid response systems to assist in recognition and stabilization of sepsis and early shock.
- Lead, coordinate, or participate in the design and implementation of performance bundles for best practice, sustainability, and performance improvement around the care provided to patients with sepsis and shock.
- Collaborate with hospital administration and community partners to develop and sustain local American Heart As-

sociation Pediatric Basic and Advanced Life Support classes for providers, community members, and other stakeholders.

## References

1. Davis AL, Carcillo JA, Aneja RK, et al. American College of Critical Care Medicine Clinical Practice Parameters for Hemodynamic Support of Pediatric and Neonatal Septic Shock. *Crit Care Med*. 2017;45(6):1061-1093. <https://doi.org/10.1097/CCM.0000000000002425>.
2. Cruz AT, Perry AM, Williams EA, et al. Implementation of goal-directed therapy for children with suspected sepsis in the emergency department. *Pediatrics*. 2011;127: e758-766. <https://pediatrics.aappublications.org/content/127/3/e758>. Accessed August 28, 2019.