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PHYSIOLOGY ASSIGNMENT

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

The kidney plays an important role in the long term regulation of arterial blood pressure. When blood pressure alters slowly in several days, months or years, the nervous mechanism adapts to the altered pressure and loses the sensitivity for the changes. The kidney regulates arterial blood pressure in two ways: -

I) By regulation of ECF volume
II) Through Renin – Angiotensin mechanism.

REGULATION OF ECF VOLUME.

When the blood pressure increases, the kidney excretes large amounts of water and sodium through pressure diuresis (excretion of large quantity of water due to increased blood pressure) and pressure natriuresis (excretion of large quantity of Sodium). This causes a decrease in ECF volume and blood volume which in turn restores arterial blood pressure to normal level. When blood pressure decreases, the reabsorption of water from renal tubules is increased. Thus in turn increases ECF volume, blood volume and cardiac output resulting in restoration of BP.

RENIN – ANGIOTENSIN MECHANISM

As blood pressure decreases, renin secretion from the kidney is increased. Angiotensinogen is produced by the liver. It remains inactive unless acted upon by renin, it is then converted to angiotensin I. This is converted to angiotensin II by angiotensin converting enzyme.

Angiotensin II is a potent vasoconstrictor and constricts peripheral arterioles which increases peripheral resistance and the blood pressure rises.

Angiotensin II also stimulates the adrenal cortex to secrete aldosterone. Aldosterone increases the reabsorption of sodium from the renal tubules. Since sodium is osmotic, it attracts more water which will increase ECF and blood volume which in turn increases the blood pressure to a normal level.

2. Write short notes on the following:

A. **PULMONARY CIRCULATION**: - Pulmonary circulation is the movement of blood from the right side of the heart to the left side through the lungs. Deoxygenated blood is pumped from the right ventricle, it passed through the semi-lunar valves into the pulmonary trunk. After leaving the right ventricle, this artery divides into right and left branches. The pulmonary artery breaks down into smaller arteries called pulmonary arterioles. Then moves into the pulmonary capillaries where there is exchange of CO_2 and O_2. After the exchange has occurred, it moves into the pulmonary venules, which come together to form the pulmonary vein. The pulmonary vein takes oxygenated blood back into the left atrium. Within the left atrium blood moves into

the left ventricle through the biscuspid valve. Another circulation could begin in the left ventricle.

B. **CIRCLE OF WILLI**: -It is the joining area of several arteries at the bottom side of the brain. At the circle of Willis, the internal carotid arteries branch into smaller arteries that supply oxygenated blood to over 80% of the cerebrum.

C. Splanchnic Circulation: - 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. It is divided into 3 portions: - Mesenteric circulation, Splenic circulation and the hepatic circulation.

Mesenteric blood flow is regulated by the following factors:

I) Local auto regulation is the primary factor regulating blood flow through mesenteric bed

II) Contraction of the wall of the GI tract reduces blood flow due to compression of blood vessels and relaxation of wall of GI tract increases the blood flow due to removal of compression on the vessel wall.

III) Mesenteric blood flow is regulated by sympathetic nerve fibers. Increase in sympathetic activity as in the case of emotional conditions or 'fight and flight reactions constrict the mesenteric blood vessels. So, more blood is diverted to organs like skeletal muscles, heart and brain, which need more blood during these conditions.

SPLENIC CIRCULATION

In spleen, two structures are involved in storage of blood, namely splenic venous sinuses and splenic pulp. Small arteries and arterioles open directly into the venous sinuses. When spleen distends, sinuses swell and large quantity of blood is stored. Capillaries of splenic pulp are highly permeable. So, most of the blood cells pass through capillary membrane and are stored in the pulp. Venous sinuses and the pulp are lined with reticuloendothelial cells.

HEPATIC CIRCULATION

The liver receives blood from two source, the portal vein and hepatic artery. Liver receives maximum amount of blood as compared to any other organ in the body since, most of the metabolic activities are carried out in the liver. Blood flow to liver is 1,500 mL/minute, which forms 30% of the cardiac output. It is about 100 mL/100 g of tissue/minute. Normally, about 1,100 mL of blood flows through portal vein and remaining 400 mL of blood flows through hepatic artery. However, portal vein carries only about 25% of oxygen to liver. It is because it carries the blood, which has already passed through the blood vessels of GI tract, where oxygen might have been used. Hepatic artery transports 75% of oxygen to the liver.

D. **CORONARY CIRCULATION**: - This circulation is responsible for providing oxygen to the myocardium. It begins in the left ventricles. Blood is pumped through the aortic semilunar valve and moves into the ascending aorta, which branches into right and left coronary artery. The blood from right coronary artery goes into the marginal artery and posterior interventricular artery which then supply the myocardium by dropping off O_2 and picking up CO_2. They are respectively drained by the small cardiac vein and the middle cardiac vein which then empties

into the coronary sinus. The blood from the left coronary artery goes into the anterior interventricular artery and circumflex artery which also supply the myocardium by dropping off O_2 and picking up CO_2. They are then drained by the great cardiac vein and posterior vein of left ventricle which also empties into the coronary sinus. The coronary sinus with deoxygenated blood now empties into the right atrium.

E. **CUTANEOUS CIRCULATION**: - It is the supply of blood to the skin. It performs two functions:-

- Supply of nutrition to skin
- Regulation of body temperature by heat loss.

Cutaneous blood flow is regulated mainly by body temperature. Hypothalamus plays an important role in regulating cutaneous blood flow. When body temperature increases, the hypothalamus is activated. Hypothalamus in turn causes cutaneous vasodilatation by acting through medullary vasomotor center. Now, blood flow increases in skin. Increase in cutaneous blood flow causes the loss of heat from the body through sweat. When body temperature is low, vasoconstriction occurs in the skin. Therefore, the blood flow to skin decreases and prevents the heat loss from the skin.

3. Discuss the cardiovascular adjustment that occurs during exercise?

- On Blood: - Mild hypoxia developed during exercise stimulates the secretion of erythropoietin. It stimulates the bone marrow and causes release of red blood cells. Increased carbon dioxide content in blood decreases pH of blood.
- On Venous return: - Venous return increases remarkably during exercise because of muscle pump, respiratory pump and splanchnic vasoconstriction.
- On Cardiac output: - Cardiac output increases up to 20 L/minute in moderate exercise and up to 35 L/minute during severe exercise. During exercise, the cardiac output increases because of increase in heart rate and stroke volume. Heart rate increases because of vagal withdrawal. Stroke volume increases due to increased force of contraction. Because of vagal withdrawal, sympathetic activity increases leading to increase in rate and force.
- On Blood pressure: - During moderate isotonic exercise, the systolic pressure is increased. It is due to increase in heart rate and stroke volume.