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COLLEGE: MEDICINE AND HEALTH SCIENCES

DEPARTMENT: MEDICINE AND SURGERY

COURSE: PHYSIOLOGY

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

2. Write short notes on the following:

a. Pulmonary circulation

b. Circle of willis

c. Splanchnic circulation

d. Coronary circulation

e.Cutaneous circulation

3. Discuss the cardiovascular adjustment that occurs during exercise?

ANSWER

1. .Long term regulation is when the renal system helps to regulate the blood pressure after the nervous mechanism has lost its sensitivity to change due to its adaptation to the altered pressure. The kidneys regulate the arterial blood pressure in two ways:

- REGULATION OF ECF: When the blood pressure increases, the kidneys excrete a large amount of water and sodium. This is done by pressure diuresis (excretion of a large quantity of water in urine) and pressure natriuresis (excretion of a large quantity of water in urine). Diuresis and Natriuresis help to decrease the ECF volume and blood volume which will make the arterial blood pressure turn back to normal. When blood pressure decreases, the reabsorption of water from renal tubules is increased. This will restore the blood pressure by increasing the ECF volume, the blood volume and the cardiac output.
- THROUGH RENIN-ANGIOTENSIN: When the blood pressure and ECF volume decreases, the secretion of renin from the granular cells in the juxtaglomerular apparatus in the kidney increases. Renin converts angiotensinogen into angiotensin I which converted to angiotensin II by angiotensin-converting enzyme(ACE)Angiotensin II restores the blood pressure in two ways;

(i) It constricts the arterioles in the body and afferent arterioles in kidneys to increase peripheral resistance and reduce glomerular filtration respectively. This results in retention of water and salts thus increasing the ECF volume to normal level. This in turn will increase in blood pressure to its normal level.

(ii) Simultaneously, the adrenal cortex secretes aldosterone due to stimulation from angiotensin II. Aldosterone increases reabsorption of sodium from renal tubules which is

then followed by water reabsorption, resulting in increased ECF volume and blood volume. This increases the blood pressure to normal level.

In addition, angiotensins III and IV also increase the blood pressure and stimulate adrenal cortex to secrete aldosterone.

2. a. 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. The term pulmonary circulation is readily paired and contrasted with the systemic circulation. The vessels of the pulmonary circulation are the pulmonary arteries and the pulmonary veins.

b. The Circle of Willis: is a structure located at the base of the brain (around eye level) encircling around the brainstem and the parts of the mid-brain. It provides a blood supply to the brain and neighboring structures. More specifically, it's a circulatory anastomosis that encircles the stalk of the pituitary gland and allows distribution of blood to the brain and nearby structures.

c. splanchnic circulation: describes the blood flow to the abdominal gastrointestinal organs including the stomach, liver, spleen, pancreas, small intestine, and large intestine. The splanchnic circulation is composed of the blood flow originating from the celiac, superior mesenteric, and inferior mesenteric arteries.

d. Coronary circulation: is the circulation of blood in the blood vessels that supply the heart muscle (myocardium). Coronary arteries supply oxygenated blood to the heart muscle, and cardiac veins drain away the blood once it has been deoxygenated.

e.Cutaneous circulation: is the circulation and blood supply of the skin. Some of the circulating blood volume in the skin will flow through arteriovenous anastomoses (AVAs) instead of capillaries.

3. Effects of Exercise on Cardiovascular System

Blood: Exercise decreases the pH of the blood. This is caused by increase in carbon dioxide due to the release of red blood cells by the bone marrow. Release of red blood cells is caused by erythropoietin secreted from the juxtaglomerular apparatus when stimulated by exercise.

Blood Volume: More heat is produced during exercise and the thermo-regulatory system is activated. This in turn, causes secretion of large amount of sweat leading to the reduction of blood volume.

Heart rate: Exercise increases the heart rate through vagal withdrawal. Heart rate increases to 180 beats/minute in moderate exercise and 240 to 260 beats/minute in severe exercise. Increase in sympathetic tone also plays some role. Increased heart rate during exercise is due to impulses from proprioceptors, increased carbon dioxide tension, rise in body temperature and circulating catecholamines.

Cardiac output: Increase in cardiac output is directly proportional to the increase in the amount of oxygen consumed during exercise. During exercise, the cardiac output increase because of increase in

heart rate and stroke volume. Heart rate increases because of vagal withdrawal and stroke volume increases because of increased force of contraction. Sympathetic activity increases because of vagal withdrawal. This leads to increase in rate and force of attraction.CO increases up to 20L/minute in moderate exercise and 35 L/minute during severe exercise.

Venous return: Increases during exercise as a result of muscle pump, respiratory pump and splanchnic vasoconstriction.

Blood pressure: In moderate isotonic exercise, the systolic pressure is increased. It is due to increase in heart rate and stroke volume. Diastolic pressure is not altered because peripheral resistance is not affected during moderate exercise. In severe isotonic exercise, systolic pressure enormously increases but the diastolic pressure decreases as a result of decrease in peripheral resistance. Decrease in peripheral resistance is due to vasodilation caused by metabolites. During exercise involving isometric contraction, the peripheral resistance increases. So the diastolic pressure also increases along with systolic pressure.

On blood flow to skeletal muscles: During the muscular activity, stoppage of blood flow occurs when the muscles contract. It is because of compression of blood vessels during contraction. And in between the contractions, the blood flow increases.