The School of Shock
Leigh Anne Wilmot RN, CEN, CLNC

The Human Cost
Shock is a medical emergency that if left untreated leads to significant morbidity and mortality.
- Septic shock is the 10th leading cause of death in the US
- The monetary cost to the healthcare system is estimated to be 16.7 billion dollars a year.
- The human cost is approximately 115,000 deaths a year.

Shock - Definition
- Syndrome in which the imbalance of oxygen supply and demand leads to decreased tissue perfusion and impaired cellular metabolism
- Caused by low circulating volume, vasodilatation or cardiogenic pump failure
- SIRS, MODS, DEATH

The Shock Cycle

SIRS
- Temperature > 100.4 or < 96.8 degrees Fahrenheit
- Heart Rate > 90 bpm
- Respirations > 20 or PaCO2 < 32mmHg
- Leukocyte count > 12,000 or < 4,000 or > 10% bands

Pathophysiology
- Shock is triggered by drop in MAP
  Calculating MAP: \[ \text{Systolic BP} + \frac{\text{2(Diastolic BP)}}{3} \]
- Can occur after \( \downarrow \) in CO
- \( \downarrow \) in circulating blood volume
- \( \uparrow \) in size of vascular bed

Stages of Shock
- Compensatory or Early Reversible
- Progressive or Intermediate
- Refractory or Irreversible
- Figure 67-6 on page 1781

Early Reversible Shock
Baroreceptors in aortic arch and carotid sinus detect drop in MAP of 10%
- Circulating blood volume decreases by < than 500 ml
- Cardiac integration center causes
- Sympathetic nervous system increases heart rate and force of contraction (CO)
- And vasconstriction to increase SVR and arterial pressure
- Perfusion is maintained

Compensatory Stage
- MAP \( \downarrow \) by 10mmHg
- SNS \( \uparrow \) HR and vasoconstriction
- \( \uparrow \) Renin \( \rightarrow \) angiotensin \( \rightarrow \) aldosterone = Na+ and H2O reabsorption
- Posterior pituitary releases ADH
- Get fluid shift from interstitial to capillaries
- ** This preserves perfusion of heart and brain
Compensatory Stage

MAP falls 10 to 15% below norm and 25-35% blood loss (1,000+ml)

Sympathetic Nervous System releases epinephrine from adrenal medulla, norepinephrine from adrenal medulla and sympathetic fibers.

These stimulate the alpha and beta-adrenergic fibers.

- Alpha-adrenergic fibers cause vasoconstriction of vessels of skin and abdominal viscera (Beta #1 response)
- Beta-adrenergic fibers cause vasodilatation of heart vessels and skeletal muscles (Beta #2 response)

Increase heart rate and force of cardiac contraction also

Respiratory blood vessels dilate and respiratory rate increases

Maintenance of Circulating VOLUME

- Renin-angiotensin response as blood flow to kidneys decreases
- Renin from the kidneys converts a plasma protein to Angiotensin II
- Causes vasoconstriction and stimulates adrenal cortex to release aldosterone
- Aldosterone causes kidneys to release water and sodium & retain potassium
- Causes vasoconstriction of vessels of skin and abdominal viscera

Aldosterone causes vasoconstriction of vessels of skin and abdominal viscera

Absorption of water maintains circulating volume, SVR, CVP, & B/P

Hypothalamus releases adrenocorticotropic hormone (ACTH)

Stimulates adrenal glands to secrete aldosterone

Water is reabsorbed in the kidneys

Posterior pituitary gland releases antidiuretic hormone (ADH)

Causes kidneys to reabsorb water

These can only maintain MAP for a short time

Progressive or Intermediate

- MAP of 20 mmHg or more
- Fluid loss of 35-50% (1800-2500ml)
- Vasoconstriction causes cells to become O2 deficient and anaerobic metabolism produces lactic acid
- Get metabolic acidosis
- Lack of ATP production
- Hypothermia with Na/K pump failure
- Fluid shifts into interstitial space
- Proteins shift into interstitial space also
- Cells in heart and brain become hypoxic
- Poor survival rate

Compensatory Shock cont.

- Hypovolemic shock – low circulating volume
- Distributive shock – vasodilatation
- Cardiogenic shock – pump failure
- Anaphylactic
- Neurogenic
- Septic

Types of Shock

- Body forms IgE against an antigen
- Vasoconstriction
- Pooling of blood in the periphery
- Histamine causes constriction of smooth muscles in bronchioles, bladder, intestines
- Serotonin increases capillary permeability in lungs (can cause pulmonary edema)
- Wear Medic Alert bracelet

- Kidneys: acute tubular necrosis
- Brain: emboli, LOC
- Heart: arrhythmias and CO
- Lungs: resp. acidosis, ARDS
- GI: paralytic ileus, ulcer, sepsis
- Liver: infection, toxicity, bleeding
- Blood: DIC
- MODS (multiple organ dysfunction or death syndrome)

Hypovolemic Shock

Low Blood Flow

- Hypovolemic: loss of intravascular circulating volume (15-25%)
  - Surgery
  - Trauma
  - 3rd spacing-liver, bowel obstruction, burns
  - Alcoholics – esophageal varices
  - Abdominal Aortic Aneurysms (AAA)
  - Severe vomiting and diarrhea (esp. pedi and geriatric)

Distributive Shock - Anaphylaxis

Midistribution of Blood Flow

- Body forms IgE against an antigen
  - Vasoconstriction
  - Pooling of blood in the periphery
  - Histamine causes constriction of smooth muscles in bronchioles, bladder, intestines
  - Serotonin increases capillary permeability in lungs (can cause pulmonary edema)
  - Wear Medic Alert bracelet
**Neurogenic Shock**
- Result of imbalance between parasympathetic and sympathetic stimulation—vasodilation
- **Causes**: head injury, trauma to spinal cord, insulin reaction damages medulla, anesthesia, tumors, osteoporosis, epidural catheter
- **Remember Cushing’s Triad!** - widening pulse pressure (rising systolic, declining diastolic), hypertension, and bradycardia

**Spinal Shock v. Neurogenic**
- Spinal shock is transient and involves only the inability to move below the level of the injury.
- Neurogenic shock is characterized by Cushing’s Triad
- They can occur together

**Septic Shock**
- Endotoxins activate coagulation and inflammatory process
- Leading cause of death for ICU pts.
- SIRS—systemic inflammatory response syndrome
- CO high and SVR low
- 2 phases—warm and cold
- Toxic shock
- DIC high risk with septic shock

**Cardiogenic Shock**
- Decreased CO and MAP
- Cyanosis & increased cardiac rate/O2 demand failure
- LVEDP (left ventricular end diastolic pressure) increases causing pulmonary edema—crackles

**Assessment**
- Cool, clammy skin
- Hypotension—widened pulse pressure
- MAP<70 (need 70-105 for organs to be perfused)
- If it only takes 40 minutes of MAP<70 to develop acute renal failure.
- ↑ in B/P by 20 and ↓ HR by 20 = shock
- Oliguria
- Tachycardia
- Decreased Level of Consciousness
- Crackles and edema-only in cardiogenic

**Diagnostic tests**
- WBC and differential
- Hgb and Hct
- Type and Cross
- PT, PTT
- ABGs—acidosis
- Electrolytes—glucose ↓, Na level ↓, K level ↑
- BUN and Creat, urine sp. gravity and osmolality
- Cardiac enzymes
- Blood, Urine, Sputum, Wound cultures
- Lactate—sepsis
- Cortisol levels—ACTH
- Chest X-ray

**Cardiac Shock**
- Decreased CO and MAP
- Cyanosis & increased cardiac rate/O2 demand failure
- LVEDP (left ventricular end diastolic pressure) increases causing pulmonary edema—crackles

**Sepsis**
- Suspected Infection
- *Temp* >102.4°F or <98.6°F
- Pulse Rate >100 bpm
- Respiratory Rate >20 bpm or PaCO₂ >54 mm Hg
- White Blood Cell Count >14,000 or WBC <4,000 or >10,000/μL
- **CO** <90 mm Hg together on 30%–60% FiO₂ below 
  *PO₂*<60 mm Hg, <40 mm Hg, or 50 mm Hg

**Septic Shock from Dog Bite**
- Hemorrhagic Rash
- DIC

**Cardiogenic Shock**
- Decreased CO and MAP
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**Diagnostic tests**
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**Diagnostic Tests**

- CVP: Measures right heart pressure
  - Normal: 4-10 cm H2O or 2-5 mmHg
  - Get a mean
  - Located in Right atrium
  - High reading means fluid overload
  - Low reading means fluid deficit

- Swan Ganz or PA catheter
  - Measures left heart pressures
  - Get PAS, PAD, PAW, and CO
  - Normal Values
    - PA: 20's/10's
    - PAW: 4-12mmHg
    - CO: 4-7L/min

**Priority Goals**

- Early Recognition and Prevention
- Rapid Intervention
- Stabilize the VS
- Reverse SIRS

**Drug Therapy**

- Positive inotropes: ↑ contractility
  - Dopamine
  - Dobutamine
  - Vasoconstrictors: in distributive
    - Levophed
    - Epinephrine
  - Vasodilators: mostly cardiogenic
    - Nipride
    - Nitroglycerine
  - Figures 67-8 & 67-9 on pp. 1786-87

**Fluid Replacement**

- Fluid Replacement
  - Blood
  - NS
  - Plasma expanders: Hespan, Dextran, albumin
  - Crystalloids: isotonic or hypotonic
    (0.9%, NS, LR, & 0.45% NS and D5W)

**Diet Therapy**

- Hypermetabolic state
- Enteral feeding first choice
- Early diet interventions decreases the risk of MODS
- If cardiogenic: low Na and fluid restriction
- High potassium if BUN and Creat OK
  - diuretics

**Prevention of Shock**

- Monitor labs and organ function
- Frequent vital signs (q15 mins.)
- Hourly urine output: when to call
- Cardiac monitoring
- Hemodynamic monitoring

**Surgical/Invasive Intervention**

- IABP: for cardiogenic shock
  - (Intraaortic balloon pump)
- VAD
  - (Ventricular assistive device)
  - Bridge to heart transplant
  - Used in patients with cardiomyopathy
**Other**
- \( O_2 \)
- Treat underlying cause
- Positioning-flat with legs elevated 20 degrees; & head up on pillow 10 degrees
- Airway
- Assess for MODS
  - ARDS, Kidney failure, Kupffer cell damage in liver, hypoglycemia, metabolic and respiratory acidosis, GI bleed, paralytic ileus, bowel necrosis, etc.

**Current Theories**
- Activated Protein C
- Tight Glycemic Control

**Nursing Diagnoses**
- Decreased tissue perfusion
- Decreased cardiac output
- Fluid volume deficit
- Anxiety

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**Test Your Knowledge**

- A client’s nursing diagnosis is Fluid Volume Deficit Related to Excessive Fluid Loss. Which action related to fluid management should be delegated to a nursing assistant?
  a. Administer IV fluids as prescribed by the physician.
  b. Provide straws and offer fluids between meals.
  c. Develop plan for added fluid intake over 24 hours.
  d. Teach family members to assist client with fluid intake.

- The client also has the nursing diagnosis Decreased Cardiac Output related to decreased plasma volume. Which finding on assessment supports this diagnosis?
  a. Flattened neck veins when client is in supine position.
  b. Full and bounding pedal and post-tibial pulses.
  c. Pitting edema located in feet, ankles, and calves.
  d. Shallow respirations with crackles on auscultation.

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**Test Your Knowledge**

- You are monitoring blood administration to a trauma victim in shock. Which of the following assessments indicate a dangerous transfusion reaction?
  a. Red raised areas on the skin that itch
  b. An increase in body temp by 3 degrees
  c. Decreasing BP and dyspnea
  d. Increasing BP and pulse

- A 17 yr old male presents to the Emergency Department via EMS. He was riding his dirt bike on a cross country trail when he struck a tree. He has bruising over his right upper quadrant and is complaining of severe pain with palpation. VS are 86/50, HR 122, RR 24 T 96.5 and his O2 sat is 94% on room air. The patient is cool and sweaty and appears confused. Hypovolemic Shock

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**Test Your Knowledge**

- A listless 2 year old is rushed into the Emergency Department in his mother’s arms. She relates he was eating a peanut butter cookie when he began crying and rubbing his mouth. Within seconds his lips and eyes became swollen and he developed a raised rash over his trunk and extremities. His breathing became labored and audible wheezing could be heard. His mother states he has never eaten nuts before. VS are BP 86/33 P 185 R 52 T 97.6 axillary and O2 Sat 88% on room air

**Case Scenario #2**

- Which of these clients in the neurologic ICU will be best to assign to an RN who has floated from the medical unit?
  a. A 26 yr-old client with a basilar skull fracture who has clear drainage coming out of the nose.
  b. A 42 yr-old client admitted several hours ago with a headache and diagnosed with a ruptured berry aneurysm.
  c. A 46 yr-old client who was admitted 48 hours ago with bacterial meningitis and has an antibiotic dose due.
  d. A 65 yr-old client with an astrocytoma who has just returned to the unit after having a craniotomy.
A 72 year old male is brought to the Emergency Department via EMS. He sustained a 10 foot fall from a ladder onto his back. He is awake and alert. BP is 80/50 P 55 R 26 T 96.6 O2 sat 91% on room air. The patient complains of mid low back pain and decreased ability to move his legs. His legs are pink, warm and dry but you notice above his waistline that he is pale, cool and clammy. 

Distributive - Neurogenic Shock

A 55 yr old diabetic female presents to the Emergency Department complaining of bilateral flank pain, foul smelling urine, vomiting and chills for 3 days. She is lethargic and her skin is pale and cool. VS are BP 90/60 P 112 T 96.6 R22 O2 sat 93% room air. 

Septic Shock

A 68 yr old male presents to the Emergency Department complaining of severe midsternal chest pain that radiates to his left arm and jaw. He reports shortness of breath, nausea and dizziness. He is lethargic, pale and diaphoretic with mottled extremities. Rales are heard bilaterally upon auscultation of his lung sounds. VS are 72/50 P 118 T 96.6 R 22 O2 sat 89% on room air. 

Cardiogenic Shock

Internet Resources

- [http://learn.sdstate.edu/vossj/Casestudies2002/chauncey.htm](http://learn.sdstate.edu/vossj/Casestudies2002/chauncey.htm)
- [http://amp.osu.edu/RT/PPTS/515_Case_5_Shock.ppt](http://amp.osu.edu/RT/PPTS/515_Case_5_Shock.ppt)
- [http://www.healthsci.clayton.edu/nurs4220/msofcase.htm](http://www.healthsci.clayton.edu/nurs4220/msofcase.htm)