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18/MHS01/009

Medicine and Surgery

PHS 201

Physiology

1. Discuss the long term regulation of arterial pressure

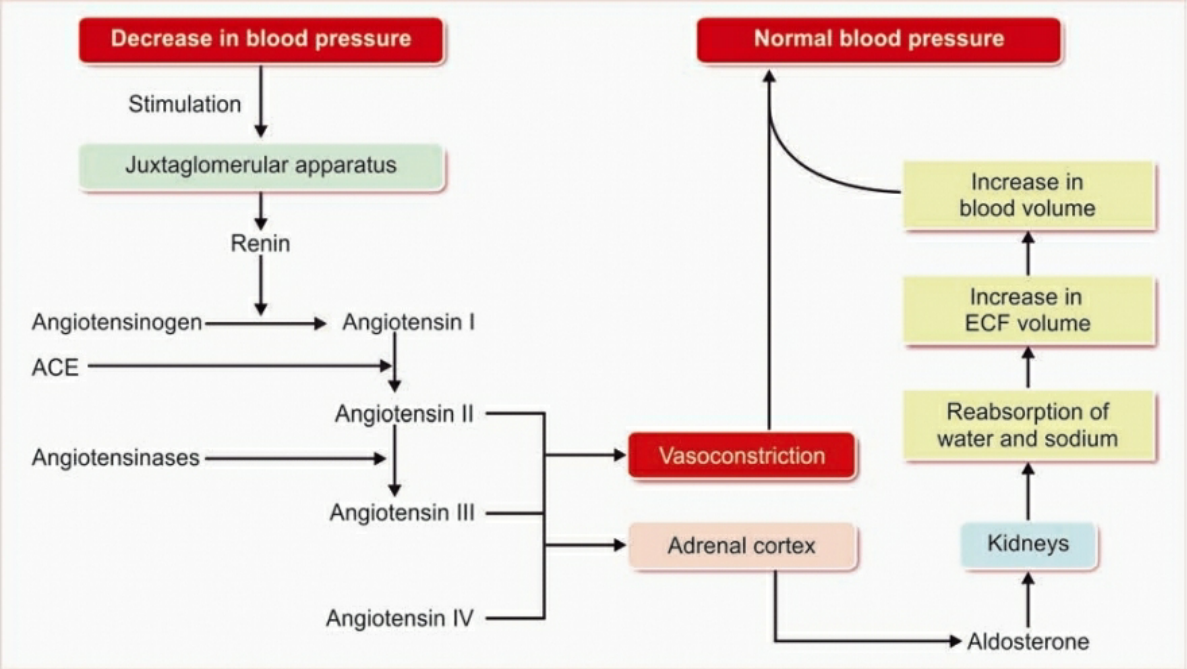
   Kidneys are responsible for the long term maintenance of arterial blood pressure and do so in two ways:

   I. 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.

   II. Through renin- angiotensin mechanism:

- Specialized cells in the distal tubule called the macula densa sense the concentration of sodium and chloride.
- If blood pressure falls there is a reduction in concentration of sodium and chloride in the distal tubule which is sensed by the macula densa.
- The macula densa releases prostaglandins which act on the juxtaglomerular apparatus which releases renin into the bloodstream.
- The drop in blood pressure is also detected by baroreceptors in the aortic arch, carotid sinus and the afferent renal arteriole which stimulates renin release by the juxtaglomerular apparatus.
- Renin cleaves angiotensinogen into angiotensin 1 which in turn is cleaved by Angiotensin Converting Enzyme (ACE)into angiotensin 2.
- Angiotensin 2 is a potent vasoconstrictor and also stimulates the adrenal cortex to release aldosterone.
- Aldosterone acts on the distal tubules and collecting ducts in the kidney causing retention of sodium and water.
- Blood pressure increases.



2. Write short note on:

   a) Pulmonary circulation: Deoxygenated blood leaves the right ventricle of the heart through the pulmonary valve and enters the pulmonary trunk. This divides into the right and left pulmonary arteries.

      In the lungs the arteries divide further into very fine capillaries at the alveoli, allowing gas exchange to take place. Oxygen diffuses from the alveoli into the pulmonary capillaries while carbon dioxide diffuses from the capillaries into the alveoli.

      This newly oxygenated blood leaves the lungs through the pulmonary veins to the left atrium of the heart, completing the pulmonary cycle. The blood is then distributed around the body via the systemic circulation.

   b) Circle of Willis: The circle of Willis is a junction of several important arteries at the bottom part of the brain. It helps blood flow from both the front and back sections of the brain. The structure encircles the middle area of the brain, including the stalk of the pituitary gland and other important structures.

      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
- basilar artery
- anterior communicating artery

c) Splachnic 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.

d) Coronary circulation: Heart muscle is supplied by two coronary arteries, namely right and left coronary arteries, which are the first branches of aorta. Arteries encircle the heart in the manner of a crown, hence the name coronary arteries (Latin word corona = crown). Right coronary artery supplies whole of the right ventricle and posterior portion of left ventricle. Left coronary artery supplies mainly the anterior and lateral parts of left ventricle. There are many variations in diameter of coronary arteries. Venous drainage from heart muscle is by three types of vessels; coronary sinus, anterior coronary veins and the thebesian veins.

e) Cutaneous circulation: Under normal conditions, the blood flow to skin is about 250 mL/square meter/minute. When the body temperature increases, cutaneous blood flow increases up to 2,800 mL/square meter/minute because of cutaneous vasodilatation.

Architecture of cutaneous blood vessels is formed in the following manner:

1. Arterioles arising from the smaller arteries reach the base of papillae of dermis

2. Then, these arterioles turn horizontally and give rise to meta-arterioles

3. From meta- arterioles, hairpin- shaped capillary loops arise. Arterial limb of the loop ascends vertically in the papillae and turns to form a venous limb, which descends down.

4. After reaching the base of papillae, few venous limbs of

neighboring papillae unite to form the collecting venule

5. Collecting venules anastomose with one another to form the subpapillary venous plexus

6. Subpapillary plexus runs horizontally beneath the bases of papillae and drain into deeper veins.

3. Discuss the cardiovascular adjustment that occurs during exercise.

During exercise, increases in cardiac stroke volume and heart rate raise cardiac output, which coupled with a transient increase in systemic vascular resistance, elevate mean arterial blood pressure (60). However, long - term exercise does promote a net reduction in blood pressure at rest.

A stronger heart does not pump blood faster but does pump it more forcefully with a greater ejection fraction, suggesting more efficient cardiac output.