5.15: Factors That Influence Blood Pressure

Five factors influence blood pressure:

1. Cardiac output
2. Peripheral vascular resistance
3. Volume of circulating blood
4. Viscosity of blood
5. Elasticity of vessels walls

Blood pressure increases with increased cardiac output, peripheral vascular resistance, volume of blood, viscosity of blood and rigidity of vessel walls.

Blood pressure decreases with decreased cardiac output, peripheral vascular resistance, volume of blood, viscosity of blood and elasticity of vessel walls.

Cardiac Output

Cardiac output is the volume of blood flow from the heart through the ventricles, and is usually measured in litres per minute (L/min). Cardiac output can be calculated by the stroke volume multiplied by the heart rate. Any factor that causes cardiac output to increase, by elevating heart rate or stroke volume or both, will elevate blood pressure and promote blood flow. These factors include sympathetic stimulation, the catecholamines epinephrine and norepinephrine, thyroid hormones, and increased calcium ion levels. Conversely, any factor that decreases cardiac output, by decreasing heart rate or stroke volume or both, will decrease arterial pressure and blood flow. These factors include parasympathetic stimulation, elevated or decreased potassium ion levels, decreased calcium levels, anoxia, and acidosis.
Peripheral Vascular Resistance

Peripheral vascular resistance refers to compliance, which is the ability of any compartment to expand to accommodate increased content. A metal pipe, for example, is not compliant, whereas a balloon is. The greater the compliance of an artery, the more effectively it is able to expand to accommodate surges in blood flow without increased resistance or blood pressure. Veins are more compliant than arteries and can expand to hold more blood. When vascular disease causes stiffening of arteries (e.g., atherosclerosis or arteriosclerosis), compliance is reduced and resistance to blood flow is increased. The result is more turbulence, higher pressure within the vessel, and reduced blood flow. This increases the work of the heart.

Volume of Circulating Blood

Volume of circulating blood is the amount of blood moving through the body. Increased venous return stretches the walls of the atria where specialized baroreceptors are located. Baroreceptors are pressure-sensing receptors. As the atrial baroreceptors increase their rate of firing and as they stretch due to the increased blood pressure, the cardiac centre responds by increasing sympathetic stimulation and inhibiting parasympathetic stimulation to increase HR. The opposite is also true.

Viscosity of Blood

Viscosity of blood is a measure of the blood’s thickness and is influenced by the presence of plasma proteins and formed elements in the blood. Blood is viscous and somewhat sticky to the touch. It has a viscosity approximately five times greater than water. Viscosity is a measure of a fluid’s thickness or resistance to flow, and is influenced by the presence of the plasma proteins and formed elements within the blood. The viscosity of blood has a dramatic effect on blood pressure and flow. Consider the difference in flow between water and honey. The more viscous honey would demonstrate a greater resistance to flow than the less viscous water. The same principle applies to blood.

Elasticity of Vessel Walls

Elasticity of vessel walls refers to the capacity to resume its normal shape after stretching and compressing. Vessels larger than 10 mm in diameter are typically elastic. Their abundant elastic fibres allow them to expand as blood pumped from the ventricles passes through them, and then to recoil after the surge has passed. If artery walls were rigid and unable to expand and recoil, their resistance to blood flow would greatly increase and blood pressure would rise to even higher levels, which would in turn require the heart to pump harder to increase the volume of blood expelled by each pump (the stroke volume) and maintain adequate pressure and flow. Artery walls would have to become even thicker in response to this increased pressure.