NAME: BABAGBALE QUEEN-ESTHER JOSEPHINE

MATRIC NUMBER: 18/MHS01/101

DEPARTMENT: MEDICINE AND SURGERY

PHYSIOLOGY ASSIGNMENT 1

1. **<u>Long-term Regulation of Mean Arterial Blood Pressure</u>**

The long-term regulation of the mean arterial blood pressure is controlled by the renin-angiotensin-aldosterone system (RAAS) of the kidney. The Renin-Angiotensin-Aldosterone System (RAAS) is a hormone system within the body that is essential for the regulation of blood pressure and fluid balance. The system is mainly comprised of the three hormones renin**,** angiotensin II and aldosterone. Primarily it is regulated by the rate of renal blood flow. The first stage of the RAAS is the release of the enzyme renin. Renin released from granular cells of the renal juxtaglomerular apparatus (JGA) in response to one of three factors:

- Reduced sodium delivery to the distal convoluted tubule detected by macula densa cells.
- Reduced perfusion pressure in the kidney detected by baroreceptors in the afferent arteriole.
- Sympathetic stimulation of the JGA via β_1 adrenoreceptors.

The release of renin is inhibited by atrial natriuretic peptide (ANP), which is released by stretched atria in response to increases in blood pressure.

Angiotensinogen is a precursor protein produced in the liver and cleaved by renin to form angiotensin I. Angiotensin I is then converted to angiotensin II by angiotensin converting enzyme (ACE). This conversion occurs mainly in the lungs where ACE is produced by vascular endothelial cells, although ACE is also generated in smaller quantities within the renal endothelium.

Angiotensin II acts on AT1 receptors found in the endothelium of arterioles throughout the circulation to achieve vasoconstriction. The net effect of this is an increase in total peripheral resistance and consequently, blood pressure.

Angiotensin II acts at the hypothalamus to stimulate the sensation of thirst, resulting in an increase in fluid consumption. This helps to raise the circulating volume and in turn, blood pressure. It also increases the secretion of ADH which constantly regulates and balances the amount of water in the blood.

Finally, angiotensin II acts on the adrenal cortex to stimulate the release of aldosterone. It causes an increase in salt and water reabsorption into the bloodstream from the kidney thereby increasing the blood volume, restoring salt levels and blood pressure.

2. a) **Pulmonary Circulation:** Pulmonary circulation is the system of transportation that shunts de-oxygenated blood from the heart to the lungs to be re-saturated with oxygen before being dispersed into systemic circulation. Deoxygenated blood is carried away from the right ventricle through the pulmonary artery before being delivered to the lungs. While in the lungs, blood diverges into the numerous pulmonary capillaries where it releases carbon dioxide and is replenished with oxygen. Once fully saturated with oxygen, the blood is transported via the pulmonary vein into the left atrium which pumps blood through the mitral valve and into the left ventricle.

b) **Circle of Willis:** The circle of Willis (also called Willis' circle, loop of Willis, cerebral arterial circle, and Willis polygon) is a circulatory anastomosis that supplies blood to the brain and surrounding structures. It is formed by the anastomosis of the two internal carotid arteries with the two vertebral arteries. The anterior communicating, anterior cerebral, internal carotid, posterior communicating, posterior cerebral, and basilar arteries are all part of the circle of Willis. This formation of arteries allows distribution of the blood entering from the internal carotid artery or vertebral artery to any part of both hemispheres. Cortical and central branches arise from the circle and further supply the brain.

c) **Splanchnic Circulation:** The splanchnic circulation comprises the gastric, small intestinal, colonic, pancreatic, hepatic, and splenic circulations. They are arranged in parallel and fed by the celiac artery and the superior and inferior mesenteric arteries. The splanchnic circulation is composed of the blood flow originating from the celiac, superior mesenteric, and inferior mesenteric arteries and is distributed to all abdominal viscera. The splanchnic circulation receives over 25% of the cardiac output and contains a similar percentage of the total blood volume under normal conditions.

d) **Coronary Circulation:** Coronary circulation **is** part of the systemic circulatory system that supplies blood to and provides drainage from the tissues of the heart. In the human heart, two coronary arteries arise from the aorta just beyond the semilunar valves; during diastole, the increased aortic pressure above the valves forces blood into the coronary arteries and thence into the musculature of the heart. Deoxygenated blood is returned to the chambers of the heart via coronary veins; most of these converge to form the coronary venous sinus, which drains into the right atrium.

e) **Cutaneous Circulation:** The cutaneous circulation is the circulation and blood supply of the skin. The skin is not a very metabolically active tissue and has relatively small energy requirements, so its blood supply is different to that of other tissues. Some of the circulating blood volume in the skin will flow through will flow through arteriovenous anastomoses (AVAs) instead of capillaries. AVAs serve a role in temperature regulation. In this article we shall consider the different adaptations of the cutaneous circulation, and its role in body temperature control.

3. The following adjustments occur to the cardiovascular system during exercise:
    - The muscular walls of the heart increase in thickness, particularly in the left ventricle, providing a more powerful contraction. The left ventricles internal dimensions increase as a result of increased ventricular filling.
    - The increase in size of the heart enables the left ventricle to stretch more and thus fill with more blood. The increase in muscle wall thickness also increases the contractility resulting in increased stroke volume at rest and during exercise, increasing blood supply to the body
    - Cardiac output increases significantly during maximal exercise effort due to the increase in SV. This results in greater oxygen supply, waste removal and hence improved endurance performance.
    - People with blood pressure in the 'normal' ranges experience little change in BP at rest or with exercise; however hypertensive people find that their BP's reduce towards normal as they do more exercise. This is due to a reduction in total peripheral resistance within the artery, and improved condition and elasticity of the smooth muscle in the blood vessel walls.

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