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Question.

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.

- In cardiovascular system, blood flow is controlled by arterial blood pressure, and in this way the long term mean blood pressure is stabilized to regulate oxygen and carbon dioxide levels. Blood pressure is a measure of the pressures within the cardiovascular system during the pumping cycle of the heart.

  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 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 and decreased blood flow to the kidney.
  - Anti-Diuretic Hormone: 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.
  - 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 system.
  - Atrial natriuretic peptide (ANP) is synthesized and stored in cardiac myocytes. It is released when the atria are stretched, indicating of high blood pressure.

2. 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. The term pulmonary circulation is often paired with the systemic circulation.
   b. Circle of Willis: also called Willis circle, loop of Willis, cerebral arterial circle, is a circulatory anastomosis that supplies blood to the brain and surrounding structures. It is part of the cerebral circulation and is composed of: Anterior cerebral artery, anterior communicating artery, internal carotid artery, posterior cerebral artery etc.

c. **Splanchnic circulation**: consists of blood supply to the gastrointestinal tract, liver, spleen, and pancreas. It consists of 2 large capillary beds and the efferent venous blood flows into the PV. The splanchnic circulation receives over 25% of the cardiac output and contains a similar percentage of the total blood volume under normal conditions. Thus, the splanchnic circulation can act as a site for regulation of distribution of cardiac output and as a blood reservoir.

d**. Coronary Circulation**: this 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. 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 also to the entire body and even the level of consciousness of the brain from time to time.

e. **Cutaneous circulation**: this is the circulation and blood supply of the skin. The skin is not 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 arteriovenous anastomoses (AVAs) instead of capillaries. AVAs serve a role in temperature regulation. AVAs are low resistance connections between the small arteries and small veins that supply and drain the skin.

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

- 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.
- An increase in local blood flow to the working muscles.
- A decrease in blood flow to other organs such as 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. Its simply calculated by heart rate, in beat per minute, times stroke volume, or the amount of blood ejected by the heart with each beat. Thus in order to increase cardiac output we can increase

heart rate, stroke volume or as it is the case during exercise, we can increase both.