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

Mean arterial pressure is the average arterial pressure throughout one cardiac cycle, systole, and diastole. **MAP** is influenced by cardiac output and systemic vascular resistance, each of which is under the influence of several variables. In regulating blood pressure in long- term, several mechanisms are employed to get this done but two will be considered.

- **Renin- angiotensin- aldosterone system (RASS):** Renin which is a peptide hormone is released by the granular cells in the kidney in response to: decreased blood flow to the kidney, sympathetic stimulation and reduced sodium- chloride delivery to the distal convoluted tubule. Angiotensinogen is being converted to angiotensin I which is only possible due to the presence of renin, and invariably angiotensin I is being converted to angiotensin II in the presence of angiotensin- converting enzyme (ACE). ACE is a potent vasodilator that breaks down bradykinin with a constricting effect. Angiotensin II also act similarly but this acts directly on the kidney to cause sodium reabsorption in the proximal convoluted tubule to increase. Angiotensin II enhances the release of aldosterone. The activities of basolateral sodium- potassium ATP-ase, enhancement of salt and water retention by acting at the distal convoluted tubule is quite possible because of Aldosterone.
- **Anti- Diuretic Hormone (ADH):** it is released 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. Sodium reabsorption from the loop of Henle is stimulated, water reabsorption increased (increase in plasma volume and decrease in osmolarity).

Clinical Application

Hypertension is defined as a condition in which the blood vessels have persistently raised pressure. Blood is carried from the heart to all parts of the body in the vessels. Each time the heart beats, it pumps blood into the vessels. The higher the pressure, the harder the harder the heart has to pump. Hypertension can cause serious medical condition and can increase the risk of heart, brain, kidney and other diseases.

2. Write short note on the following:
    a) **Pulmonary circulation:** this 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. Deoxygenated blood from the lower half of the body and upper part of the body is delivered to the heart via inferior and superior vena cava respectively which is being emptied into the right atrium. The tricuspid valve opens and blood flows into the right ventricle, then via the pulmonary valve into the pulmonary artery before being delivered into the lungs. While in the lungs oxygenation takes place and carbondioxide is released.

The oxygenated blood is then transported via the pulmonary vein into the left atrium, then pumps blood through the bicuspid valve into the left ventricle. Blood rich in oxygen is being expelled from the left ventricle through the aortic valve into the aorta.

b) **Circle of Willis:** this is the joining area of several arteries at inferior side of the brain. It provide important communications between the blood supply of the forebrain and hindbrain. The circle of Willis is formed when the right and left internal carotid artery (ICA) enters the cranial cavity and each ICA bifurcate into two main branches- the middle cerebral artery (MCA) and the anterior cerebral artery (ACA). The anterior cerebral arteries then unite so that blood can flow by the anterior communicating artery.
ACAs- supply midline portions of the frontal lobes and superior medial parietal lobes.
PCAs – the basilar artery (BA), formed by the left and right vertebral arteries, branches into a left and right **posterior cerebral artery**. The PCAs basically supply to the occipital lobe and inferior portion of the temporal lobe.

c) **Splanchnic circulation:** this circulation comprises the gastric, colonic, hepatic, splenic, pancreatic, and small intestinal circulations. Blood flow originating from the celiac, inferior and superior mesenteric arteries is been distributed to all abdominal viscera. Under normal condition over 25% of the cardiac output is received therefore, making splanchnic circulation to act as a site for the regulation of cardiac output distribution as well as a blood reservoir. Autoregulation response in splanchnic circulation serves to restore blood to areas that are suffering hypoperfusion.

d) **Coronary circulation:** this is the circulation of blood within the blood vessels that supply the heart muscle. Coronary arteries and cardiac veins supply oxygenated blood to the heart muscle, and drain away deoxygenated blood respectively. The heart basically has to work continuously because the brain and other vital organs in the body needs an uninterrupted supply of oxygenated blood. When this is interrupted cases like (heart attack) can occur and there can be obstruction in blood flow.

e) **Cutaneous circulation:** this is the circulation of blood to the skin. For blood flow instead of capillaries blood volume in the skin flow through the arteriovenous anastomoses (AVAs) which play a crucial role in temperature regulation since they are not involved in transport of nutrients. The amount of blood flow to the skin will be a determining factor in the degree of heat loss. In temperature regulation when the level of sympathetic outflow to the cutaneous vessels, temperature is being returned to its normal range.

3. Discuss the cardiovascular adjustment that occurs during exercise?

The heart is a muscle that is required to contract continuously throughout the life of an individual. Blood vessels connect the heart and lungs that carbondioxide is expelled from the blood and oxygen can be added. This blood (oxygenated) is then pumped throughout the body by the heart. Exercise now places an increasing demand on the cardiovascular system to pump more oxygen to supply the working muscle to produce

energy. Oxygen demand by the muscles increases, more nutrients are needed and more waste is needed.

- Heart rate- average heart rate at rest is 60 to 80beats/min. Increased heart rate before exercise caused by the released of epinephrine (anticipatory response)- heart rate increases even before exercise begins and this is called anticipatory response.
- Stroke volume- it increases proportionally with exercise intensity.
- Cardiac output- this increases also when either heart rate or stroke volume increases or both. It remains relatively unchanged or slight decrease following endurance training. There is a meaningful increase in cardiac output during maximal exercise.
- Blood flow-the vascular system can redistribute blood to those tissues having an immediate demand for energy e.g. muscles.
- Blood pressure- during exercise systolic pressure can increased to even about 200mmHg.

Enhanced oxygen delivery and utilization during exercise will improve mitochondrial respiration and subsequently the capacity for endurance exercise. A reduction in the oxygen carrying capacity in conditions like Anemia can lead to shortness of breath, fatigue etc.

Benefits of cardio- respiration on exercise- increased muscle tone, management of stress, increase in physical performance, fitness etc.

Diseases of Cardiovascular system and exercise- blood pressure (hypertension) and coronary Heart Diseases.