

Chapter 21: Cardiovascular System: Peripheral Circulation and Regulation

I. General Features of Blood Vessel Structure

A. General Pattern of Circulation

1. Ventricles pump blood into _____
2. These arteries branch repeatedly to form _____
3. The arteries undergo a gradual transition with decreased size:
 - a. From _____
 - b. To _____
4. Arteries are classified as:
 - a. _____
 - b. _____
 - c. _____
5. Blood flows from arterioles into _____
6. Why does most material exchange occur across capillary walls?
 - a. _____
 - b. _____
 - c. _____
7. Blood flows from the capillaries into _____
8. Compared to arteries the walls of veins are:
 - a. _____
 - b. Contain _____
 - c. Fewer _____
9. As veins project toward the heart they:
 - a. Increase _____
 - b. Decrease _____
 - c. Walls _____
10. Veins are classified as:
 - a. _____
 - b. _____
 - c. _____

B. Capillaries

1. What is the endothelium? _____
 - a. What is it continuous with? _____
2. The capillary wall consists of _____
3. Outside the basement membrane is _____
4. Between the basement membrane and the endothelial cells are scattered cells called _____
5. What is the average diameter of a capillary? _____
6. How do red blood cells flow through capillaries? _____
7. Types of Capillaries
 - a. Classification is based on _____ & _____
 - b. Continuous capillaries
 1. Have a diameter of approximately _____
 2. Walls exhibit _____ endothelial cells
 3. _____ permeable to _____
 - c. Fenestrated capillaries
 1. Endothelial cells have _____
 2. What are the fenestrae? _____

 3. Fenestrated capillaries are _____ permeable
 - d. Sinusoidal capillaries
 1. _____ diameter than the other two types
 2. Basement membrane is _____
 3. Fenestrae are _____ than fenestrated capillaries
 4. Occur where _____ cross their walls
 - e. Sinusoids are _____
 1. Basement membrane is _____ & often _____
 2. Their structure suggests that _____
 3. What are closely associated with the sinusoid endothelium in the liver?

 - f. Venous sinuses are even _____ than _____

1. Occur primarily in _____
 2. Have _____ endothelial cells
 - g. Substances cross the capillary walls by _____
 1. Through _____
 2. Through _____
 3. Between _____
 - a. Lipid-soluble substances readily _____
 - b. Larger water-soluble substances must _____
or _____
 - h. Why are capillaries effective permeability barriers? _____

8. Capillary Network
- a. Blood is supplied to a capillary network by _____
 - b. Blood is drained from a capillary network by _____
 - c. What is an arterial capillary? _____
 - d. What is a venous capillary? _____
 - e. Blood flows from an arteriole through _____
 - f. A thoroughfare channel connects the _____ to a _____
 1. Blood flow through a thoroughfare channel is _____
 - g. Capillaries branch from the _____
 1. Blood flow in these branches is _____
 2. Blood flow is regulated by _____ which
consist of _____ located at _____
- C. Structure of Arteries and Veins
1. General Features
 - a. Consist of three layers, which are most apparent in the _____
and least apparent in _____
 - b. Which layer is in direct contact with the blood? _____
 - c. What is the name of the outer layer? _____

d. Tunica Intima

1. This layer consists of:

- a. _____
- b. _____
- c. _____
- d. _____

2. What separates the tunica intima from the tunica media?

e. Tunica Media

1. Consists of:

- a. _____
- b. Also contains variable amounts of:
 1. _____
 2. _____

2. Functionally the smooth muscle regulates _____

a. Vasoconstriction

1. Is the result of muscle _____
2. _____ the diameter of the vessel
3. Results in _____ blood flow

b. Vasodilation

1. Is the result of muscle _____
2. _____ the diameter of the vessel
3. Results in _____ blood flow

3. What is the external elastic membrane? _____

f. Tunica Adventitia

1. Composed of _____ that varies from:

- a. _____ near the tunica media to
- b. _____ that _____

g. The relative thickness of each layer varies with _____

2. Large Elastic Arteries

- a. Have the _____
- b. Are also called _____
- c. Pressure is relatively _____ and fluctuates between _____ & _____ values
- d. Have a greater amount of _____ and a smaller amount of _____
- e. The elastic fibers are responsible for _____

3. Muscular Arteries

- a. Are often called _____
- b. Their walls are _____ compared to _____
 1. This is due to _____
- c. Frequently called _____ because _____
- d. Small muscular arteries are adapted for _____

4. Arterioles

- a. Transport blood from _____ to _____
- b. The smallest artery in which _____
- c. What is their diameter range? _____
- d. The arterioles are capable of _____

5. Venules and Small Veins

- a. Venules have a diameter of _____
- b. Structure is similar to _____
- c. Venules have a few _____ outside the endothelium
- d. The vessels are called small veins when:
 1. Diameter _____
 2. Smooth muscle _____
 3. Have a tunica adventitia composed of _____
- e. Venules collect blood from _____ and pass it to _____ that pass it to _____

6. Medium and Large Veins

- a. Medium veins collect blood from _____ and pass it to _____
- b. The large veins transport blood to _____
- c. What layer is predominant in large veins? _____

7. Valves

- a. Valves are found in veins having a diameter larger than _____
 1. _____ toward the heart
 2. _____ away from the heart
- b. Valves consist of:
 1. Folds _____
 2. Form two _____ that are _____ & _____ like the _____ of the heart
- c. The two folds _____ so that _____ the valves _____

D. Vasa Vasorum

1. Found in vessels larger than _____ in diameter
2. Penetrate from the _____ to form a capillary network in
 - a. _____
 - b. _____

E. Arteriovenous Anastomoses

1. Allow blood to flow from _____ to _____ without passing _____
2. What is a glomus? _____
3. Naturally occurring arteriovenous anastomoses function in _____

F. Nerves

1. The walls of most blood vessels are richly innervated by _____
 - a. _____ & _____ are innervated to the greatest extent
2. Sympathetic stimulation causes _____

3. Smooth muscle cells of blood vessels act as a _____
 - a. This is due to frequent _____
4. Stimulation of a few smooth muscle cells results in _____

G. Aging of the Arteries

1. The most significant age related changes occur in the:
 - a. _____
 - b. _____
 - c. _____
2. What is arteriosclerosis? _____
3. What is atherosclerosis? _____
 - a. The material is _____
 - b. Later it can be replaced with _____
4. In arteriosclerosis:
 - a. Tunica intima _____
 - b. Tunica media _____ because of _____
 - c. Fat _____ between the _____
 1. Produces a _____ that can bulge _____
 - d. In advanced arteriosclerosis _____ accumulate
5. Arteriosclerosis greatly increases _____

II. Pulmonary Circulation

- A. The right ventricle pumps blood into the _____
- B. This vessel divides into the _____ & _____
 1. One to each _____
- C. After gas exchange occurs:
 1. _____ exit each lung
 2. Enter the _____

III. Systemic Circulation: Arteries

A. Aorta

1. The part of the aorta leaving the left ventricle is called _____
 - a. What 2 arteries branch off this part of the aorta? _____ & _____
2. The aorta then arches _____ & to the _____ as the _____
 - a. What three major branches originate here:
 1. _____
 2. _____
 3. _____
3. The longest part of the aorta is called the _____
 - a. Which portion is the thoracic aorta? _____
 - b. Which portion is the abdominal aorta? _____
4. At its termination the aorta divides into _____

B. Coronary Arteries

1. Refer to Chapter 20.

C. Arteries to the Head and the Neck

1. What is the first branch off the aortic arch? _____
 - a. It branches at the level of the clavicle to form:
 1. _____
 - a. Transports blood to _____
 2. _____
 - a. Transports blood to _____
2. What is the second branch off the aortic arch? _____
 - a. Transports blood to _____
3. What is the third branch off the aortic arch? _____
 - a. Transports blood to _____
4. Each common carotid artery divides into:
 - a. _____
 - b. _____
5. What is the carotid sinus? _____

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- a. Why is it important? _____
6. The external carotid arteries supply blood to _____
7. Blood Supply to the Brain
- a. Left and right vertebral arteries are branches of the _____
1. Enter the cranial cavity through the _____
 2. They join together to form the _____
- b. The basilar artery:
1. Gives off branches to the _____ & _____
 2. Branches to form two _____
 - a. That supply blood to _____
- c. The internal carotids enter the cranial cavity through _____
1. They terminate by forming _____
 - a. That supply blood to _____
 2. Posterior branches are the _____
 - a. These connect to _____
 3. Anterior branches are the _____
 - a. That supply blood to _____
 - b. These arteries are connected by _____
- d. Forms a complete circle at the base of the brain around the pituitary called _____ or _____

D. Arteries of the Upper Limb

1. One continuous artery in the upper limb has three names based on location:
 - a. Deep to the clavicle it is called _____
 - b. In the axilla it is called _____
 - c. Within the arm itself it is called _____
2. The brachial artery divides at the elbow to form:
 - a. _____ on the ulna side of the forearm
 - b. _____ on the radial side of the forearm
3. In the palm of the hand:
 - a. The ulnar artery forms _____

- b. The radial artery forms _____
4. Extending from the two palmar arches are _____
- a. That supply blood to _____
- E. Thoracic Aorta and Its Branches
1. Visceral branches supply blood to _____
2. Parietal branches supply blood to _____
- a. The walls of the thorax are supplied by _____
- b. What supplies blood to the diaphragm? _____
- F. Abdominal Aorta and Its Branches
1. The three major unpaired visceral branches are:
- a. _____
- b. _____
- c. _____
1. Each has branches supplying _____
2. Paired visceral branches supply the _____, _____, & _____
- G. Arteries of the Pelvis
1. At the level of the fifth lumbar vertebrae the aorta divides into two _____
2. Each of these divide into a:
- a. _____ which supplies _____
- b. _____ which supplies _____
- H. Arteries of the Lower Limb
1. Based on location the external iliac artery becomes the:
- a. _____ in the thigh which becomes the:
- b. _____ behind the knee
1. Below the knee it gives off a branch called _____
2. It continues down the back of the leg as the _____
2. At the foot the anterior tibial artery becomes the _____
3. The posterior tibial artery gives off branches called:
- a. _____ or _____
- b. _____

- c. _____
1. The plantar arteries give off _____ to the _____

IV. Systemic Circulation: Veins

A. Three Major Veins Return Blood to Right Atrium

1. From the walls of the heart _____
2. From the head, neck, thorax, & upper limbs _____
3. From the abdomen, pelvis, & lower limbs _____

B. Veins Draining the Heart

1. Refer to Chapter 20.

C. Veins of the Head and Neck

1. External Jugular Veins

- a. More _____ of the two veins
- b. Drain blood from _____
- c. Usually drain into _____

2. Internal Jugular Veins

- a. Drain blood from _____
- b. Outside the cranial cavity they receive tributaries that drain _____
- c. Join the subclavian veins to form the _____

D. Veins of the Upper Limb

1. Most of the blood from the upper limb drains through the:

- a. _____
- b. _____
- c. _____

2. The basilic vein becomes the _____ in the axilla

- a. This vein then becomes the _____ at the first rib

3. The cephalic vein drains into the _____

- ###### 4. Where is the median cubital vein? _____
- _____
- a. Why is it important? _____

5. Draining the forearm are:

- a. _____ on the radial side of the forearm
- b. _____ on the ulnar side of the forearm
 1. These veins drain into the _____

E. Veins of the Thorax

1. The superior vena cava receives blood from three veins:

- a. Right _____
- b. Left _____
- c. _____

2. Brachiocephalic veins receive blood from the anterior thoracic wall from:

- a. _____
 1. They receive blood from _____

3. The azygos vein receives blood from the posterior thoracic wall from:

- a. _____ on the right
- b. _____ or _____ on the left

F. Veins of the Abdomen and Pelvis

1. Blood from the posterior abdominal wall drains into _____

a. These empty into the superior vena cava via the:

1. _____ on the right
2. _____ on the left

2. The internal iliac veins drain the _____

3. The external iliac veins drain the _____

4. The internal iliac vein and external iliac vein join to form _____ which join to form _____

5. Hepatic Portal System

a. What is a portal system? _____

6. The hepatic portal vein is formed by the union of:

- a. _____ draining _____
- b. _____ draining _____
 1. _____ draining _____
 2. _____ draining _____

- c. Also receives _____ before entering the liver
7. The hepatic portal vein empties blood into the liver sinusoids, which collect into _____, which empty into _____
8. The hepatic veins also receive blood from:
- a. _____ draining the _____
9. Hepatic veins empty into the _____
10. What happens to nutrients in the liver? _____
11. What happens to toxins in the liver? _____

G. Veins of the Lower Limb

1. The deep veins of the leg are the:
- a. Anterior _____
- b. Posterior _____
1. These veins unite just inferior to the knee forming _____
2. The popliteal vein becomes the _____ as it passes through the thigh and then become the _____
3. _____ or _____ empty into the posterior tibial veins
4. The great saphenous vein:
- a. Originates _____
- b. Ascends _____
- c. Empties into _____
5. The small saphenous vein:
- a. Begins _____
- b. Ascends _____
- c. Empties into _____

V. Dynamics of Blood Circulation

A. Laminar and Turbulent Flow in Vessels

1. What is laminar flow? _____
- _____
- a. Which layer moves slowest? _____
- b. Which layer moves fastest? _____

2. What causes turbulent flow? _____

B. Blood Pressure

1. Define blood pressure: _____
2. What is a mercury manometer? _____
 - a. Pressure of 100 mm Hg. means _____
3. Why is the auscultatory method used to measure blood pressure? _____

4. What is a sphygmomanometer? _____
5. What are Korotkoff sounds? _____
6. The process of measuring the blood pressure involves:
 - a. Inflating blood pressure cuff until _____
 - b. Deflating cuff until the first Korotkoff sound is heard:
 1. Blood is flowing through the constricted area during _____
 2. The pressure that this occurs at is recorded as _____
 - c. Continuing to deflate cuff until no sound is heard:
 1. Continuous _____ has been reestablished
 2. The pressure that this occurs at is recorded as _____

C. Blood Flow

1. Blood flow is usually reported in _____
2. Blood flow in a vessel is proportional to _____
 - a. If the pressure at point 1 and point 2 are the same _____
 - b. The greater the pressure difference _____
 - c. Flow always occurs from a _____ to a _____ pressure
3. What is resistance? _____
 - a. As resistance increases _____
 - b. As resistance decreases _____
4. What is the mathematical formula for blood flow? _____

D. Poiseuille's Law

1. What does Poiseuille's Law express? _____
2. Resistance to flow dramatically decreases when _____

- a. Because flow is proportional to _____
 3. What effect does increased viscosity have on flow? _____
 4. What effect does increased vessel length have on flow? _____
- E. Viscosity
1. What does viscosity measure? _____
 2. As the viscosity of a liquid increases _____
 3. Compared to distilled water blood has a viscosity of _____
 4. What is the hematocrit? _____
 5. How does hematocrit effect the viscosity of the blood? _____
-
- F. Critical Closing Pressure and Laplace's Law
1. What is critical closing pressure? _____
-
2. Laplace's Law
 - a. States that _____
 - b. Helps explain _____
 1. As the pressure in a vessel decreases _____
 2. If the pressure decreases below the minimum requirement _____
 3. As the pressure in a vessel increases _____
 - c. The formula is _____
 - d. As the diameter of a vessel increases _____
 1. Why is this important in aneurysms? _____
-
- G. Vascular Compliance
1. What is compliance? _____
 2. The more easily a vessel wall stretches _____
 3. If the pressure increases a small amount:
 - a. Vessels with a large compliance _____
 - b. Vessels with a small compliance _____
 4. Which human blood vessels have the greatest compliance? _____
 - a. These vessels can act as _____ for blood

VI. Physiology of Systemic Circulation

A. Cross-Sectional Area of Blood Vessels

1. Total cross-sectional area is the result of determining _____ multiplied by _____
2. The aorta has a cross-sectional area of _____
3. Although capillaries are minute there are millions of them so there total cross-sectional area is _____
4. When cross-sectional area is small, blood flow is _____
5. When cross-sectional area is large, blood flow is _____

B. Pressure and Resistance

1. What causes the decrease in arterial pressure? _____

C. Pulse Pressure

1. What is pulse pressure? _____
2. What two major factors influence pulse pressure?
 - a. _____
 - b. _____
3. How does a change in stroke volume effect pulse pressure? _____

4. As arteries age they become _____
 - a. This results in _____ systolic pressure & _____ pulse pressure
5. The pulse pressure caused by left ventricular ejection produces a _____
 - a. This can be felt in peripheral arteries and used to determine _____
6. Dampening of the pulse results in capillaries receiving blood at a steady _____

D. Capillary Exchange and Regulation of Interstitial Fluid Volume

1. What is capillary exchange? _____
2. The most important process for capillary exchange is _____
3. Net filtration pressure (NFP) is _____
 - a. Mathematically it is $NFP =$ _____

4. Net hydrostatic pressure is the difference _____

 - a. Blood pressure results from _____
 - b. Interstitial fluid pressure is _____
 5. Net osmotic pressure is the difference _____

 - a. Blood colloid osmotic pressure is _____
 - b. Interstitial colloid osmotic pressure is _____
 6. At the arterial end of capillaries fluid moves out of the capillary because _____

 7. At the venous end of capillaries fluid moves into the capillary because _____

 8. The volume of interstitial fluid is kept within a narrow range by:
 - a. Exchange _____
 - b. Movement _____
- E. Functional Characteristics of Veins
1. What is venous tone? _____
 2. Increased sympathetic stimulation causes:
 - a. Increases _____ by _____
 - b. Increases _____ return and _____ causing _____
 3. Decreased sympathetic stimulation causes:
 - a. Decreases _____ allowing _____
 - b. Decreases _____, _____, and _____
 4. Contraction of skeletal muscle _____ the veins
 - a. Forces blood _____
- F. Blood Pressure and the Effect of Gravity
1. What effect does standing have on pressure in the venules of the feet?

 2. The major effect of prolonged standing without movement is _____

VII. Control of Blood Flow in Tissues

A. Local Control of Blood Flow by the Tissues

1. In most tissues, blood flow is proportional to _____
 - a. Increases in response to _____ oxygen demand
 - b. Increases in response to _____ metabolic end products
2. Blood flow does serve other purposes:
 - a. In the skin _____
 - b. In the kidney _____
 - c. In the liver _____
3. Functional Characteristics of the Capillary Bed
 - a. Innervation of the metarterioles and precapillary sphincters is _____
 - b. Vasodilator Substances
 1. Produced as _____
 2. Diffuse to _____, _____, & _____
 - a. Cause these structures to _____
 3. Vasodilator substances include: _____

 4. How does lack of nutrients cause vasodilation? _____

 5. What is vasomotion? _____
 - c. Autoregulation of Blood Flow
 1. What is autoregulation? _____
 2. Increased blood flow occurs when:
 - a. Need for _____ & buildup of _____ cause
 - b. _____
 - d. Long-Term Local Blood Flow
 1. If the metabolic activity of a tissue remains elevated for a long period:
 - a. Diameter _____
 2. If oxygen levels remain elevated in a tissue _____
- B. Nervous and Hormonal Regulation of Local Circulation
 1. Nervous control of arterial blood pressure is important _____

-
2. Blood pressure must be adequate to move blood through capillaries:
 - a. While _____
 - b. During _____
 - c. In response _____
 3. Nervous regulation shunts blood _____
 4. Which part of the autonomic nervous system is most important in controlling blood flow? _____
 5. Where is the vasomotor center? _____
 6. Peripheral blood vessels are partially constricted at all times due to:

 - a. This condition of the vessels is referred to as _____
 7. Vasoconstriction results from _____
 8. Vasodilation results from _____
 9. What areas of the brain can effect the vasomotor center? _____

 10. Norepinephrine binds to _____ receptors and causes _____
 11. Epinephrine binds to _____ receptors and causes _____

VIII. Regulation of Mean Arterial Pressure

A. Mean Arterial Pressure (MAP)

1. MAP is slightly less than _____
2. What is peripheral resistance? _____
3. MAP is proportional to _____ times _____
4. Mathematically MAP is represented as _____
 - a. Increasing any of these factors _____ blood pressure
 - b. Decreasing any of these factors _____ blood pressure

B. Short-Term Regulation of Blood Pressure

1. Baroreceptor Reflexes
 - a. Important in regulating blood pressure on _____
 1. Detect even _____

2. Respond _____
- b. What are baroreceptors sensitive to? _____
 1. Where are they located? _____

- c. The carotid sinus reflex is activated by _____
- d. The aortic arch reflex is activated by _____
- e. Normal blood pressure _____ the arterial wall so that

- f. In response to a sudden increase in blood pressure:
 1. Frequency of action potentials _____
 2. Action potentials influence the _____ & _____ centers of the _____
 3. The vasomotor center responds by:
 - a. _____
 - b. Which causes peripheral vessels to _____
 4. The cardioregulatory center responds by:
 - a. _____
 - b. Heart rate _____ & blood pressure _____
- g. In response to a sudden decrease in blood pressure:
 1. Frequency of action potentials _____
 2. Action potentials influence the _____ & _____ centers of the _____
 3. The vasomotor center responds by:
 - a. _____
 - b. Which causes peripheral vessels to _____
 4. The cardioregulatory center responds by:
 - a. _____ and
 - b. Is accompanied by _____
 - c. Heart rate _____ & stroke volume _____
 5. Blood pressure _____

- h. How long does it take for the baroreceptors to adapt to any new sustained blood pressure? _____
2. Adrenal Medullary Mechanism
- a. The mechanism is activated when _____

1. Examples are:
- Large _____
 - Sudden _____
 - Other _____
- b. The adrenal medullary mechanism results from stimulation _____

1. The adrenal medulla releases _____ & smaller amounts of _____ causing:
- Increased _____
 - Increased _____
 - _____ in blood vessels to skin and viscera
 - Epinephrine can _____
- c. The mechanism is _____ & _____
3. Chemoreceptor Reflexes
- a. Where are the carotid bodies? _____
- b. Where are the aortic bodies? _____
- c. When oxygen availability decreases in the chemoreceptor cells:
1. Frequency _____
 2. Stimulates _____
 3. Resulting in _____
 4. Normally don't respond _____
- d. The chemoreceptor cells are also stimulated by:
1. Increased _____
 2. Increased _____
- e. Increased vasomotor tone:
1. Increases _____

2. Increases blood flow through tissues in which _____
4. Central Nervous System Ischemic Response
- What is the central nervous system ischemic response? _____

 - Reduced blood flow to the medulla results in:
 - Reduced _____
 - Increased _____
 - Reduced _____
 - This strongly stimulates the _____
 - Which causes _____
 - Systemic blood pressure _____
 - Increases _____
 - If severe ischemia lasts longer than a few minutes _____

 - Vasomotor center becomes inactive & _____
 - Prolonged ischemia of the medulla oblongata leads to _____

- C. Long-Term Regulation of Blood Pressure
- Renin-Angiotensin-Aldosterone Mechanism
 - This mechanism helps regulate _____
 - Can also influence _____
 - The kidneys release an enzyme called _____
 - What structure releases renin? _____
 - Where is angiotensinogen synthesized? _____
 - What does renin do to angiotensinogen? _____
 - The fragment is called _____
 - What enzyme is found in the lungs? _____
 - This enzyme converts _____ to _____
_____ or _____
 - Angiotensin II causes vasoconstriction in _____ & _____
 - Increasing _____ & _____

- j. Angiotensin II also stimulates the adrenal cortex to release _____
- k. Aldosterone acts on the kidneys to:
1. Increase _____
 2. Increase _____
 3. If ADH is present increase _____
 - a. This conserves water to _____
- l. Angiotensin II also increases the _____, _____, & _____
- m. Renin secretion is stimulated by _____
- n. Renin secretion decreases in response to _____
2. Vasopressin (ADH) Mechanism
- a. Baroreceptors detect decreases in blood pressure and stimulate release _____ from _____
 - b. ADH acts directly on blood vessels to cause _____
 - c. ADH also acts on the kidneys to decrease _____
 1. This helps to maintain _____
 - d. ADH is also released in response to _____ in solute concentration
3. Atrial Natriuretic Mechanism
- a. Where does atrial natriuretic hormone come from? _____
 - b. What causes its release? _____
 - c. Functionally atrial natriuretic hormone:
 1. Acts on the kidneys to:
 - a. Increase _____
 - b. _____ loss in the urine
 1. Causes the blood volume to _____ which _____ venous return
 2. Also _____ arteries and veins
 - a. Results in a decrease in _____
 3. Both effects cause a _____
4. Fluid Shift Mechanism
- a. The fluid shift mechanism occurs in response to _____
-

- b. As blood pressure increases _____
 - 1. Helps prevent development of _____
 - c. As blood pressure falls _____
 - 1. Resists _____
 - d. Blood pressure is _____ because interstitial _____
5. Stress-Relaxation Response
- a. When blood volume suddenly declines:
 - 1. Blood pressure _____
 - 2. Causing _____
 - 3. In response the smooth muscle cells _____ reducing the _____ & resisting _____
 - b. When blood volume increases rapidly:
 - 1. Blood pressure _____
 - 2. In response smooth muscle cells _____
 - 3. Resulting in _____