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200 Level

PHS 201 Assignment

1. *The long term regulation of mean arterial blood pressure*

   Kidneys play an important role in the long-term regulation of arterial blood pressure. When blood pressure alters slowly with time, the nervous mechanism adapts to the altered pressure and loses 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:

   - *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.*

     Juxtaglomerular cells secrete renin. Along with angiotensin, renin forms the renin-angiotensin system, which is a hormone system that plays an important role in the maintenance of blood pressure.

     When renin is released into the blood, it acts on a specific plasma protein called angiotensinogen or renin substrate. By the activity of renin, the angiotensinogen is converted into a decapeptide called angiotensin I. Angiotensin I is converted into angiotensin II, which is an octapeptide by the activity of angiotensin-converting enzyme (ACE) secreted from lungs. Most of the conversion of angiotensin I into angiotensin II takes place in lungs.

     Angiotensin II has a short half-life of about 1 to 2 minutes. Then it is rapidly degraded into a heptapeptide called angiotensin III by angiotensinases, which are present in RBCs and vascular beds in many tissues. Angiotensin III is converted into angiotensin IV, which is a hexapeptide.

     - *Actions of Angiotensin II*

     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:

     - ✓ 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.

- ✓ 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

2. *<u>Short notes on:</u>*

   - ✓ *Pulmonary 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.
   - ✓ *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.
   - ✓ *Splanchnic circulation*
     Also called visceral Circulation. The splanchnic circulation consists of the blood supply to the gastrointestinal tract, liver, spleen, and pancreas.
   - ✓ *Coronary circulation*
     Coronary circulation is the circulation of blood in the blood vessels that supply the heart muscle (myocardium). Coronary arteries supply oxygenated blood to the heart muscle, and cardiac veins drain away the blood once it has been deoxygenated.
   - ✓ *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.

3. *<u>Cardiovascular adjustment during exercise</u>*

Exercise has several effect on the cardiovascular system. Each has been broken down and explained

- *On blood*
  Mild hypoxia developed during exercise stimulates the secretion of erythropoietin to balance the levels of carbon dioxide in the blood. It stimulates the bone marrow and causes release of red blood cells. Increased carbon dioxide content in blood decreases the ph of blood.
- *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: fluid loss, reduced blood volume, hemoconcentration.
- *On heart rate*
  Heart rate increases during exercise. 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.

- *On cardiac output*
  Cardiac output increases up to 20 l/minute in moderate exercise and up to 35 l/minute during severe exercise. During exercise, the cardiac output increases because of increase in heart rate and stroke volume. Heart rate increases because of vagal withdrawal. Stroke volume increases due to increased force of contraction. Because of vagal withdrawal, sympathetic activity increases leading to increase in rate and force of contraction.
- *On venous return*
  Venous return increases during exercise because of muscle pump, respiratory pump and splanchnic vasoconstriction.
- *On blood flow to skeletal muscles*
  There is a great increase in the amount of blood flowing to skeletal muscles during 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. Sympathetic nerves cause vasodilatation in muscles.
- *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. During exercise involving isometric contraction, the peripheral resistance increases. So, the diastolic pressure also increases along with systolic pressure.

References

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