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COURSE: GENERAL PHYSIOLOGY (PHS201)

ASSIGNMENT

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

ANSWER

Kidney plays an important role in the long-term regulation of arterial blood pressure. Long-term regulation occurs when the blood pressure alters slowly in several days or months or years, the nervous mechanism adapts to the altered pressure and loses the sensitivity for the changed. It cannot regulate the pressure anymore. In such conditions, the renal mechanism operates efficiently to regulate the blood pressure. Therefore, it is called long-term regulation. Kidney regulates arterial blood pressure by two ways:

a. BY REGULATION OF EXTRACELLULAR FLUID VOLUME: When blood pressure increases, kidney excrete large amount of water and salt, particularly sodium, by means of pressure diuresis and pressure natriuresis. Pressure diuresis is the excretion of large quantity of water in urine because of increased blood pressure. Pressure natriuresis is the excretion of large quantity of sodium in urine.

Because of diuresis and natriuresis, there is a decrease in ECF volume, which in turn brings the arterial blood pressure back to normal level. When blood pressure decreases, the reabsorption of water from renal tubules is increased. This in turn, increases ECF volume, blood volume and cardiac output, resulting in restoration of blood pressure.

b. THROUGH RENIN-ANGIOTENSIN MECHANISM:

- **ACTION OF ANGIOTENSIN II**

When blood pressure and ECF volume decreases, renin secretion from kidneys is increased. It converts angiotensinogen into angiotensin I. This is converted into angiotensin II by angiotensin-converting enzyme. Angiotensin II causes contraction of arterioles in the body so that the peripheral resistance is increased and blood pressure rises and simultaneously, angiotensin II stimulated the adrenal cortex to secrete aldosterone.

- **ACTION OF ANGIOTENSIN III AND ANGIOTENSIN IV**

Like angiotensin II, the angiotensin III and IV also increase the blood pressure and stimulates adrenal cortex to secrete aldosterone.

2. Write short note on the following:

a. PULMONARY CIRCULATION: It is otherwise called lesser circulation. Blood is pumped from right ventricle to lungs through pulmonary artery. Exchange of gases occurs between

blood and alveoli of the lungs at pulmonary capillaries. Oxygenated blood returns to left atrium through the pulmonary vein. Thus, the left side of the heart contains oxygenated or arterial blood and the right side of the heart contains deoxygenated or venous blood.

b. CIRCLE OF WILLIS: Branches from the basilar artery and ternal carotid artery form **CIRCLE OF WILLIS.** The brain receives blood from the basilar and ternal carotid artery. Venous drainage is by sinuses, which open into the internal jugular vein. Normally, brain receives 750-800mmL of blood per minute. It is about 12-16% total cardiac output and about 50-55Ml/100g of brain tissue per minute.

c. SPLANCHNIC CIRCULATION: It is also known as visceral circulation and it constitute three portions:

- Mesenteric circulation supplying blood to gastrointestinal tract.
- Splenic circulation supplying blood to spleen.
- Hepatic circulation supplying blood to liver.

Unique future of splanchnic circulation is that the blood from mesenteric bed and spleen forms a major amount of blood flowing to liver. Blood flows to liver from gastrointestinal tract and spleen through portal system.

d. CORONARY CIRCULATION: Coronary circulation is the circulation of blood through blood vessels of the heart muscle (myocardium). It is responsible for the functional blood supply to heart muscles itself. Blood flowing through the chambers of the heart does not nourish the myocardium. When functioning normally, blood in coronary blood vessels supply adequate oxygen to myocardium. Like systemic circulation and pulmonary circulation, coronary circulation is also made u of arteries, arterioles, capillaries, venules and veins. Normal blood flow through coronary circulation is about 200mL/min. it forms 4% of cardiac output. It is about 66 to 70 mL/min/100g of cardiac muscle.

Factors regulating coronary circulation include; Need for oxygen, metabolic factors, coronary perfusion pressure, and nervous factors.

e. CUTANEOUS CIRCULATION: Cutaneous circulation is regulated mainly by body temperature. Hypothalamus plays an important role regulating cutaneous blood flow. When body temperature increases, the hypothalamus is activated. Hypothalamus in turn causes cutaneous vasodilation by acting through medullary vasomotor center. Now, blood flow increases in skin. Increase in cutaneous blood flow causes the loss of heat from the body through sweat. When body temperature is low, vasoconstriction occurs in the skin. Therefore, the blood flow to skin decreases and prevents the heat loss from skin. Cutaneous blood flow helps the supply nutrients to the skin and regulation of the body temperature by heat loss.

3. Describe the effect cardiovascular adjustment that occurs during exercise.

ANSWER

During exercise, there is an increase in metabolic needs of body tissues, particularly the muscles. Various adjustments in the body during exercise are aimed at supply of various metabolic requisites and prevention of increase in body temperature.

TYPES OF EXERCISE

Exercise is generally classified in two depending on the type of muscular contraction and type of metabolism.

Depending on the muscular contraction they are classified into two:

- **DYNAMIC EXERCISE:** involves the isotonic muscular contraction with movement of the joints and muscles.in this type of exercise, the heart rate, force of contraction, cardiac output and systolic blood pressure increases. However, the diastolic blood pressure is altered or decreased, because during exercise, peripheral resistance is unaltered or decreased depending upon the severity of the exercise e. g swimming, bicycling, external work e.t.c.
- **STATIC EXERCISE:** involves isometric muscular contraction without movement of joints. During this exercise, apart from increase in heart rate, force of contraction, cardiac output and systolic blood pressure. The diastolic blood pressure also increases because of peripheral resistance increases during exercise e. g pushing heavy object.

Depending on the type of metabolism, they are classified into two namely:

- **AEROBIC EXERCISE:** involves activities with lower intensity which is performed for a longer period. The energy is obtained by utilizing nutrients in the presence of oxygen. During this period, fat is not burnt. Only glycogen is burnt without using energy. This is called aerobic exercise. Examples are skiing, rowing; badminton etc. at the beginning, the body obtains energy by burning glycogen stored in the liver. After about 20minutes, when the stored glycogen is exhausted, the body starts burning fat. Body fat is converted to glucose, which is utilized for energy. This process is known as **aerobic metabolism.** Lactic acid is not produced, so the burning sensation disappears.
- **ANAEROBIC EXERCISE:** involves exertion for short periods followed by periods of rest. It uses the muscles at high intensity and a high rate of work for a short period. Examples are push-ups, pull-ups, weightlifting etc. Body obtains energy by burning glycogen stored in the muscles without oxygen. Muscles burn all the muscle glycogen within 3-5 minutes. If the person continues the exercise beyond this, glycogen stored in the liver is converted into glucose, which is transported to

muscles through food. This is called **anaerobic metabolism.** Lactic acid is produced during this period. Presence of lactic acid causes some sorts of burning sensations in the muscles, particularly the muscles of the arm, leg and back.

SEVERITY OF EXERCISE

Cardiovascular and other changes in the body depend upon the severity of exercise. Based on the severity, the exercise is classified into three types namely:

- **MILD EXERCISE:** Little or no changes occur in cardiovascular system. It is a very slow form of exercise like slow walking.
- **MODERATE EXERCISE:** It does not involve strenuous muscular activity and can be performed for a longer period. Exhaustion does not occur at the end. Examples are fast walking and slow running.
- **SEVERE EXERCISE**: it involves strenuous muscular activity and can be maintained for a short period. Complete exhaustion occurs at the end of the exercise. Example is fast running for a distance of 100 or 400 meters.

Effect of exercise on cardiovascular system includes;

- **ON BLOOD:** Mild hypoxia developed during exercise stimulated the juxtaglomerular apparatus to severe erythropoietin. It stimulates the bone marrow and cause release of red blood cells. Increased carbon dioxide content in blood decreases the PH of blood.
- **ON BLOOD VOLUME:** More heat is produced during exercise and the thermoregulatory system is activated. This in turn causes secretion of large amount of sweating leading to reduced fluid loss, reduced blood volume, hemoconcentration and sometimes, severe exercise leads to dehydration.
- **ON VENOUS RETURN:** Venous return increases remarkably during exercise because of muscle pump, respiratory pump and splanchnic vasoconstriction.
- **ON HEART RATE:** Heart rate increases during exercise. It is because of cerebral cortex to medullary centers, which reduces vagal tone. In moderate exercise, the heart rate increases to 180beats per minute. In severe muscular exercise, it reaches 240-260 beats per minute. Increased heart rate during exercise is mainly because of vagal withdrawal. Increase in sympathetic tone also plays some role.
- **ON BLOOD PRESSURE:** During moderate isotonic exercise, the systolic pressure is increased. It is due to increase in heart rate and stroke volume. Diastolic pressure is not altered because peripheral resistance is not affected.

In severe exercise involving isotonic muscular contraction, the systolic pressure enormously increases but the diastolic pressure decreases. Decrease in diastolic pressure is because of the decrease in peripheral resistance. Decrease in peripheral resistance is due to vasodilation caused by metabolites.

During exercise involving isometric contraction, the peripheral resistance increases. So, the diastolic pressure also increases along with systolic pressure.