

**McHenry Western Lake County EMS System**  
**Paramedic, EMT-B and PHRN**  
**Continuing Education**  
**April 2008**  
**Shock**  
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Shock is a physiologic state characterized by a significant, systemic reduction in tissue perfusion. Tissue perfusion is determined by SVR (systemic vascular resistance), and cardiac output. SVR is governed by vessel length, blood viscosity and the inverse vessel diameter. Cardiac output is equal to heart rate times stroke volume. Stroke volume depends upon preload (volume of blood in the ventricle prior to contraction), myocardial contractility and afterload (the pressure against which the heart must pump).

Shock can develop from a variety of conditions that result from:

- Insufficient circulatory blood volume ( preload)
- Changes in vascular resistance (afterload)
- Heart failure (contractility)
- Obstruction to blood flow

The effects of decreased tissue perfusion include:

- Poor perfusion of vital organs resulting in impaired function, decreased mental state and decreased urine output
- Lactic acid accumulates as cells switch to anaerobic metabolism resulting in metabolic acidosis
- Hypoperfusion initiates inflammatory events that cause micro ischemia and cell damage.

There are three stages of shock:

1. Preshock – Sometimes called warm or compensated shock. In preshock the body mechanisms rapidly compensate for the diminished perfusion.
2. Shock – Regulatory mechanisms are overwhelmed and signs and symptoms of organ dysfunction appear. These include tachycardia, tachypnea, metabolic acidosis, decreased urine output, cool and clammy skin and restlessness. These symptoms usually correspond to one of the following:
  - 20 – 25 percent reduction in blood volume
  - Decrease in cardiac index to less than 2.5L/min
  - Activation of innumerable mediators of the sepsis syndrome
3. End-organ dysfunction – During this stage, progressive end-organ dysfunction leads to irreversible organ damage and death:
  - Decreased urine output leads to anuria (the absence of urine production)
  - Restlessness progresses to agitation, obtundation and coma
  - Acidosis from decreased cardiac output alters cellular metabolic processes
  - Multi-system organ failure proceeds to cause demise of the patient

## Classifications of Shock

### Hypovolemic Shock

Hypovolemic shock results from decreased preload. Since preload is one of the determinants of stroke volume, cardiac output falls when preload drops. It is caused by either hemorrhage or fluid loss (diarrhea, vomiting, heat stroke, burns and “third spacing.”)

### Cardiogenic Shock

Cardiogenic shock results from pump failure. Its causes are divided into 4 categories:

- Cardiomyopathies
- Arrhythmias
- Mechanical abnormalities (i.e. aortic stenosis, mitral valve regurgitation, dissecting aortic aneurysm, ruptured papillary muscle)

### Obstructive Shock

Obstructive shock results from mechanical factors that interfere with the filling or emptying of the heart or great vessels.

Mechanisms interfering with ventricular filling include: tension pneumothorax, vena cava compression, cardiac tamponade, atrial tumor or clot.

Mechanisms interfering with ventricular emptying include: pulmonary emboli

### Distributive Shock

Distributive or vasodilatory shock results from decrease in SVR producing increased blood flow to skin and a wide pulse pressure. Causes of distributive shock include:

- Anaphylaxis
- Sepsis
- Toxic Shock Syndrome
- Drug or toxin reaction
- Addisonian crisis
- Myxedema coma
- Central nervous system or spinal cord injury – sudden loss of sympathetic tone

## Pathophysiology Profile of Shock States

Physiologic state	Preload	Cardiac Output	Afterload
<b>Hypovolemic</b>	decreased	decreased	increased
<b>Cardiogenic</b>	increased	decreased	increased
<b>Obstructive</b>	decreased	decreased	increased
<b>Distributive</b>	decreased or unchanged	increased	decreased

## Clinical Presentation

The patient's clinical presentation varies with the type and cause of their particular shock, but there are several symptoms common amongst them all:

- Hypotension
- Cool and clammy skin
- Oliguria – decreased urine output
- Change in mental status
- Metabolic acidosis

Initial assessment and history will help determine the specific type of shock. A patient may have more than one type of shock, such as a child with cardiogenic shock from SVT who is also hypovolemic because he has been unable to drink or someone with underlying cardiomyopathy who is septic.

Patterns that may be helpful:

**Hypovolemic** History of volume loss, narrow pulse pressure, signs of poor perfusion, small or normal heart on x-ray

**Septic** History of fever or immunocompromised, wide pulse pressure, variable peripheral perfusion, purpuric rash

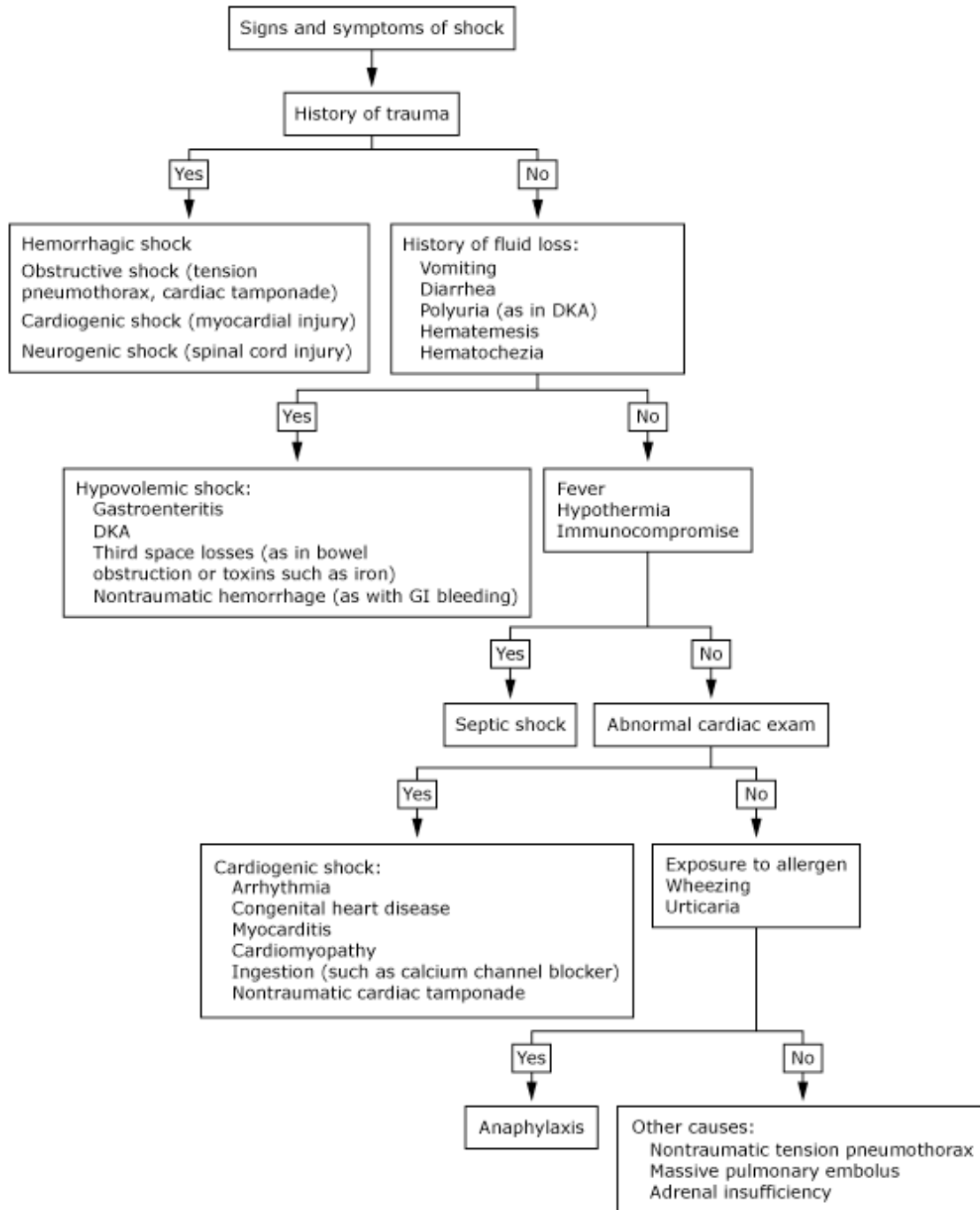
**Anaphylactic** History of exposure to an allergen, stridor or wheezing, wide pulse pressure, vasodilatation, urticaria, facial edema, abdominal cramping

**Neurogenic** History of trauma, decreased blood pressure with wide pulse pressure, normal heart rate or bradycardia

**Cardiogenic** History of heart disease, central cyanosis, signs of heart failure, heart murmur, decreased pulse or BP in lower extremities

**Obstructive** History of major chest injury, recent surgery or long bone fracture, narrow pulse pressure.

## Approach to the Classification of Undifferentiated Shock



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 Post Test**

1. Tissue perfusion is determined by \_\_\_\_\_ and \_\_\_\_\_.
2. Stroke volume is dependent on:
  - A. \_\_\_\_\_
  - B. \_\_\_\_\_
  - C. \_\_\_\_\_
3. List and define the 3 stages of shock.
  - A.
  
  
  
  - B.
  
  
  
  - C.
4. Match the classification of shock with its cause:
 

Hypovolemic _____	A. Results from pump failure
Cardiogenic _____	B. Results from a mechanical obstruction
Distributive _____	C. Results from decrease in SVR
Obstructive _____	D. Results from decreased preload
5. Fill in the effects that each of the 4 shock classifications has on preload, cardiac output and afterload.

	Preload	Cardiac Output	Afterload
Hypovolemic			
Cardiogenic			
Obstructive			
Distributive			

6. You are called to the scene of a 38 year old male who fell off a ladder onto his right side. Patient complains of severe pain to his left ribs. You note he is pale with increased work of breathing. VS: BP 88/70, HR 112 RR 36. You suspect the patient to be in :
- A. Neurogenic (distributive) shock
  - B. Obstructive shock
  - C. Hypovolemic shock
  - D. Cardiogenic shock
7. You arrive on the scene to find a 6y.o. female. Her parents tell you she has not been acting herself. She is lethargic with VS BP 72/34 HR 128 RR 40. You notice a petechial rash to both her lower extremities. You suspect the child to be in:
- A. Septic shock
  - B. Hypovolemic shock
  - C. Obstructive shock
  - D. Anaphylactic shock