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18/MHS01/299

Department of Medicine and Surgery

Physiology Assignment

Questions:

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

2. Write short notes on the following:

a. Pulmonary circulation

b. Circle of willis

c. Splanchnic circulation

d. Coronary circulation

e. Cutaneous circulation

2. Discuss the cardiovascular adjustment that occurs during exercise.

Answers:

1. Mean arterial blood pressure is the average between systolic and diastolic pressures. Arterial pressure responds easily and directly to cardiac output, peripheral vascular resistance and arterial elasticity. This means it can easily be altered. Physiological mechanisms that alter arterial pressure in the long term are:-

- *The Renin-Anglotensin-Aldosterone System (RAAS).*

- *Anti-Diuretic Hormone (ADH).*

- *Atrial natriuretic peptide (ANP).*

RAAS begins with the production and release of renin from juxtaglomerular cells of the kidney. It is released in response to reduced NaCl delivery to the distal convoluted tubule, decreased blood follow to the kidney and sympathetic stimulation. It facilitates the conversion of angiotensinogen to angiotensin I which is then converted to angiotensin II using the enxyme ACE. Angiotensin II acts directly on the kidney to increase sodium reabsorption in the proximal convoluted tubule. Sodium is reabsorbed through the NaH exchanger. Angiotensin II also

promotes the release of *aldosterone.* Aldosterone promotes salt and water retention andalso increases the activity of the basolateral sodium-potassium ATPase. Sodium collects in the kidney tissue and water then follows by osmosis resulting in decreased water excretion and increased blood volume and pressure.

ADH acts to increase the permeability of the collecting duct to water by inserting aquaporin channels into the apical membrane. It also stimulates sodium reabsorption from the thick ascending limb of the loop of Henle, thereby increasing water reabsorption and causing the plasma volume to increase, decreasing osmolarity as well.

ANP is released when the atria are stretched (this indicates high blood pressure). It helps promote sodium excretion, therefore ANP secretion is low when blood pressure is low and high when blood pressure is high.

2a. **PULMONARY CIRCULATION** is the flow of blood between the heart and lungs. Here, deoxygenated blood is carried away from the right ventricle to the lungs, and oxygenated blood returns to the left atrium and the ventricle of the heart. The *pulmonary arteries and veins* are the vessels involved in this type of circulation.

2b. **CIRCLE OF WILLIS** is the joining area of several arteries at the bottom inferior side of the brain. It is in the circle of willis that the internal carotid arteries branch into smaller arteries that supply oxygenated blood to most parts of the cerebrum.

2c. **SPLANCHNIC CIRCULATION** consists of blood supply to the liver, spleen, gastrointestinal tract and pancreas. It may also include the kidney. It is consist of two large capillary beds supplied by the small splanchnic arterial branches.

2d, **CORONARY CIRCULATION** refers to the flow of blood within the heart**.** *Coronary arteries* supply blood to the heart muscle and cardiac veins drain away the blood once it has been oxygenated.

2e. **CUTANEOUS CIRCULATION** is the blood suplly of the skin. The skin requires its own special blood supply because it is not a very metabolically active tissue and has relatively small energy requirements.

3. During exercise, cardiac output increases primarily due to increase in heart rate. This increase in heart rate is to enhance the delivery of oxygen to body muscles. There is also an increase in stroke volume due to an increase in end-diastolic cardiac size and a decrease in end-systolic cardiac size. The reduction in end-systolic dimension can be attributed to increased contractility. Blood flow to the heart also increases, reflecting the metabolic requirements of the myocardium. Visceral flow is normally maintained during severe exercise as long as compensatory mechanisms are intact.