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18/MHS01/109

200L MBBS

PHY 201

PHYSIOLOGY ASSIGNMENT

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1. **LONG TERM REGULATION OF MEAN ARTERIAL BLOOD PRESSURE**

The force which blood exerts on the walls of the blood vessels is called blood pressure. This is the force exerted when the blood flows through the arteries. Arterial pressure changes continuously throughout each cardiac cycle. The highest pressure reached during systole is termed systolic arterial pressure and the lowest pressure reached during diastole is called diastolic arterial pressure. The pulse pressure is the difference between the systolic pressure and diastolic pressure.

Mean arterial pressure is the average pressure during the cardiac cycle. Mean arterial pressure is given by the formula:

Mean pressure = diastolic pressure + 1/3 of pulse pressure

Blood pressure is given by the formula:

B.P = C.O x P.R.

Where C.O is the cardiac output

P.R is the peripheral resistance

Blood pressure can be varied by changing the cardiac output or by changing both PR and CO. Therefore, all factors affecting cardiac output and peripheral resistance will influence arterial pressure. In the long term other mechanisms such as Renin-Angiotensin-Aldosterone System and Anti-Diuretic hormone. Renin is a peptide hormone released by the granular cells of the juxtaglomerular apparatus in the kidney. Renin facilitates the conversion of angiotensinogen to angiotensin I which is then converted to angiotensin II 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 **i**ncreasing 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. 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 reabsorption from the thick ascending limb of the loop of Henle. This increases water reabsorption thus increasing plasma volume and decreasing osmolarity.

CLINICAL SIGNIFICANCE - HYPERTENSION

Hypertension is the sustained increase in blood pressure. It causes damage to the walls of blood pressure making them weaker hence, causing conditions to the body such as atherosclerosis, thromboembolism and aneurysms.

2. PULMONARY CIRCULATION

Pulmonary circulation is a part of the cardiovascular system which is responsible for carrying deoxygenated from the heart to the lungs and then back to the heart for it to transfer the oxygenated blood to the rest of the body. Oxygen-depleted blood from the body leaves the systemic circulation when it enters the right atrium through the superior and inferior vena cavae. The blood is then pumped through the tricuspid valve into the right ventricle. From the right ventricle, blood is pumped through the pulmonary valve and into the pulmonary artery. The pulmonary artery splits into the right and left pulmonary arteries and travel to each lung. In the lungs, the blood travels through capillary beds on the alveoli where gaseous exchange occurs, removing carbon dioxide and adding oxygen to the blood. The alveoli are air sacs in the lungs that provide the surface for gas exchange during respiration. The oxygenated blood then leaves the lungs through pulmonary veins, which returns it to the left atrium, completing the pulmonary circuit. After entering the left heart, the blood flows through the bicuspid valve into the left ventricle. From the left ventricle, the blood is pumped through the aortic valve into the aorta to travel through systemic circulation, delivering oxygenated blood to the body before returning again to the pulmonary circulation.

CLINICAL SIGNIFICANCE – RIGHT HEART FAILURE

Chronic hypoxia is due to the hypoxic pulmonary vasoconstriction. This chronic hypoxic vasoconstriction causes a chronic increase in vascular resistance leading to pulmonary hypertension. This increases the afterload on the right ventricle causing right ventricular hypertrophy and diastolic right heart failure. Chronic hypoxia can occur at an altitude or as a consequence of a lung disease such as emphysema.

B. CIRCLE OF WILLIS

The circle of Willis is a ring of interconnecting arteries located at the base of the brain around the optic chiasma. This arterial rig provides blood to the brain and neighboring structures. It is an

anastomosis between the anterior and posterior circulation providing arterial branches that vascularize the brain.

Anterior circulation:

Common carotid - Internal carotid – Anterior cerebral artery (- anterior communicating artery), middle cerebral artery.

Posterior Circulation:

Subclavian artery – Vertebral arteries – Unite forming the basilar artery – Anterior inferior cerebellar, superior cerebellar, posterior cerebral arteries (- posterior communicating artery)

Circle of Willis: Polygonal anastomosis between:
Internal carotid artery (branch of the common carotid)
Anterior cerebral artery (branch of the internal carotid)
Anterior communicating artery (branch of the anterior carotid, connects left and right anterior cerebral arteries)
Posterior cerebral artery (branch of the basilar artery)
Posterior communicating artery (branch of the posterior cerebral, connects the three cerebral arteries on the same side

CLINICAL SIGNIFICANCE

Obstruction of blood-flow to brain tissues leads to oxygen and nutrients starvation, and may ultimately result in conditions like stroke, paralysis, personality changes, dulling of sensations, Aphasia, etc. depending on the degree and site of occlusion.

C**. SPLANCHNIC CIRCULATION**

The splanchnic circulation is composed of gastric, small intestinal, colonic, pancreatic, hepatic, and splenic circulations, arranged in parallel with one another. The three major arteries that supply the splanchnic organs, cellac and superior and inferior mesenteric, give rise to smaller arteries that anastomose extensively. The circulation of some splanchnic organs is complicated by the existence of an intramural circulation. Redistribution of total blood flow between intramural vascular circuits may be as important as total blood flow.

D. **CORONARY CIRCULATION**

It is a part of the systemic circulatory system that supplies blood to and provides drainage from the tissues of the heart. In the human heart, two coronary arteries arise from the aorta just beyond the semilunar valves; during diastole, the increased aortic pressure above the valves forces blood into the coronary arteries and thence 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.

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 (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. These allow the shunt of blood directly into the **venous plexus** of the skin, without it passing through capillaries. Since AVAs contain no capillary section, they are not involved in transport of nutrients to/from the tissues, but instead play a major role in temperature regulation.

CLINICAL SIGNIFICANCE

- Red reaction- Within 10seconds, due to histamine and bradykinn.
- Flare- Spreading redness after few minutes mediated by axon reflex.

3. CARDIOVASCULAR ADJUSTMENT THAT OCCURS DURING EXERCISE

During exercise, the job of the cardiovascular system is to deliver blood and oxygen from the heart and lungs to your working muscles. Oxygen is needed for exercise and blood carries nutrients to the muscle cells to create energy the muscles need to contract. During aerobic exercise the cardiovascular system responds to meet the increased oxygen need of the muscles. During the first few minutes of exercise the body tries to meet the new oxygen needs and this results in oxygen deficit. In order to meet oxygen and energy needs during aerobic exercise and overcome the oxygen deficit. The cardiovascular system goes through some changes from your normal resting state. Cardiac output is influenced by your heart rate and stroke volume. Both heart rate and stroke volume increase during exercise which increases the cardiac output. However, the systolic blood pressure also increases as the vessels that deliver blood to active tissues during exercise such as your muscles will dilate allowing more blood to flow to your muscles.