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DEPARTMENT; MEDICINE AND SURGERY 200L

PHYSIOLOGY ASSIGNMENT

LONG TERM REGULATION OF ARTERIAL BLOOD PRESSURE

The kidney plays an important role in the long-term regulation of arterial blood pressure.

When blood pressure alters slowly in several days /months/years, the neural mechanism adapts to the altered pressure and loses the sensitivity for the changes. 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 regulate arterial blood pressure by two ways;

- By regulation of extracellular fluid volume
- Through renin-angiotensin mechanism

BY REGULATION OF EXTRACELLULAR FLUID VOLUME

When blood pressure increase, the kidney excretes 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 large quantity of water in urine because of increase blood pressure.

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

Because of natriuresis and diuresis there is decrease in the extracellular fluid 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 the renal tubules is increased.

This in turn increases extracellular fluid volume and cardiac output resulting in restoration of blood pressure.

THROUGH RENIN- ANGIOTENSIN MECHANISM

When blood pressure and extracellular fluid volume decrease the juxtaglomerular apparatus in the kidney is stimulated to increase its secretion of renin.

Renin converts angiotensinogen into angiotensin I.
Angiotensin I is converted into angiotensin II by ACE (angiotensin converting enzyme).

Angiotensin II acts in two ways to restore the blood pressure

1.It causes constriction of arterioles in the body so that the peripheral resistance is increased and blood pressure rises.

2.Simultaneously, angiotensin II stimulates the adrenal cortex to secrete aldosterone.

This hormone increase reabsorption of sodium from renal tubules, sodium reabsorption is followed by water reabsorption resulting in increased extracellular fluid volume and blood volume which it increases the blood pressure to normal level.
Action of angiotensin III and angiotensin IV like angiotensin II, the angiotensin III and IV also increase the blood pressure and stimulate adrenal cortex to secrete aldosterone.

2)Write short note on the following

a) Pulmonary circulation
b) Circle of wills
c) Splanchnic circulations
d) Coronary circulation
e) Cutaneous circulation

PULMONARY CIRCULATION: Is the system of transportation that shunts de-oxygenated 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 enters the heart from the inferior vena cava while deoxygenated blood from the upper body is delivered to the heart via the superior vena cava.
Both the superior and inferior vena cava empty blood into the right atrium, then blood flows through the tricuspid valve into the right ventricle then it flows through the pulmonary valve into the pulmonary artery before being delivered to the lungs for oxygenation and the oxygenated blood will be returned through the pulmonary vein into the left atrium.

CIRCLE OF WILLIS: The circle of willis encircles the stalk of the pituitary gland and provides important communications between the blood supply of the forebrain and hindbrain.
The circle of willis acts to provide collateral blood flow between the anterior and posterior circulations of the brain protecting against ischemia in the event of vessel disease or damage in one or more areas.

SPLANCHNIC CIRCULATION: is composed of the blood flow originating from the celiac, superior mesenteric and inferior mesenteric arteries and is distributed to all abdominal viscera.
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.
The splanchnic circulation comprises the gastric, small intestine, colonic, pancreatic, hepatic and splenic circulations.

CORONARY CIRCULATION: is the part of the systemic circulatory system that supplies blood to and provide 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 then into the musculature of the heart. Deoxygenated blood is returned to the chambers of the heart via coronary veins.
The heart normally extracts 70 to 75 percent of the available oxygen from the blood in coronary circulation, which is more than the amount extracted by the other organs from their circulations.
Obstruction of a coronary artery, depriving the heart tissue of oxygen-rich blood leads to death of the part of the heart muscle (myocardial infarction) in several cases and total health failure death may ensure.

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 arteriovenous anastomoses (AVAs) instead of capillaries.
AVAs serve a role in temperature regulation.

3)Discuss the cardiovascular adjustment that occurs during exercise?
The heart is a muscle that is required to contract continuously throughout the life to deliver oxygen to all organs in the body and breath out carbon dioxide
Blood vessels connect the heart and lungs so that carbon dioxide can be removed from the blood and oxygen can be added to the blood.
Exercise places an increased 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 created.
Cardiovascular response to exercise

1) Heart rate
2) Stroke volume
3) Cardiac output
4) Blood flow
5) Blood pressure

HEART RATE

Resting heart rate averages 60 to 80 beats/min in healthy adults.

In sedentary, middle aged individuals it may be as high as 100 beats/min

In elite endurance athletes heart rates is as low as 28 to 40 beats/min.

There is an anticipatory response before the exercise which initiate increase heart rate before exercise caused by the release of neurotransmitters epinephrine and norepinephrine also known as adrenaline and noradrenaline.

During exercise heart rate increases in response to exercise and is associated with increased sympathetic and decrease parasympathetic activity resulting in an acceleration of heart and begins to decrease with recovery period.

STROKE VOLUME

Stroke volume is the amount of blood ejected per beat from the left ventricle and measured in ml/beat

Stroke volume increases proportionally with exercise intensity

In untrained individual stroke volume at rest it averages 50-70ml/beat

During intense physical activity, stroke volume increases up to 110-130ml/beat

In elite athletes resting stroke volume averages 90-110ml/beat increasing to as much as 150-220ml/beat.

CARDIAC OUTPUT

Cardiac output is the amount of blood pumped by the heart in 1 minute measured in L/min. It is a product of stroke volume and heart rate

If either heart rate or stroke volume increases, or both, cardiac output increases also.

Cardiac output remains relatively unchanged or decreases only slightly following endurance training.

During maximal exercise on the other hand, cardiac output increases significantly and this is as a result of an increase in maximal stroke volume as maximal heart rate remains unchanged with training.

BLOOD FLOW

The vascular system can redistribute blood to those tissues with the greatest immediate demand for energy such as muscles (Skeletal muscles receives a greater blood supply)

At rest 15-20% of circulating blood supplies skeletal muscle and during vigorous exercise this increases to 80-85% of cardiac output.

BLOOD PRESSURE

At rest, a typical systolic blood pressure in a healthy individual ranges from 110-140mmHg and 60-90mmHg for diastolic blood pressure.

During exercise systolic pressure, the pressure during contraction of the heart known as systole can increase to over 200mmHg and in highly trained healthy athletes.