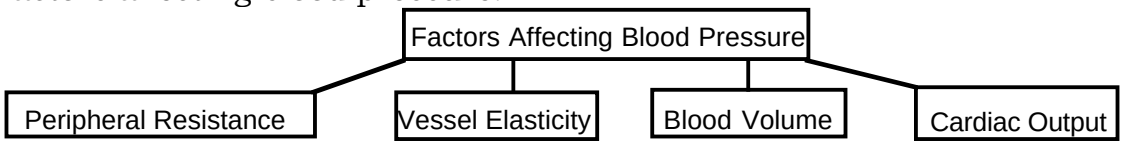
# Factors that Affect Blood Pressure



**Page 1. Introduction**

- Blood pressure is affected by several factors:
  - peripheral resistance
  - vessel elasticity
  - blood volume
  - cardiac output
- As you go through this topic, keep in mind this flow chart, which outlines the factors affecting blood pressure:

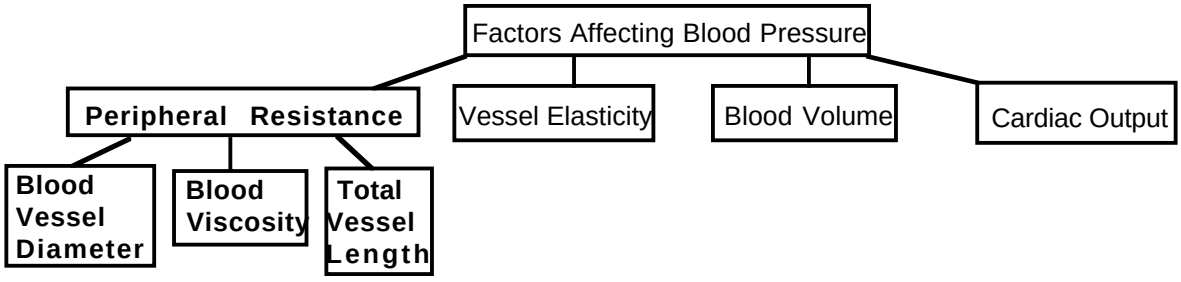



**Page 2. Goals**

- To understand the factors that affect peripheral resistance, and therefore blood pressure.
- To understand how vessel elasticity, blood volume, and cardiac output affect blood pressure.

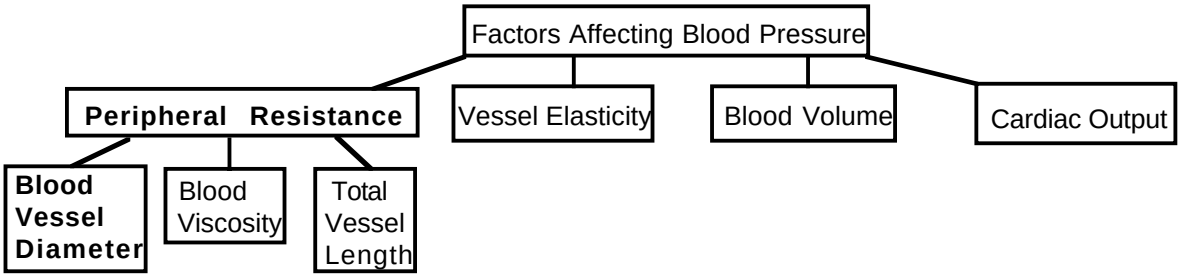
**Page 3. Sources of Peripheral Resistance**

- One of the main factors that affects blood pressure is peripheral resistance.
- Blood cells and plasma encounter resistance when they contact blood vessel walls.
- If resistance increases, then more pressure is needed to keep blood moving.
- Three main sources of peripheral resistance:
  1. blood vessel diameter
  2. blood viscosity
  3. total vessel length




**Page 4. Vessel Diameter Analogy**

- Vessel diameter affects peripheral resistance.
- As a the diameter of a tube gets smaller, a greater proportion of the fluid is in contact with the wall of the tube. Therefore resistance to flow is increased and pressure rises.
- Larger diameter, same volume, less pressure.
- Smaller diameter, same volume, more pressure.




**Page 5. Vasomotor Fibers**

- Constriction of blood vessels raises blood pressure.
- Vessel diameter is actively regulated by vasomotor fibers, sympathetic nerve fibers that innervate the vessel's smooth muscle layer.
- Vasomotor fibers release norepinephrine, a powerful vasoconstrictor.
- A vasoconstrictor is a substance that causes blood vessels to constrict.

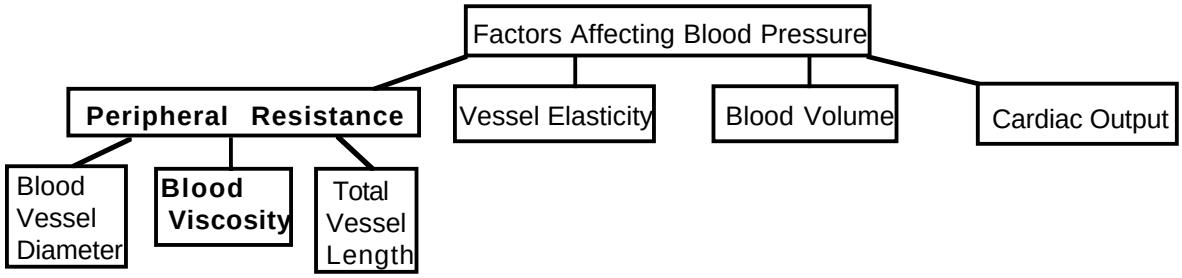
**Page 6. Vasoconstrictors**

- Blood vessel diameter is also regulated by blood-borne vasoconstrictors.
- Record the effect of each of these chemicals on the blood vessel:

| | |
|---|---|
| **Epinephrine** | |
| **Angiotensin II** | |
| **Vasopressin** | |

**Page 7. Viscosity Demonstration**

- Blood viscosity affects peripheral resistance.
- Viscosity is related to the thickness of a fluid.
- The greater the viscosity, the less easily molecules slide past one another and the more difficult it is to get the fluid moving and keep it moving.
- Because of this greater resistance to flow, a greater pressure is required to pump the same volume of viscous fluid.

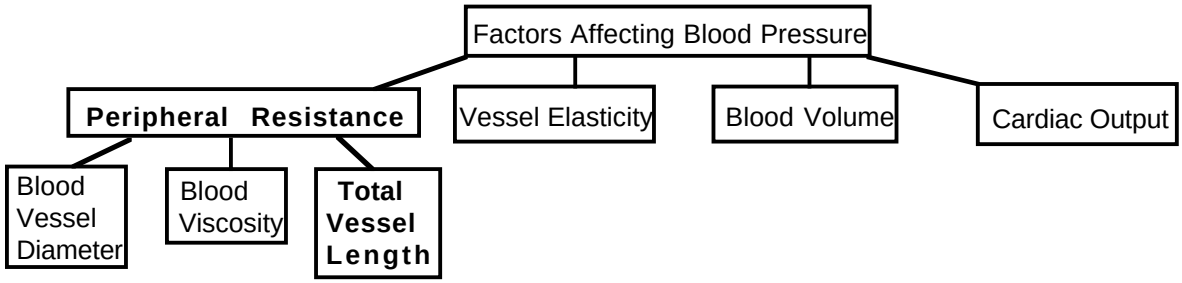



**Page 8. Blood Viscosity**

- The hematocrit is the percentage of red blood cells in the total blood volume.
- The hematocrit affects blood viscosity and therefore resistance to flow.
- The more viscous the blood, the greater resistance it encounters and the higher the blood pressure.
- The hematocrit can increase when there are more red blood cells or less plasma in the blood.
- The hematocrit can decrease when there are fewer red blood cells or more plasma.

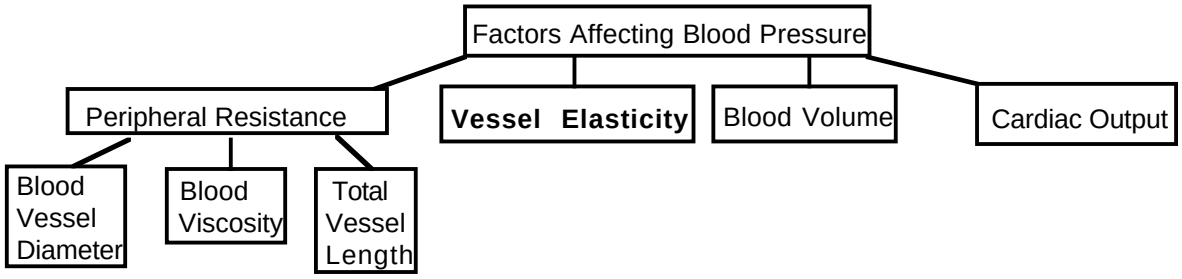
**Page 9. Vessel Length**

- Total vessel length affects peripheral resistance.
- Increased fatty tissue requires more blood vessels to service it and adds to the total vessel length in the body.
- The longer the total vessel length, the greater the resistance encountered, and the greater the blood pressure.



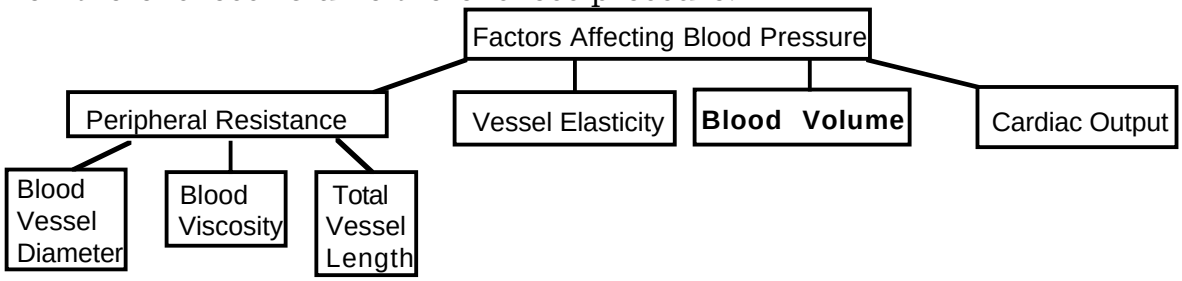

**Page 10. Vessel Elasticity**

- Besides peripheral resistance, blood vessel elasticity also affects blood pressure.
- A healthy elastic artery expands, absorbing the shock of systolic pressure. The elastic recoil of the vessel then maintains the continued flow of blood during diastole.
- When an individual has arteriosclerosis, arteries become calcified and rigid, so they can't expand when the pulse wave of systolic pressure passes through them. Thus the walls of the artery experience higher pressures and become weaker and weaker.




**Page 11. Blood Volume Analogy: Hoses**

- Blood volume affects blood pressure.
- When there is a greater volume of fluid, more fluid presses against the walls of the arteries resulting in a greater pressure.
- When there is less volume there is less pressure.




**Page 12. Blood Volume Examples**

- Reduced blood volume (for example due to excessive sweating) reduces blood pressure short term. Long term homeostatic mechanisms compensate, bringing blood volume and blood pressure back up to normal levels.

- Increased blood volume (for example due to water retention from excessive salt intake) increases blood pressure short term. Long term homeostatic mechanisms compensate, bringing blood volume and blood pressure back up to normal levels.

**Page 13. Cardiac Output: Heart Rate**

- Anything that decreases cardiac output, also decreases blood pressure, because there is less pressure on the vessel walls.
- An increase in cardiac output results in increased blood pressure.
- Cardiac Output = Heart Rate X Stroke Volume
- Anything that affects heart rate or stroke volume affects cardiac output and thus blood pressure.
- What happens to heart rate, cardiac output, and blood pressure with parasympathetic stimulation (vagus nerve)?

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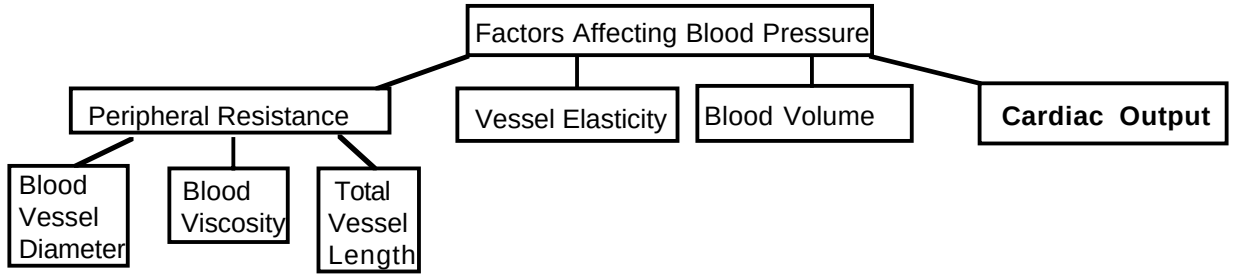
- What happens to heart rate, cardiac output, and blood pressure with sympathetic stimulation?

_____




**Page 14. Cardiac Output: Stroke Volume**

- Affect of stroke volume on blood pressure.
- If less blood is ejected from the heart with each beat, then blood pressure will be lower because there will be less blood pressing against the vessel walls.
- Blood volume affects end diastolic volume and therefore stroke volume.
- With decreased stroke volume, due to decreased venous return, volume there is a decreased cardiac output and a decreased blood pressure.
- With increased stroke volume, due to increased venous return and/or increased contractility, there is an increased cardiac output and increased blood pressure.

**Page 15. Summary**

- Increases in peripheral resistance, blood volume, and cardiac output result in higher blood pressure. Conversely decreases in any of these factors lead to lower blood pressure.
- Three main sources of peripheral resistance: Blood vessel diameter, blood viscosity, and total vessel length.
- If arteries lose their elasticity and become more rigid, blood pressure increases.

** Now is a good time to go to quiz question 1:
- Click the Quiz button on the left side of the screen.
- Work through quiz question 1.

## Notes on Quiz Questions:

**Quiz Question #1:**

- This question asks you to choose the factors that will decrease the blood pressure.

## Study Questions on Factors that Affect Blood Pressure:

1. (Page 1.) What are the four main factors affecting blood pressure?
2. (Page 3.) Blood cells and plasma encounter resistance when they contact blood vessel walls. What is this resistance called?
3. (Page 3.) Is more or less pressure needed to keep blood moving when resistance increases?
4. (Page 3.) What are the three main sources of peripheral resistance?
5. (Page 4.) What is the relationship between the diameter of a tube and the proportion of fluid that is in contact with the wall of the tube?
6. (Page 4.) What is the relationship between the diameter of a tube and resistance to flow? What effect does this have on pressure?
7. (Page 5.) Does constriction of blood vessels raise or lower blood pressure?
8. (Page 5.) What actively regulates the diameter of blood vessels?
9. (Page 5.) What chemical is released by vasomotor fibers that acts as a powerful vasoconstrictor?
10. (Page 6.) List three blood-borne vasoconstrictors?
11. (Page 7.) Explain viscosity.
12. (Page 7.) What is the relationship between viscosity and pressure required to pump a fluid?
13. (Page 8.) Define hematocrit.
14. (Page 8.) What is the effect of hematocrit on blood viscosity?
15. (Page 8.) When does hematocrit increase?
16. (Page 9.) What is the relationship between the total vessel length, resistance, and blood pressure?
17. (Page 10.) Why is expansion and recoil of the elastic arteries important?
18. (Page 10.) Why does blood pressure often increase in individuals with arteriosclerosis?

19 (Page 11.) What is the relationship between blood volume and blood pressure?

20. (Page 13.) What is the relationship between blood pressure and cardiac output?
21. (Page 13.) What is the relationship between heart rate, stroke volume and cardiac output?

22. (Page 13.) What happens to heart rate, cardiac output, and blood pressure with both parasympathetic and sympathetic stimulation?

23. (Page 14.) What is the relationship between venous return and stroke volume?