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DEPARTMENT: MEDICINE AND SURGERY

LEVEL: 200

COURSE: PHYSIOLOGY

ASSIGNMENT

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

ANSWER

Kidneys play an important role in the long term regulation of arterial blood pressure. When blood pressure alters slowly in several days/months/years, the nervous mechanism adapts to the altered pressure and looses the sensitivity for the changes. It cannot regulate the pressure any more. In such conditions, the renal
mechanism operates efficiently to regulate the blood pressure. Therefore, it is called long term regulation.

Kidneys regulate arterial blood pressure by two ways:

1. By regulation of ECF volume
2. Through renin angiotensin mechanism.

By Regulation Of ECF Volume:

When the blood pressure increases, kidneys excrete large amounts 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. Even a slight increase in blood pressure doubles the
water excretion.

Pressure natriuresis is the excretion of
large quantity of sodium in urine.

Because of diuresis and natriuresis, there is a decrease in ECF volume and blood 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.

Through Renin Angiotensin Mechanism:

When blood pressure and ECF volume decrease, renin secretion from kidneys is increased. It converts
angiotensinogen into angiotensin I. This is converted into angiotensin II by ACE (angiotensin converting enzyme).

Angiotensin II acts in two ways to restore the blood pressure:

i. It causes constriction of arterioles in the body so that the peripheral resistance is increased and blood pressure rises. In addition, angiotensin II causes constriction of afferent arterioles in kidneys, so that glomerular filtration reduces. This results in retention of water and salts, increases ECF volume to normal level. This in turn increases the blood pressure to normal level.

ii. Simultaneously, angiotensin II stimulates the adrenal cortex to secrete aldosterone. This hormone increases reabsorption of sodium from
renal tubules. Sodium reabsorption is followed by water reabsorption, resulting in increased ECF volume and blood volume. It increases the
blood pressure to normal level.

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

2. Write short notes on the following:
a. Pulmonary circulation.
b. Circle of Willis
c. Splanchnic circulation
d. Coronary circulation
e. Cutaneous circulation

ANSWER

A. **PULMONARY CIRCULATION:**

Blood is pumped from right ventricle to the lungs through pulmonary artery. Exchange of gases occurs between blood and alveoli of lungs at pulmonary capillaries. Oxygenated blood returns to left atrium through the pulmonary veins.

Thus, left side of the heart contains oxygenated or arterial blood and the right side of the great contains deoxygenated or venous blood.

B. 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.

C. SPLANCHNIC CIRCULATION:

Splanchnic or visceral circulation constitutes three portions:

1. Mesenteric circulation supplying blood to GI tract
2. Splenic circulation supplying blood to spleen
3. Hepatic circulation supplying blood to liver.

Unique feature 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 GI tract and spleen through portal system.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.

D. CORONARY CIRCULATION:

Coronary circulation is the circulation of blood in the blood vessels that supply the heart muscle(myocardium). Coronary arteries supply oxygenatedblood 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, needs 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 infarctions), 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.

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.

3. Discuss the cardiovascular adjustment that occurs during exercise.

ANSWER

I. ON BLOOD:

Severe exercise involves strenuous muscular activity. The severity can be maintained only for short duration. Fast running for a distance of 100 or 400 meters is the best example of this type of exercise. Complete exhaustion occurs at the end of severe exercise.

II. ON BLOOD VOLUME:

More heat is produced during exercise and the thermoregulatory system is activated. This in turn, causes
secretion of large amount of sweat leading to:
i. Fluid loss
ii. Reduced blood volume
iii. Hemoconcentration
iv. Sometimes, severe exercise leads to even
dehydration.

III. ON HEART RATE:

Heart rate increases during exercise. Even the thought of exercise or

preparation for exercise increases the heart rate. It is because of impulses from cerebral cortex to medullary centers, which reduces vagal tone.
In moderate exercise, the heart rate increases to 180 beats/minute. In severe muscular exercise, it reaches 240 to 260 beats/minute. Increased heart rate during exercise is mainly because of vagal withdrawal. Increase in sympathetic tone also plays some role.

IV. ON VENOUS RETURN:

Venous return increases remarkably during exercise because of muscle pump, respiratory pump and splanchnic vasoconstriction.

V. ON BLOOD FLOW TO SKELETAL MUSCLES:

There is a great increase in the amount of blood flowing to skeletal muscles during exercise. In resting condition, the blood supply to the skeletal muscles is 3 to 4 mL/100 g of the muscle/minute. It increases up to 60 to 80 mL in moderate exercise and up to 90 to120 mL in severe exercise.During the muscular activity, stoppage of blood flow occurs when the muscles contract. It is because of compression of blood vessels during contraction. And in between the contractions, the blood flow increases.Sometimes the blood supply to muscles starts increasing even during the preparation for exercise. It is due to the sympathetic activity. Sympathetic nerves cause vasodilatation in muscles. The sympathetic nerve fibers causing vasodilatation in skeletal muscle are called sympathetic cholinergic fibers since these fibers secrete acetylcholine instead of noradrenaline.

VI. 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 during moderate isotonic exercise.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 vasodilatation caused by metabolites. During exercise involving isometric contraction, the peripheral resistance increases. So, the diastolic pressure also increases along with systolic pressure.