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Medicine and Surgery

Physiology Assignment

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

Long term regulation of blood pressure is done through the renal mechanism. Kidneys play an important role in the long­term regulation of arterial blood pressure.

Kidneys regulate arterial blood pressure by two ways:

* 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 renin­angiotensin 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 (angiotensin­converting 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

The pulmonary circulation is the portion of the [circulatory system](https://en.wikipedia.org/wiki/Circulatory_system) which carries [deoxygenated](https://en.wikipedia.org/wiki/Blood#Oxygen_transport) [blood](https://en.wikipedia.org/wiki/Blood) away from the right ventricle, to the [lungs](https://en.wikipedia.org/wiki/Lung), and returns [oxygenated blood](https://en.wikipedia.org/wiki/Blood#Oxygen_transport) to the left atrium and ventricle of the heart. From the right atrium, the blood is pumped through the [tricuspid valve](https://en.wikipedia.org/wiki/Tricuspid_valve) (or right atrioventricular valve), Deoxygenated blood leaves through the right ventricle through the [pulmonary artery](https://en.wikipedia.org/wiki/Pulmonary_artery) into the [right ventricle](https://en.wikipedia.org/wiki/Right_ventricle). Blood is then pumped from the right ventricle through the pulmonary valve and into the main pulmonary artery. The pulmonary arteries carry deoxygenated blood to the lungs, where [carbon dioxide](https://en.wikipedia.org/wiki/Carbon_dioxide) is released and oxygen is picked up during [respiration](https://en.wikipedia.org/wiki/Respiration_%28physiology%29). Arteries are further divided into very fine [capillaries](https://en.wikipedia.org/wiki/Capillaries) which are extremely thin-walled. The pulmonary vein returns oxygenated blood to the left atrium of the heart.the blood enters the left ventricle through the bicuspid valve. The blood is then distributed to the body through the systemic circulation before returning again to the pulmonary circulation.

b.) Circle of Willis

The Circle of Willis is a [circulatory anastomosis](https://en.wikipedia.org/wiki/Circulatory_anastomosis) that supplies [blood](https://en.wikipedia.org/wiki/Blood) to the [brain](https://en.wikipedia.org/wiki/Brain) and surrounding structures.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. The arrangement of the brain's arteries into the circle of Willis creates redundancy for [collateral circulation](https://en.wikipedia.org/wiki/Collateral_circulation) in the [cerebral circulation](https://en.wikipedia.org/wiki/Cerebral_circulation). If one part of the circle becomes blocked or narrowed ([stenosed](https://en.wikipedia.org/wiki/Stenosis)) or one of the arteries supplying the circle is blocked or narrowed, blood flow from the other [blood vessels](https://en.wikipedia.org/wiki/Blood_vessel) can often preserve the cerebral perfusion well enough to avoid the symptoms of [ischem](https://en.wikipedia.org/wiki/Ischemia%22%20%5Co%20%22Ischemia)ia



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.

* The splanchnic circulation consists of the blood supply to the gastrointestinal tract, liver, [spleen](https://www.sciencedirect.com/topics/medicine-and-dentistry/spleen), and pancreas. It consists of two large capillary beds partially in series. The small splanchnic arterial branches supply the capillary beds, and then the efferent [venous blood flows](https://www.sciencedirect.com/topics/medicine-and-dentistry/vein-blood-flow) into the portal vvein. The portal vein and [hepatic artery](https://www.sciencedirect.com/topics/medicine-and-dentistry/common-hepatic-artery) supply blood flow to the liver.
* Splenic circulation:

In spleen, two structures are involved in storage of blood, namely splenic venous sinuses and splenic pulp. Small arteries and arterioles open directly into the venous sinuses. When spleen distends, sinuses swell and large quantity of blood is stored. Capillaries of splenic pulp are highly permeable. So, most of the blood cells pass through capillary membrane and are stored in the pulp. Venous sinuses and the pulp are lined with reticuloendothelial cells.

* Hepatic Circulation

The liver receives blood from two major vessels, the hepatic artery and the portal vein

A 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

d. Coronary circulation

**Coronary circulation**, part of the systemic [circulatory system](https://www.britannica.com/science/circulatory-system) that supplies blood to and provides drainage from the tissues of the [heart](https://www.britannica.com/science/heart). [Coronary arteries](https://en.wikipedia.org/wiki/Coronary_arteries) supply [oxygenated](https://en.wikipedia.org/wiki/Oxygen_saturation_%28medicine%29) blood to the heart muscle, and [cardiac veins](https://en.wikipedia.org/wiki/Coronary_circulation#Cardiac_veins) drain away the blood once it has been deoxygenated.Two coronary arteries arise from the [aorta](https://www.britannica.com/science/aorta) just beyond the semilunar valves; during [diastole](https://www.britannica.com/science/diastole-heart-function), 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](https://www.britannica.com/science/venous-sinus), which drains into the right [atrium](https://www.britannica.com/science/atrium-heart). . Because the rest of the body, and most especially the [brain](https://en.wikipedia.org/wiki/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](https://en.wikipedia.org/wiki/Level_of_consciousness) of the brain from moment to moment. Interruptions of coronary circulation quickly cause heart attacks ([myocardial infarctions](https://en.wikipedia.org/wiki/Myocardial_infarction)), in which the heart muscle is damaged by [oxygen starvation](https://en.wikipedia.org/wiki/Hypoxia_%28medical%29). Such interruptions are usually caused by ischemic heart disease ([coronary artery disease](https://en.wikipedia.org/wiki/Coronary_artery_disease)) and sometimes by [embolism](https://en.wikipedia.org/wiki/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. Cutaneous blood flow is regulated mainly by body temperature. Hypothalamus plays an important role in regulating cutaneous blood flow. When body temperature increases, the hypothalamus is activated. Hypothalamus in turn causes cutaneous vasodilatation 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.

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.

Functions of cutaneous circulation

-Supply of nutrition to the skin

-Regulation of body temperature by heat loss

3. Discuss the cardiovascular adjustment that occurs during exercise?

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:

 1. Supply of various metabolic requisites like nutrients and oxygen to muscles and other tissues involved in exercise 2. Prevention of increase in body temperature.

During exercise the following adjustments are made to the cardiovascular system

* There is a stimulation of the sympathetic nervous system

The heart is stimulated greatly to increase heart rate and increase pumping strength as a result of the sympathetic drive to the heart plus release of the heart from normal parasympathetic inhibition.

* Most of the arterioles of the peripheral circulation are strongly contracted, except for the arterioles in the active muscles, which are strongly vasodilated by the local vasodilator effects in the muscles. Thus, the heart is stimulated to supply the increased blood flow required by the muscles, while at the same time blood flow through most nonmuscular areas of the body is temporarily reduced, thereby “lending” blood supply to the muscles. This accounts for as much as 2 L/min of extra blood flow to the muscles, which is exceedingly important when one thinks of a person running for his life—even a fractional increase in running speed may make the difference between life and death. Two of the peripheral circulatory systems, the coronary and cerebral systems, are spared this vasoconstrictor effect because both these circulatory areas have poor vasoconstrictor innervation— fortunately so because both the heart and the brain are as essential to exercise as are the skeletal muscles’
* The muscle walls of the veins and other capacitative areas of the circulation are contracted powerfully, which greatly increases the mean systemic filling pressure this causes an increase in venous return of blood to the heart and, therefore, in increasing the cardiac output
* Heart rate increases during exercise due to the stimulation of sympathetic nerves which causes vagal withdrawal and allows the heart to beat faster which causes blood to be circulated more quickly
* Cardiac output increases increases during exercise which allows for the delivery of more nutrients and oxygen to the muscles at a higher rate