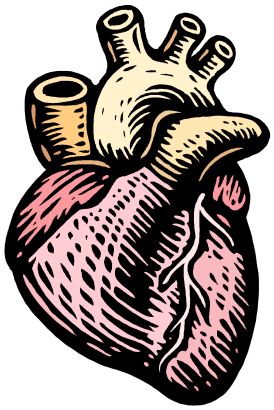
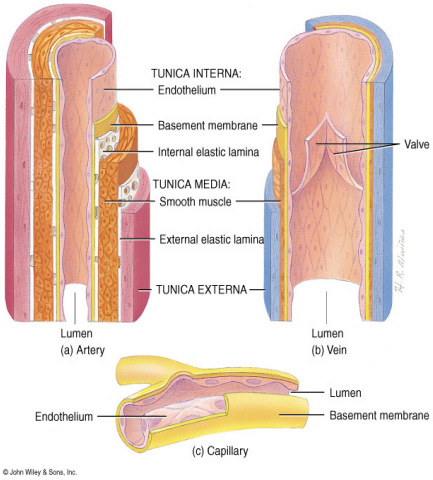
Bio& 242
Unit 3 Lecture 3



Comparative Structure of Artery and Vein Vessel Walls

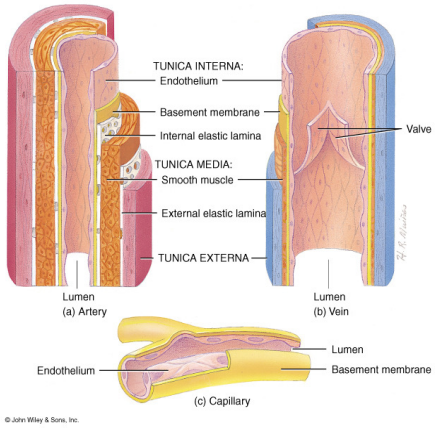
- **Arteries:** have greatest pressure

1. **Tunica Interna**
   a. **Endothelium**
   b. **Basement membrane**
   c. **Internal elastic lamina**
2. **Tunica Media**
   a. **Smooth muscle**
   b. **External elastic lamina**
3. **Tunica Externa**
   a. **Connective tissue**



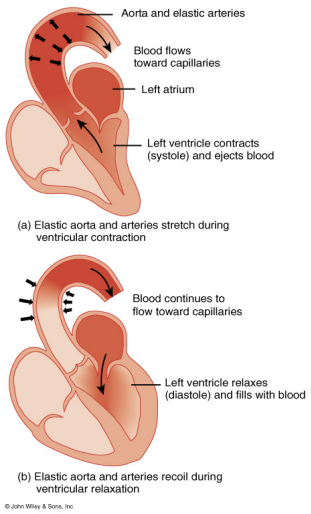
Comparative Structure of Artery and Vein Vessel Walls

- **Veins:** have lowest pressure
  1. **Tunica Interna**
     - a. **Endothelium**
     - b. **Basement membrane**
  2. **Tunica Media**
     - a. **Smooth Muscle**
  3. **Tunica Externa**
     - a. **Connective Tissue**
- **Capillary**
  - a. **Endothelium**
  - b. **Basement membrane**



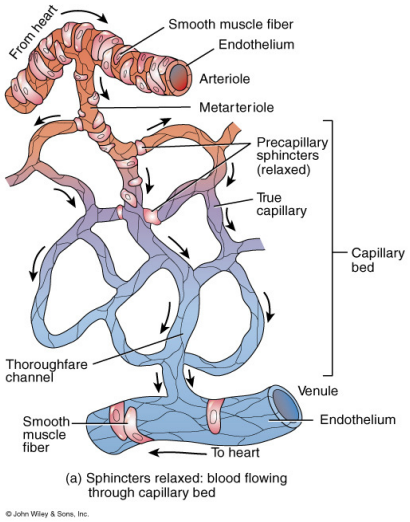
Classification of Arteries

- **Elastic Arteries**
  (Conducting arteries)
  Aorta, Brachiocephalic, Common Carotid, Subclavian, Vertebral, Pulmonary, Common Iliac
- **Muscular Arteries**
  (Distributing Arteries)
  Brachial artery, Radial artery, Popliteal, Common Hepatic



Circulation Through a capillary bed

- **Arterioles: deliver blood to capillaries**
- **Metarterioles: emerges from arterioles and supplies a group of capillaries**
- **Thoroughfare Channel: arise from metarterioles and contain no smooth muscle. Thoroughfares allow blood to bypass the capillary**



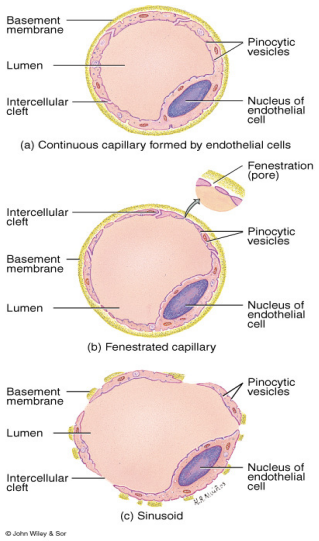
Different types of Capillaries

- **Continuous Capillaries**

  Plasma membranes of endothelial cells form a continuous tube only interrupted by intercellular clefts (gaps between cells) (lungs and muscle)
- **Fenestrated Capillaries**

  Plasma membrane of endothelial cells contain pores or fenestrations

  (Kidney and villi of small intestines)

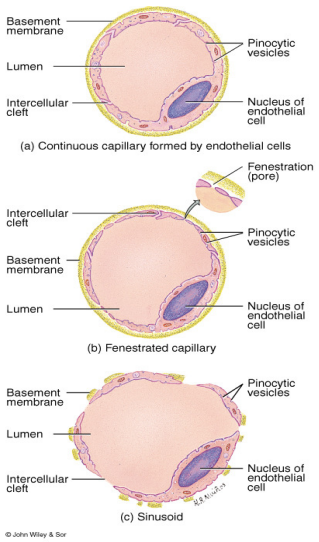


Different types of Capillaries

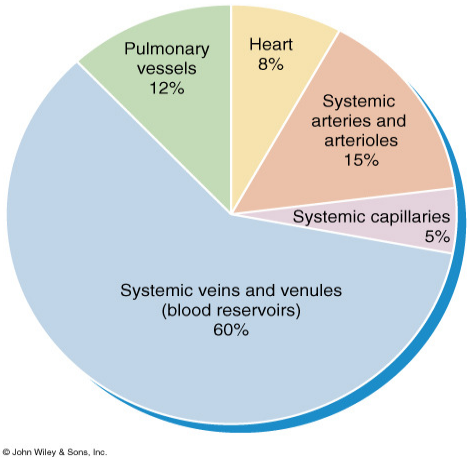
- **Sinusoids:**

  Wider and more winding than other capillaries, with incomplete basement membranes and large fenestrations

  (red bone marrow and liver)

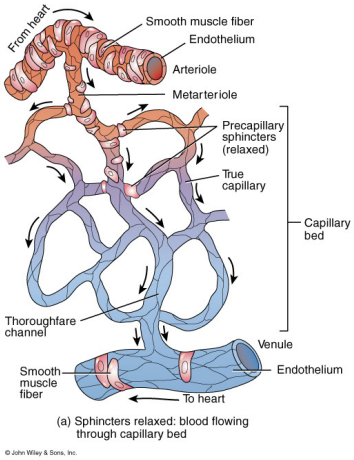


Blood distribution in the Cardiovascular System

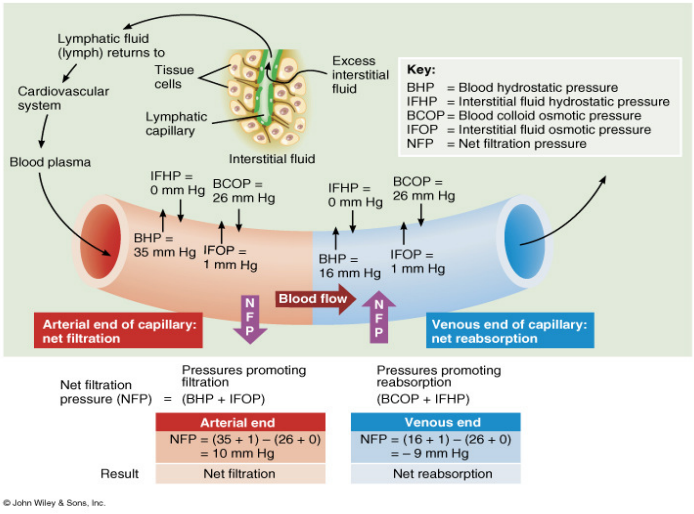


Mechanisms of Capillary Exchange

- **Simple Diffusion:**
  (CO2, O2, glucose, amino acids, and hormones)
- **Transcytosis:**
  Substances enter lumen side of endothelial cells via endocytosis and exit the other side via exocytosis
- **Bulk Flow:**
  Substances dissolved in fluid are moved in the same direction as the fluid



Forces involved in Capillary Exchange



Factors that Affect Capillary Exchange

- **Edema = increased Interstitial Fluid**
  1. **Increased BHP**
     - **a. increased CO**
     - **b. increased blood volume**
  2. **Increased Permeability of Capillaries**
     - **a. Increased IFOP**
     - **b. Bacteria**
     - **c. Tissue damage**

Factors that Affect Capillary Exchange

- **Edema = increased Interstitial Fluid**
  3. **Decreased reabsorption**
     - **a. Decreased BCOP: liver disease, burns, kidney disease**
     - **b. Lymphatic blockage: cancer and parasites**

Elephantiasis: **is a rare disorder of the lymphatic system caused by parasitic worms such as *Wuchereria bancrofti*, *Brugia malayi*, and *B. timori*, all of which are transmitted by mosquitoes. Inflammation of the lymphatic vessels causes extreme enlargement of the affected area, most commonly a limb or parts of the head and torso. It occurs most commonly in tropical regions and particularly in parts of Africa.**

Elephantiasis of the legs due to filariasis (CDC).

Blood Pressure

The pressure exerted on the walls of a blood vessel. Clinically, BP refers to pressure in arteries.

Systolic pressure = the force of blood recorded during ventricular contraction.

Diastolic pressure = the force of blood recorded during ventricular relaxation

Normal Adult BP: 120/80

Factors that affect blood pressure include:

a) cardiac output

b) blood volume

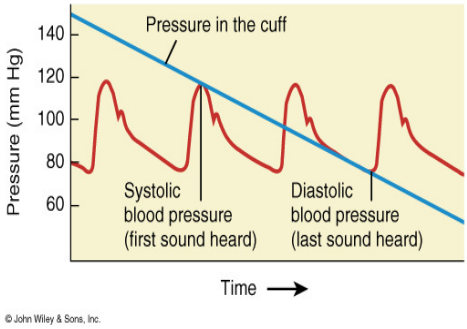
c) viscosity of blood

d) resistance

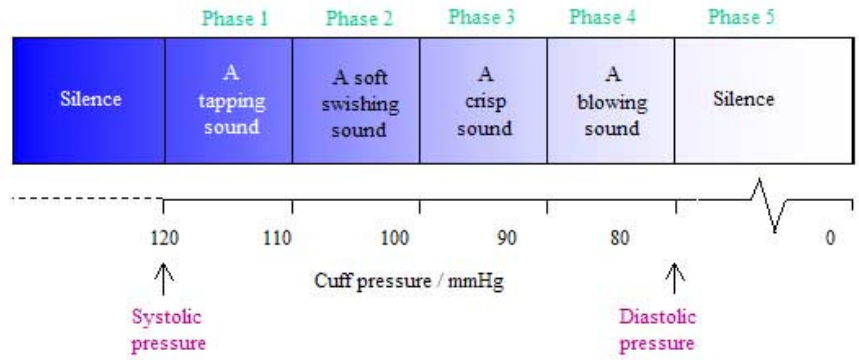
e) elasticity of arteries

Relationship between Blood Pressure, Cuff Pressure, and Korotkoff Sounds

- **Blood Pressure is measured in the Brachial Artery using a Sphygmomanometer**
- **As cuff pressure drops to a point where it equals systolic pressure, the first Korotkoff sound is heard**
- **As cuff pressure continues to drop to the point where it equals diastolic pressure, the last Korotkoff sound is heard**
- **Blood pressure is recorded as the first sound (systolic) and the last sound (diastolic) pressure**



Korotkoff Sounds



http://www.thinklabsmedical.com/stethoscope_community/sound_library/other-sounds/content/blood-pressure-korotkoff-sounds-2

Factors That Affect Circulation

- **Velocity of Blood:**

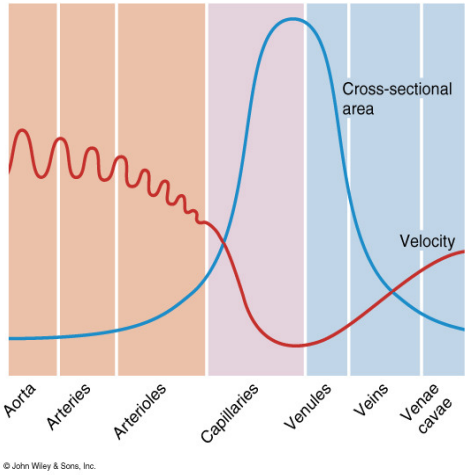
  1. Measured as the volume of blood that flows through any tissue in a given time period.

  2. Velocity is inversely related to cross-sectional area

  Aorta: 3-5 cm2, 40cm/sec

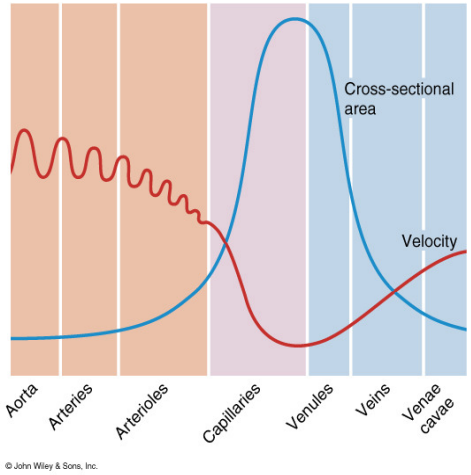
  Capillaries: 4,500-6,000 cm2/ 0.1cm/sec

  Vena Cavas: 14cm2, 5-20cm/sec



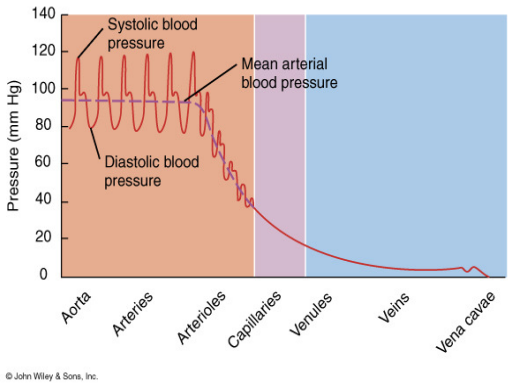
Factors That Affect Circulation

- **Resistance:**
  Measured as the opposition to blood flow through blood vessels due to friction between the blood and vessel walls.
  1. **Average vessel radius:**
     Resistance is inversely proportional to the fourth power of the radius
  2. **Blood viscosity: Resistance is directly proportional to viscosity**
  3. **Total vessel length: Resistance is directly proportional to vessel length**



Factors That Affect Circulation

- **Volume of Blood Flow:**
  Measured by Cardiac Output
  CO = SV x HR
- **Blood Pressure:**
  Measured as the hydrostatic pressure exerted on vessel walls by the blood
  Young Adult: 120/80
  120 = ventricular systole
  80 = ventricular diastole
  Mean arterial blood pressure:
  MABP = diastolic BP + 1/3[Pulse Pressure (PP)]
  PP = (systolic BP – diastolic BP)

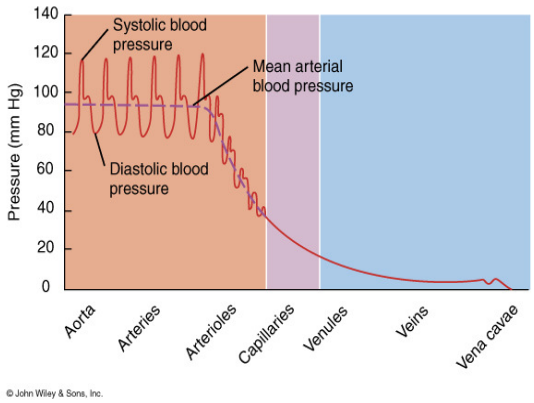


Factors That Affect Circulation

- **Cardiac Output is directly related to blood pressure**

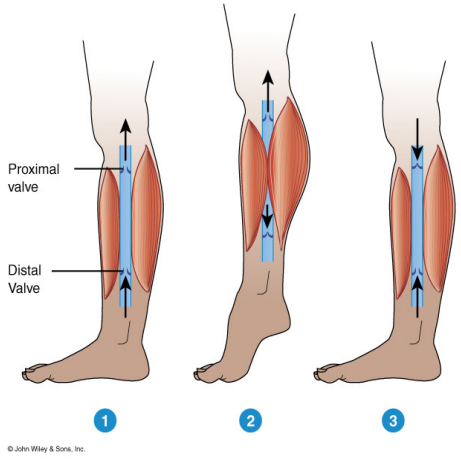
  CO = MABP/R

  R= Resistance

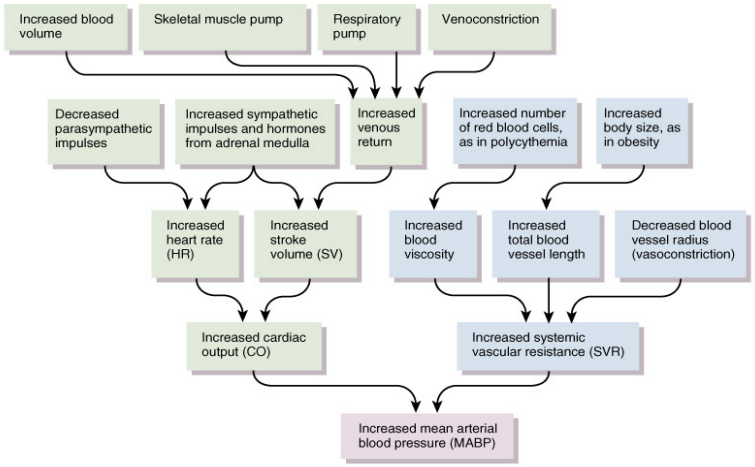


Action of Skeletal Muscle in Venous Return

- **While standing at rest, venous valves are open**
- **Contraction of muscles pushes blood upward through the proximal valve, back-pressure closes the distal valve**
- **As muscle relaxes, pressure drops closing the proximal valve. Higher blood pressure in the foot opens the distal valve allowing blood to flow into section of the vein.**



Summary of Factors that Increase Blood Pressure



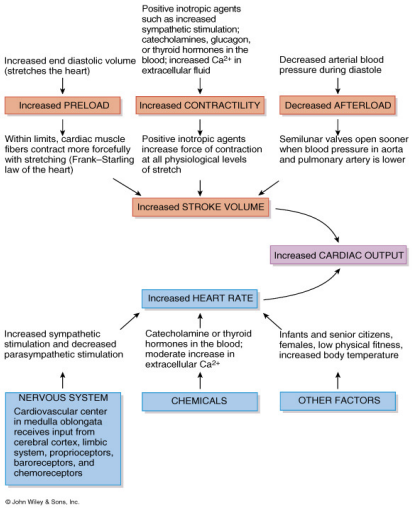
Overview of Hormones that Regulate Blood Pressure

1. **Cardiac Output:**

   Increased CO = Increased BP

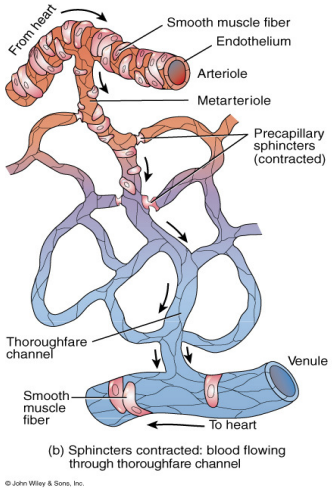
   Increased CO and contractility

   - **Epinephrine from Adrenal Medulla**
   - **Norepinephrine from sympathetic neurons**



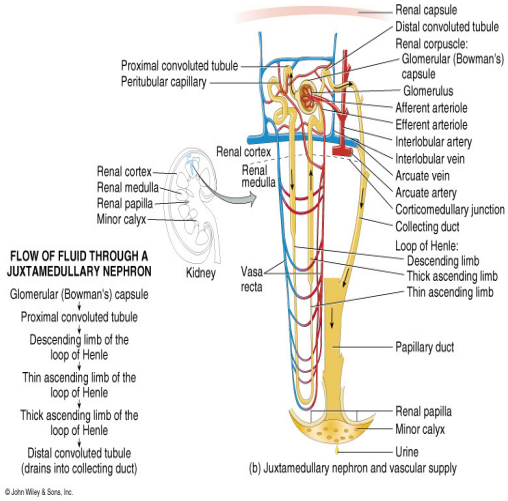
Overview of Hormones that Regulate Blood Pressure

- **Systematic Vascular Resistance**
  1. **Vasoconstriction (increased)**
     - a. **Angiotensin II**
     - b. **ADH (vasopressin)**
     - c. **Epinephrine**
     - d. **Norepinephrine**
  2. **Vasodilation (decreased)**
     - a. **ANP**
     - b. **Epinephrine**
     - c. **Nitric Oxide**



Overview of Hormones that Regulate Blood Pressure

- **Blood Volume**
  1. **Increased**
     - a. **Aldosterone**
     - b. **ADH**
  2. **Decreased**
     - a. **ANP**



TYPES OF SHOCK

1. Hypovolemic shock = due to decreased blood volume
2. Cardiogenic shock = due to poor heart function.
3. Vascular shock = due to inappropriate vasodilation. (example = too long in hot tub)
4. Obstructive shock = due to obstruction of blood flow such as by a pulmonary embolism

Signs and symptoms of shock include:
a) pulse weak but rapid
b) skin is cool, pale and clammy
c) rapid resting heart rate
d) systolic blood pressure is low (<90 mm Hg)
e) patient may be thirsty and/or nauseous
f) confused mental state due to lack of oxygen to the brain

Hypovolemic Shock

Due to decreased blood volume: hemorrhage or excessive fluid loss (vomiting, diarrhea, burns, dehydration, sweating, increased urine output)

- **Stages of shock**

  Stage 1: compensated or nonprogressive

  Stage 2: decompensated or progressive (up to 25% loss)

  Stage 3: irreversible shock (death)

Hypovolemic Shock

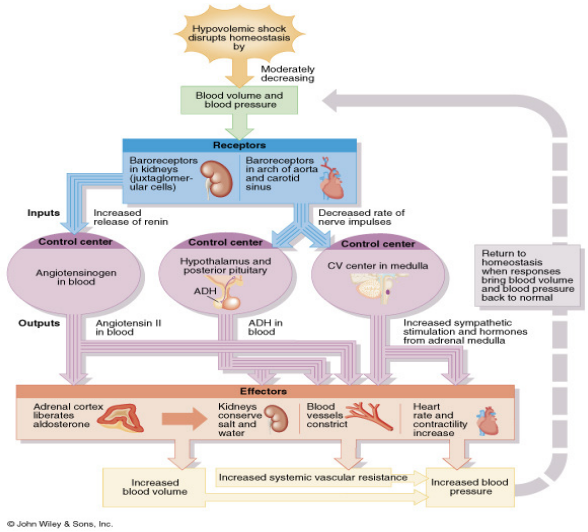
Stage 1: compensated or non-progressive

- **a. Activation of the sympathetic nervous system**
- **b. Activation of the renin-angiotensin pathway**
- **c. Release of ADH**
- **d. Signs of clinical hypoxia**

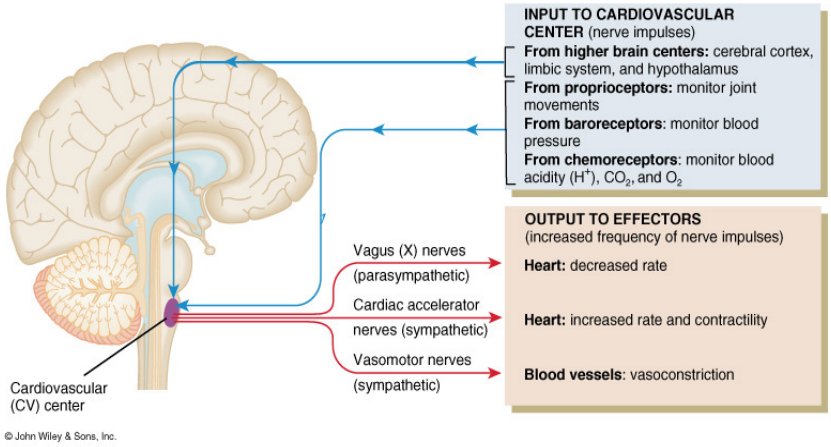
Stage 2: Decompensated or progressive (up to 25% loss)

- **a. Depressed cardiac activity (MABP as low as 60)**
- **b. Depressed vasoconstriction (MABP as low as 40)**
- **c. Increased capillary permeability**
- **d. Intravascular clotting**
- **e. Cellular death occurs**
- **e. Respiratory acidosis**

Negative Feedback Response to Hypovolemic Shock



CNS Input and Regulation of Cardiac Activity



ANS Regulation of Cardiac Activity