UMEOKEKE MARY KENECHUKWU. 18/MHS01/362. PHYSIOLOGY ASSIGNMENT

QUESTION 1:

(Discuss the long- term regulation of mean arterial blood pressure)

- **LONG TERM REGULATION OF MEAN ARTERIAL PRESSURE.**

DEFINITION: mean arterial pressure (MAP) can be defined as the average arterial pressure throughout one cardiac cycle, systole, and diastole. It is thus calculated as Pdiast + 1/3(Psyst – Pdiast).

INTRODUCTION: Mean arterial pressure is influenced by cardiac output and systemic vascular resistance, each of which is under the influence of several variables. MAP functions to perfuse blood to all the tissues of the body to keep them functional. Mechanisms are in place to ensure that the MAP remains at least 60 mmHg so that blood can effectively reach all tissues.

LONG TERM REGULATION OF MEAN ARTERIAL PRESSURE: Mean arterial long-term blood pressure (MAP) is regulated by the **feedback of chemo and cardiopulmonary receptors**. Long-Term Regulation of Blood Pressure. There are several physiological mechanisms that regulate blood pressure in **the long-term,** the first of which is the **renin-angiotensin-aldosterone system** (RAAS). Renin-Angiotensin-Aldosterone System (RAAS) Renin is a peptide hormone released by the granular cells of the juxtaglomerular apparatus in the kidney.

- **Renin-Angiotensin-Aldosterone System (RAAS)**

Renin is a peptide hormone released by the granular cells of the **juxtaglomerular apparatus** in the kidney. It is released in response to:

- Sympathetic stimulation
- Reduced sodium-chloride delivery to the distal convoluted tubule
- Decreased blood flow to the kidney

Renin facilitates the conversion of angiotensinogen to angiotensin I which is then converted to angiotensin II using angiotensin-converting enzyme **(ACE)**. Angiotensin II is a potent vasoconstrictor. It acts directly on the kidney to increase sodium reabsorption in the proximal convoluted tubule. Sodium is reabsorbed via the sodium-hydrogen exchanger. *Angiotensin II* also promotes release of **aldosterone**.

- **Anti-Diuretic Hormone (ADH)**

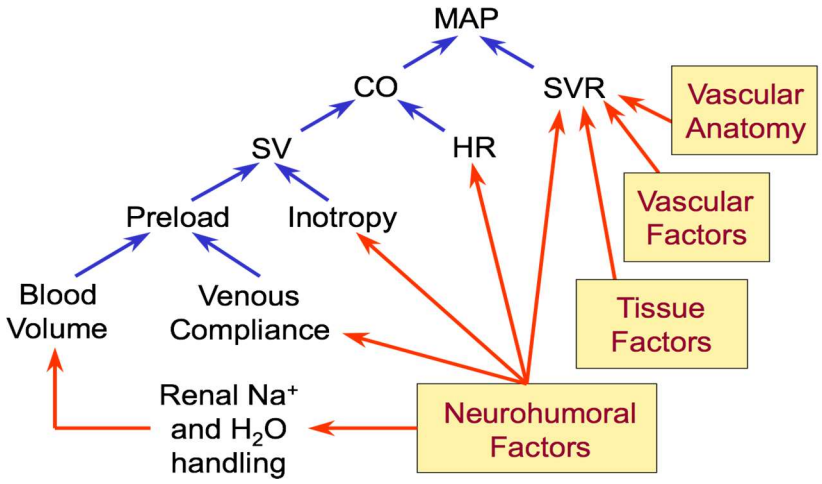
The second mechanism by which blood pressure is regulated is release of Anti Diuretic Hormone (ADH) from the OVLT of the hypothalamus in response to **thirst** or an increased plasma osmolarity.

Further Control of Blood Pressure

Other factors that can affect long-term regulation of blood pressure are natriuretic peptides. These include:

- Atrial natriuretic peptide **(ANP)** is synthesized and stored in cardiac myocytes. It is released when the atria are stretched, indicating of high blood pressure.
- ANP acts to promote sodium excretion. It dilates the **afferent arteriole** of the glomerulus, increasing blood flow (GFR). Moreover, ANP inhibits sodium reabsorption along the nephron. Conversely, ANP secretion is low when blood pressure is low.
- **Prostaglandins** act as local vasodilators to increase GFR and reduce sodium reabsorption. They also act to prevent excessive vasoconstriction triggered by the sympathetic nervous and renin-angiotensin-aldosterone systems.

REGULATION OF MEAN ARTERIAL PRESSURE.

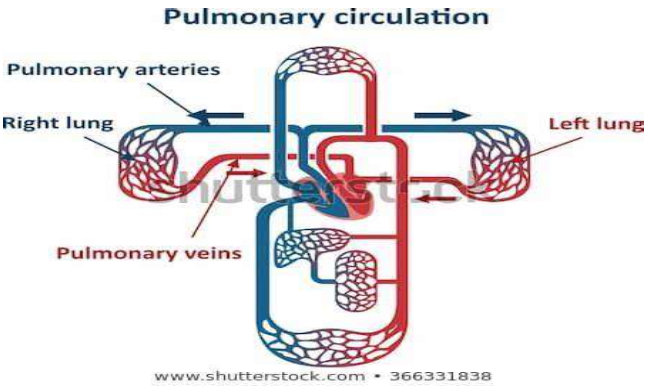


QUESTION 2

(Write short notes on the following)

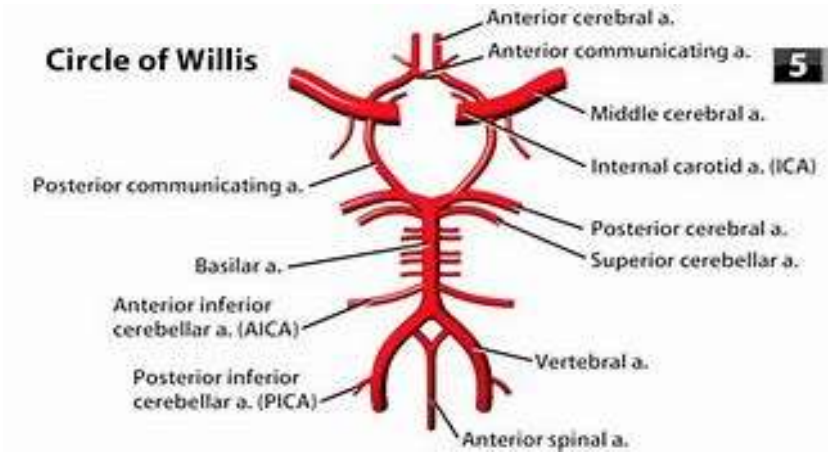
a) PULMONARY CIRCULATION

The pulmonary circulation is the portion of the circulatory system which carries deoxygenated blood away from the right ventricle, to the lungs, and returns oxygenated blood to the left atrium and ventricle of the heart. Pulmonary circulation**,** system of blood vessels that forms a closed circuit between the heart and the lungs, as distinguished from the systemic circulation between the heart and all other body. The pulmonary veins are the veins that transfer oxygenated blood from the lungs to the heart. The largest pulmonary veins are the four main pulmonary veins, two from each lung that drain into the left atrium of the heart. The pulmonary veins are part of the pulmonary circulation.



b) CIRCLE OF WILLIS

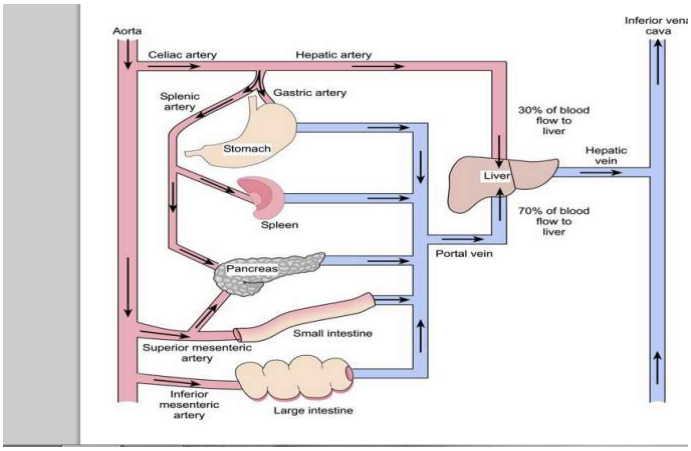
The circle of Willis (also called Willis' circle, loop of Willis, cerebral arterial circle, and Willis polygon) is a circulatory anastomosis that supplies blood to the brain and surrounding structures. It is named after Thomas Willis (1621–1675), an English physician. The circle of Willis is a group of blood vessels in the brain that connect with each other, forming a continuous structure that resembles a circle. These nine arteries supply blood to a large portion of the brain. Most of the time, blood can flow through the vessels of the circle of Willis without any interruption. Its a ring-like arterial structure located at the base of the brain that supplies blood to the brain and surrounding structures. The circle of Willis begins to form when the right and left internal carotid artery (ICA) enters the cranial cavity and each one divides into two main branches: the anterior cerebral artery (ACA) and middle cerebral artery (MCA). [2] The anterior cerebral arteries are then united and blood can cross flow by the anterior communicating (ACOM) artery.



c) SPLANCHNIC CIRCULATION

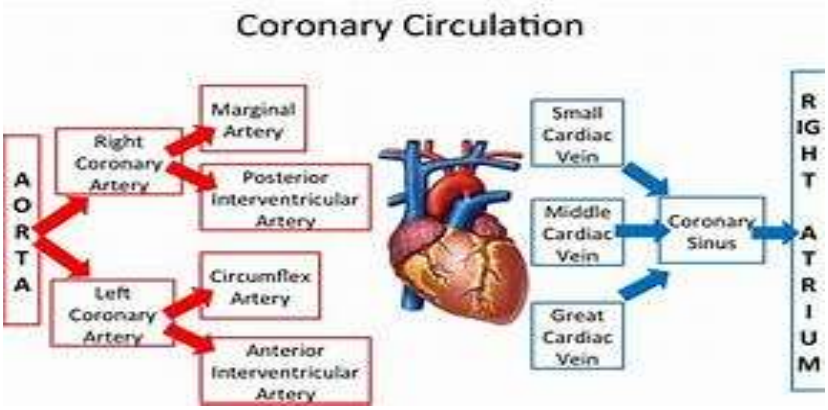
The term ‘splanchnic circulation’ describes the blood flow to the abdominal gastrointestinal organs including the stomach, liver, spleen, pancreas, small intestine, and large intestine. It comprises three major branches of the abdominal aorta; the coeliac artery; superior mesenteric artery (SMA); and inferior mesenteric artery (IMA). The hepatic portal circulation delivers the

majority of the blood flow to the liver. The anatomy of the circulation of the gut (splanchnic circulation) is unusual in that the venous blood does not return directly to the heart, but instead it flows in the portal vein to the liver, and only after this does it reach the hepatic vein and the inferior vena cava.



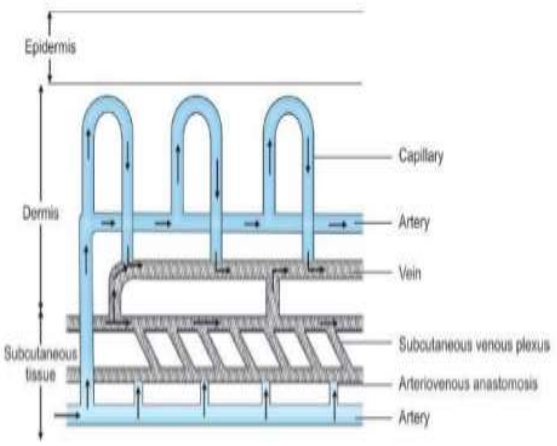
d) CORONARY CIRCULATION

Coronary circulation is the circulation of blood in the blood vessels that supply the heart muscle. Coronary arteries supply oxygenated blood to the heart muscle, and cardiac veins drain away the blood once it has been deoxygenated. Because the rest of the body, and most especially the brain, needs a steady supply of oxygenated blood that is free of all but the slightest interruptions, the heart is required to function continuously. Therefore its circulation is of major importance not only to its own tissues but to the entire body and even the level of consciousness of the brain from moment to moment. Interruptions of coronary circulation quickly cause heart attacks, in which the heart muscle is damaged by oxygen starvation. Such interruptions are usually caused by ischemic heart disease and sometimes by embolism from other causes like obstruction in blood flow through vessels.



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. The arteries that supply the skin, originate from richly anastomosing irregular plexus (first plexus) of the deepest part of the corium (dermis). From this cutaneous arterial plexus, the single arteriole arises and ascends through the corium and forms the second plexus just below the dermis. Because the cutaneous circulation has potentially large vascular conductance, blood flow, and blood volume, control of the resistance and compliance vessels within the skin has an importance well beyond that of tissue nutrition.



QUESTION 3

(Discuss cardiovascular adjustment that occurs during exercise)

CARDIOVASCULAR ADJUSTMENT THAT OCCURS DURING EXERCISE

INTRODUCTION: Cardiovascular adjustments to exercise and **training**. The cardiovascular system provides the link between pulmonary ventilation and oxygen usage at the cellular level. During exercise, **efficient delivery of oxygen to working skeletal and cardiac muscles** is vital for maintenance of ATP production by aerobic mechanisms.
Also cardiac output is a determing factor during endurance activities. Cardiac output increases during endurance activities in the following way

- ✓ Chemo baroreceptors detect the new demand
- ✓ Stimulate the cardiac accelerator centers
- ✓ Initiates sympathetic output via accelerator
- ✓ Increased impulse at SA node
- ✓ Increased HR/ SV = Increased Q

I. Heart and Exercise:

Prolonged and systematic exercise causes enlargement of the heart, and this is happens only to cope with the excessive work load imposed upon the heart during work. There is a lot of misunderstanding that prolonged exercise may cause dilatation of the heart similar to that happens in heart disease. But the hypertrophy of the heart in athletes is caused by physiological processes.

II. Heart Rate Changes during Exercise

The acceleration of the heart is observed immediately following exercise. It has been observed that the heart rate is increased slightly even before onset of exercise and it is presumably due to influence of the cerebral cortex on the medullary cardiac center. A short rise of heart rate is observed at first minute of exercise but after that this rate of rise is slight decreased.

III. STROKE VOLUME

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.

IV. CARDIAC OUTPUT:

During exercise the cardiac output is greatly increased. The following processes occur

- ✓ Chemo baroreceptors detect the new demand
- ✓ Stimulate the cardiac accelerator centers
- ✓ Initiates sympathetic output via accelerator
- ✓ Increased impulse at SA node
- ✓ Increased HR/ SV = Increased Q

V.BLOOD PRESSURE

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.

VI.VENOUS RETURN:

Venous return is greatly increased during exercise for the following reason:

(a) Milking and massaging action of skeletal muscles

(b) Respiratory Movements:

(c) Contraction of Limb Veins: