Shock Classification and Treatment in EMS

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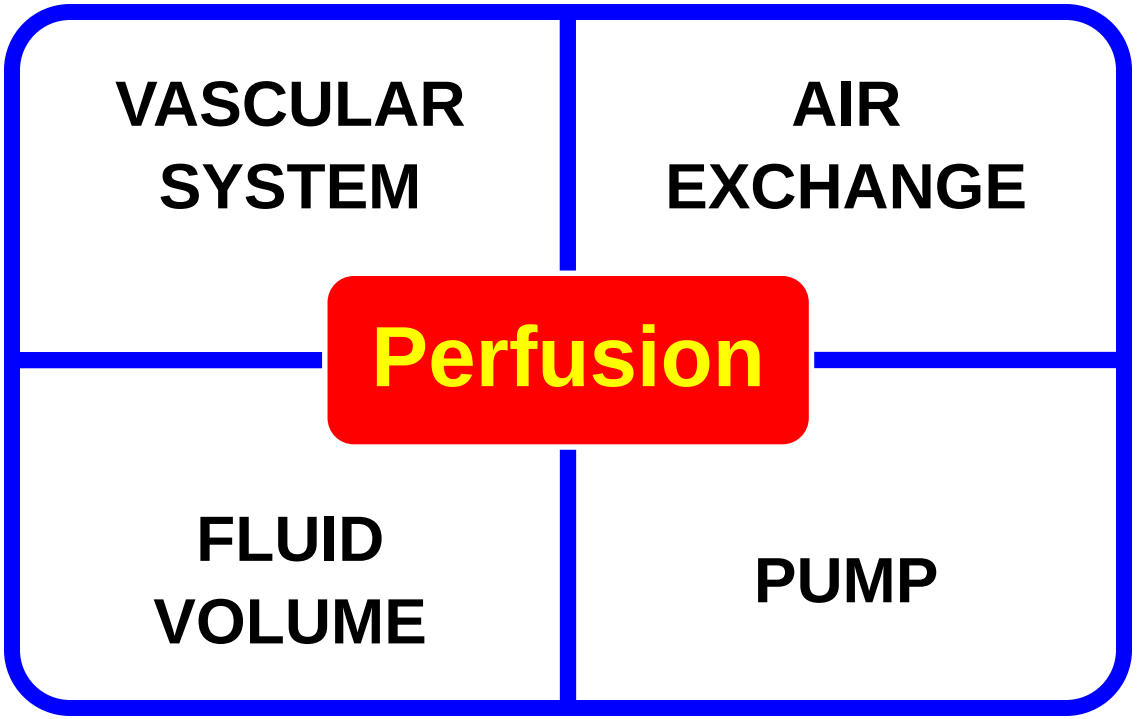
Objectives

- List the four components of normal tissue perfusion
- Describe the symptoms and signs of shock
- Describe the four common clinical shock syndromes
- Explain the pathophysiology of hemorrhagic shock,
- Describe the management of Hemorrhage shock

Objectives

- Discuss the use of hemostatic agents
- Discuss the use of IV fluids in the treatment of hemorrhagic shock
- Describe when it is appropriate to use tranexamic acid (TXA) in the management of hemorrhage

Normal Perfusion



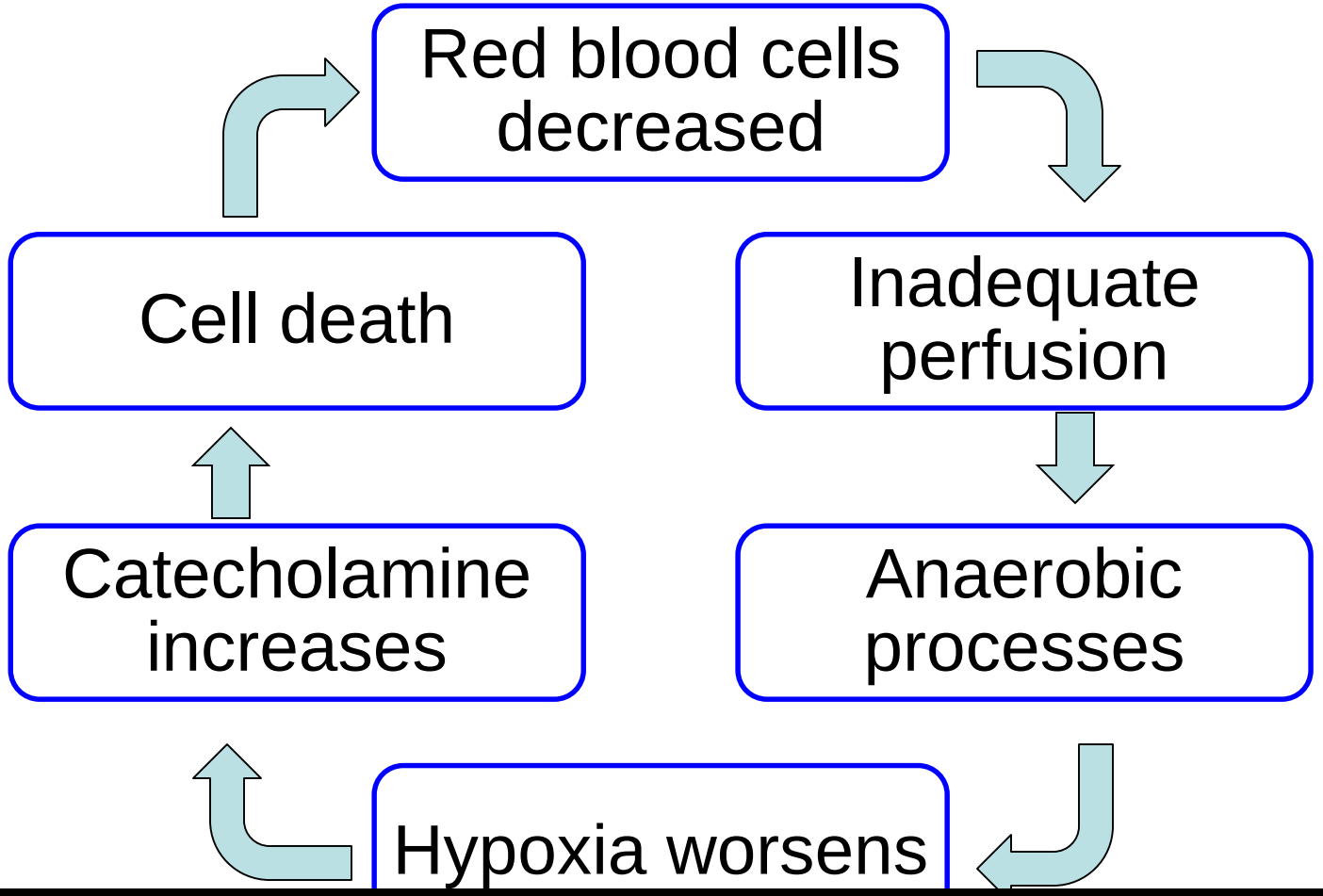
➢ Normal Perfusion

Blood Pressure = Cardiac Output × PVR

Cardiac Output = Heart Rate × Stroke Volume

CO = 70 bpm × 70 ml = 4900 ml

Shock Progression



Shock

- **Shock is a continuum**
  - Signs and symptoms are progressive
  - Many symptoms due to catecholamines
  - Cellular process has clinical manifestations
- **Compensated and decompensated**
  - How low can you go?
  - Healthy versus older or underlying problems

Hypovolemic Shock

- **Compensated progression**
  - Weakness and lightheadedness
  - Pallor
  - Tachycardia
  - Diaphoresis
  - Tachypnea
  - Urinary output decreased
  - Peripheral pulses weakened
  - Thirst

Hemorrhagic Shock

American College of Surgeons Classes of Acute Hemorrhage

Factors	I	II	III	IV
Blood loss	<15% (<750ml)	15-30% (750-1500ml)	30-40% (1500-2000ml)	>40% (>2000ml)
Pulse	>100	>100	>120	>140
B.P.	Normal	Normal	↓	↓↓
Pulse pressure	N or ↓	↓	↓↓	↓↓
Capillary refill	<2s	2-3s	3-4s	>5s
Resp. rate	14-20	20-30	30-40	>40
Urine output ml/hr	30 or more	20-30	5-10	Negligible
Mental status	Slightly anxious	Mildly anxious	Anxious & confused	Confused Lethargic

Shock Progression

- **Compensated to decompensated**
  - Initial rise in blood pressure due to shunting
  - Initial narrowing of pulse pressure
    - Diastolic raised more than systolic
  - Prolonged hypoxia leads to worsening acidosis
  - Ultimate loss of catecholamine response
  - Compensated shock suddenly “crashes”

Hypovolemic Shock

- **Decompensated progression**
  - **Hypotension**
    - Hypovolemia and/or diminished cardiac output
  - **Altered mental status**
    - Decreased cerebral perfusion, acidosis, hypoxia, catecholamine stimulation
  - **Cardiac arrest**
    - Critical organ failure
      - Secondary to blood or fluid loss, hypoxia, arrhythmia

Classic Shock Pattern

- **Early shock**
  - 15–25% blood volume
  - Weakness
  - Pallor
  - Tachycardia 120 B/M
  - Narrowed pulse pressure
  - Thirst
  - Delayed capillary refill
- **Late shock**
  - 30–45% blood volume
  - Hypotension
    - First sign of “late shock”
  - Weak or no peripheral pulse
  - Prolonged capillary refill

Capillary Refill

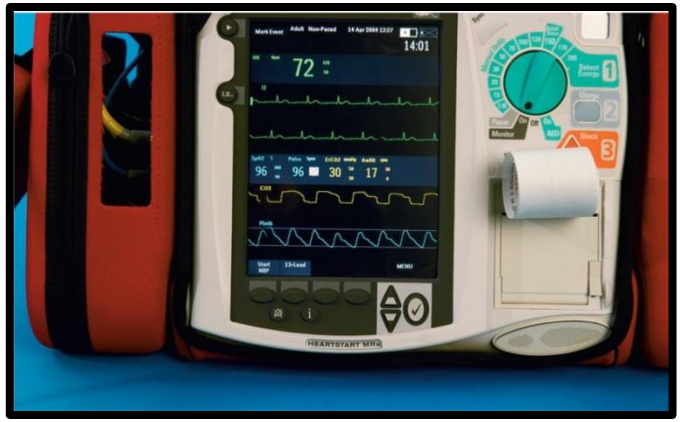
Capillary Refill

Tachycardia

- Most common early sign of illness
  - Transient rise with anxiety, quickly to normal
  - Determine underlying cause
- **Early sign of shock**
  - **Suspect hemorrhage: sustained rate >100**
  - **Red flag for shock: pulse rate >120**
- No tachycardia does not rule out shock
  - "Relative bradycardia"

Capnography

- Level of exhaled CO_2 as waveform ($ETCO_2$)
  - **Typically ~35–40 mmHg**
- **Falling $ETCO_2$**
  - Hyperventilation or decreased oxygenation
- **$ETCO_2$ <20 mmHg**
  - May indicate circulatory collapse
  - Warning sign of worsening shock



Courtesy of Louis B. Mallory, MBA, REMT-P

Shock Classification (Syndromes)

1. Low-volume shock

- **Absolute hypovolemia**
  - **Hemorrhagic**
    or other **fluid loss**

2. Distributive shock

- **Relative hypovolemia**
  - **Neurogenic shock**
  - **Vasovagal syncope**
  - **Sepsis**
  - **Drug overdose**
  - **Anaphylaxis**

3. Mechanical shock

- **Obstructive**
  - **Cardiac tamponade**
  - **Tension pneumothorax**
  - **Massive pulmonary embolism**

4. Cardiogenic

- **Myocardial contusion**
- **Myocardial infarction**
- **Severe Arrythmias**

Low-Volume Shock

- **Absolute hypovolemia**
  - **Loss of volume**
    - Blood vessels can hold more than actually flows
    - **Catecholamines cause vasoconstriction**
      - Minor blood loss: vasoconstriction sufficient
      - Severe blood loss: vasoconstriction insufficient
- **Clinical presentation**
  - **"Thready" pulse; tachycardia; pale, flat neck veins**

High-Space Shock

- **Relative hypovolemia**
  - "Vasodilatory shock"
  - Large intact vascular space
  - Interruption of sympathetic nervous system
  - Loss of normal vasoconstriction; vascular space becomes much "too large"
- **Clinical presentation**
  - Varies dependent on type of high-space shock

High-Space Shock Types

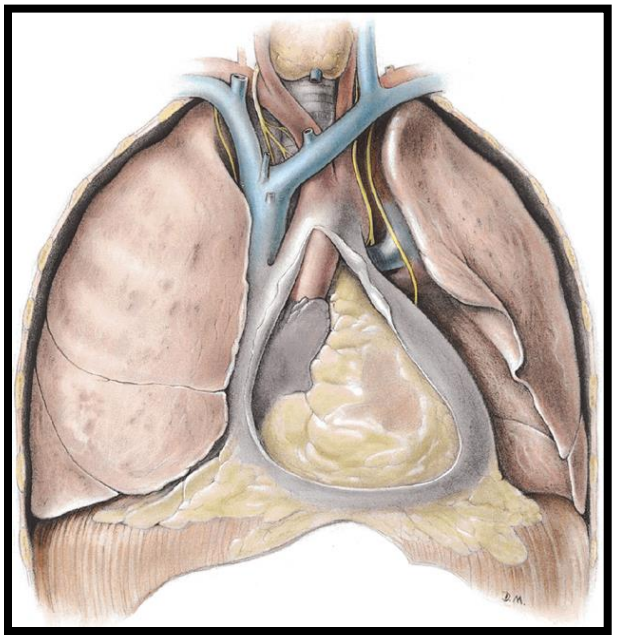
- **Several causes**
  - Sepsis syndrome
  - Drug overdose
  - Trauma
- **Neurogenic shock**
  - Most typically after injury to spinal cord
    - Injury prevents additional catecholamine release
    - Circulating catecholamines may briefly preserve

High-Space Shock

- **Neurogenic shock**
  - Hypotension
  - Heart rate normal or slow
  - Skin warm, dry, pink
  - Paralysis or deficit
    - No chest movement, simple diaphragmatic
- **Drug overdose,** sepsis
  - Tachycardia
  - Skin pale or flushed
  - Flat neck veins

Mechanical Shock

- **Obstructs blood flow to or through** heart
  - Slows venous return
  - Decreases cardiac output
- **Clinical presentation**
  - Distended neck veins
  - Cyanosis
  - **Catecholamine effects**
    - **Pallor, tachycardia, diaphoresis**



PASG Research

- **Pneumatic antishock garment**
  - Uncontrollable internal hemorrhage due to penetrating injury
    - May increase mortality, especially intrathoracic
    - Probably increases bleeding, death due to exsanguination

Courtesy of John Campbell

Controllable Hemorrhage

- **Management**
  - Control bleeding
  - High-flow oxygen
  - Rapid safe transport
  - Large-bore IV access

Controllable Hemorrhage

- **Management**
  - **Fluid bolus (500–1,000 mL for adult and 20 ml/kg for pediatrics) rapidly, repeat if necessary**
  - **Cardiac monitor, SpO_2, $ETCO_2$**
  - Ongoing exam

Uncontrollable Hemorrhage

- **Management: External**
  - Control bleeding
  - Shock position
  - High-flow oxygen
  - Rapid safe transport
  - Large-bore IV access
  - Fluid administration
  - Cardiac monitor, SpO_2, $ETCO_2$
  - Ongoing exam

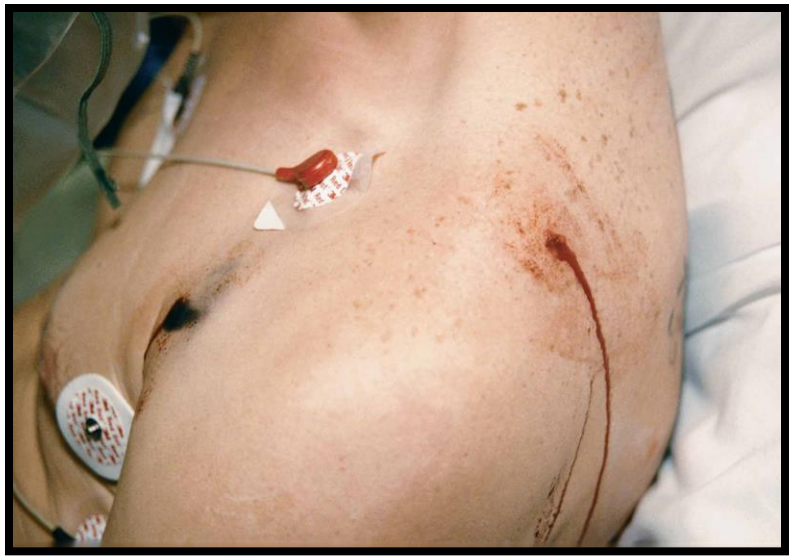
Courtesy of John Campbell

Fluid Administration

- **Uncontrollable hemorrhage**
  - May increase bleeding and death
  - Dilutes clotting factors
  - **Early blood transfusion in severe cases**
    - IV fluids carry almost no oxygen
  - Moribund trauma patients
    - Fluid may be indicated to maintain some circulation
  - Local medical direction

Uncontrollable Hemorrhage

- **Management: Internal**
  - Rapid safe transport
  - Shock position
  - High-flow oxygen
  - Large-bore IV access
  - Fluid administration
  - **Cardiac monitor, SpO_2, $ETCO_2$**
  - Ongoing Exam



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Fluid Administration

- **Internal hemorrhage from blunt trauma**
  - **Large-bone fractures**
    - Usually self-limiting bleed, except pelvis
    - Fluid administration for volume expansion
  - **Large internal blood vessel tear, or laceration or avulsion of internal organ**
    - Fluid may increase bleeding and death
    - Fluid administration to maintain peripheral perfusion
  - **Local medical direction**

Fluid Administration

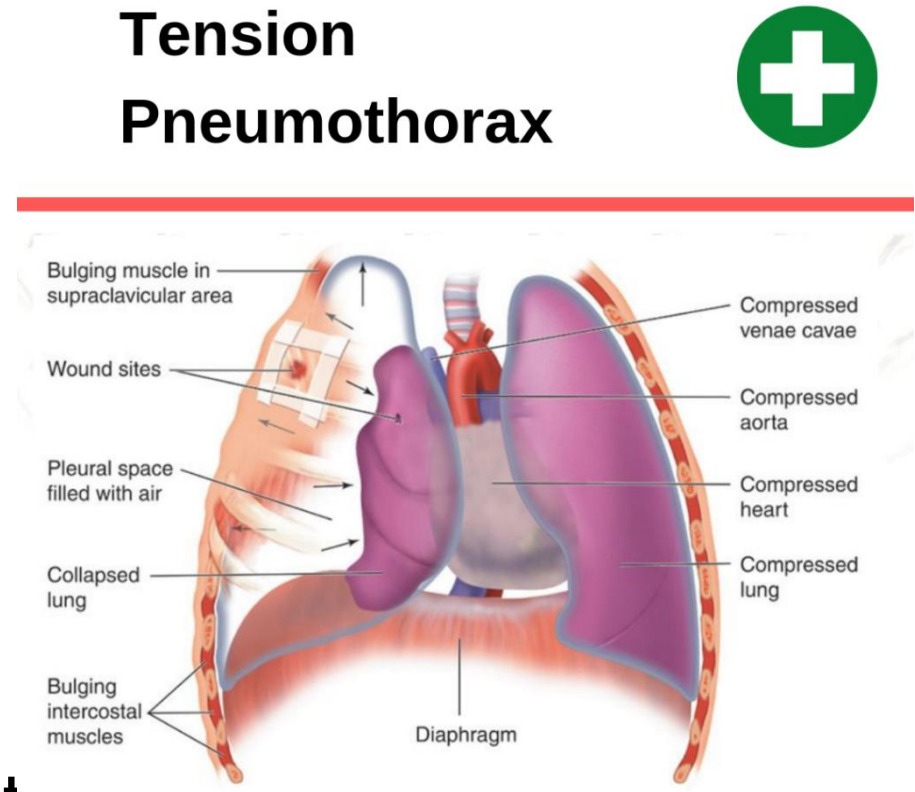
- **Uncontrollable hemorrhage**
  - **Maintain peripheral perfusion**
    - **Peripheral pulse**
      - Higher systolic may be required with increased ICP or with history of hypertension
    - **Maintaining consciousness**
      - In absence of traumatic brain injury
    - **"Adequate blood pressure"**
      - Controversial with ongoing research
      - Local medical direction

Special Situations

- **Severe head injury hypovolemic shock**
  - Glasgow Coma Score of 8 or less
  - Fluid administration
  - BP of **100 mmHg systolic** to maintain cerebral perfusion pressure of at **least 60 – 80 mmHg**
- **Non hemorrhagic hypovolemic shock**
  - General management same as controllable
  - Fluid administration for volume replacement

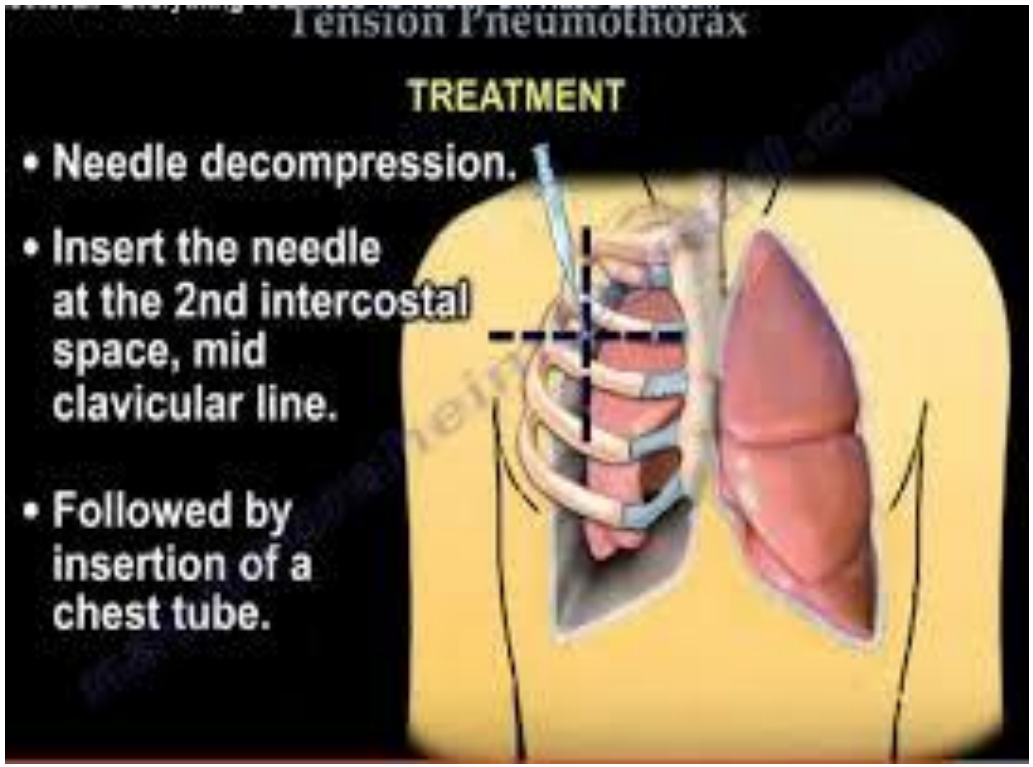
Mechanical Shock

- **Tension pneumothorax**
  - Vena cava collapses, prevents venous return
  - Mediastinal shift lowers venous return
  - Tracheal deviation away from affected side
  - Decreased cardiac output



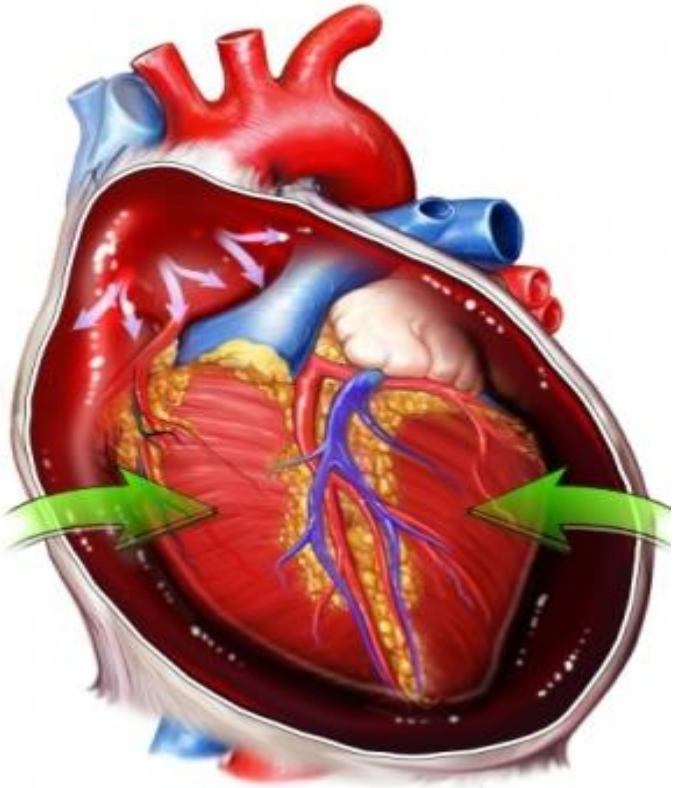
Mechanical Shock

- **Management**
  - Chest decompression
  - Prompt decompression of pleural pressure

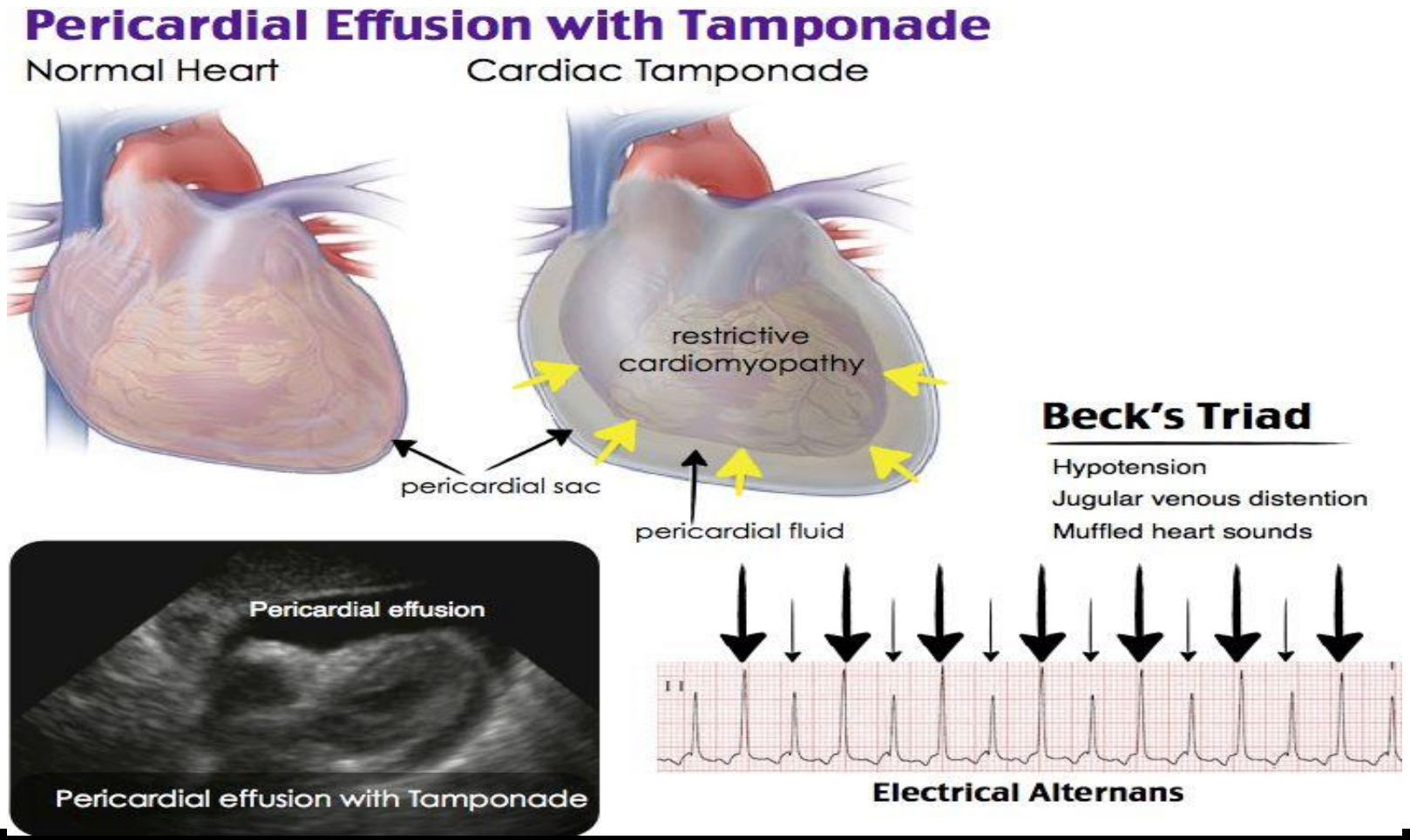


Mechanical Shock Causes

- **Cardiac tamponade**
  - Blood fills “potential” space prevents heart filling
  - May occur >75% with penetrating cardiac injury
  - **“Beck's triad”**
  - **Shock, muffled heart tones, distended neck veins**

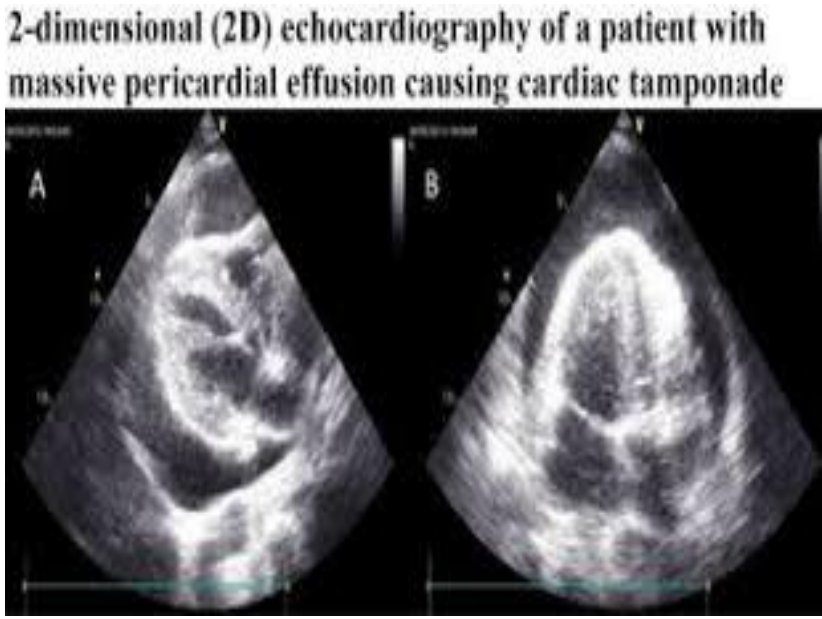


Mechanical Shock Causes



Cardiac Tamponade

- **Management**
  - Rapid safe transport to appropriate facility
    - Cardiac arrest can occur in minutes
  - Fluid administration by local medical direction
  - **Pericardiocentesis** (if within scope of practice)



Mechanical Shock Causes

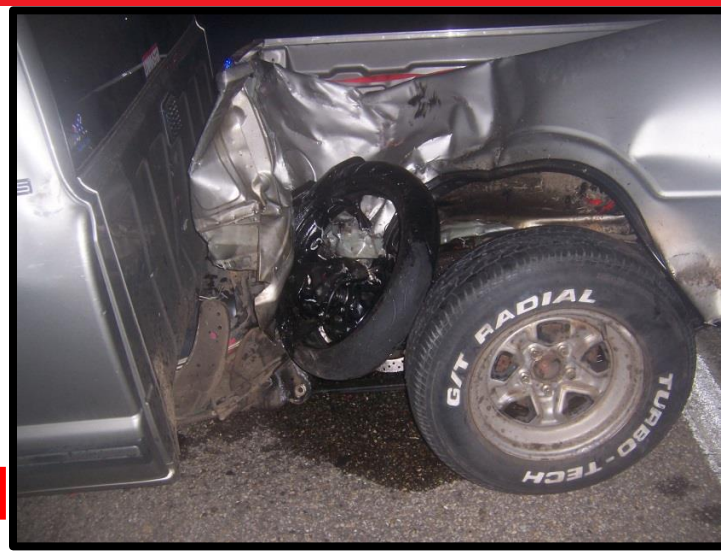
- **Myocardial contusion**
  - Heart muscle injury and/or cardiac **dysrhythmias**
  - Rarely causes shock; mostly little or no signs
    - Severe may cause acute heart failure

Myocardial Contusion

- **Management**
  - **Rapid safe transport**
  - **Cardiac arrest may occur in 5–10 minutes**
  - **Cardiac monitoring and treat arrhythmias**
  - **Fluid administration may worsen condition**

High-Space Shock

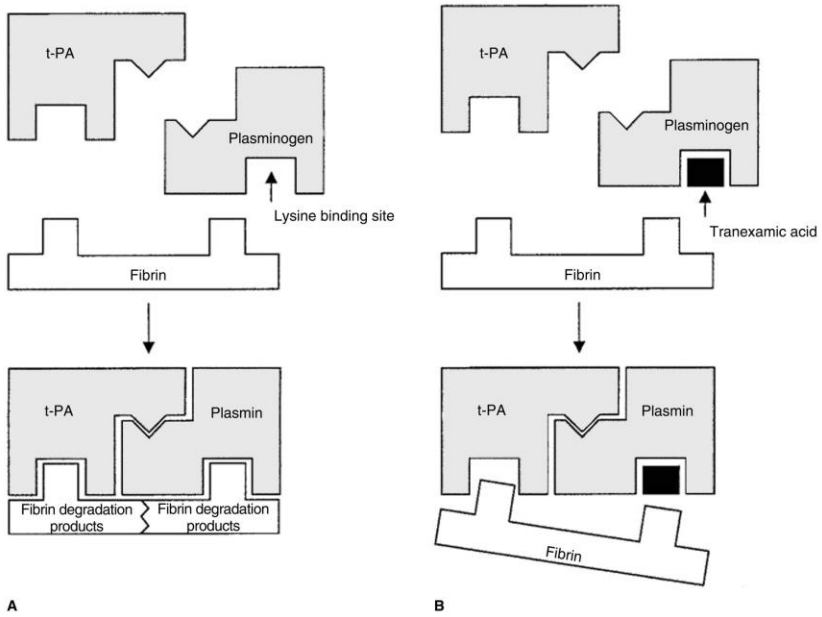
- **Management**
  - High-flow oxygen
  - Rapid safe transport
  - Large-bore IV access
  - **Fluid bolus 20 mL/kg rapid**
  - **Consider vasopressors** for vasodilatory shock
    - Calcium channel blocker overdose or sepsis
  - Ongoing exam



Courtesy of John Campbell

Tranexamic Acid (TXA)

- Stabilizes fibrin clot after trauma
- By mechanism it cannot be thrombogenic



Dunn CJ, Goa KL: Tranexamic acid: A review of its use in surgery and other indications. Drugs 1999;57:1005-1032

Tranexamic Acid (TXA)

- **Tranexamic acid** should be given as early as possible to bleeding trauma patients. For trauma patients seen late after injury (>3h), tranexamic acid is less effective and could be harmful.

- **TXA in EMS**
  - Give in the field, early and when there is no other option
  - Give in the outlying hospital, prior to transport
  - Use 1:1:1 in the trauma center +/- TXA (if < 3h); the injury is still out.

Summary

- **Knowledge about pathophysiology and treatment of shock is essential**
  - Critical condition that leads to death
  - Assessment and intervention must be rapid
  - Monitor closely for early signs
- **Be aware of management controversies**
  - Rely on local medical direction

- **Thank you for your attention**

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