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

LONG_TERM REGULATION OF MEAN ARTERIAL BLOOD PRESSURE (RENAL MECHANISM)

Kidney plays a significant role in blood pressure regulation i.e. long term regulation of blood pressure. When nervous mechanism fails in regulating the Blood pressure, the kidney falls in. Two ways of Blood pressure regulation include:

- By regulation of ECF
- Through renin-angiotensin mechanism

BY REGULATION OF ECF:

When the blood pressure increases, Kidneys excrete large amount of water and salt. Sodium is excreted particularly by means of pressure diuresis and pressure natriuresis.
Pressure diuresis: is the excretion of large quantity of water in urine, large amount of water is excreted due to increase in blood pressure. Even slight increase in blood pressure will double the amount of water excretion
Pressure natriuresis: it is the excretion of large quantity of sodium in urine. There is a huge decrease in ECF because of diuresis and natriuresis. Decreased ECF volume will increase the blood volume and a s a result of this, arterial blood pressure goes back to normal.

When BP 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.

RENIN-ANGIOTENSIN MECHANISM

ACTION OF ANGIOTENSIN II: When BP 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 causes constriction of arterioles, so that the peripheral resistance is increased and BP rises. The glomerular filtration reduces, this results in water and salt retention, which in turn increases the BP to normal level. 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, this in turn increases the ECF and blood Volume. It increases the blood pressure back to normal

Write short notes on the following:

a. **Pulmonary circulation**: system of blood vessels that forms a closed circuit between the heart and the lungs, as distinguished from the systemic circulation between the heart and all other body tissues. On the evolutionary cycle, pulmonary circulation first occurs in lungfishes and amphibians, the first animals to acquire a three-chambered heart. The pulmonary circulation becomes totally separate in crocodilians, birds, and mammals, when the ventricle is divided into two chambers, producing a four-chambered heart. In these forms the pulmonary circuit begins with the right ventricle, which pumps deoxygenated blood through the pulmonary artery. This artery divides above the heart into two branches, to the right and left lungs, where the arteries further subdivide into smaller and smaller branches until the capillaries in the pulmonary air sacs (alveoli) are reached. In the capillaries the blood takes up oxygen from the air breathed into the air sacs and releases carbon dioxide. It then flows into larger and larger vessels until the pulmonary veins (usually four in number, each serving a whole lobe of the lung) are reached. The pulmonary veins open into the left atrium of the heart.

b. **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. Numerous extrinsic and intrinsic factors influence the splanchnic circulation. Extrinsic factors include general hemodynamic conditions of the cardiovascular system, autonomic nervous system, and circulating neurohumoral agents. Intrinsic mechanisms include special properties of the vasculature, local metabolites, intrinsic nerves, paracrine substances, and local hormones. The existence of a multiplicity of regulatory mechanisms provides overlapping controls and restricts radical changes in tissue perfusion.

c. **Coronary circulation**: 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. The heart normally extracts 70 to 75 percent of the available oxygen from the blood in coronary circulation, which is much more than the amount extracted by other organs from their circulations—e.g., 40 percent by resting skeletal muscle and 20 percent by the liver. Obstruction of a coronary artery, depriving the heart tissue of oxygen-rich blood, leads to death of part of the heart muscle (myocardial infarction) in severe cases, and total heart failure and death may ensure

d. **The circle of Willis:** is an important junction of arteries at the base of the brain. The structure encircles the middle area of the brain, including the stalk of the pituitary gland and other important structures.
Two arteries, called the carotid arteries, supply blood to the brain. They run along either side of the neck and lead directly to the circle of Willis.
Each carotid artery branches into an internal and external carotid artery. The internal carotid artery then branches into the cerebral arteries. This structure allows all of the blood from the two internal carotid arteries to pass through the circle of Willis.
The structure of the circle of Willis includes:

left and right internal carotid arteries
left and right anterior cerebral arteries
left and right posterior cerebral arteries
left and right posterior communicating arteries

Function
The circle of Willis plays an important role, as it allows for proper blood flow from the arteries to both the front and back hemispheres of the brain. The arteries that stem off from the circle of Willis supply much of the blood to the brain.
The circle of Willis also serves as a sort of safety mechanism when it comes to blood flow. If a blockage or narrowing slows or prevents the blood flow in a connected artery, the change in pressure can cause blood to flow forward or backward in the circle of Willis to compensate.
This mechanism could also help blood flow from one side of the brain to the other in a situation in which the arteries on one side have reduced blood flow. In an emergency, such as a stroke, this may reduce the damage or aftereffects of the event.
Importantly, the circle of Willis does not actively carry out the function. Instead, the natural shape of the circle and the way that pressure acts in the area simply allow for bidirectional blood flow when necessary.

e. **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. In this article we shall consider the different adaptations of the cutaneous circulation, and its role in body temperature control.
Temperature Regulation
The skin is the body's main heat dissipating surface: the amount of blood flow to the skin determines the degree of heat loss and therefore the core body temperature. The blood flow through AVAs is heavily influenced by the sympathetic nervous system. At rest, the sympathetic nervous system dominates and acts to constrict AVAs.
Any changes in core temperature are detected by the thermoregulatory centre in the hypothalamus. It regulates temperature by altering the level of sympathetic outflow to the cutaneous vessels, to return temperature to its normal range:
In high core temperatures:
Sympathetic innervation is decreased, reducing the vasomotor tone in the AVAs.
More blood flows through the AVAs and reaches the venous plexus (close to the surface of the skin), increasing heat loss to reduce core temperature.
In low core temperatures, Sympathetic innervation is increased, increasing the vasomotor tone in the AVAs.
Less blood flows to the apical skin (of nose, lips, ears, hands and feet), reducing heat loss to increase the core temperature

2. **<u>Discuss cardiovascular adjustments that occure during exercise</u>**

The integrated response to severe exercise involves fourfold to fivefold increases in cardiac output, which are due primarily to increases in cardiac rate and to a lesser extent to augmentation of stroke volume. The increase in stroke volume is partly due to an increase in end-diastolic cardiac size (Frank-Starling mechanism) and secondarily due to a reduction in end-systolic cardiac size. The full role of the Frank-Starling mechanism is masked by the concomitant tachycardia. The reduction in end-systolic dimensions can be related to increased contractility, mediated by beta adrenergic stimulation. Beta adrenergic blockade prevents the inotropic response, the decrease in end-systolic dimensions, and approximately 50% of the tachycardia of exercise. The enhanced cardiac output is distributed preferentially to the exercising muscles including the heart.

Blood flow to the heart increases fourfold to fivefold as well, mainly reflecting the augmented metabolic requirements of the myocardium due to near maximal increases in cardiac rate and contractility. Blood flow to the inactive viscera (e.g., kidney and gastrointestinal tract) is maintained during severe exercise in the normal dog. It is suggested that local autoregulatory mechanisms are responsible for maintained visceral flow in the face of neural and hormonal autonomic drive, which acts to constrict renal and mesenteric vessels and to reduce blood flow. However, in the presence of circulatory impairment, where oxygen delivery to the exercising muscles is impaired as occurs to complete heart block where normal heart rate increases during exercise are prevented, or in congestive right heart failure, where normal stroke volume increases during exercise are impaired, or in the presence of severe anemia, where oxygen-carrying capacity of the blood is limited, visceral blood flows are reduced drastically and blood is diverted to the exercising musculature. Thus,, visceral flow is normally maintained during severe exercise as long as all other compensatory mechanisms remain intact. However, when any other compensatory mechanism is disrupted (even the elimination of splenic reserve in the dog), reduction and diversion of visceral flow occur.