

## Trauma Resuscitation

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### Shock:

Shock is defined as inadequate delivery of oxygen to the tissues. Therefore, our goal in the treatment of shock is to improve oxygen delivery

**There are four key components required for adequate delivery of oxygen to the tissues:**

Key Component #1:

#### Clear and unobstructed airway

The following conditions impair this component:

Foreign material

Facial fractures

Neck hematoma

Upper airway injury

KeyComponent #2:

#### Adequate Oxygenation

The following conditions impair this component:

Impaired ventilation

Impaired oxygen diffusion (movement from alveoli into capillary)

Decreased circulating volume or hemoglobin

Key Component #3:

#### Adequate Ventilation

The following conditions impair this component:

Rib / thoracic vertebrae fractures

Chest wall contusions

Flail chest

Pneumothorax / hemothorax

Pulmonary contusion

Key Component #4:

#### Adequate Circulation

The following conditions impair this component:

Massive Hemorrhage

Chest – 2 liters

Abdomen – 3 liters

Pelvis – 1 – 2 liters

Femur – 1 – 1.5 liters

Mechanical

Pericardial tamponade

Tension pneumothorax/hemothorax

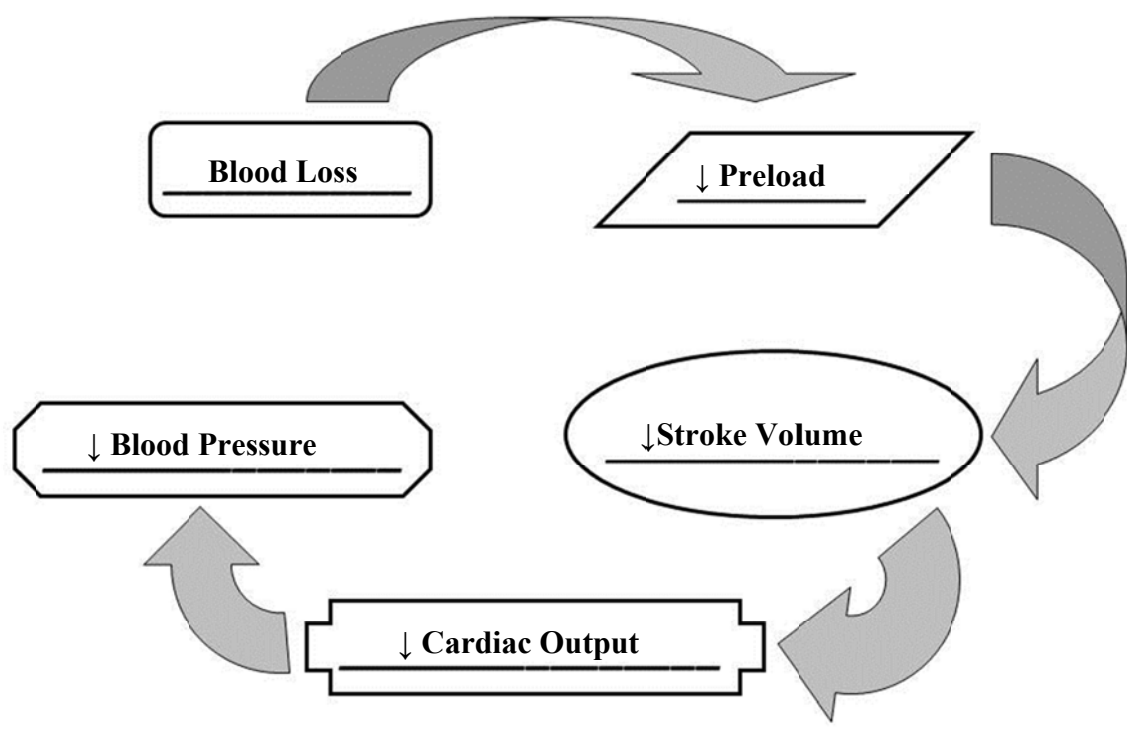
Blunt myocardial injury

Dysrhythmias

Impaired contractility (contusion)

**The three main forms of shock we deal with in trauma are:**

- Mechanical / Obstructive
  - Impaired heart filling
  - Pump problems
- Distributive / Neurogenic
  - Affect blood vessel tone -> increased size of the container
- Hemorrhagic: What happens when we bleed?



The body has several **compensatory mechanisms** in response to hemodynamically significant hemorrhage. All of these mechanisms lead to **sympathetic nervous system (fight or flight) stimulation** and involve:

- Vasoconstriction & Venoconstriction shunts blood away from:
  - **Skin**
  - **Skeletal muscles**
  - **Gut circulation**
- Preferential increase in **coronary** & **cerebral** circulation
- Increased **central venous** blood flow
- Decreased **renal** blood flow occurs last

### **Specific Compensatory Mechanisms**

- Baroreceptors sense **pressure** and cause an **increase** in **heart rate**
- Circulating **vasoconstrictors (like epinephrine)** cause **increased vascular tone and heart rate**
- Fluid shifts from the **cells** into the **capillaries** to help restore volume.
- Stimulation of the thirst mechanism **increases fluid intake** and causes the kidneys to absorb **sodium** & **water**

### **Initial Contact:**

Is the patient sick or not sick? Six things that say “SICK!!!” are:

- **Decreased level of consciousness**
- **Noisy respirations**
- **Pale, gray, mottled, or cyanotic skin**
- **Abnormal respiratory patterns**
- **Abnormal chest wall movement**
- **Uncontrolled external hemorrhage in combination with above**

Sick patients require: **IMMEDIATE TRANSPORT!!!**

## **Clear and Unobstructed Airway:**

The first key component in achieving the goal of oxygen delivery is insuring the patient has a clear and unobstructed airway.

### Assessment:

Signs of airway issues include:

- **Altered mental status**
- **Gurgling or snoring**
- **Facial injury**
- **Neck trauma, masses**
- **Hoarse voice**
- **Neck asymmetry**

### Management Plan:

**The goal is to manage the airway, which can be accomplished in a number of ways based upon the specific patient, the tools available, and comfort with those tools. Intubation does not a paramedic (or CCT or I) make! Its choosing the correct method for the specific patient.**

## **Adequate Oxygenation:**

The second key component in achieving the goal of oxygen delivery is insuring the patient has adequate oxygenation.

### Assessment:

Signs of inadequate oxygenation:

- **Altered mental status** (often the earliest sign of hypoxemia)
- Cyanosis of the **mucous membranes** (first areas to become cyanotic)
- **Pallor** (may be secondary to hypoxia or circulatory collapse)
- **Pulse oximetry** (often unreliable – check waveform)

### Management Plan:

**High flow, high concentration oxygen** should be administered to all **hypoxis** or **hypotensive** patients.

## **Adequate Ventilation:**

The third key component in achieving the goal of oxygen delivery is insuring the patient has adequate ventilation.

### Assessment:

- Observe the patient for signs of increased work of breathing which include:
  - **Accessory muscle use**
  - **Pursed lip breathing**
  - **Sternal retractions**
  - **Intercostal retractions**
- Observe chest for **wounds, ecchymosis**
- **Auscultate** the chest for **lung aeration**
- Palpate the chest for **instability, crepitus, and subcutaneous emphysema**

- A tension pneumothorax is a life threatening condition! Assessment findings that suggest a tension pneumothorax include:
  - **Severe dyspnea**
  - **Decreased SaO<sub>2</sub>**
  - **Hypotension**
  - **Increased jugular venous pressure (JVD)**
  - **Absent breath sounds**
  - **Hyperresonant percussion note (like a snare drum)**
  - **Penetrating chest trauma**

**Notice I did not list tracheal deviation which is a late sign that is very difficult to appreciate! If you wait until the patient's trachea deviates, your patient will be dead!**

#### Management Plan:

- Inadequate ventilation should be treated with **BVM assist**
- An open pneumothorax should be treated with **occlusive dressing**
- A tension pneumothorax should be treated with **needle decompression (needle thoracostomy)** using a needle that is at least **5** cm long.

### **Adequate Circulation:**

The fourth key component in achieving the goal of oxygen delivery is insuring the patient has adequate circulation. Assessment attempts to determine cause for shock.

#### Assessment:

- **Skin color** and **capillary refill** are early indicators of poor perfusion even with a normal blood pressure and heart rate.
- The pulse pressure (difference between systolic and diastolic pressures) will initially be **narrowed** because of the “fight or flight” (sympathetic nervous system) activation but will **widen** due to fluid loss.
- **Uncontrolled hemorrhage** is always assumed to be the cause of hypotension.
- To help identify neurogenic (distributive) shock, observe for:
  - **Spontaneous extremity movement**
  - **Warm, pink skin** below level of injury and **pale, cool skin** above the level of injury.
- To help identify obstructive shock, observe for:
  - **Distended neck veins**
  - Signs of:
    - **Tension pneumothorax** or
    - **Pericardial tamponade**

#### Management Plan:

- The two main treatments for **hemorrhagic shock** are, in order, **STOP THE BLEEDING** and **FLUID RESUSCITATION**
- Hemorrhage control notes:

**The use of tourniquets for extremity hemorrhage is back into consideration and some would argue (including myself) that their use should be moved up the algorithm for significant extremity hemorrhage, especially in the situation where the patient has multiple issues or is critically ill. Based on data from the recent wars, the dreaded complication of**

**losing a limb from the tourniquet or long term neurologic or vascular damage does not occur. This link brings you to a good article regarding tourniquets along with suggested algorithm. This is the same as presented in the Prehospital Emergency Care journal article below. You can also download my talk on Tourniquets from my website for more info.**

[http://www.jems.com/resources/supplements/the\\_war\\_on\\_trauma/tourniquet\\_first.html](http://www.jems.com/resources/supplements/the_war_on_trauma/tourniquet_first.html)

- Fluid resuscitation notes:
  - Recommended fluid resuscitation endpoints:
    - **Palpable radial pulse**
    - **Appropriate mentation in a non-head injured patient**
    - **MAP 40 – 60 or SBP 90 – 100**

**There is a lot of good evidence that we should not be rapidly infusing 2 liters of IV fluids into most trauma patients. It takes approximately a half hour for a clot to form and stabilize. During that time, the clot is sensitive to pressure changes. Disruption of the clot can lead to increased bleeding. Large volume IV fluid administration can also cause dilution of clotting factors, hypothermia, and immune / inflammatory system activation with as little as 750 ml infusion. The recommendation is to titrate fluid administration to the endpoints above. For more information, please download my talk on Permissive Hypotension from my website.**

- Neurogenic shock notes:

**Because neurogenic shock often does not respond to IV fluids, vasopressors may be required to help decrease the size of the vessels and increase the blood pressure. While dopamine is more familiar, other pure alpha adrenergic medications, for example norepinephrine and phenylephrine, are preferred because they don't affect the heart rate as much as dopamine.**

- Special Case of Adrenal insufficiency:

**Adrenal insufficiency occurs when the adrenal glands do not produce enough cortisol, a natural steroid. Whether the cause is congenital or acquired, the body doesn't produce enough cortisol to compensate for the stress. These patients**

**Patients with congenital adrenal insufficiency often have a medical alert bracelet or tag and carry a kit that contains hydrocortisone. In the absence of a kit, administering either hydrocortisone 100 mg IV or methylprednisolone 125 mg IV will help the patient respond to stress. Hydrocortisone is preferred as methylprednisolone will only partially replace the hormones required but methylprednisolone will at least temporarily help resuscitate the patient. YOU MUST TELL THE ED STAFF / PHYSICIAN THE PATIENT HAS ADRENAL INSUFFICIENCY AS UNTREATED, IT CAN CAUSE DEATH.**

## Key References:

- Davis DP, Hoyt DB, Ochs M, et al. The effect of Paramedic rapid-sequence intubation on outcome in patients with severe traumatic brain injury. *Journal of Trauma* 2003;54(3):444-453
- Doyle GS, Taillac PP. Tourniquets: a review of current use with proposals for expanded prehospital use. *Prehospital Emergency Care* 2008;12(2):241-256
- Stern SA. Low volume fluid resuscitation for presumed hemorrhagic shock: helpful or harmful? *Curr Opin Crit Care* 2001;7:422-430