Shock

- Syndrome of impaired oxygen delivery to tissues
- Mechanisms
  - Absolute/relative decrease in oxygen delivery
  - Ineffective tissue perfusion
  - Ineffective utilization of delivered oxygen

### Components of Shock

<table>
<thead>
<tr>
<th>Cardiac output</th>
<th>Filling pressures</th>
<th>Vascular resistance</th>
<th>ScvO₂, SvO₂</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiogenic</td>
<td>↓</td>
<td>↑</td>
<td>↑</td>
</tr>
<tr>
<td>Hypovolemic</td>
<td>↑</td>
<td>↑</td>
<td>↑</td>
</tr>
<tr>
<td>Distributive</td>
<td>↑ or N</td>
<td>↑</td>
<td>↑ or N</td>
</tr>
<tr>
<td>Obstructive</td>
<td>↓ or N</td>
<td>↑</td>
<td>↑ or N</td>
</tr>
</tbody>
</table>

### Examination

- Hypotension
  - Decreased pulse pressure
  - Cool extremities
  - Poor cap refill

- Wide pulse pressure

- Fluid Overload

- Hypovolemic

Diagnosis of SIRS requires at least 2 of the following:

1. Temperature >38°C or <36°C
2. Heart rate >90 beats/min
3. Respiratory rate >20 breaths/min, or arterial PCO₂ <32 mm Hg
4. WBC count >12,000/mm³ or <4,000/mm³, or >10% immature neutrophils (band forms)

### Management of Hypotension

#### Initial Fluid Bolus

- Hypovolemic
- Adequate Volume
- No Hypovolemic

- Inadequate Vasoactive

- Adequate BP

- Inadequate BP

#### Further Assessment

- Assess Volume Status
- Assess Oxygen Delivery
- Infuse Fluids and Vasoactive Agents

#### Guidelines for the Treatment of Severe Sepsis and Septic Shock from the Surviving Sepsis Campaign

- Begin goal-directed resuscitation during first 6 hours after recognition
- Begin initial fluid resuscitation with crystalloid and consider the addition of albumin
- Consider the addition of albumin when substantial amounts of crystalloid are required to maintain adequate arterial pressure
- Avoid betahematin formulations
- Begin initial fluid challenge in patients with tissue hypoperfusion and suspected hypovolemia, to achieve ≥30 ml of crystalloid per kilogram of body weight
- Continue fluid challenge technique as long as there is hemodynamic improvement
- Use norepinephrine as the first-choice vasopressor to maintain a mean arterial pressure of ≥65 mm Hg
- Use epinephrine when an additional agent is needed to maintain adequate blood pressure
- Add vasopressin (at a dose of 0.01 units/min) with warming of norepinephrine, if tolerated
- Avoid the use of dopamine except in carefully selected patients (e.g., patients with a low risk of arrhythmias and either normal left ventricular ejection fraction or low heart rate)
- Infuse dobutamine or add to vasopressor therapy in the presence of myocardial dysfunction (e.g., elevated cardiac filling pressures or low cardiac output) or ongoing hypoperfusion despite adequate intravascular volume and mean arterial pressure
- Avoid the use of intravenous hydrocortisone if adequate fluid resuscitation and vasopressor therapy restore hemodynamic stability; if hydrocortisone is used, administer at a dose of 100 mg/day

- Target a hematocrit level of 0 to 9 g/dl in patients without hypoperfusion, critical coronary artery disease or myocardial ischemia, or acute hemorrhage

### Interventions for Managing Shock

<table>
<thead>
<tr>
<th>Component</th>
<th>Intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood pressure</td>
<td>Fluids, vasopressor, or vasodilator*</td>
</tr>
<tr>
<td>Cardiac Output</td>
<td>Preload Fluids, vasodilator*</td>
</tr>
<tr>
<td>Contractility</td>
<td>Inotropic agents</td>
</tr>
<tr>
<td>Afterload</td>
<td>Vasopressor or vasodilator*</td>
</tr>
<tr>
<td>Oxygen Content</td>
<td>Mechanical ventilation, sedation, analgesia, antipyretics</td>
</tr>
</tbody>
</table>

*Vasodilator is only indicated when the patient is euvolemic or hypovolemic and the blood pressure is adequate

### Septic Shock

#### Septic Shock Overview

- Sepsis
- Sepsis-associated organ dysfunction
- Septic shock

### Cardiogenic Shock

#### Cardiogenic Shock Overview

- Myocardial dysfunction
- Cardiac output reduction
- Cardiac arrest

### Cardiogenic Shock Management

- Immediate transfer to intensive care unit

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