Author(s): Patrick Carter, Daniel Wachter, Rockefeller Oteng, Carl Seger, 2009-2010.

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Advanced Emergency Trauma Course

Shock

Presenter: Carl Seger, MD

Ghana Emergency Medicine Collaborative
Patrick Carter, MD • Daniel Wachter, MD • Rockefeller Oteng, MD • Carl Seger, MD
Overview

- Introduction
  - Definition
  - Physiology
- Initial Patient Assessment
  - Recognize
- Types of Shock
- Classes of Hemorrhagic Shock
- Treating Hemorrhagic Shock
  - Fluid/Blood Resuscitation
  - Evaluating treatment of Shock
Introduction

- In order to treat shock appropriately, it must first be recognized, then identify the cause.

- In order to recognize it, it is important to understand some of the physiology of the disease process.
Definition

- A physiological state that results in inadequate organ perfusion and tissue oxygenation

- Downward spiral of impaired perfusion leading to impaired function

- Results in multiple organ failure and death
Basic Physiology

- Oxygen Delivery = CO x arterial content of O2
- Cardiac Output = HR x Stroke Volume
- Stroke Volume is a function
  - Preload
  - Afterload
  - Myocardial Contractility
Pathophysiology

Blood loss

- Release of endogenous catecholamines
  - Increase cardiac output
    - Increase heart rate
    - Vasoconstriction of less vital organs
      - skin, muscle
  - Results in higher diastolic BP (narrow PP)
  - Continue to perfuse vital organs as long as possible (brain, heart, kidney)
Initial Patient Assessment

- Recognition of Shock
  - Clinical signs and symptoms depend on the severity of the shock
  - Early manifestations include tachycardia and cutaneous vasoconstriction
Clinical Pathophysiology of Shock

- General / Vital signs
- Cardiovascular- tachycardia
- Skin- vasoconstriction vs. vasodilation
- Respiratory- increased RR
- Urinary- decrease urine output
- Neurologic- confusion, agitation
- Extremities- cold vs. warm
Clinical Endpoints of Shock

DECREASED BLOOD FLOW TO BRAIN AND HEART
- Restless, agitated, confused, lethargy
- Hypotension
- Tachycardia
- Tachypnea

END-STAGE SHOCK
- Bradycardia
- Arrhythmias
- Death
Classifying Shock

- Hypovolemic
  - Hemorrhagic
- Distributive / Vasogenic
  - Sepsis, Anaphylactic
- Cardiogenic
- Neurogenic
  - Spinal cord injury
SIRS

- Systemic Inflammatory Response Syndrome - SIRS
  - Defined by the presence of two or more of the following:
    - Body temp < 36 °C (97 °F) or > 38 °C (100 °F)
    - Heart Rate > 90 bpm
    - RR > 20 bpm
    - WBC < 4,000 cells/mm$^3$ or > 12,000 cells/mm$^3$ (< $4 \times 10^9$ or > $12 \times 10^9$ cells/L), or greater than 10% band
Sepsis and Septic Shock

- **Sepsis**- Defined as SIRS in response to a confirmed infectious process.
- **Septic shock**- Defined as sepsis with refractory arterial hypotension or hypoperfusion abnormalities in spite of adequate fluid resuscitation.
Septic Shock

- A blood borne infection widely disseminated to many areas of the body
- Common features are high fever, vasodilatation (especially in affected tissues)
- Sludging of the blood, and RBC agglutination resulting in DIC

[Image of Staphylococcus aureus Gram stain]
Anaphylactic Shock

- An IgE mediated event that triggers massive release of immune response mediators
- Results in widespread peripheral vasodilation, bronchial smooth muscle contraction, and local vascular dilatation
Cardiogenic Shock

- Key elements are hypotension (SBP < 90) and hypoperfusion with pulmonary congestion
- Mortality is 50 - 80% before reperfusion therapy
- Acute myocardial ischemia is most common cause
Neurogenic Shock

- Result of spinal cord injury
- Loss of sympathetic tone
- Decreased vasomotor tone
- Results in hypotension and bradycardia
- Patients may remain alert, warm, and dry despite the hypotension

Photo of Christopher Reeve taken by gunkyboy (Wikipedia)
Case 1

- 29 y/o male, PVA while crossing the street, awake, complaining of severe back pain, and inability to move or feel his legs

- HR 45 RR 25  BP 100/45  SaO2 98% T34.0
What do we do next?

- Maintain ventilation
- Enhance perfusion
- Treat underlying cause
What studies or labs can help you immediately?

- X-rays
- FAST exam
- Frequent vital signs
- Continuous cardiac and oxygen monitoring

X-rays from the trauma bay
Neurogenic Resuscitation

- Adequate oxygenation
- Assess breathing
- Maximize circulation
  - IV fluids or blood
  - Pressors if necessary
- Support heart rate if needed
  - Atropine
- Prepare for the OR
Hypovolemic

- Hemorrhagic
  - Mostly traumatic
  - Focus of today
- Severe burn
- GI losses
  - vomiting and diarrhea
- Urinary
  - DKA
# Classes of Hypovolemic Shock

<table>
<thead>
<tr>
<th>CLASS</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>BVL</td>
<td>&lt; 15%</td>
<td>15 - 30%</td>
<td>30 - 40%</td>
<td>&gt; 40%</td>
</tr>
<tr>
<td>AMOUNT</td>
<td>750 cc</td>
<td>750 - 1500 cc</td>
<td>1500 - 2000 cc</td>
<td>&gt; 2000 cc</td>
</tr>
<tr>
<td>PULSE</td>
<td>&lt;100</td>
<td>&gt; 100</td>
<td>&gt;120</td>
<td>&gt;140</td>
</tr>
<tr>
<td>BP</td>
<td>No change</td>
<td>Narrowed pulse pressure</td>
<td>Consistent decrease in SBP</td>
<td>Decreased SBP and narrowed pulse pressure or no DBP</td>
</tr>
<tr>
<td>RESP</td>
<td>No change</td>
<td>20-30</td>
<td>30-40</td>
<td>&gt;35</td>
</tr>
<tr>
<td>CNS</td>
<td>No change</td>
<td>Anxiety</td>
<td>Anxious, confused</td>
<td>Confused. lethargic</td>
</tr>
<tr>
<td>Urine</td>
<td>&gt;30cc per hr</td>
<td>20-30cc per hr</td>
<td>5-15cc per hr</td>
<td>negligible</td>
</tr>
<tr>
<td>TX</td>
<td>Replace fluid loss</td>
<td>2L NS IV</td>
<td>2 L NS IV, usually requires blood transfusion</td>
<td>Rapid transfusion of blood and NS, requires immediate intervention to stop hemorrhage</td>
</tr>
</tbody>
</table>
Treating Hemorrhagic Shock

- As always ABC’s
  - Airway and Breathing
    - Would prefer O2 sat greater than 95%
    - Placing O2 on the patient
  - Circulation
    - Hemorrhage Control
    - Vascular Access, Large bore IV x 2
Monitoring

- Continuous monitoring
- Oxygen Saturation
- Urine output
Treating Hemorrhagic Shock

- Identify & reverse the cause
- Restore tissue perfusion
- Restore organ function
Initial Fluid Therapy

- Adult with normal Cardiac Function
  - 1 to 2 Liters of LR or NS rapidly
- Pediatric
  - 20ml/kg of LR or NS rapidly
- Evaluate patients response to fluid
Evaluation of Treatment

- Assess organ perfusion
  - Urinary output
  - Mental Status
  - Skin exam
  - Vitals
## Response to Initial Fluid

<table>
<thead>
<tr>
<th></th>
<th>Rapid Response</th>
<th>Transient Response</th>
<th>No Response</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Vitals</strong></td>
<td>Return to normal</td>
<td>Transient improvement with return to previous</td>
<td>Remain Abnormal</td>
</tr>
<tr>
<td><strong>Estimated Blood loss</strong></td>
<td>10-20%</td>
<td>20-40% with ongoing likely</td>
<td>Severe &gt;40%</td>
</tr>
<tr>
<td><strong>Need for more Fluid</strong></td>
<td>Low</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td><strong>Need for Blood</strong></td>
<td>Type and cross</td>
<td>Type specific</td>
<td>O neg</td>
</tr>
<tr>
<td><strong>Need for surgery</strong></td>
<td>Possible</td>
<td>Likely</td>
<td>Highly likely</td>
</tr>
</tbody>
</table>
Case 2

- 25 year old male in a head on motor vehicle accident. He has sustained obvious chest and abdominal trauma and has a GCS of 13.

- VS: HR 125  RR 28  BP 100/50  T 36.0  Sa02 93% on 100%

- Patient is agitated and confused.
What class of Shock?

- Class III
- ABC
- IV Access
- 2 liters of NS
Case #2 cont

- Patients Vitals after 2 liters:
  - HR 95 RR 25 BP 110/70
Case #3

- 17 y/o male cuts his inner thigh with a sickle
  - Presents hemorrhaging from left groin area
  - Awake and Alert
  - VS: BP 120/60 HR 120 RR 30 Sat 98% on RA
  - Pt has pulse distally in Lt Leg
What to do?

- ABC
  - Direct Pressure to bleeding area
  - IV Access
  - 2 Liters NS
Case #3

- After 2 Liters
  - Having difficulty controlling bleeding
  - Vital Signs
    - HR 130 BP 85/60 RR 30 Sat 100% on NC
Case #3

What Next?

- More Fluid
- Blood
- Surgeon?
Which Pressor should I choose?

- **Hypovolemic shock**
  - Fluids and Blood

- **Cardiogenic shock**
  - Dobutamine - B1 agonist
    - Increases squeeze and heart rate

- **Neurogenic shock**
  - Fluids, phenylephrine, Levophed, look for another type of shock if it is persistent

- **Anaphylactic shock**
  - Fluids and epinephrine

- **Septic shock**
  - Neosynephrine - alpha agonist
    - Increases SVR by arteriolar constriction
  - Norepinephrine/Levophed - alpha and beta agonists

- **Dopamine**
  - Low Dose - increases renal blood supply
  - Medium Dose - beta effects (increases heart rate and squeeze)
  - High Dose - alpha effects (arteriolar constriction)
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Questions?

Dksully (flickr)
References