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Recognition and Management of Shock

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Shock: Lecture Objectives

- Define shock
- Recognize stages or degrees of shock
- Know appropriate management for each stage
Shock

• Definitions:
  • A state of inadequate tissue oxygenation & organ perfusion
  • Situation when the circulation is inadequate for metabolic needs
Principles of Shock Recognition and Management

• Patients in shock may only exhibit subtle signs
• Identifying the cause is usually less important than starting treatment
• Goal is to restore perfusion and correct the shock state
• Frequent reassessment of response to treatment is important
The Body's Mechanisms to Try to Compensate for Shock

- Increase cardiac output: tachycardia
- Increase oxygen supply: tachypnea
- Release of vasoactive mediators
  - Nausea
  - Peripheral vasoconstriction
    - Cool, clammy skin, increased diastolic pressure, decreased urine output
- **Note**: "Compensated" shock is still dangerous and needs treatment; pediatric patients may maintain a partially compensated shock and then suddenly catastrophically deteriorate
Types of Shock

• Hemorrhagic: most common in trauma patients
• Hypovolemic (emesis, diarrhea, etc.)
• "Obstructive"
  • Pulmonary embolus, cardiac tamponade, tension pneumothorax
• Cardiogenic
  • Acute myocardial infarction, Myocardial contusion
• Neurogenic
• Septic
• Anaphylactic
Principle of Treatment for Shock

• In the trauma patient in shock: *always* treat for hemorrhagic shock first
General Symptoms of Shock

- Weakness
- Dizziness
- Lightheadedness
- Nausea
- Sense of impending doom
General Signs of Shock

- Decreased mental status or confusion
- Cool, clammy, or grey or ashen color skin
- Diaphoresis
- Tachycardia
- Tachypnea
- Hypotension
- Oliguria
Hemorrhagic Shock

- **Hemorrhage definition:**
  - Acute loss of circulating blood; can be internal and/or external

- **Normal body blood volume**
  - Adults: 7% of ideal body weight
    - 5 liters in 70 kg adult
  - Children: 8% of ideal body weight
    - 80 ml/kg
The Four Stages of Hemorrhagic Shock

- Stage 1 hemorrhage: 0 to 15% of total blood volume (TBV)
- Stage 2 hemorrhage: 15 to 30% of TBV
- Stage 3 hemorrhage: 30 to 40% of TBV
- Stage 4 hemorrhage: > 40% of TBV
# Comparison of the Four Stages of Hemorrhagic Shock

<table>
<thead>
<tr>
<th>Stage</th>
<th>Blood lost (cc)</th>
<th>% TBV lost</th>
<th>CNS SX</th>
<th>Systolic BP</th>
<th>Diastolic BP</th>
<th>Resps.</th>
<th>Pulse</th>
<th>Urine Output (ml/hr)</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>&lt;750</td>
<td>0 to 15</td>
<td>Slightly anxious</td>
<td>Normal.</td>
<td>Normal.</td>
<td>14 to 20</td>
<td>&lt;100</td>
<td>&gt;30</td>
<td>Crystalloid</td>
</tr>
<tr>
<td>2</td>
<td>750 - 1500</td>
<td>15 to 30</td>
<td>Mildly anxious</td>
<td>Normal.</td>
<td>Normal.</td>
<td>20 to 30</td>
<td>&gt;100</td>
<td>20 to 30</td>
<td>Crystalloid, may need blood</td>
</tr>
<tr>
<td>3</td>
<td>1500 - 2000</td>
<td>30 to 40</td>
<td>Confused, anxious</td>
<td>30 to 40</td>
<td>&gt;120</td>
<td>5 to 15</td>
<td>Crystalloid &amp; blood</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>&gt;2000</td>
<td>&gt;40</td>
<td>Lethargic or unconc.</td>
<td>&gt;40</td>
<td>&gt;140</td>
<td>Negligible</td>
<td>Rapid fluids, blood, surgery</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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14
Stage 1 Hemorrhage

- Blood lost: < 750 cc
- % TBV lost: 0 to 15
- CNS Symptoms: Slightly anxious
- Systolic BP: Normal
- Diastolic BP: Normal
- Respirations: 14 to 20
- Pulse: < 100
- Urine Output (ml/hr): ≥ 30
- Treatment: crystalloid (3 to 1 ratio) IV
Stage 2 Hemorrhage

- Blood lost: 750 to 1500 cc
- % TBV lost: 15 to 30
- CNS Symptoms: mildly anxious
- Systolic BP: normal
- Diastolic BP: increased
- Respirations: 20 to 30
- Pulse: > 100
- Urine output: 20 to 30 cc/hr
- Treatment: crystalloid, may need blood
Stage 3 Hemorrhage

- Blood lost: 1500 to 2000 cc
- % TBV lost: 30 to 40
- CNS symptoms: confused, anxious
- Systolic BP:
- Diastolic BP:
- Respirations: 30 to 40
- Pulse: > 120
- Urine output: 5 to 15 cc/hr
- Treatment: crystalloid and blood
Stage 4 Hemorrhage

- Blood lost: > 2000 cc
- % TBV lost: > 40
- CNS symptoms: lethargic or unconscious
- Systolic BP: ᵒ ᵒ
- Diastolic BP: ᵒ ᵒ
- Respirations: > 40
- Pulse: > 140
- Urine output: negligible
- Treatment: rapid fluids, blood, surgery
Variations in Manifestations of the Four Stages of Shock

• Patients do not always show the progression of signs & sx listed on the prior 4 slides with progression of the degree or severity of shock

• Some adults, especially young adults, may have normal pulse rates or even bradycardia with stage 2 or 3 shock

• Pediatric patients may remain in "compensated" shock until almost preterminal stage 4 shock
Sequence of Assessment of the Patient in Shock

- Airway
- Breathing
  - Oxygenate
  - Ventilate
- Circulation
  - Stop external hemorrhage with direct pressure
  - Start IV fluid resuscitation
  - Assess for "obstructive shock"
    - Tension pneumothorax: needle thoracostomy
    - Cardiac tamponade: pericardiocentesis
Rapid Fluid Resuscitation for Shock

- Draw blood for type and cross-match from the needlestick for the IV line
- Place large bore (> 18 gauge) IV if possible
- Place 2 IV lines if Stage 3 or 4 shock
- Initially run fluid in "wide-open"
  - Use large drip chamber IV tubing
  - May need pressure bags on the IV bags
  - Usually use Lactated Ringers
    - Choose normal saline if patient may be hyperkalemic
    - Normal saline also preferred for same IV line to be used for blood transfusion
- Do not use vasopressors; treat with fluids
Alternative Vascular Access Sites for Shock Treatment

- Peripheral vein in upper extremity; Preferred in most patients
  - Avoid if possible proximal limb fracture
- Central veins
- Subclavian or internal jugular vein; accessible even in Stage 4 shock
  - Access can cause pneumothorax (always get CXR to check)
- Femoral vein; easy and safer to place
  - If abdominal injury present, fluid may extravasate in abdomen
- Intraosseous line: may be easiest and even preferred initial route in children; can also be tried in adults
- Intraperitoneal
Other Resuscitative Procedures for Severe Shock

- Blood transfusion
  - Type - O-negative (if needed immediately)
  - Type - specific (if needed in < 15 minutes)
  - Fully crossmatched

- Emergent left thoracotomy, pericardiotomy, aortic clamping

- Autotransfusion
  - Most useful for blood output from chest tubes
Indications for Emergent Transfusion With O-Negative Blood

- No palpable blood pressure at arrival
- Multiple simultaneous patients requiring emergent transfusion
- Rapid deterioration or sudden large volume external blood loss and type specific blood not immediately available
Indications for Transfusion With Type-Specific or Fully Crossmatched Blood

- **Type-specific**: (usually takes 5 to 10 minutes to obtain from blood bank)
  - Transfusion emergent but can wait 10 minutes but not 60 minutes
- **Fully crossmatched**: (takes 45 to 60 minutes)
  - Patient stable enough that transfusion can be delayed 45 to 60 minutes until blood is ready
Non-Hemorrhagic Types of Shock

- Hypovolemic (non-hemorrhagic) shock
  - Due to vomiting, diarrhea, "third spacing" of fluid
  - Treat with IV Lactated Ringers or saline
  - Does not need blood transfusion

- Anaphylactic shock
  - Due to allergic reaction with release of vasoactive mediators which can cause airway edema & vasodilatation
  - Treat with IV fluids & epinephrine
Non-Hemorrhagic Types of Shock (cont.)

- **Septic Shock**
  - Can be a late or delayed complication
  - Patient may have fever or hypothermia
  - Treat with IV fluids; sometimes need secondary treatment with vasopressors
  - Finding and directly treating the source of the sepsis is critical to save the patient (start antibiotics, drain abscess if present, etc.)
Non-Hemorrhagic Types of Shock (cont.)

- "Obstructive": key sign is distended neck veins in the patient with shock
  - Tension pneumothorax
    - Treat with anterior needle thoracostomy
  - Cardiac tamponade
    - Treat initially with IV fluids
    - Consider pericardiocentesis
  - Pulmonary embolus:
    - Need to confirm diagnosis (V/Q or spiral CAT scan)
    - Then treat with thrombolytics or embolectomy
Non-Hemorrhagic Types of Shock (cont.)

- Cardiogenic: due to heart pumping dysfunction
  - Acute myocardial infarction (sometimes this can be the original cause of a person injuring themself in a traffic accident or fall)
  - Myocardial contusion
    - Actually is rare even with major blunt chest trauma
  - May require treatment with vasopressors (dopamine)
Non-Hemorrhagic Types of Shock (cont.)

- **Neurogenic**: due to spinal cord injury and loss of sympathetic nervous system outflow
  - Results in venous pooling, peripheral vasodilation
  - Often has relative bradycardia
  - Treat with IV fluids first, then alpha vasoconstrictors if hypovolemic shock ruled out

- **Spinal shock**: actually is a "cord-stunning" syndrome
  - Flaccidity and loss of reflexes
  - Is an "electrical" phenomenon of the spinal cord
  - May have complete recovery
Pneumatic Anti-Shock Garment (PASG)

- Also called MAST (Military Anti-Shock Trousers)
- Probably not useful for most trauma cases
- Some studies actually indicate increased mortality with routine use
- Placement can interfere with physical exam and placement of femoral IV lines
- Dangerous if prematurely or rapidly deflated
- Most of complications associated with inflation of abdominal compartment
- Prolonged inflation can cause compartment syndrome
Pneumatic Anti-Shock Garment (PASG)

- Inflation may be helpful for:
  - Reducing bleeding from pelvic fractures
  - Splinting fractured femurs
  - Non-pharmacologic treatment of Supraventricular tachycardia
  - Anaphylactic shock
PASG : Contraindications

- Pregnancy
- Evisceration
- Suspected diaphragm rupture
- Increased intracranial pressure
- Uncontrolled hemorrhage from body area (chest) not covered by the garment
- Pulmonary edema
Measurement of Central Venous Pressure (CVP) in Shock Patients

- CVP acts as measure of right side of heart's ability to accept a fluid load
- Central venous IV line not needed for most trauma patients
- CVP line measurements may be helpful for patients with:
  - Preexistent cardiac dysfunction (CHF)
  - Implanted pacemaker
  - Neurogenic shock
  - Myocardial contusion
  - Suspected cardiac tamponade
Interpretation of Initial CVP in Trauma Patients

- Low (< 6 mm Hg) : Hypovolemia
  - Continue IV fluids or transfusion
- High (> 15 to 18 mm Hg) :
  - Hypervolemia (overtransfusion)
  - Right heart failure (infarction)
  - Cardiac tamponade
  - Lung disease
  - Tension pneumothorax
  - Catheter malposition
  - Vasopressors or PASG inflation
## Interpretation of CVP Changes With Resuscitation

<table>
<thead>
<tr>
<th>Initial CVP</th>
<th>Change</th>
<th>Interpretation</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>None</td>
<td>Persistent Hypovolemia</td>
<td>More IV fluid</td>
</tr>
<tr>
<td>Low</td>
<td>Rising</td>
<td>Resuscitation succeeding</td>
<td>Slow IV rate</td>
</tr>
<tr>
<td>Low or Mid</td>
<td>Falling</td>
<td>Ongoing fluid loss</td>
<td>More rapid IV fluid</td>
</tr>
<tr>
<td>High</td>
<td>None</td>
<td>Hypervolemia or problems on prior slide</td>
<td>Slow IV rate</td>
</tr>
</tbody>
</table>
Monitoring of the Shock Patient

- Response to therapy judged by monitoring:
  - Patient's mental status & speech
  - Pulse, blood pressure, respirations
  - Urine output (should be at least 1 cc / Kg / hr. or 30 cc / hr in adults)
  - Capillary refill & skin pertusion
  - CVP
  - Lab data (less important than clinical parameters)
Lab Results in the Shock Patient

- **Hematocrit**
  - May be normal initially despite severe blood loss
  - If low initially may represent very severe blood loss

- **Blood urea nitrogen**
  - May be elevated if hypovolemic (prerenal azotemia) or if blood in upper GI tract
  - Small elevations may represent severe dehydration in children

- **Serum glucose**
  - May be highly elevated from stress alone (not due to diabetes)
Lab Results in the Shock Patient (cont.)

- **White blood cell count**
  - Whether high or normal or low has little diagnostic or prognostic significance

- **Serum calcium**
  - May be low if citrated blood transfused
  - Usually not necessary to treat
Causes of Coagulopathy in the Shock Patient

• Hypothermia: (usually temp. < 35.5 degrees Celsius)
  • Most common cause
  • Very important to take all possible measures to prevent
• Massive transfusion
  • "Washout" of coagulation factors and platelets
  • May need one unit fresh frozen plasma per 6 to 8 units of blood transfused
  • May need one pack (6 to 8 units) of platelets per 8 to 12 units of blood transfused
• Sepsis
• Preexistent coagulopathy or liver failure
• Drug or toxin effect
Considerations If the Patient Fails to Respond to Treatment for Shock

- Unrecognized fluid loss
- Ventilation problems
- Acute gastric distention
  - Treat by NG tube / suction
- Cardiac tamponade
- Acute myocardial infarction
- Diabetic Ketoacidosis
- Adrenal crisis
- Neurogenic shock
- Hypothermia
- Drug or toxin effect
# Hidden Blood Loss from Fractures

<table>
<thead>
<tr>
<th>INJURY</th>
<th>Range of Blood Loss (ml)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Closed leg fracture</td>
<td>500 to 1000</td>
</tr>
<tr>
<td>Closed femur fracture</td>
<td>500 to 2500</td>
</tr>
<tr>
<td>Open femur fracture</td>
<td>1000 to &gt; 2500</td>
</tr>
<tr>
<td>Closed arm fracture</td>
<td>500 to 750</td>
</tr>
<tr>
<td>Closed spine fracture</td>
<td>500 to 1500</td>
</tr>
<tr>
<td>Closed pelvis fracture</td>
<td>1000 to &gt; 3000</td>
</tr>
<tr>
<td>Open pelvic fracture</td>
<td>&gt; 2500</td>
</tr>
</tbody>
</table>
Shock Assessment & Treatment Summary

- Start shock treatment with the primary survey
- Categorize the initial estimated blood loss
- Assess the type(s) of shock present
- Frequently reassess the response to treatment
- Progressive or non-responsive shock may require emergent surgery for correction