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PHYSIOLOGY ASSIGNMENT

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

Blood pressure is a measure of how well our cardiovascular system is functioning. We all require a blood pressure high enough to give our organs the blood and nutrients they need, but not so high our blood vessels become damaged.

The blood pressure is a measure of the pressures within the cardiovascular system during the pressures during the pumping cycle of the heart. There is a normal range of blood pressure considered acceptable, when blood pressure is outside this range people start to have problems in both long and short term.

The 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. It is released in response to:

1. Sympathetic stimulation
2. Reduced sodium-chloride delivery to the distal convulated tube
3. Decreased blood flow to the kidney.

Renin facilitates the conversion of angiotensinogen to angiostensin 1 which is then converted to angiotensin 11 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.

ACE also breaks down a substance called bradykinin which is a potent vasodilator. Therefore, the breakdown of bradykinin potentiates the overall constricting effect.

Aldosterone promotes salt and water retention by acting at the distal convoluted tubule to increase expression of epithelial sodium channels. Furthermore, aldosterone increases the activity of the basolateral sodium-potassium ATP-ase, thus increasing the electrochemical gradient for movement of sodium ions. More sodium collects in the kidney tissue and water then follows by osmosis. This results in decreased water excretion and therefore increased blood volume and thus blood pressure.

**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. ADH acts to increase the permeability of the collecting duct to water by inserting aquaporin channels (AQP2) into the apical membrane.

It also stimulates sodium reabsorbtion from the thick ascending limb of the loop of Henle. This increases water reabsorption thus increasing plasma volume and decreasing osmolarity.

Other factors that affect long term regulation are natriuretic peptides:

1. Atrial natriuretic petide(ANP)
2. Prostagladins

QUESTION 2

1. **PULMONARY CIRCULATION**

It is a 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 tissues. It is the system of transportation that shunts deoxygenated blood from the heart to the lungs to be re-saturated with oxygen before being dispersed into systemic circulation. De-oxygenated 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.

1. **CIRCLE OF WILLIS**

The circle of willis is the joining area of several arteries at the bottom (inferior) 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. It encircles the stalk of the pituary gland and provides the important communications between the blood supply of the forebrain and hindbrain.

Although a complete circle of willis is present in some individuals, it is rarely seen radio graphically in its entirety anatomy variations are very common and a well-developed communication between each of its part is identified in less than half of the population.

It encircles the stalk of the pituary gland and provides important communications between the blood supply of the forebrain and the hindbrain (ie, between the internal carotid and vertebra-basilar systems following obliteration of primitive embryonic connections).

1. **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. 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 of regulation of distribution of cardiac output and also as a blood reservoir.

It is comprised of gastric, small intestinal, colonic, pancreatic, hepatic and splenic circulations. They are arranged in parallel and fed by the inferior mesenteric arteries.

1. **CORONARY CIRCULATION**

The 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. Because the rest of the body, and most especially the brain, need 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 (myocardial infarction), in which the heart muscle is damaged by oxygen starvation. Such interruptions are usually caused by ischemic heart disease (coronary artery disease) and sometimes by embolism from other causes like obstruction in blood flow through vessels.

1. **CUTANEOUS CIRCULATION**

It is the circulation and blood supply to 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 atrioveneous anastomoses (AVAs) instead of capillaries. AVAs serve a role in temperature regulation. In this article we shall consider the different adaptations of the cutaneous circulation, and its role in the body temperature control.

Cutaneous blood flow increases to favor body cooling, however, with maximal effort cutaneous vasoconstriction can overcome thermoregulatory vasodilator responses, and the core body temperature can rise.

QUESTION 3

**Discuss the cardiovascular adjustments that occur during exercise.**

It involves four to five folds increase in cardiac output, which are due primarily to increases in cardiac rate and to a lesser extent to augmentation of stroke volume. The increase in strike volume is partly due to an increase in end-diastolic cardiac size(Frank- Starling mechanism) and secondarily due to a reduction in end-systolic cardiac size. The full role of the Frank-s Starling mechanism is masked by the concomitant tachycardia. The reduction in end-systolic dimensions can be related to increased contractility mediated by beta adrenergic stimulation.

The enhanced Co is distributed prefentially to the exercising muscles including the heart. Blood flow to the heart increases four to five fold as well, mainly reflecting the augmented metabolic requirements of the myocardium due to near maximal increases in cardiac rate and contractility.

Blood flow to the inactive viscera (e.g kidney and gastrointestinal tract) is maintained during severe exercise. However, in the presence of circulatory impairment, where oxygen delivery to the exercising muscle is impaired as occurs to complete heart block where normal heart rate increases during exercise are prevented, or in congestive right heart failure where normal SC increases during exercise are impaired or in the presence of severe anemia. Thus visceral flow is normally maintained during severe exercises as long as all other compensatory mechanism remain intact.