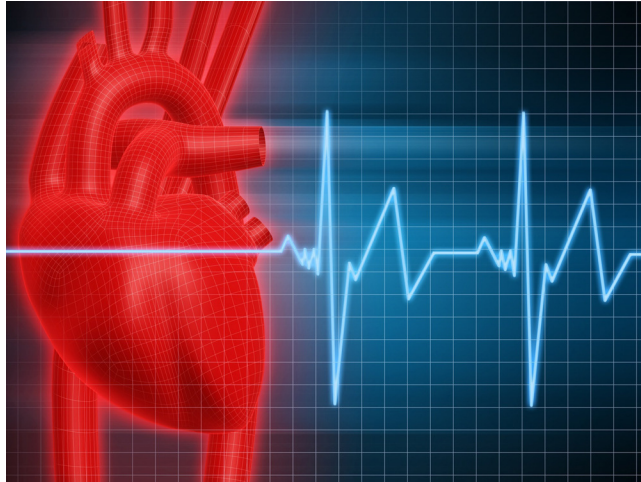


## PTA/OTA 106

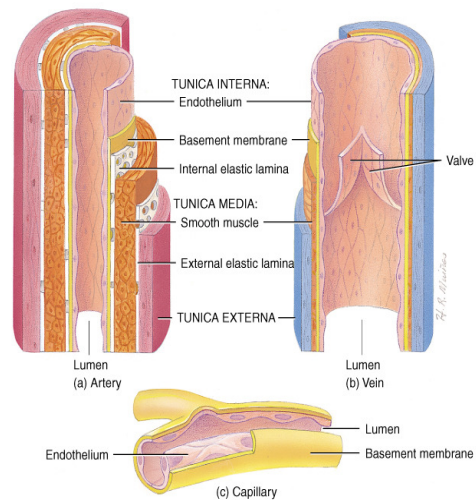
### Unit 2 Lecture 2



### Comparative Structure of Artery and Vein Vessel Walls

#### Arteries:

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



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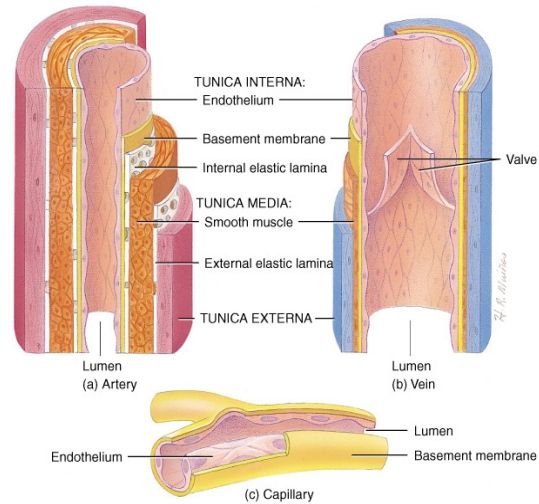
## Comparative Structure of Artery and Vein Vessel Walls

### Veins:

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

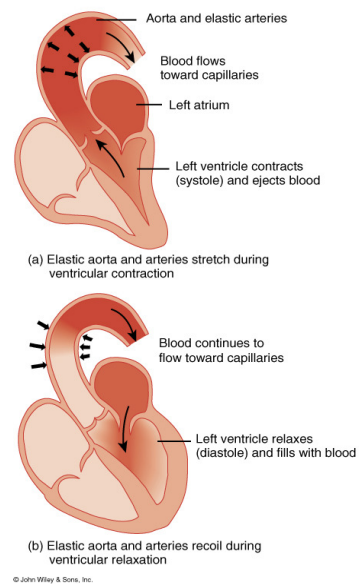
(Conducting arteries)

Aorta, Brachiocephalic,  
Common Carotid, Subclavian,  
Vertebral, Pulmonary,  
Common Iliac

### Muscular Arteries

(Distributing Arteries)

Brachial artery, radial artery,  
Popliteal, Common Hepatic

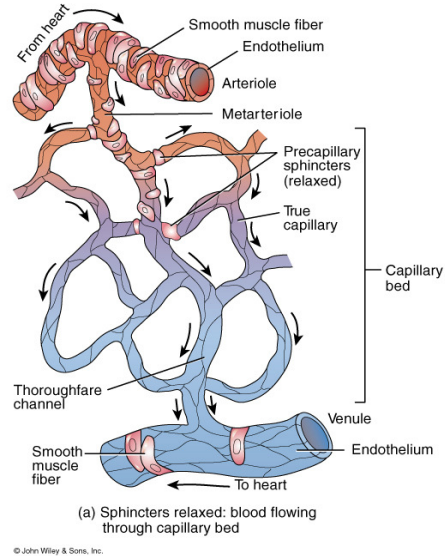


## Circulation Through a capillary bed

**Arterioles:** deliver blood to capillaries

**Metarterioles:** emerges from arterioles and supplies a group of capillaries

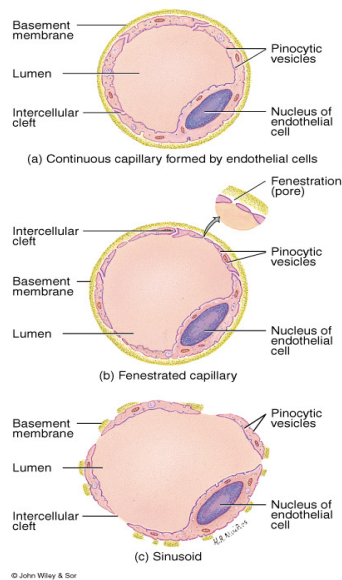
**Thoroughfare Channel:** arise from metarterioles and contain no smooth muscle. Thoroughfares allow blood to bypass the capillary



## Different types of Capillaries

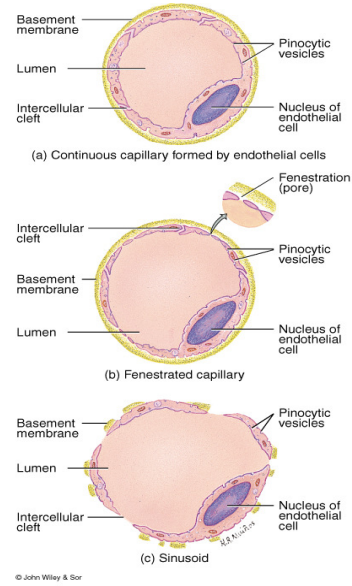
**Continuous Capillaries**  
Plasma membranes of endothelial cells forms a continuous tube only interrupted by intercellular clefts (gaps between cells) (lungs and muscle)

**Fenestrated Capillaries**  
Plasma membrane of endothelial cells contain pores or fenestrations (Kidney and Villi of small intestines)

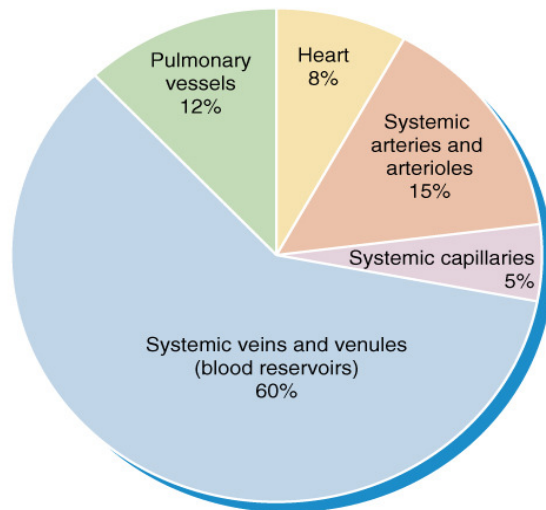


## Different types of Capillaries

**Sinusoids:**  
**Wider and more winding than other capillaries, with incomplete basement membranes and large fenestrations (red bone marrow and liver)**



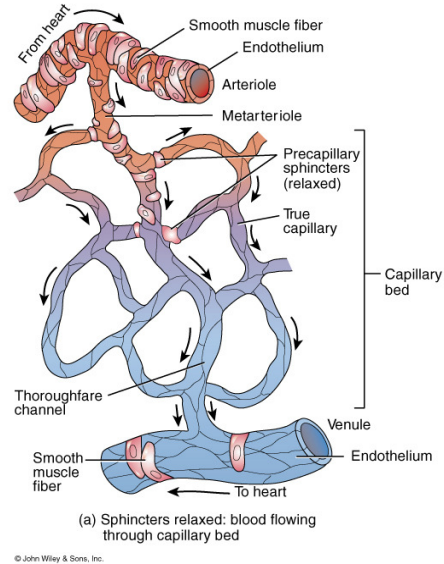
## Blood distribution in the Cardiovascular System



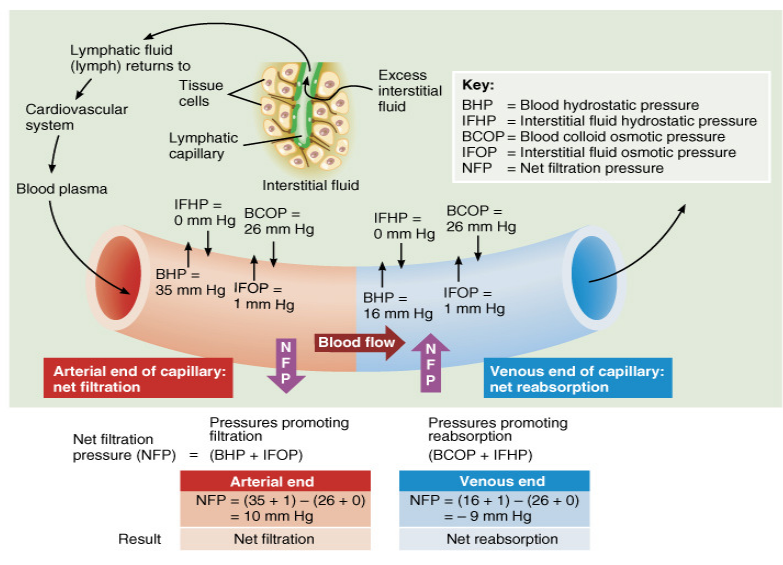
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## Mechanisms of Capillary Exchange

- **Simple Diffusion:**  
(CO<sub>2</sub>, O<sub>2</sub>, 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 toward in the same direction as the fluid



## Forces involved in Capillary Exchange



## **Factors that Affect Capillary Exchange**

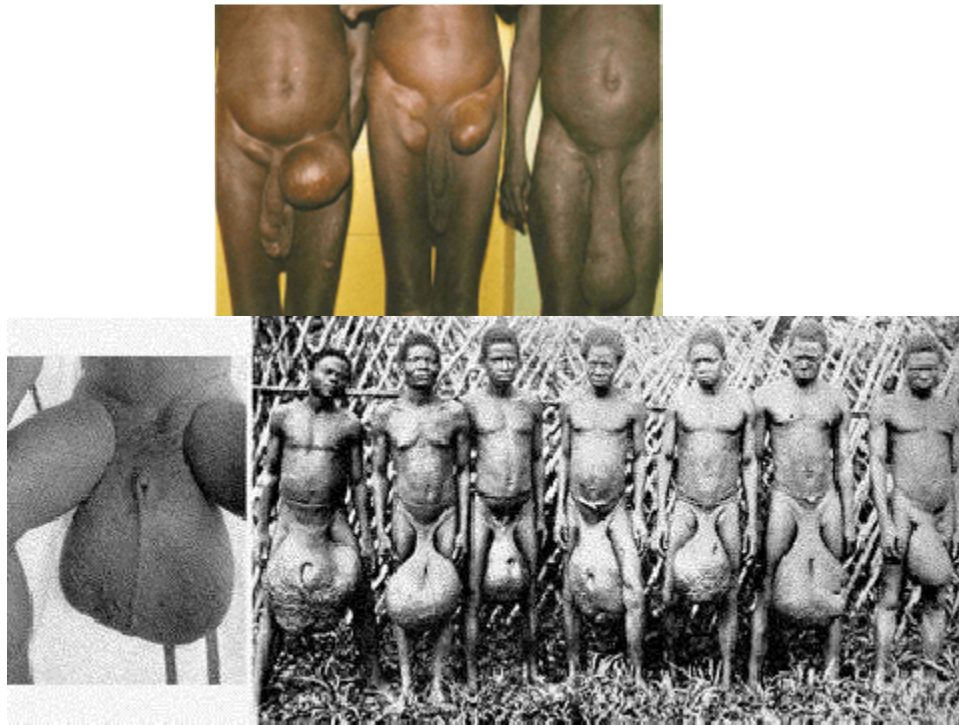
- **Edema = increased Interstitial Fluid**
  1. **Increased BHP**
    - a. **increased CO**
    - b. **increased blood volume**
  2. **Increased Permeability of Capillaries**
    - a. **Increased IFOP**
    - b. **Bacteria**
    - c. **Tissue damage**

## **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 mosquitos. 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.

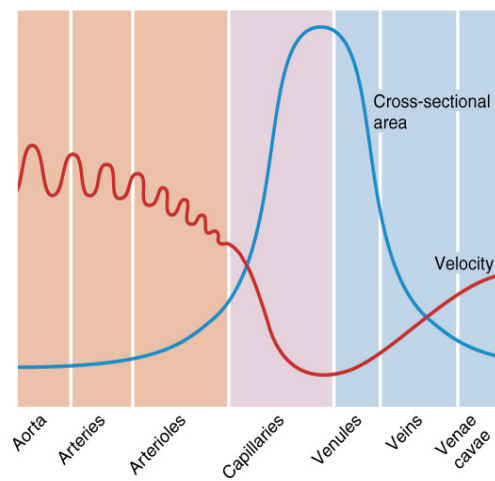




## Factors That Affect Circulation

- **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

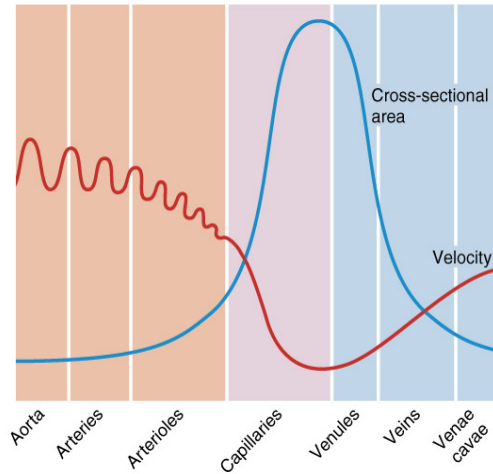
Aorta: 3-5 cm<sup>2</sup>, 40cm/sec  
 Capillaries: 4,500-6,000 cm<sup>2</sup>/  
 0.1cm/sec  
 Vena Cava's: 14cm<sup>2</sup>, 5-20cm/sec





## Factors That Affect Circulation

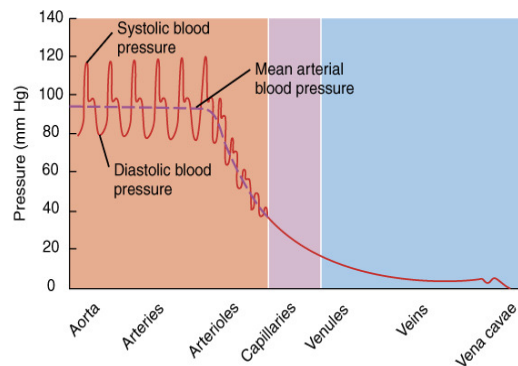
- **Resistance:**  
Measured as the opposition to blood flow through blood vessels due to friction between the blood and vessel walls.
  1. **Average Vessel radius:**  
Resistance is inversely proportional to the fourth power of the radius
  2. **Blood viscosity:** Resistance is directly proportional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



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## Factors That Affect Circulation

- **Volume of Blood Flow:**  
Measured by Cardiac Output  
 $CO = SV \times HR$
- **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:  
 $MABP = \text{diastolic BP} + \frac{1}{3}(\text{systolic BP} - \text{diastolic BP})$

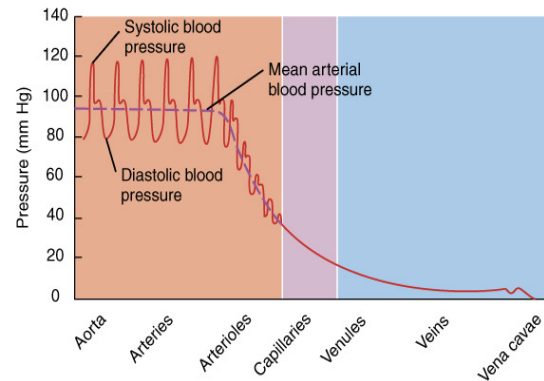


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## Factors That Affect Circulation

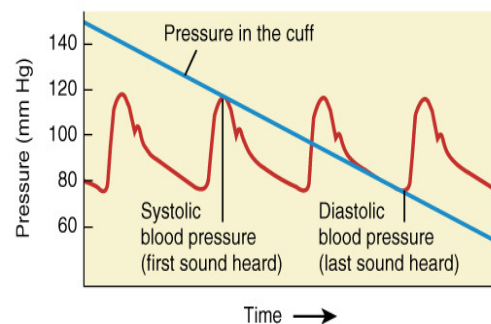
- **Cardiac Output is directly related to blood pressure**

$$CO = MABP/R$$



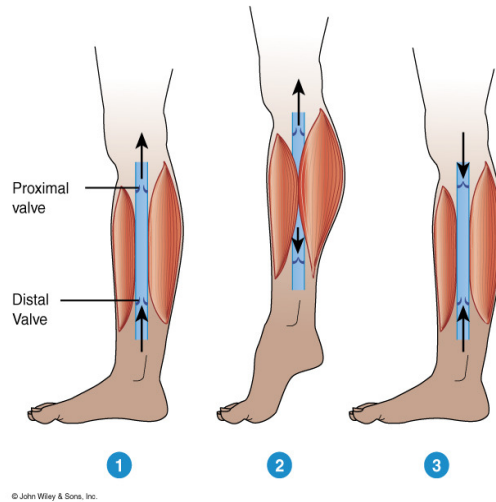
## Relationship between Blood Pressure, Cuff Pressure, and Korotkoff Sounds

- **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**

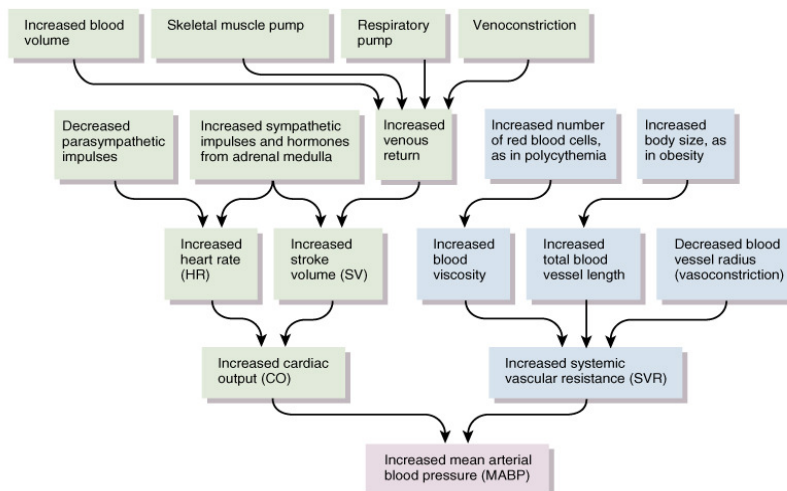


## Action of Skeletal Muscle in Venous Return

- While standing at rest venous valves are open
- Contraction of muscles pushes blood upward through the proximal valve, back-pressure closed 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

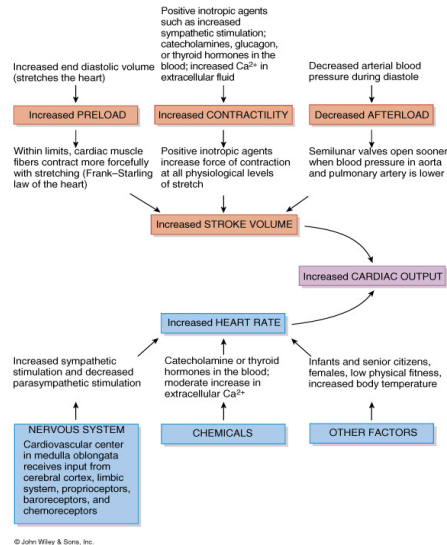
### 1. Cardiac Output:

**Increased CO = Increased BP**

**Increased CO and contractility**

**epinephrine from Adrenal Medulla**

**Norepinephrine from sympathetic neurons**



## Overview of Hormones that Regulate Blood Pressure

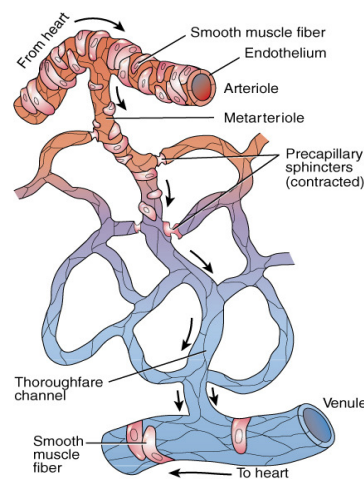
### • Systemic Vascular Resistance

#### 1. Vasoconstriction (increased)

- a. Angiotensin II
- b. ADH (vasopressin)
- c. Epinephrine
- d. Norepinephrine

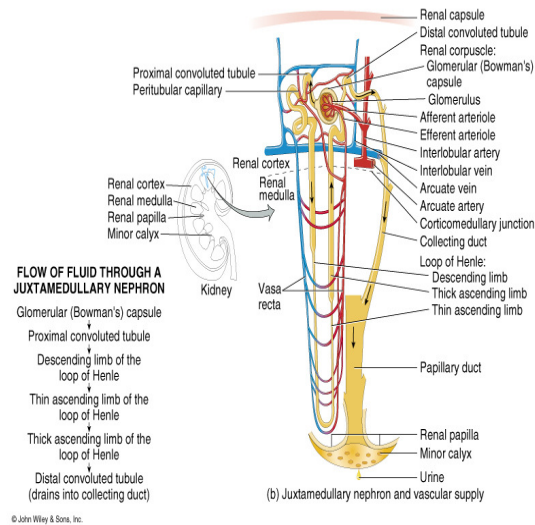
#### 2. Vasodilation (decreased)

- 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**



## Hypovolemic Shock

- **During to decreased blood volume**
- **Stages of shock**
  - Stage 1: compensated or nonprogressive**
  - Stage 2: decompensated or progressive (up to 25% loss)**
  - Stage 3: irreversible shock (death)**

## Hypovolemic Shock

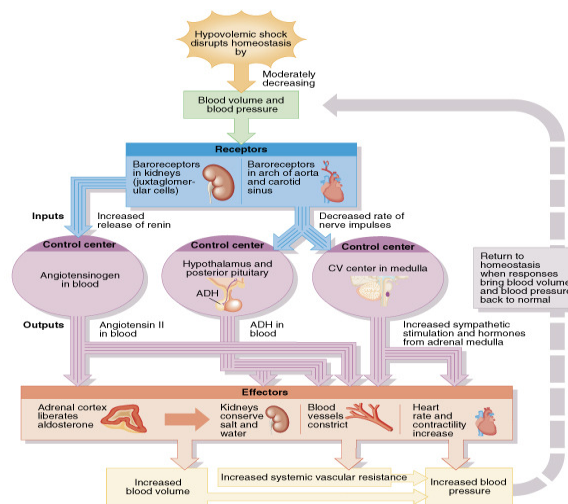
### Stage 1: compensated or nonprogressive

- Activation of the sympathetic nervous system
- Activation of the renin-angiotensin pathway
- Release of ADH
- Signs of clinical hypoxia

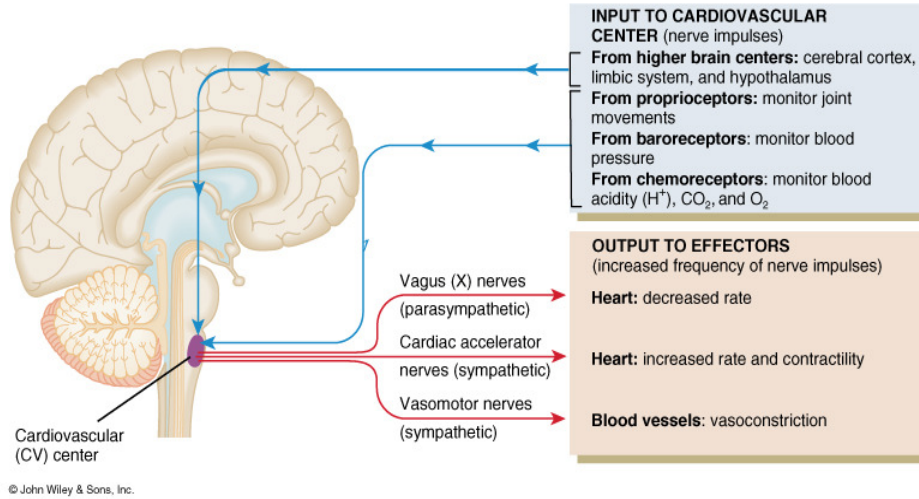
### Stage 2: decompensated or progressive (up to 25% loss)

- Depressed cardiac activity (MABP as low as 60)
- Depressed vasoconstriction (MABP as low as 40)
- Increased capillary permeability
- Intravascular clotting
- Cellular death occurs
- Respiratory acidosis

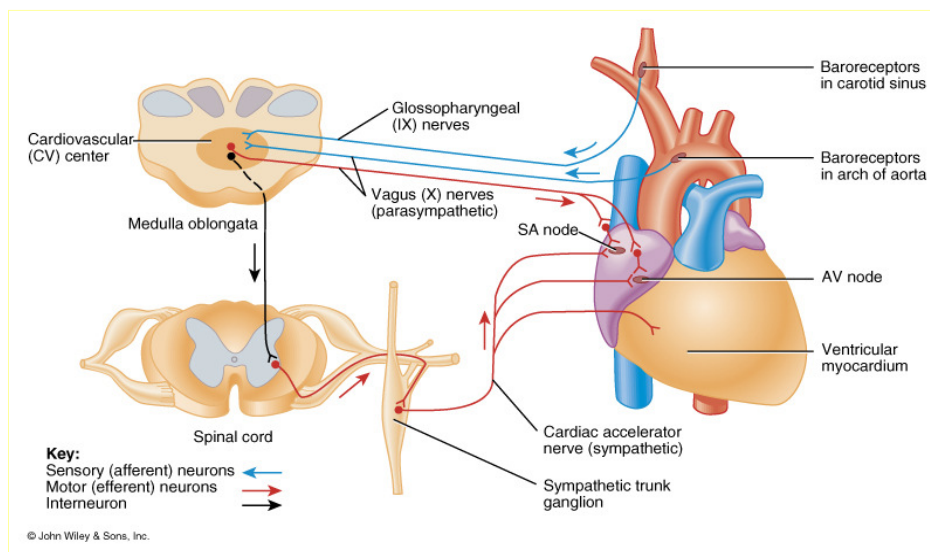
## Negative Feedback response to Hypovolemic Shock



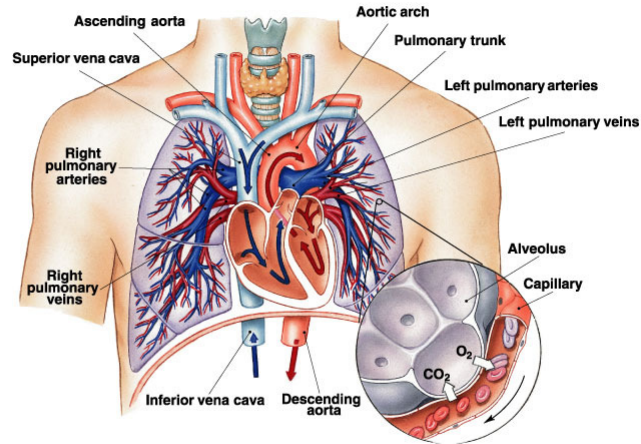
## CNS Input and Regulation of Cardiac Activity



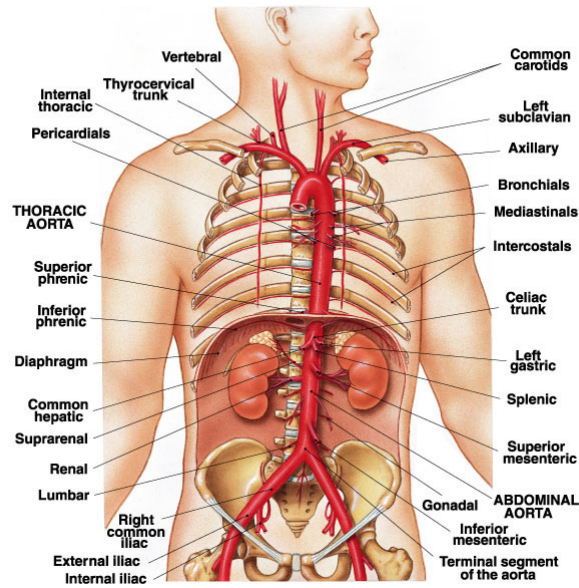
## ANS Regulation of Cardiac Activity



## Arteries and Veins of the Heart



## Major Arteries of the Thoracic Region





## Veins of the Upper Thoracic Region

