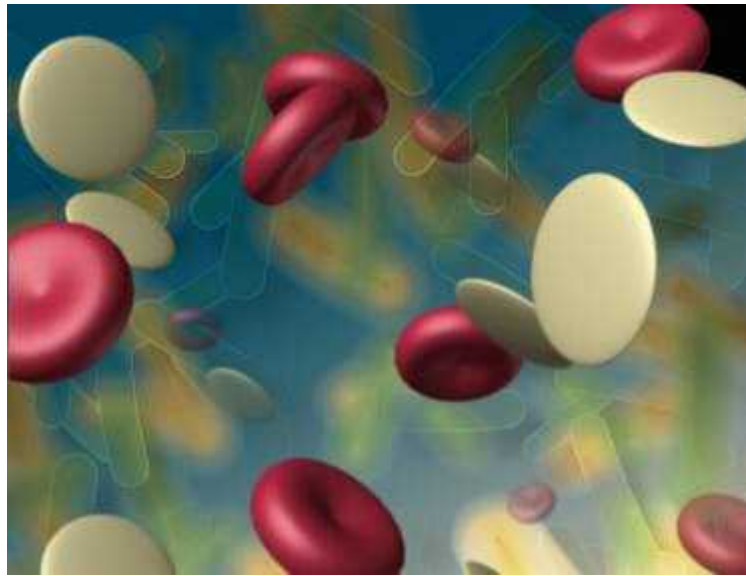


Shock



Presented by:

Indah Dwi Pratiwi



Objectives

- Definition
- Approach to the hypotensive patient
- Types
- Specific treatments

Definition of Shock



- Inadequate oxygen delivery to meet metabolic demands
- Results in global tissue hypoperfusion and metabolic acidosis
- Shock can occur with a normal blood pressure and hypotension can occur without shock



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
- Goal is to maintain cerebral and cardiac perfusion
 - Vasoconstriction of splanchnic, musculoskeletal, and renal blood flow
- Leads to systemic metabolic lactic acidosis that overcomes the body's compensatory mechanisms



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

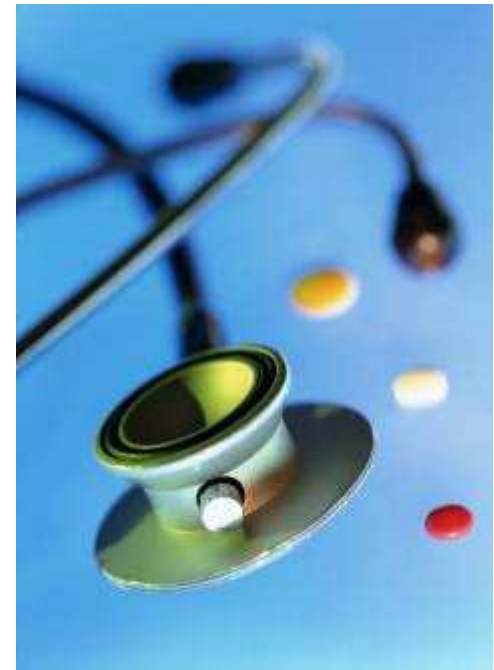


Approach to the Patient in Shock

- ABCs
 - Cardiorespiratory monitor
 - Pulse oximetry
 - Supplemental oxygen
 - IV access
 - ABG, labs
 - Foley catheter
 - Vital signs including rectal temperature

Diagnosis

- Physical exam (VS, mental status, skin color, temperature, pulses, etc)
- Infectious source
- Labs:
 - CBC
 - Chemistries
 - Lactate
 - Coagulation studies
 - Cultures
 - ABG





Further Evaluation

- CT of head/sinuses
- Lumbar puncture
- Wound cultures
- Acute abdominal series
- Abdominal/pelvic CT or US
- Cortisol level
- Fibrinogen, FDPs, D-dimer



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?

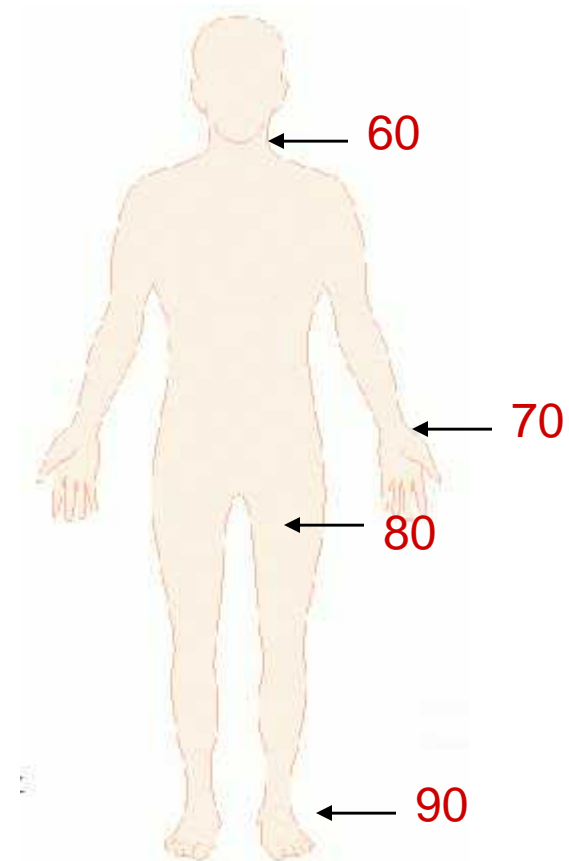
- Patient looks ill
- Altered mental status
- Skin cool and mottled or hot and flushed
- Weak or absent peripheral pulses
- SBP <110
- Tachycardia

Yes!

These are all signs and symptoms of shock

Shock

- Do you remember how to quickly estimate blood pressure by pulse?
- If you palpate a pulse, you know SBP is at least this number





Goals of Treatment

- ABCDE
 - Airway
 - control work of Breathing
 - optimize Circulation
 - assure adequate oxygen Delivery
 - achieve End points of resuscitation



Airway

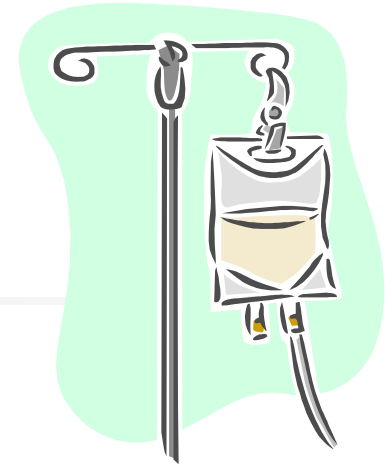
- Determine need for intubation but remember: intubation can worsen hypotension
 - Sedatives can lower blood pressure
 - Positive pressure ventilation decreases preload
- May need volume resuscitation prior to intubation to avoid hemodynamic collapse



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

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 fluids
- No outcome benefit from colloids



Maintaining Oxygen Delivery

- Decrease oxygen demands
 - Provide analgesia and anxiolytics to relax muscles and avoid shivering
- Maintain arterial oxygen saturation/content
 - Give supplemental oxygen
 - Maintain Hemoglobin > 10 g/dL
- Serial lactate levels or central venous oxygen saturations to assess tissue oxygen extraction



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
 - CVP 8-12 mmHg
 - MAP 65 to 90 mmHg
 - Central venous oxygen concentration $> 70\%$



Persistent Hypotension

- Inadequate volume resuscitation
- Pneumothorax
- Cardiac tamponade
- Hidden bleeding
- Adrenal insufficiency
- Medication allergy



Practically Speaking....

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



Types of Shock

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



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





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 negative or cross matched
- Control any bleeding
- Arrange definitive treatment



Evaluation of Hypovolemic Shock

- CBC
- ABG/lactate
- Electrolytes
- BUN, Creatinine
- Coagulation studies
- Type and cross-match
- As indicated
 - CXR
 - Pelvic x-ray
 - Abd/pelvis CT
 - Chest CT
 - GI endoscopy
 - Bronchoscopy
 - Vascular radiology

Infusion Rates



Access

Gravity

Pressure

18 g peripheral IV

50 mL/min

150 mL/min

16 g peripheral IV

100 mL/min

225 mL/min

14 g peripheral IV

150 mL/min

275 mL/min

8.5 Fr CV cordis

200 mL/min

450 mL/min



What Type of Shock is This?

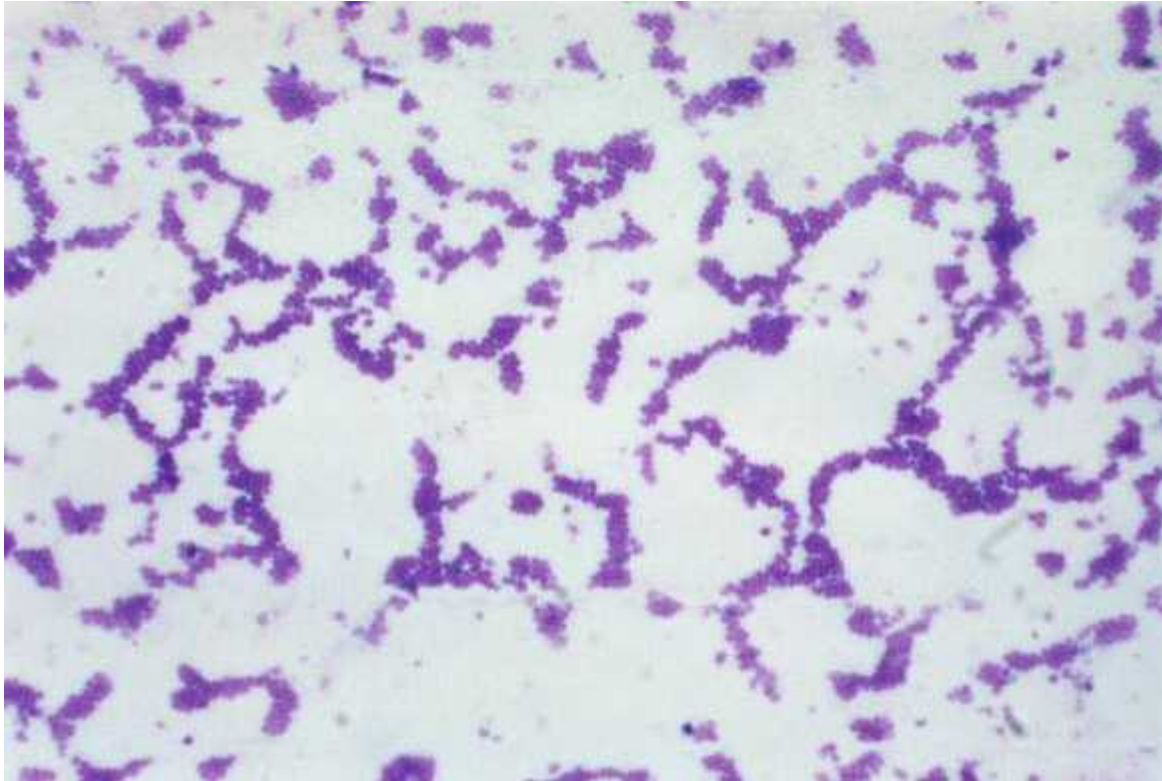
- An 81 yo F resident of a nursing home presents to the ED with altered mental status. She is febrile to 39.4, hypotensive with a widened pulse pressure, tachycardic, with warm extremities

Septic

Types of Shock

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

Septic Shock





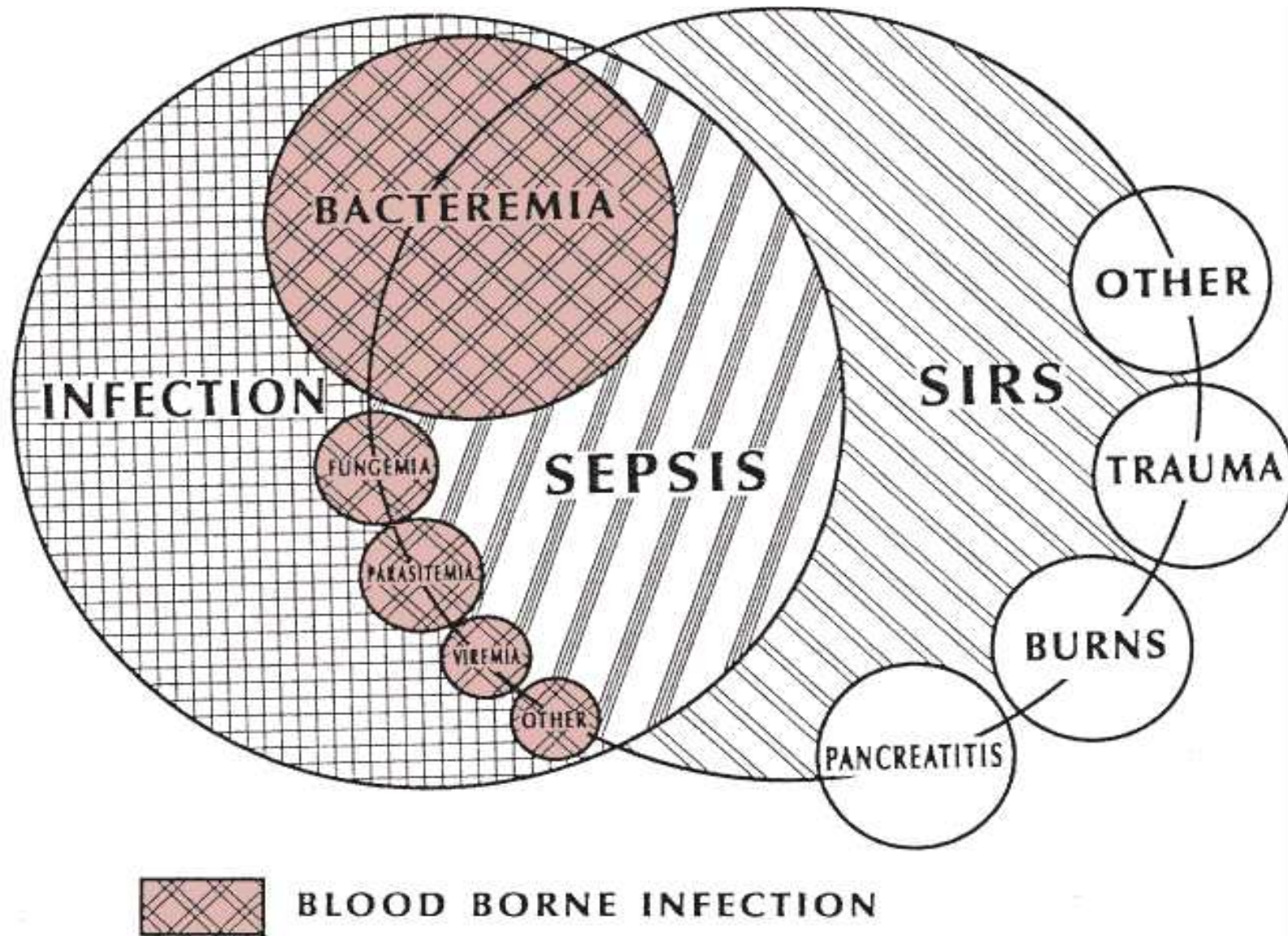
Sepsis

- Two or more of SIRS criteria
 - Temp > 38 or < 36 C
 - HR > 90
 - RR > 20
 - WBC $> 12,000$ or $< 4,000$
- Plus the presumed existence of infection
- Blood pressure can be normal!

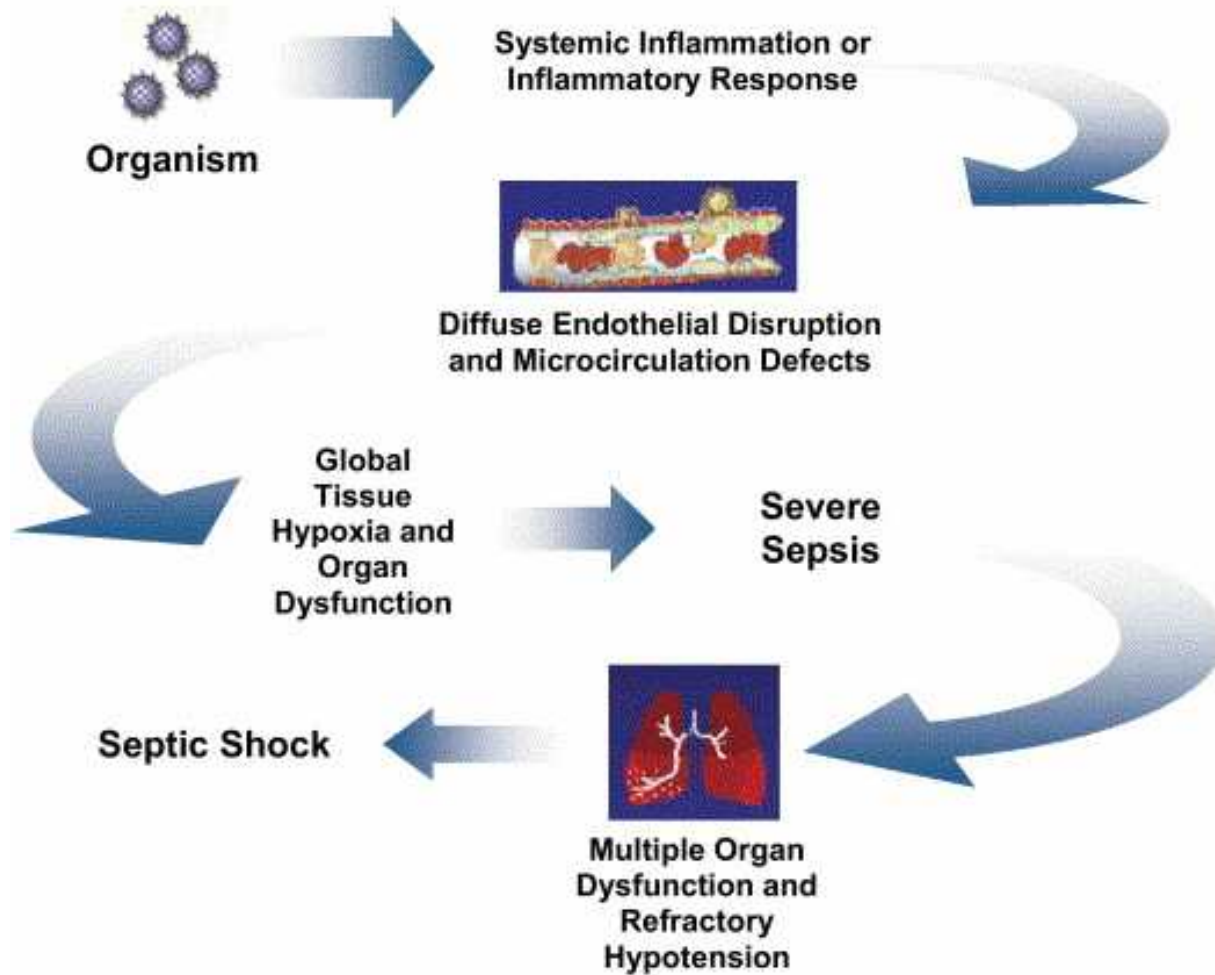


Septic Shock

- Sepsis (remember definition?)
- Plus refractory hypotension
 - After bolus of 20-40 mL/Kg patient still has one of the following:
 - SBP < 90 mm Hg
 - MAP < 65 mm Hg
 - Decrease of 40 mm Hg from baseline



Pathogenesis of Sepsis





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”



Ancillary Studies

- Cardiac monitor
- Pulse oximetry
- CBC, Chem 7, coags, LFTs, lipase, UA
- ABG with lactate
- Blood culture x 2, urine culture
- CXR
- Foley catheter (why do you need this?)



Treatment of Septic Shock

- 2 large bore IVs
 - NS IVF bolus- 1-2 L wide open (if no contraindications)
- Supplemental oxygen
- Empiric antibiotics, based on suspected source, as soon as possible



Treatment of Sepsis

- Antibiotics- Survival correlates with how quickly the correct drug was given
- Cover gram positive and gram negative bacteria
 - Zosyn 3.375 grams IV and ceftriaxone 1 gram IV or
 - Imipenem 1 gram IV
- Add additional coverage as indicated
 - Pseudomonas- Gentamicin or Cefepime
 - MRSA- Vancomycin
 - Intra-abdominal or head/neck anaerobic infections- Clindamycin or Metronidazole
 - Asplenic- Ceftriaxone for N. meningitidis, H. influenzae
 - Neutropenic – Cefepime or Imipenem



Persistent Hypotension

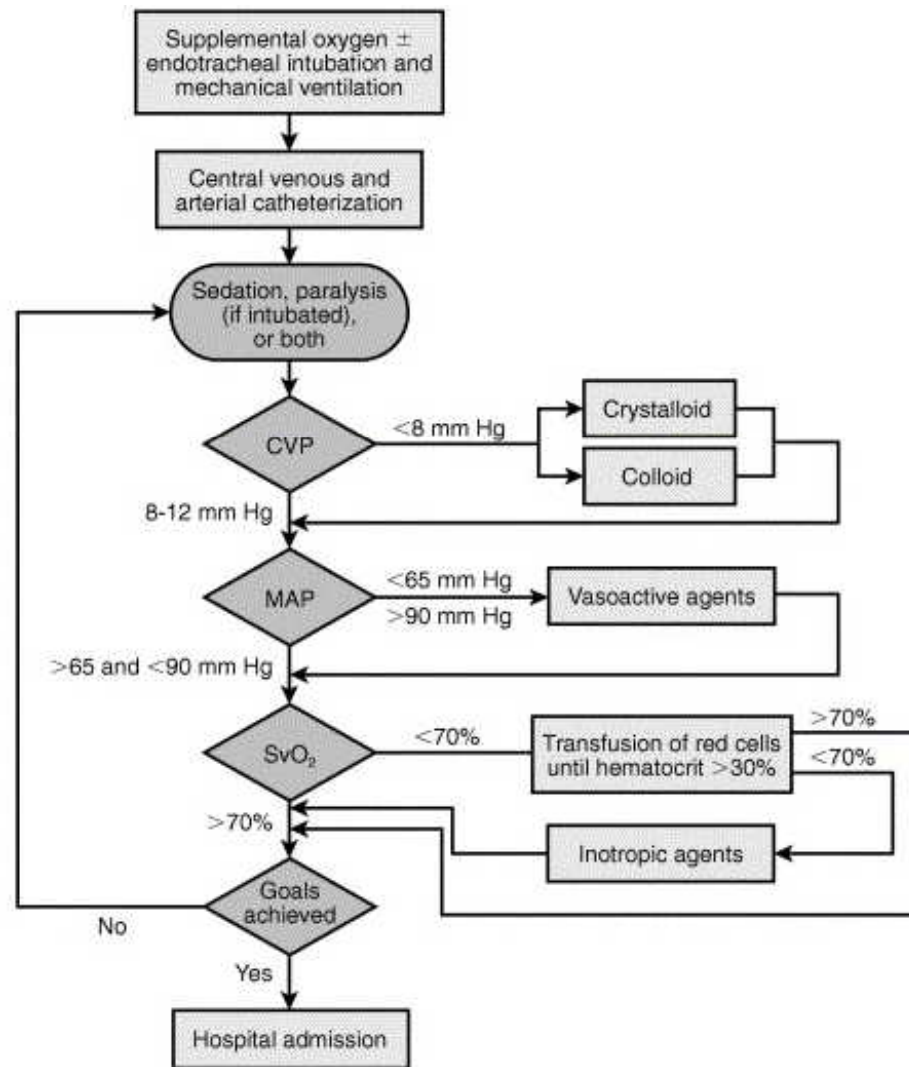
- If no response after 2-3 L IVF, start a vasopressor (norepinephrine, dopamine, etc) and titrate to effect
- Goal: MAP > 60
- Consider adrenal insufficiency: hydrocortisone 100 mg IV



Early Goal Directed Therapy

- Septic Shock Study 2001
 - 263 patients with septic shock by refractory hypotension or lactate criteria
 - Randomly assigned to EGDT or to standard resuscitation arms (130 vs 133)
 - Control arm treated at clinician's discretion and admitted to ICU ASAP
 - EGDT group followed protocol for 6 hours then admitted to ICU

Treatment Algorithm





EGDT Group

- First 6 hours in ED
 - More fluid (5 L vs 3.5 L)
 - More transfusion (64.1% vs 18.5%)
 - More dobutamine (13.7% vs 0.8%)
- Outcome
 - 3.8 days less in hospital
 - 2 fold less cardiopulmonary complications
 - Better: SvO₂, lactate, base deficit, PH
 - Relative reduction in mortality of 34.4%
 - 46.5% control vs 30.5% EGDT



What Type of Shock is This?

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

Cardiogenic

Types of Shock

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

Cardiogenic Shock





Cardiogenic Shock

- Defined as:
 - SBP < 90 mmHg
 - CI < 2.2 L/m/m²
 - PCWP > 18 mmHg
- 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



Pathophysiology of Cardiogenic Shock

- Often after ischemia, loss of LV function
 - Lose 40% of LV → clinical shock ensues
- CO reduction = lactic acidosis, hypoxia
- Stroke volume is reduced
 - Tachycardia develops as compensation
 - Ischemia and infarction worsens



Ancillary Tests

- EKG
- CXR
- CBC, Chem 10, cardiac enzymes, coagulation studies
- Echocardiogram



Treatment of Cardiogenic Shock

- Goals- Airway stability and improving myocardial pump function
- Cardiac monitor, pulse oximetry
- Supplemental oxygen, IV access
- Intubation will decrease preload and result in hypotension
 - Be prepared to give fluid bolus



Treatment of Cardiogenic Shock

- AMI
 - Aspirin, beta blocker, morphine, heparin
 - If no pulmonary edema, IV fluid challenge
 - If pulmonary edema
 - Dopamine – will ↑ HR and thus cardiac work
 - Dobutamine – May drop blood pressure
 - Combination therapy may be more effective
 - PCI or thrombolytics
- RV infarct
 - Fluids and Dobutamine (no NTG)
- Acute mitral regurgitation or VSD
 - Pressors (Dobutamine and Nitroprusside)



What Type of Shock is This?

- A 34 yo F presents to the ER 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.

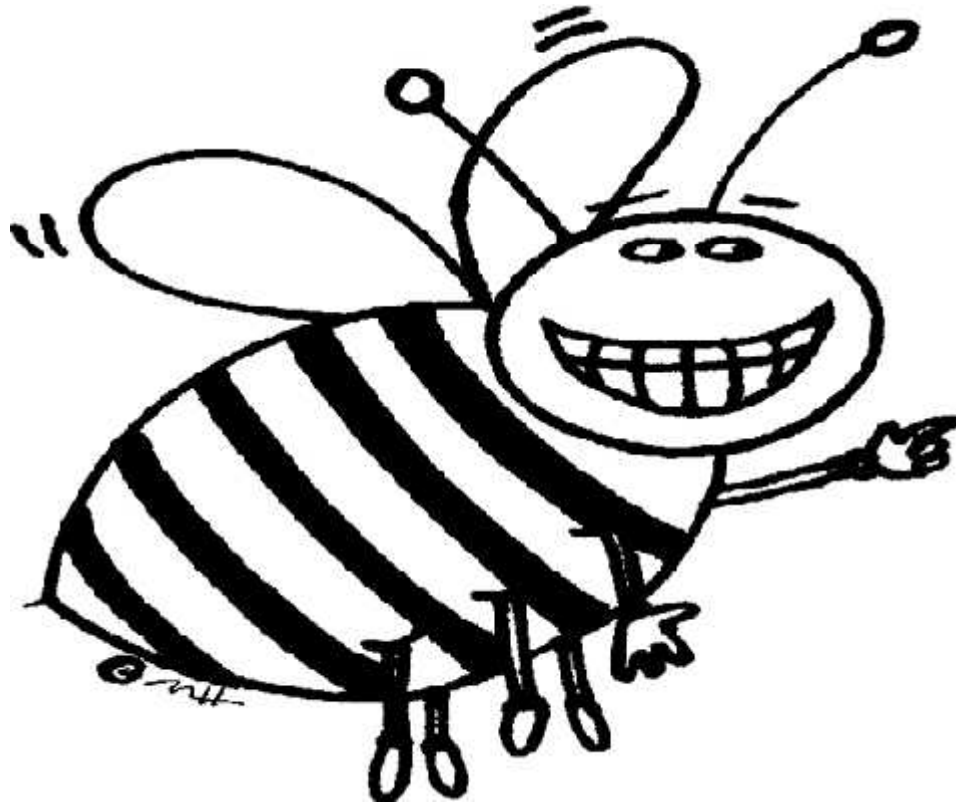
Anaphalactic

Types of Shock

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



Anaphalactic Shock





Anaphylactic 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?
 - 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

- Risk factors for fatal anaphylaxis
 - Poorly controlled asthma
 - Previous anaphylaxis
- Reoccurrence rates
 - 40-60% for insect stings
 - 20-40% for radiocontrast agents
 - 10-20% for penicillin
- Most common causes
 - Antibiotics
 - Insects
 - Food



Anaphylactic Shock

- Mild, localized urticaria can progress to full anaphylaxis
- 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



Anaphylactic Shock- Diagnosis

- Clinical diagnosis
 - Defined by airway compromise, hypotension, or involvement of cutaneous, respiratory, or GI systems
- Look for exposure to drug, food, or insect
- Labs have no role



Anaphylactic Shock- Treatment

- ABC's
 - Angioedema and respiratory compromise require immediate intubation
- IV, cardiac monitor, pulse oximetry
- IVFs, oxygen
- Epinephrine
- Second line
 - Corticosteroids
 - H1 and H2 blockers



Anaphylactic Shock- Treatment

- Epinephrine
 - 0.3 mg IM of 1:1000 (epi-pen)
 - Repeat every 5-10 min as needed
 - Caution with patients taking beta blockers- can cause severe hypertension due to unopposed alpha stimulation
 - For CV collapse, 1 mg IV of 1:10,000
 - If refractory, start IV drip



Anaphylactic Shock - Treatment

- Corticosteroids
 - Methylprednisolone 125 mg IV
 - Prednisone 60 mg PO
- Antihistamines
 - H1 blocker- Diphenhydramine 25-50 mg IV
 - H2 blocker- Ranitidine 50 mg IV
- Bronchodilators
 - Albuterol nebulizer
 - Atrovent nebulizer
 - Magnesium sulfate 2 g IV over 20 minutes
- Glucagon
 - For patients taking beta blockers and with refractory hypotension
 - 1 mg IV q5 minutes until hypotension resolves



Anaphylactic Shock - Disposition

- All patients who receive epinephrine should be observed for 4-6 hours
- If symptom free, discharge home
- If on beta blockers or h/o severe reaction in past, consider admission



What Type of Shock is This?

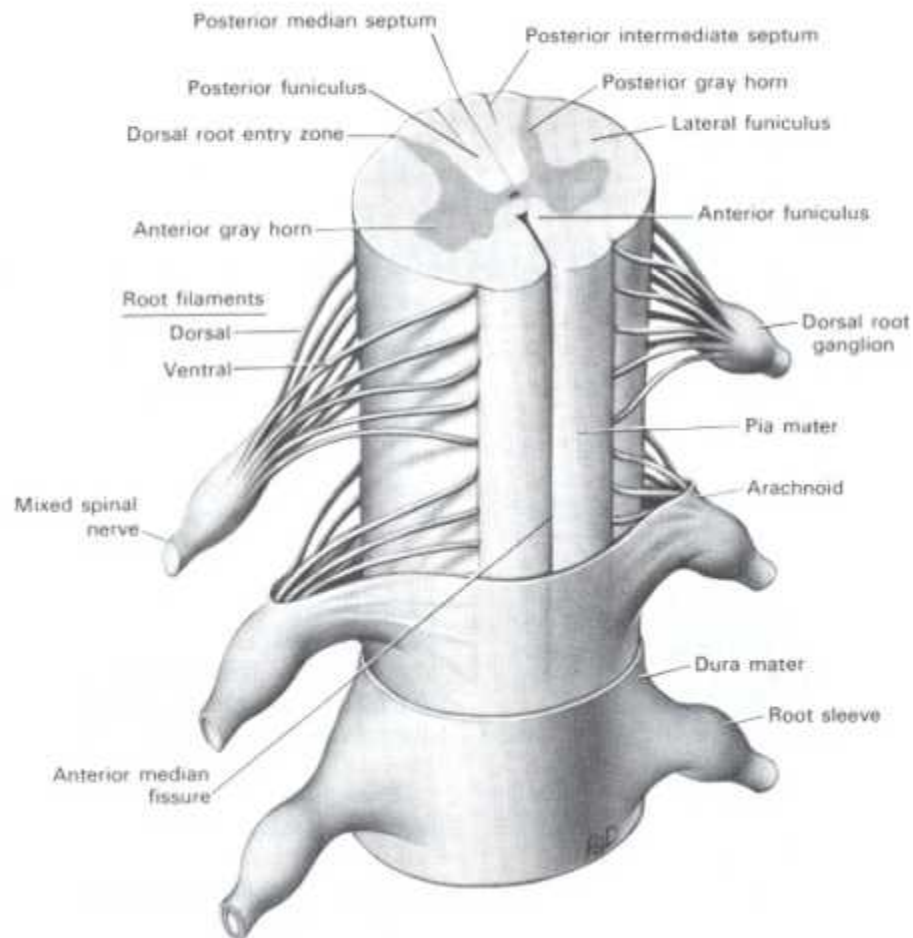
- A 41 yo M presents to the ER after an MVC complaining of decreased sensation below his waist and is now hypotensive, bradycardic, with warm extremities

Neurogenic

Types of Shock

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

Neurogenic Shock





Neurogenic Shock

- Occurs after acute spinal cord injury
- Sympathetic outflow is disrupted leaving unopposed vagal tone
- Results in hypotension and bradycardia
- Spinal shock- temporary loss of spinal reflex activity below a total or near total spinal cord injury (not the same as neurogenic shock, the terms are not interchangeable)



Neurogenic Shock

- Loss of sympathetic tone results in warm and dry skin
- Shock usually lasts from 1 to 3 weeks
- Any injury above T1 can disrupt the entire sympathetic system
 - Higher injuries = worse paralysis



Neurogenic Shock- Treatment

- A,B,Cs
 - Remember c-spine precautions
- Fluid resuscitation
 - Keep MAP at 85-90 mm Hg for first 7 days
 - Thought to minimize secondary cord injury
 - If crystalloid is insufficient use vasopressors
- Search for other causes of hypotension
- For bradycardia
 - Atropine
 - Pacemaker



Neurogenic Shock- Treatment

- Methylprednisolone
 - Used only for blunt spinal cord injury
 - High dose therapy for 23 hours
 - Must be started within 8 hours
 - Controversial- Risk for infection, GI bleed



What Type of Shock is This?

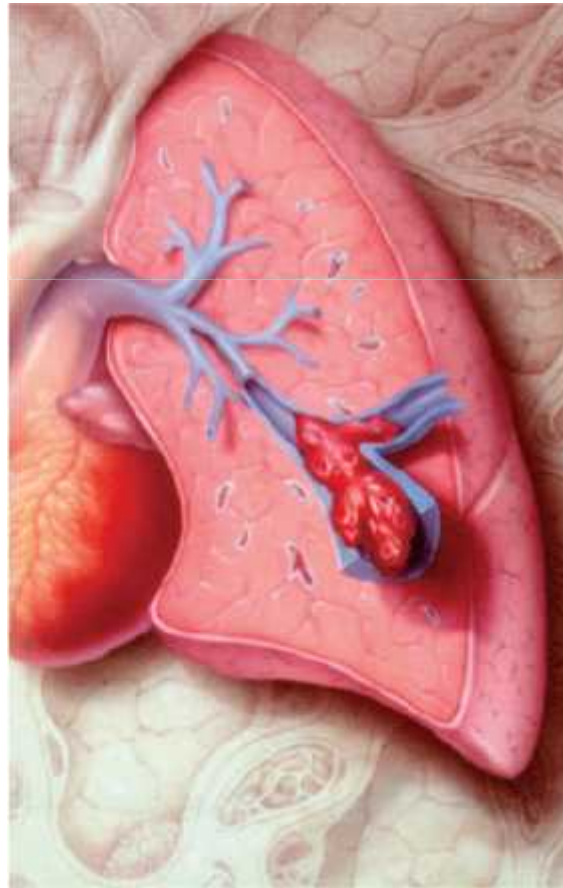
- A 24 yo M presents to the ED after an MVC c/o chest pain and difficulty breathing. On PE, you note the pt to be tachycardic, hypotensive, hypoxic, and with decreased breath sounds on left

Obstructive

Types of Shock

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

Obstructive Shock



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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
 - No tests needed!
 - Rx: Needle decompression, chest tube



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
 - Diagnosis: large heart CXR, echo
 - Rx: Pericardiocentesis



Obstructive Shock

- Pulmonary embolism
 - Virscow triad: hypercoaguable, venous injury, venostasis
 - Signs: Tachypnea, tachycardia, hypoxia
 - Low risk: D-dimer
 - Higher risk: CT chest or VQ scan
 - Rx: Heparin, consider thrombolytics



Obstructive Shock

- Aortic stenosis
 - Resistance to systolic ejection causes decreased cardiac function
 - Chest pain with syncope
 - Systolic ejection murmur
 - Diagnosed with echo
 - Vasodilators (NTG) will drop pressure!
 - Rx: Valve surgery



The End

Any Questions?