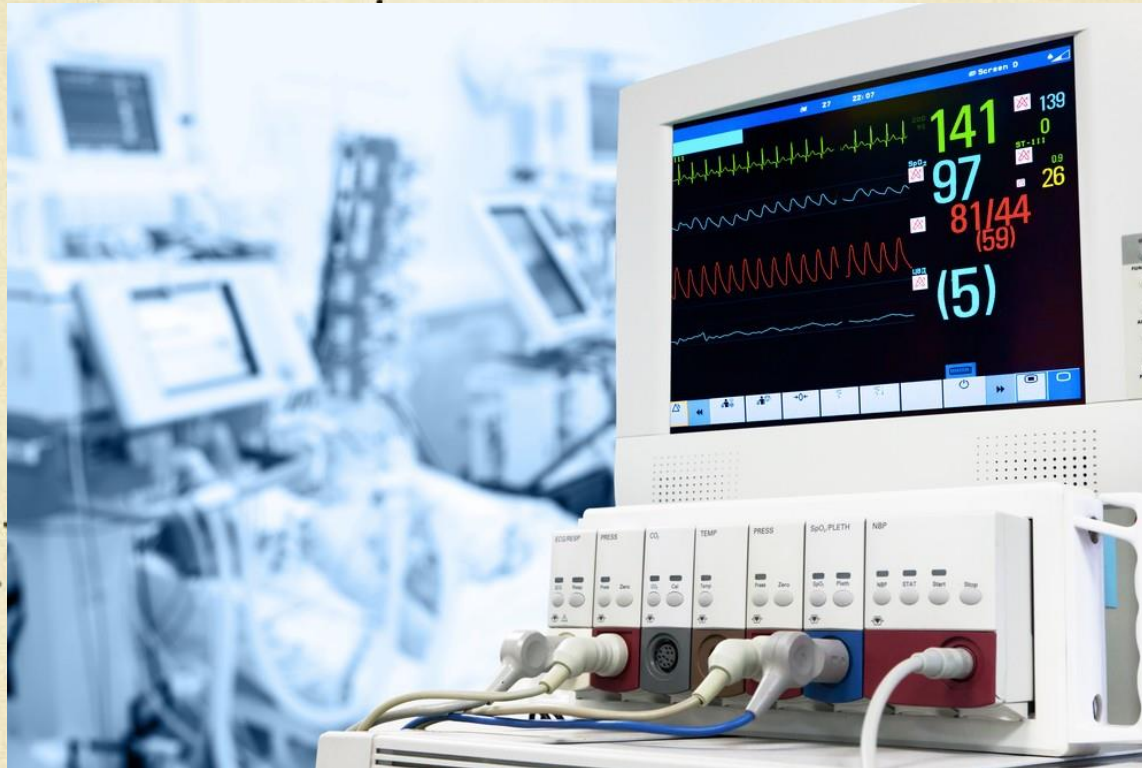
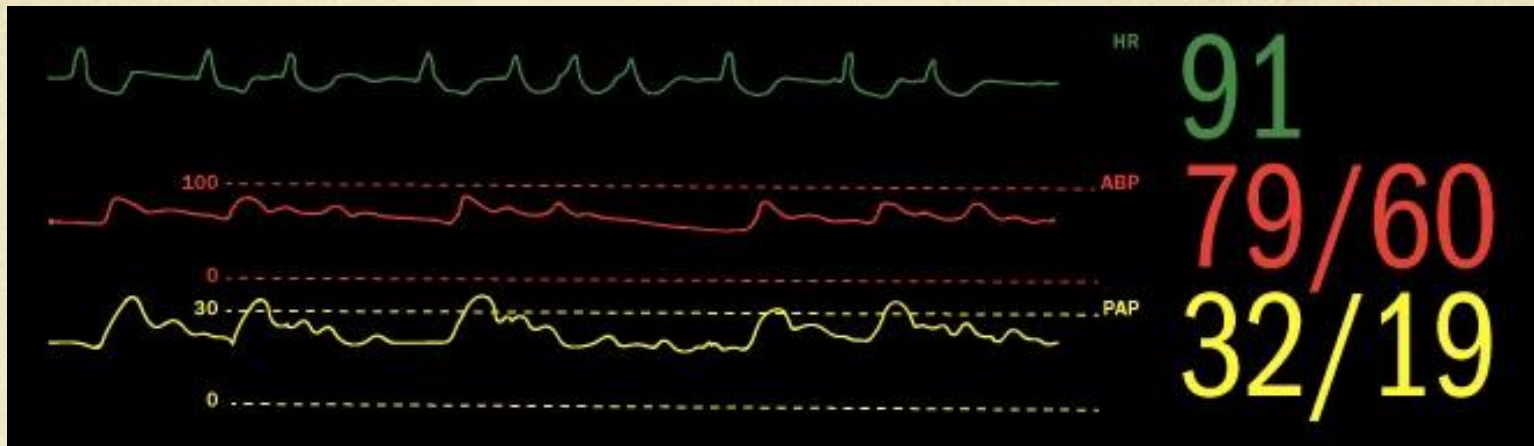


Shock



Badr Aldawood, MBBS, FRCPC
Assistant Professor EM-CCM
April, 2020



Objectives

- Definition ?
- Approach to shock ?
- Types of Shock ?

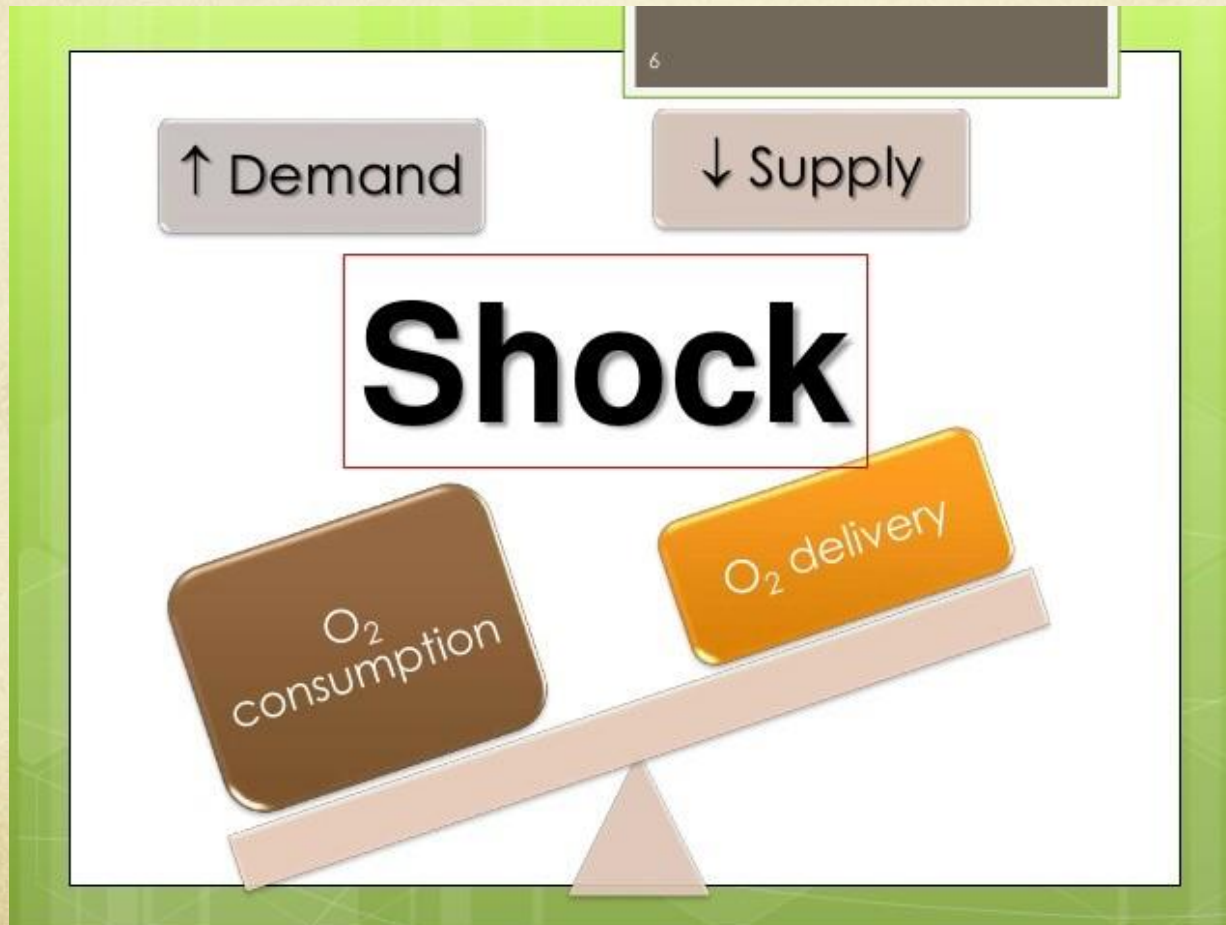
Definition of Hypotension

- Hypotension is typically defined as:
 - SBP < 90 mmHg,
 - MAP < 60 mmHg,
 - A decrease greater than 40 mmHg or 30% from patient's baseline MAP.

- SBP Systolic Blood Pressure
- MAP Mean Arterial Blood Pressure



Definition of Shock



Definition of Shock

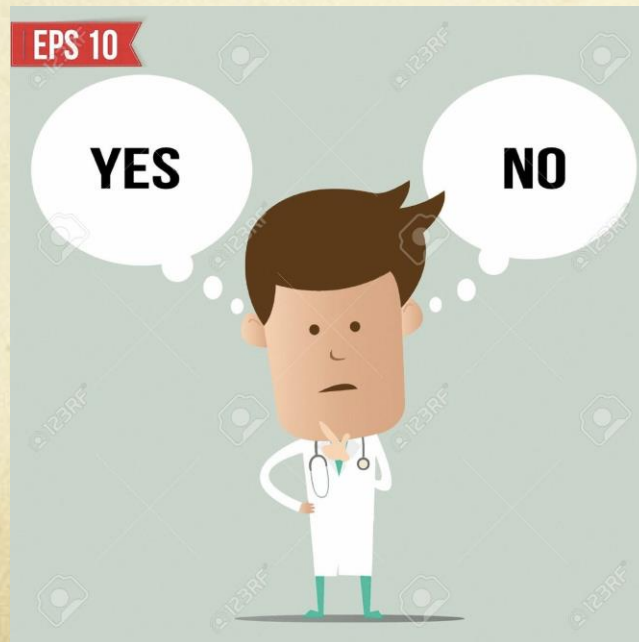


- Inadequate oxygen delivery to meet metabolic demands
- Results in global tissue hypoperfusion and metabolic acidosis

Definition of Shock



Shock = Hypotension ??



Understanding Shock

- Inadequate systemic oxygen delivery activates autonomic responses to maintain systemic oxygen delivery
 - Sympathetic nervous system
 - Renin-angiotensin axis

Understanding Shock

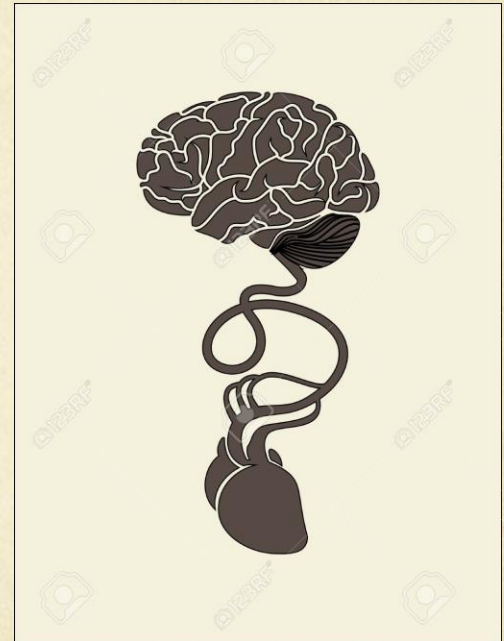
- Inadequate systemic oxygen delivery activates autonomic responses to maintain systemic oxygen delivery
 - Sympathetic nervous system
 - NE, epinephrine, dopamine, and cortisol release
 - Causes vasoconstriction, increase in HR, and increase of cardiac contractility (cardiac output)
 - Renin-angiotensin axis
 - Water and sodium conservation and vasoconstriction
 - Increase in blood volume and blood pressure

Understanding Shock

- Cellular responses to decreased systemic oxygen delivery
 - ATP depletion → ion pump dysfunction
 - Cellular edema
 - Hydrolysis of cellular membranes and cellular death

Understanding Shock

- Goal is to maintain perfusion to vital organs:
 - Cerebral and cardiac perfusion:



Global Tissue Hypoxia

- Endothelial inflammation and disruption
- Inability of O₂ delivery to meet demand
- Result:
 - Lactic acidosis
 - Cardiovascular insufficiency
 - Increased metabolic demands

Multiorgan Dysfunction Syndrome (MODS)

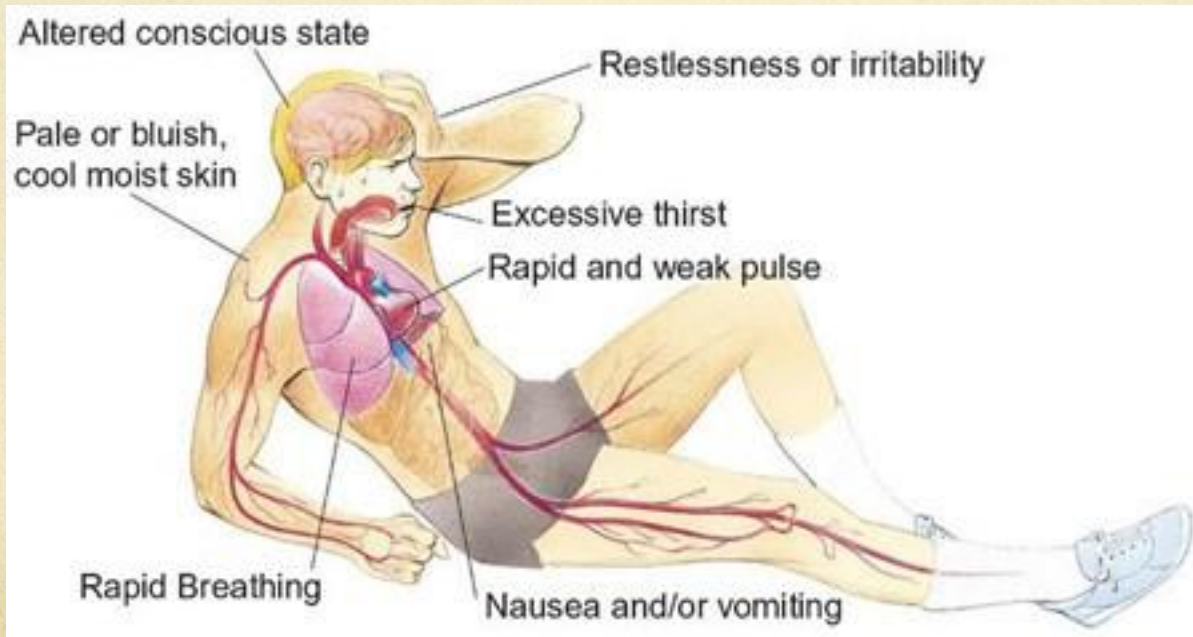
- Progression of physiologic effects as shock ensues
 - Cardiac depression
 - Respiratory distress
 - Renal failure
 - DIC
- **Result is end organ failure**

Approach to the Patient in Shock

- ABCs
 - Cardiorespiratory monitor
 - Vital signs including temperature
 - Supplemental oxygen
 - IV/IO access

Diagnosis

- Physical exam (Shock signs)



Diagnosis

- Physical exam (Shock signs)
- Labs:
 - ABG
 - CBC
 - Chemistries
 - Lactate
 - Coagulation studies
 - Cultures



Approach to the Patient in Shock

- History
 - Recent illness
 - Fever
 - Chest pain, SOB
 - Abdominal pain
 - Comorbidities
 - Medications
 - Toxins/Ingestions
 - Recent hospitalization or surgery
 - Baseline mental status
- Physical examination
 - Vital Signs
 - CNS – mental status
 - Skin – color, temp, rashes, sores
 - CV – JVD, heart sounds
 - Resp – lung sounds, RR, oxygen sat, ABG
 - GI – abd pain, rigidity, guarding, rebound
 - Renal – urine output

Is This Patient in Shock?

- Patient looks ill
- Altered mental status
- Skin cool and mottled or hot and flushed
- Weak or absent peripheral pulses
- SBP <110
- Tachycardia

Yes!

These are mostly signs and symptoms of shock

Hypotension Physiology

Critical clinical question
What are my hemodynamic targets?

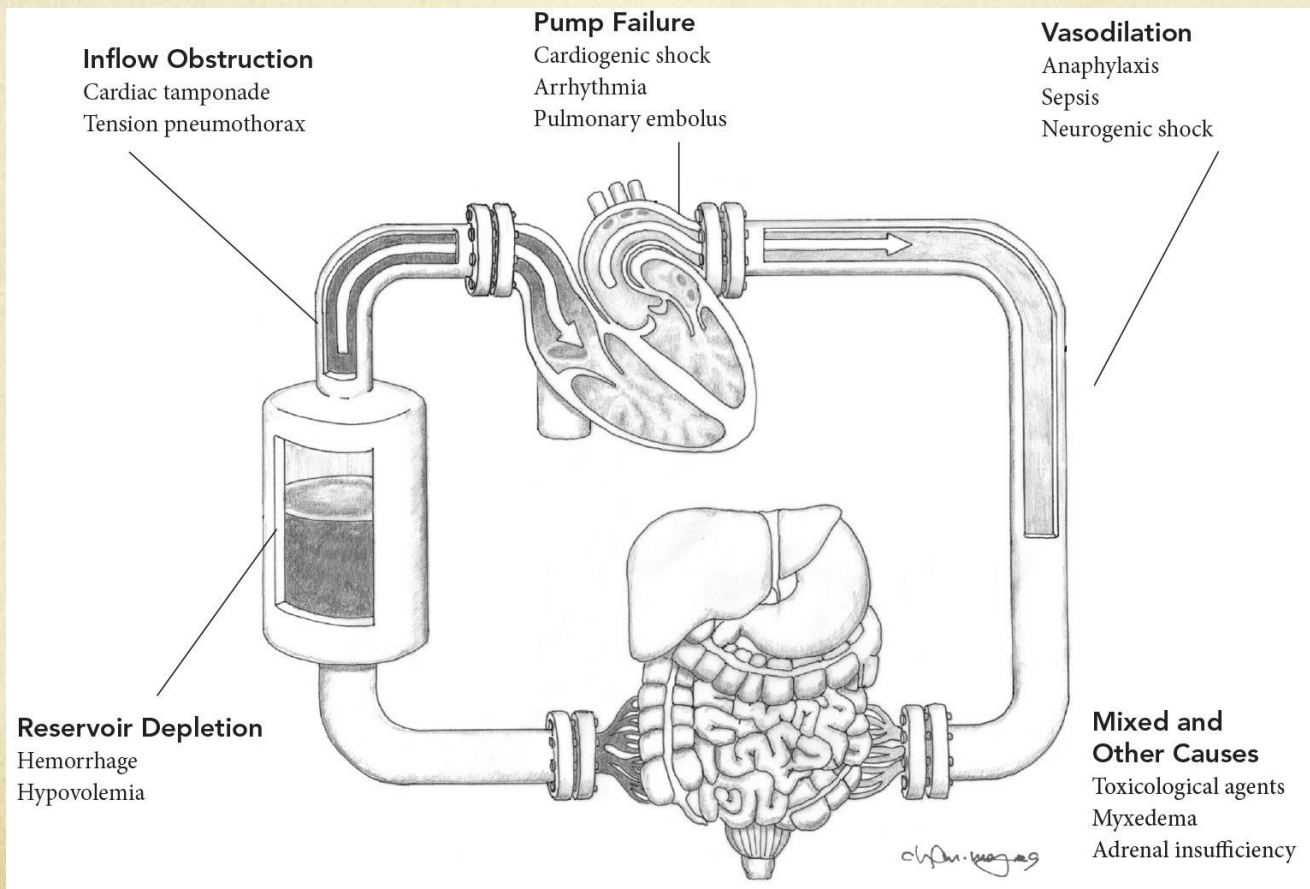


Tank

Pump

Pipes

Hypotension Physiology



Hypotension Physiology

$$\mathbf{BP = CO \times SVR}$$

Pump X Tone (Pipes)

$$\mathbf{CO = HR \times SV}$$

SV : Preload (Tank) , Contractility, Afterload

Goals of Treatment

- ABCDE
 - **A**irway
 - control work of **B**reathing
 - optimize **C**irculation
 - assure adequate oxygen **D**elivery
 - achieve **E**nd points of resuscitation

Airway





The Laryngoscope as a *Murder* Weapon

Airway

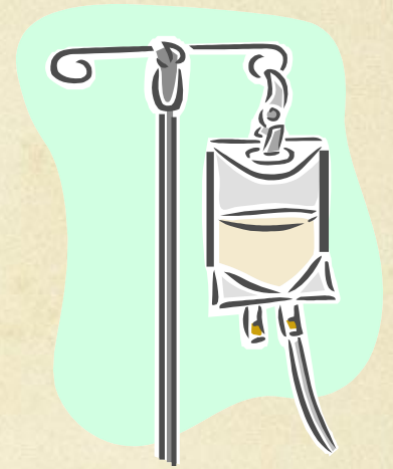
- Determine need for intubation but remember: intubation can worsen hypotension
- May need volume resuscitation prior to intubation to avoid hemodynamic collapse

Control Work of Breathing

- Respiratory muscles consume a significant amount of oxygen
- Tachypnea can contribute to lactic acidosis
- Mechanical ventilation and sedation **decrease WOB** and improves survival for the right patient

Optimizing Circulation

- Isotonic crystalloids
- Titrated to:
 - CVP 8-12 mm Hg
 - Urine output 0.5 ml/kg/hr (30 ml/hr)
 - Improving heart rate
- May require 4-6 L of volume



Maintaining Oxygen Delivery

- Decrease oxygen demands
- Maintain arterial oxygen saturation/content
 - Give supplemental oxygen
 - Maintain adequate level of Hemoglobin
- Serial lactate levels or central venous oxygen saturations to assess tissue oxygen extraction (ScvO₂)

End Points of Resuscitation

- Goal of resuscitation is to maximize survival and minimize morbidity
- Use objective hemodynamic and physiologic values to guide therapy
- Goal directed approach
 - Urine output > 0.5 mL/kg/hr
 - Central Venous Pressure (CVP): 8-12 mmHg
 - MAP 65 to 90 mmHg
 - Central venous oxygen concentration $> 70\%$

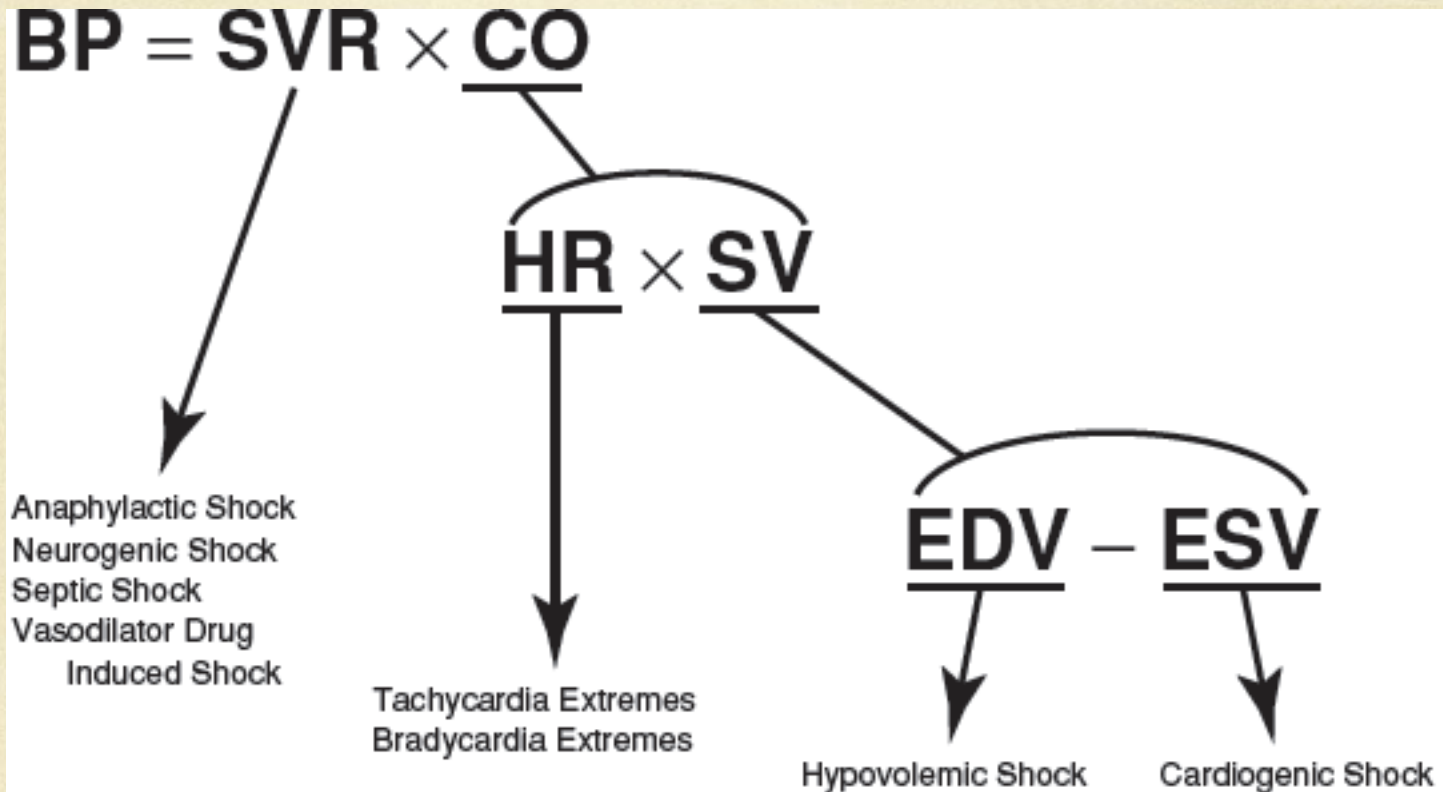
Practically Speaking....

- Keep one eye on these patients
- **Frequent vitals signs:**
 - Monitor success of therapies
 - Watch for decompensated shock
- Let your team know that these patients are sick!

Types of Shock

- Hypovolemic
- Distributive
- Cardiogenic
- Obstructive

Circulatory Shock



BP = blood pressure, SVR = systemic vascular resistance, HR = heart rate, SV = stroke volume, EDV = end diastolic volume (i.e. preload), ESV = end systolic volume (i.e. contractility)

Source: Stone CK, Humphries RL: *Current Diagnosis & Treatment: Emergency Medicine, 7th Edition*: www.accessmedicine.com
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What Type of Shock is This?

- 68 yo M with hx of HTN and DM presents to the ER with abrupt onset of diffuse abdominal pain with radiation to his low back. The pt is hypotensive, tachycardic, afebrile, with cool but dry skin

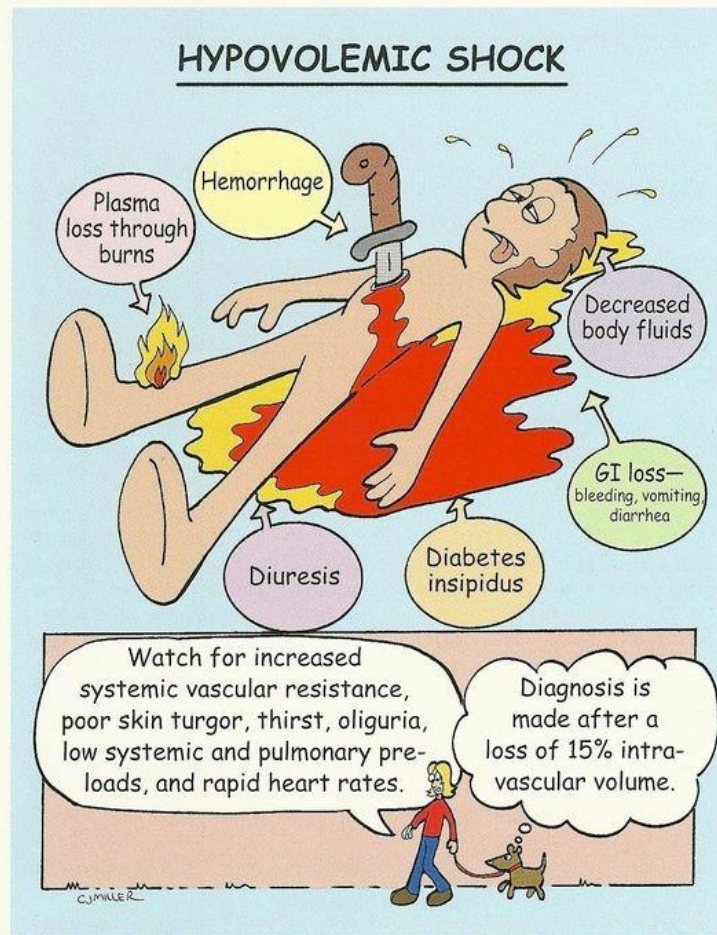
Hypovolemic Shock

Types of Shock

- Hypovolemic
- Septic
- Cardiogenic
- Anaphylactic
- Neurogenic
- Obstructive

Hypovolemic Shock

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Hypovolemic Shock

- Non-hemorrhagic
 - Vomiting
 - Diarrhea
 - Bowel obstruction, pancreatitis
 - Burns
 - Neglect, environmental (dehydration)
- Hemorrhagic
 - GI bleed
 - Trauma
 - Massive hemoptysis
 - AAA rupture
 - Ectopic pregnancy, post-partum bleeding

Hypovolemic Shock

- ABCs
- Establish 2 large bore IVs or a central line
- Crystalloids
 - Normal Saline or Lactate Ringers
 - Up to 3 liters
- PRBCs
 - O -ve or cross matched
- Control any bleeding
- Arrange definitive treatment

What Type of Shock is This?

- An 81 yo F resident of a nursing home presents to the ED with altered mental status. She is febrile to 39.4, hypotensive with a widened pulse pressure, tachycardic, with warm extremities

Septic

Types of Shock

- Hypovolemic
- Septic
- Cardiogenic
- Anaphylactic
- Neurogenic
- Obstructive

Sepsis

**life-threatening organ
dysfunction caused by a
dysregulated host response to
infection**

Septic Shock

- Sepsis (remember definition?)
- Plus refractory distributive

Septic Shock

- Clinical signs:
 - Hyperthermia or hypothermia
 - Tachycardia
 - Wide pulse pressure
 - Low blood pressure (SBP<90)
 - Mental status changes
- Beware of compensated shock!
 - Blood pressure may be “normal”

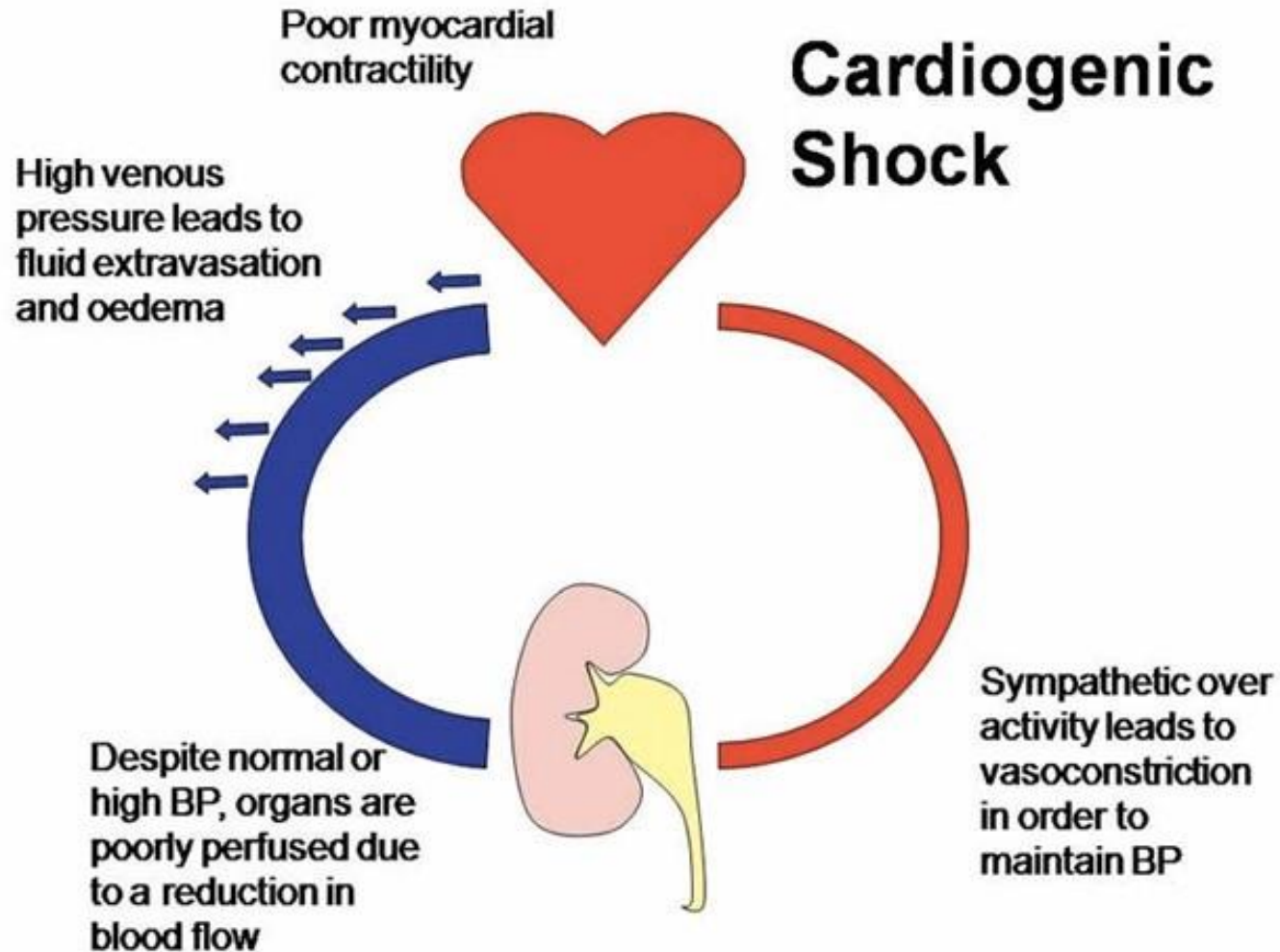
What Type of Shock is This?

Types of Shock

- A 55 yo M with hx of HTN, DM presents with “crushing” substernal CP, diaphoresis, hypotension, tachycardia and cool, clammy extremities
- Hypovolemic
 - Septic
 - Cardiogenic
 - Anaphylactic
 - Neurogenic
 - Obstructive

Cardiogenic

Cardiogenic Shock



Cardiogenic Shock

- Signs:
 - Cool, mottled skin
 - Tachypnea
 - Hypotension
 - Altered mental status
 - Narrowed pulse pressure
 - Rales, murmur

Etiologies

- What are some causes of cardiogenic shock?
 - AMI
 - Sepsis
 - Myocarditis
 - Myocardial contusion
 - Aortic or mitral stenosis, HCM
 - Acute aortic insufficiency

What Type of Shock is This?

- A 34 F presents to the ED after dining at a restaurant where shortly after eating the first few bites of her meal, became anxious, diaphoretic, began wheezing, noted diffuse pruritic rash, nausea, and a sensation of her "throat closing off".
- She is currently hypotensive, tachycardic and ill appearing.

Anaphalactic

Types of Shock

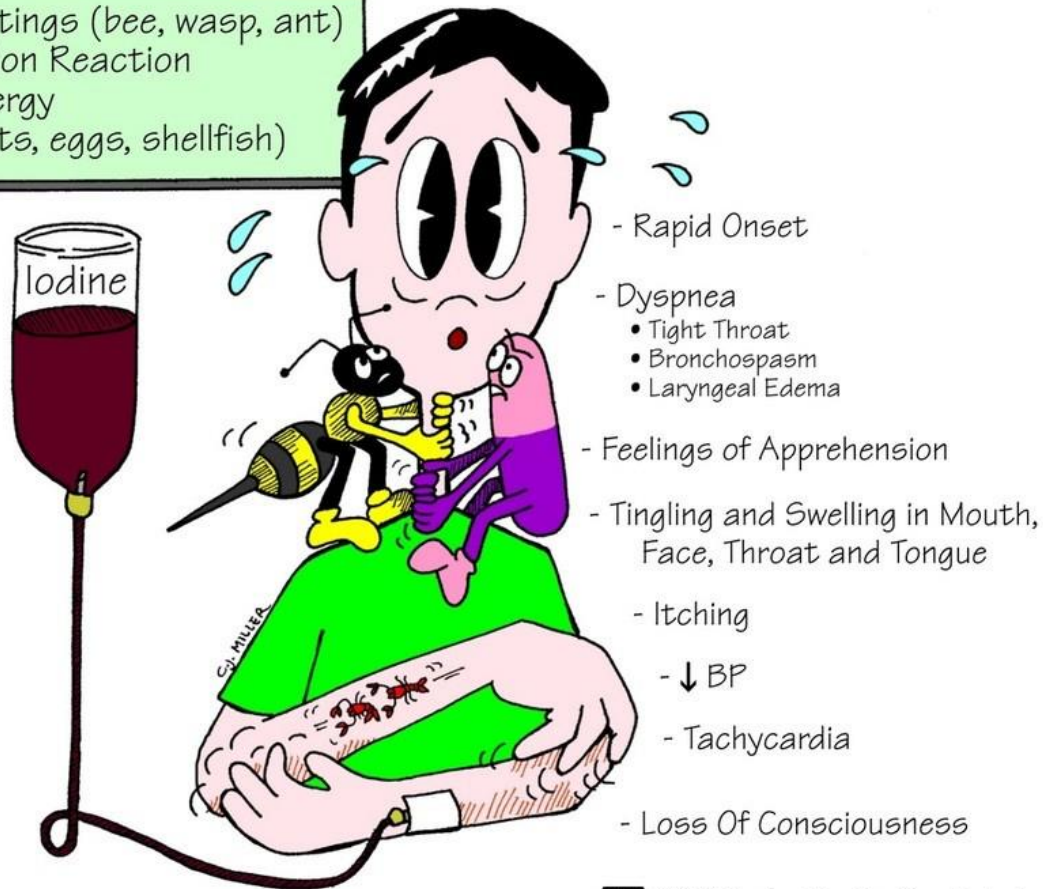
- Hypovolemic
- Septic
- Cardiogenic
- Anaphylactic
- Neurogenic
- Obstructive

Anaphalactic Shock

ANAPHYLACTIC REACTION

Causes:

- Insect Stings (bee, wasp, ant)
- Medication Reaction
- Food Allergy
(peanuts, eggs, shellfish)



- Rapid Onset

- Dyspnea

- Tight Throat
- Bronchospasm
- Laryngeal Edema

- Feelings of Apprehension

- Tingling and Swelling in Mouth,
Face, Throat and Tongue

- Itching

- ↓ BP

- Tachycardia

- Loss Of Consciousness

Anaphylactic Shock

- Anaphylaxis –
- Anaphylactoid reaction –

Anaphylactic Shock

- Anaphylaxis – a severe systemic hypersensitivity reaction characterized by multisystem involvement
 - **IgE mediated**
- Anaphylactoid reaction – clinically indistinguishable from anaphylaxis, do not require a sensitizing exposure
 - **Not IgE mediated**

Anaphylactic Shock

- What are some symptoms of anaphylaxis?

Anaphylactic Shock

- What are some symptoms of anaphylaxis?
 - First- Pruritus, flushing, urticaria appear
 - Next- Throat fullness, anxiety, chest tightness, shortness of breath and lightheadedness
 - Finally- Altered mental status, respiratory distress and circulatory collapse

Anaphylactic Shock

- Symptoms usually begin within 60 minutes of exposure
- Faster the onset of symptoms = more severe reaction
- Biphasic phenomenon occurs in up to 20% of patients
 - Symptoms return 3-4 hours after initial reaction has cleared
- A “Lump in my throat” and “Hoarseness” heralds life-threatening laryngeal edema

What Type of Shock is This?

- A 41 yo M presents to the ER after an MVC complaining of decreased sensation below his waist and is now hypotensive, bradycardic, with warm extremities

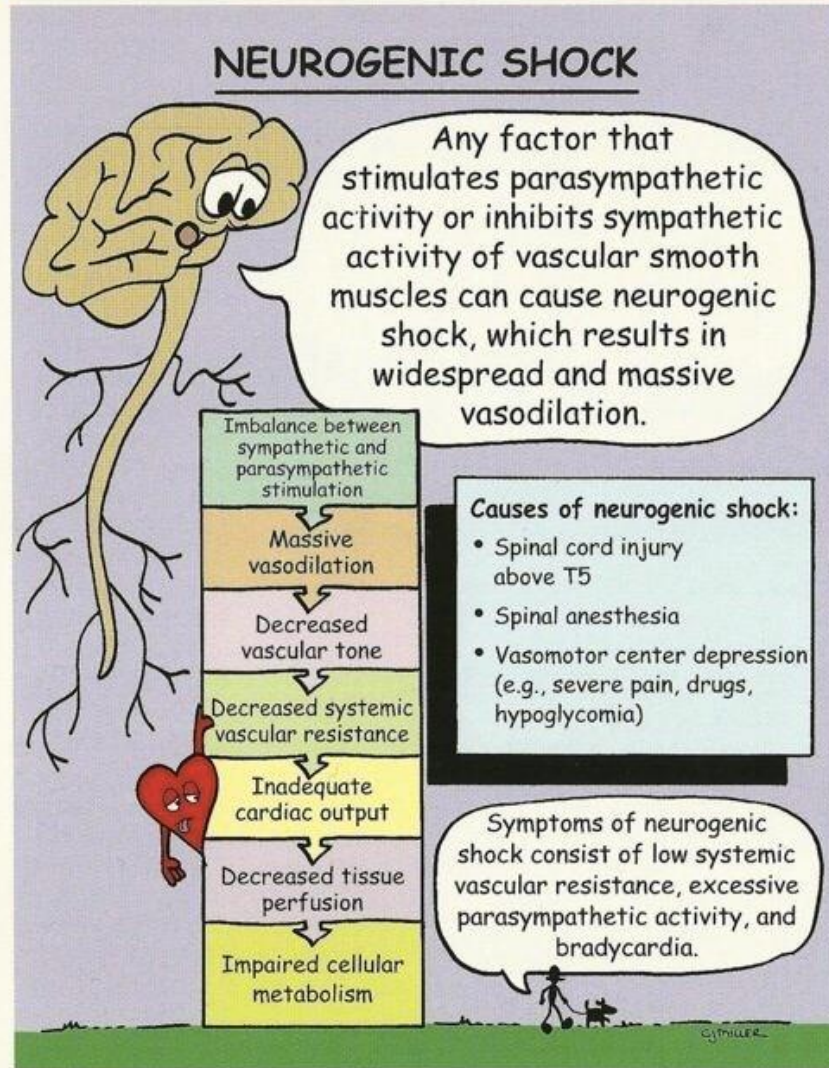
Neurogenic

Types of Shock

- Hypovolemic
- Septic
- Cardiogenic
- Anaphylactic
- Neurogenic
- Obstructive

Neurogenic Shock

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Neurogenic Shock

- Occurs after acute spinal cord injury
- Sympathetic outflow is disrupted leaving unopposed vagal tone
- Results in **hypotension** and **bradycardia**
- Spinal shock ?

What Type of Shock is This?

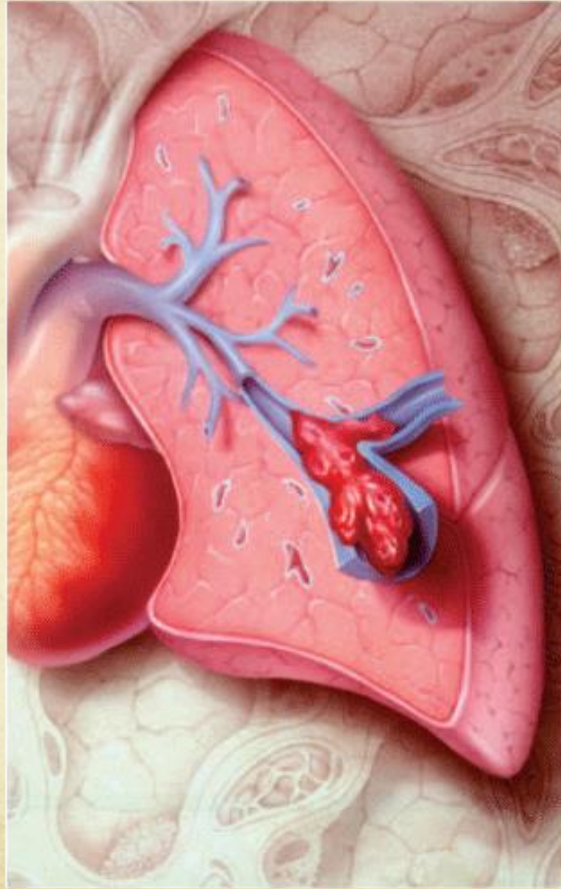
- A 24 yo M presents to the ED after an MVC c/o chest pain and difficulty breathing. On exam, you note the pt to be tachycardic, hypotensive, hypoxic, and with decreased breath sounds on left chest

Obstructive

Types of Shock

- Hypovolemic
- Septic
- Cardiogenic
- Anaphylactic
- Neurogenic
- Obstructive

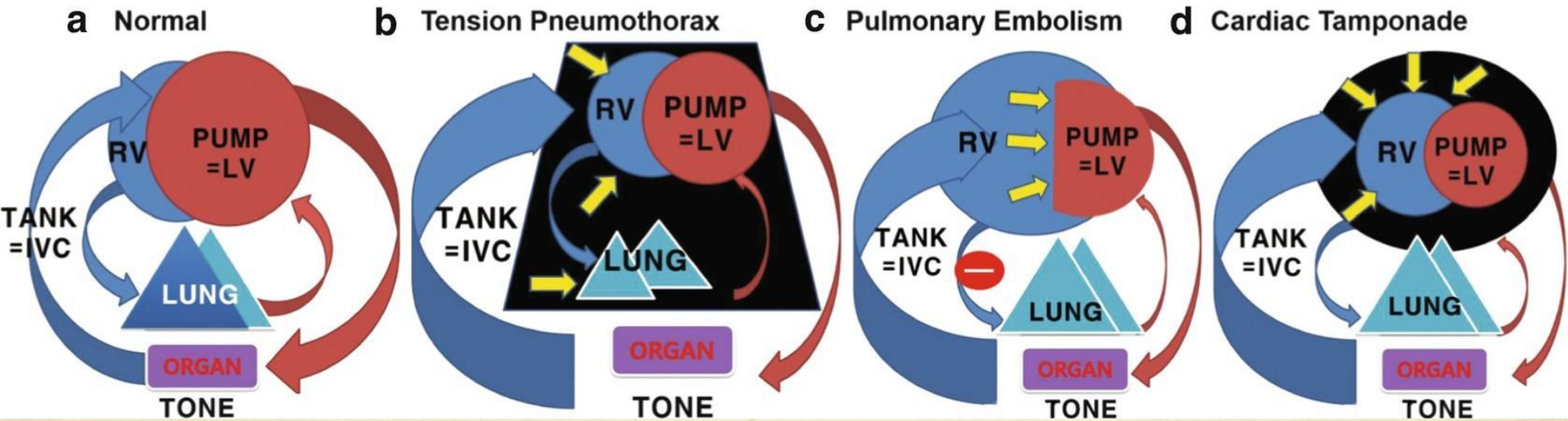
Obstructive Shock



Obstructive Shock

- Tension pneumothorax
- Pulmonary Embolism
- Cardiac Tamponade

Obstructive Shock



Obstructive Shock

- Tension pneumothorax

Obstructive Shock

- Tension pneumothorax
 - Air trapped in pleural space with 1 way valve, air/pressure builds up
 - Mediastinum shifted impeding venous return
 - Chest pain, SOB, decreased breath sounds
 - Tests needed?...
 - Rx: Needle decompression, chest tube

Obstructive Shock

- Cardiac tamponade

Obstructive Shock

- Cardiac tamponade
 - Blood in pericardial sac prevents venous return to and contraction of heart
 - Related to trauma, pericarditis, MI
 - **Beck's triad**: hypotension, muffled heart sounds, JVD

Obstructive Shock

- Pulmonary embolism

Obstructive Shock

- Pulmonary embolism
 - **Virchow's triad**: hypercoaguable, venous injury, venostasis
 - Signs: Tachypnea, tachycardia, hypoxia

Summary

- Be alert to recognize Shock
- Try to identify the type of shock
- Volume is the answer for **most** Shock cases
- ABC Approach
- Goals are the end points of resuscitation.



Questions ?