Shock

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KEYWORDS

• Shock • Massive pulmonary embolism • Cardiac tamponade
• Tension pneumothorax • Hypovolemia • Hemorrhage • Anaphylaxis
• Acute myocardial infarction

KEY POINTS

- Critically ill patients with undifferentiated shock are complex and challenging cases in the emergency department.
- A systematic approach to patients assessment and management is essential to prevent unnecessary morbidity and mortality.
- The simplified, systematic approach described in this article focuses on determining the presence of a pump, tank, or pipe problem.

INTRODUCTION

Shock is defined as a state of insufficient perfusion and oxygen delivery to the tissues. Regardless of the cause, mortality rates of patients with shock remain high, ranging from 40% to 60% for those with septic shock and approaching 40% for those with hemorrhagic shock.[1,2] Patients with shock commonly present to the emergency department (ED) and require rapid assessment and initiation of treatment to prevent unnecessary increases in morbidity and mortality. As a result, it is imperative that the emergency physician be expert in the rapid identification, assessment, and treatment of patients with shock. This article describes a systematic approach to the evaluation and management of the ED patient with undifferentiated shock, with attention to rapidly identifying conditions that require time-sensitive therapy.

PATHOPHYSIOLOGY

Although the circulatory system is complex and depends on a multitude of variables, it can be simplified to three main components: cardiac function (the pump), intravascular

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volume (the tank), and systemic vascular resistance (the pipes). In normal conditions, intravascular volume is adequate to maintain cardiac preload, stroke volume and heart rate are adequate to maintain cardiac output, and systemic vascular resistance is preserved to maintain sufficient perfusion to the tissues. In shock, malfunction occurs with the pump, tank, or pipes, such that perfusion and oxygen delivery are impaired. Acute pump malfunction can be caused by arrhythmias, conditions that result in a sudden decrease in cardiac contractility or by extracardiac conditions that obstruct cardiac output.[3] Acute tank malfunction primarily results from a decrease in intravascular volume due to hemorrhage or volume loss. Significant volume loss leads to decreases in venous return and impaired left ventricular preload. Acute tank dysfunction can also result from conditions that mechanically obstruct venous return. Malfunction of the pipes is commonly seen in septic shock and is generally caused by cytokine-induced vasodilation.[4] Alteration in vascular tone is also a common feature of anaphylactic shock, caused by the release of histamine and other immune mediators.[5] Regardless of the underlying mechanism of shock, if impaired perfusion and oxygen delivery are not recognized and reversed, organ dysfunction, tissue necrosis, and death rapidly ensue.

CAUSES

The causes of shock are innumerable and difficult to remember at the bedside of a critically ill patient. Notwithstanding, they can be categorized into conditions that result in pump, tank, or pipe dysfunction. Critical conditions that require time-sensitive therapy and should be considered early in the evaluation of ED patients with shock are listed in **Box 1**.

Box 1
Critical causes of shock

- Pump dysfunction
  - Mechanical obstruction
    - Pericardial tamponade
    - Massive pulmonary embolus
  - Acute myocardial infarction
  - Acute valvular insufficiency
  - Arrhythmia
- Tank dysfunction
  - Hemorrhage
  - Hypovolemia
  - Tension pneumothorax
  - Abdominal compartment syndrome
- Pipe dysfunction
  - Anaphylaxis
  - Sepsis
  - Vascular catastrophes
    - Ruptured abdominal aortic aneurysm
    - Aortic dissection