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DEPARTMENT: MBBS

COURSE: PHYSIOLOGY

ASSIGNMENT

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

Kidneys play an important role in the long-term regulation of arterial blood pressure. When blood pressure alters slowly in several days/months/years, the nervous mechanism adapts to the altered pressure and loses the sensitivity for the changes. It cannot regulate the pressure anymore. In such conditions, the renal mechanism operates efficiently to regulate the blood pressure. Therefore, it is called long term regulation.

Kidneys regulate arterial blood pressure by two ways:

1. By regulation of ECF volume: When the blood pressure increases, kidneys excrete large amounts of water and salt, particularly sodium, by means of pressure diuresis and pressure natriuresis.

2. Through renin angiotensin mechanism: Along with angiotensin, renin forms the renin-angiotensin system, which is a hormone system that plays an important role in the maintenance of blood pressure. Angiotensin II increases arterial blood pressure by directly acting on the blood vessels and causing vasoconstriction

2. Write short notes on the following:
   a. **Pulmonary circulation**

Pulmonary circulation is otherwise called lesser circulation. Blood is pumped from right ventricle to the lungs through pulmonary artery. Exchange of gases occurs between blood and alveoli of the lungs at pulmonary capillaries. Oxygenated blood returns to left atrium through the pulmonary veins. Thus, left side of the heart contains oxygenated or arterial blood and the right side of the heart contains deoxygenated or venous blood.

In pulmonary circulation deoxygenated blood from the lower half of the body enters the heart from the inferior vena cava while deoxygenated blood from the upper body is delivered to the heart via the superior vena cava. Both the superior vena cava and inferior vena cava empty blood into the right atrium. Blood flows through the tricuspid valve into the right ventricle. It then flows through the pulmonic valve into 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. With a powerful contraction, the left ventricle expels oxygen-rich blood through the aortic valve and into the aorta: This is the beginning of systemic circulation

b. Circle of Willis

Circle of Willis is a critical arterial circle at the base of the brain. It is a junction of several important arteries at the bottom part of the brain. The circle of Willis receives all the blood that is pumped up the two internal carotid arteries that come up the front of the neck. The two arteries supply blood to the brain. It helps blood flow from both the front and back sections of the brain. They run along either side of the neck and lead directly to the circle of Willis.

Each carotid artery branches into an internal and external carotid artery. The internal carotid artery then branches into the cerebral arteries. This structure allows all the blood from the two internal carotid arteries to pass through the circle of Willis, the meeting point of many important arteries supplying blood to the brain. The internal carotid arteries branch off from here into smaller arteries, which deliver much of the brain’s blood supply. The circle of Willis plays an important role, as it allows for proper blood flow from the arteries to both the front and back hemispheres of the brain. The arteries that stem off from the circle of Willis supply much of the blood to the brain.

The circle of Willis also serves as a sort of safety mechanism when it comes to blood flow. If a blockage or narrowing slows or prevents the blood flow in a connected artery, the change in pressure can cause blood to flow forward or backward in the circle of Willis to compensate. This mechanism could also help blood flow from one side of the brain to the other in a situation in which the arteries on one side have reduced blood flow. In an emergency, like stroke, this may reduce the damage or aftereffects of the event.

c. Splanchnic circulation

Splanchnic or visceral circulation constitutes three portions: Mesenteric circulation supplying blood to GI tract, Splenic circulation supplying blood to spleen and the Hepatic circulation supplying blood to liver.

Splanchnic circulation is 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 most of the blood flow to the liver.

A unique feature of splanchnic circulation is that the blood from mesenteric bed and spleen forms a major amount of blood flowing to liver. Blood flows to liver from GI tract and spleen through portal system.

d. Coronary circulation

Coronary circulation is a part of the systemic circulatory system that supplies blood to and provides drainage from the tissues of the heart(myocardium). In the human heart, two coronary arteries arise from the aorta just beyond the semilunar valves during diastole, the increased aortic pressure above the valve's forces blood into the coronary arteries and then 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.

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.

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 instead of capillaries. Arteriovenous anastomoses serve a role in temperature regulation. Cutaneous blood flow 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.

3. Discuss the cardiovascular adjustment that occurs during exercise?

The three major adjustments made by the cardiovascular system during exercise include:

a. An increase in cardiac output or the pumping capacity of the heart, designed to enhance the delivery of oxygen and fuel to the working muscles.
b. An increase in local blood flow to the working muscles.
c. A decrease in blood flow to other organs such as the kidneys, liver and stomach, thereby redirecting blood flow to the working muscles.

Cardiac output is the amount of blood pumped from the heart in one minute, generally measured in litres per minute. In order to increase cardiac output, there is increased heart rate, stroke volume, or as it is the case during exercise, an increase both.

First, there is a reduction or withdrawal of the parasympathetic nerve activity to the heart. As parasympathetic nerve activity causes a lowering of heart rate, its withdrawal will result in an increase in heart rate.

Second, an increase in sympathetic nerve activity to the heart will directly cause an increase in heart rate. This increase in sympathetic nerve activity will be a function of the exercise intensity.

Lastly, an increase in the hormone epinephrine or adrenaline circulating in the blood will also stimulate an increase in heart rate. An increase in stroke volume also contributes to an increase in cardiac output during exercise. A more forceful contraction of the ventricles of the heart, resulting in more blood being pumped per beat, can be accomplished by both increasing sympathetic nerve activity and circulating epinephrine.

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