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

   Mean arterial pressure is maintained within a narrow range and is tightly regulated. This is because without sufficient arterial pressure, the brain and the heart do not receive adequate blood flow , no matter what adjustment are made in the bad in the vascular resistance by local control mechanism.

   Long term regulation of arterial pressure is linked closely to volume homeostasis through the renal body fluid feedback mechanism. A key feature of the renal body fluid mechanism feedback control system is pressure natriuresis or the ability of the kidneys to respond to changes in arterial pressure by altering the renal excretion of salt and water.

   In the kidney(within the afferent arteriole that supplies the renal corpuscle) lies the juxtaglomerular cells(**JG)** that pick up the impulse of low blood pressure and release renin into the bloodstream.

   - Renin converts angiotensinogen which is released by the liver into angiotensin I. Low blood pressure and epinephrine acting on the beta adrenergic receptors of the JG cells are stimulants that increase the release of renin.
   - Angiotensin I goes through the bloodstream to the capillaries of the lungs where it gets acted upon by angiotensin converting enzyme(**ACE)** and is converted to angiotensin II
   - Angiotensin II comes over to receptor cells on the zona glomerulosa which stimulates the release of aldosterone in the bloodstream.
   - The angiotensin II also comes to the hypothalamus and stimulates supra optic nuclei which sends action potentials down to the hypothalamus hypophyseal tract and release vasopressin (**ADH)** into the bloodstream.

- Angiotensin II also stimulates the hypothalamic thirst centres and release chemicals that increase our thirst and increase absorption of fluid from the G.I tract which increases blood volume and eventually blood pressure.
- **ADH** acts on the collecting tubules of the nephron in the kidney and binds onto V2 receptors in the collecting duct, generates pKA which phosphorylates aquaporin2. The urine is mostly made of water. Water flows through aquaporin 2 this retains the amount of water in the blood by preventing it from being excreted into the urine. This increases the volume of water inside the blood which increases blood pressure.
- **Angiotensin II** can also bind onto the receptors on the proximal convoluted tubule and trigger an increase in Na, Cl and water reabsorbed which increases blood pressure.
- **Angiotensin II** can bind into receptors on the tunica media of arterioles and trigger vasoconstriction which increases blood pressure.

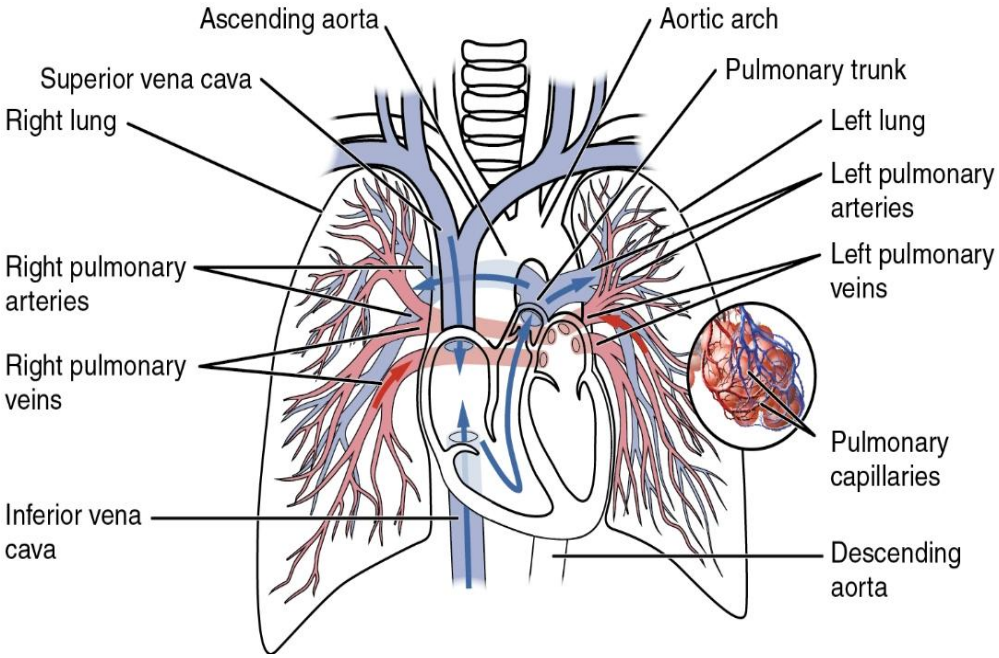
As the arterial pressure or sodium intake increases, the renin angiotensin aldosterone system is suppressed, which enhances the ability of the kidneys to excrete salt and water. Conversely, when either arterial pressure or sodium intake is reduced, high endogenous levels of angiotensin. Angiotensin II decreases renal excretion which promotes sodium retention. In the absence of appropriate changes in the **RAAS**, there is abnormal shift in the pressure natriuresis relationship resulting in sustained alteration of arterial pressure.

2.Write short notes on the following:

Pulmonary circulation

This circulatory system is exclusively for the circulation of blood between the lungs and the heart. It includes the pulmonary artery which conveys deoxygenated blood from the right atrium to the lungs to be oxygenated. This oxygenated blood is received by the pulmonary vein and conveyed to the left atrium.

Though " pulmonary" means *related to the lungs,* the pulmonary circulation is not



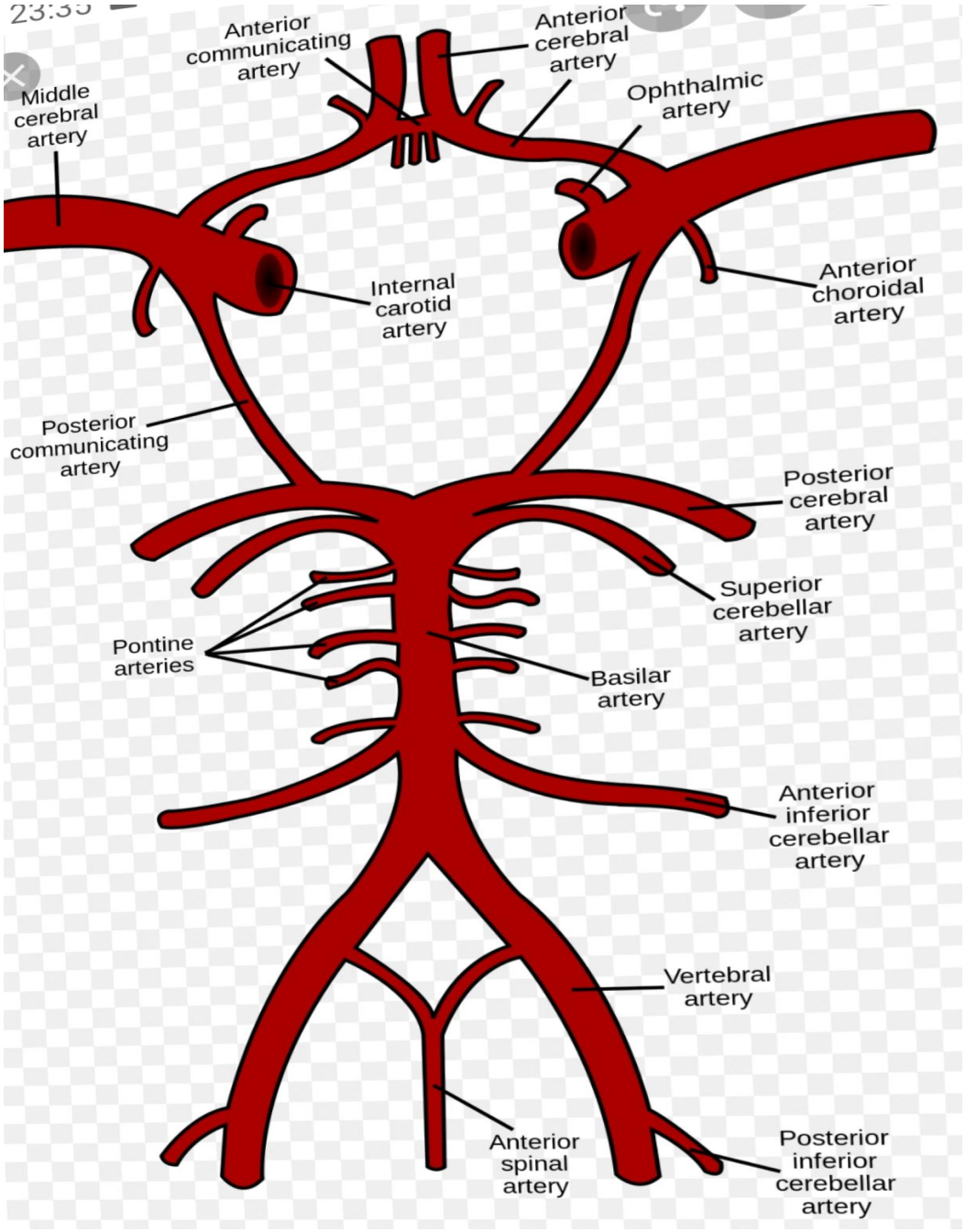
actually the supply to the tissues of the larger airways of the lungs as this is carried out by another circulation- the **bronchial circulation.**

Circle of Willis

The circle of Willis is a circulatory anastomosis that supplies blood to the external brain and surrounding structures. The circle of Willis is part of the cerebral circulation and is formed by branches of the vertebral and internal carotid arteries. The circle of Willis is composed of the following arteries:

- Posterior inferior cerebellar arteries- branch of the vertebral artery to the posterior and inferior aspect of the cerebellum.
- Anterior inferior cerebellar arteries- branch of the vertebral artery to the brainstem and inferior part of the cerebellum
- Right and left superior cerebellar arteries: brachial of the basilar artery to the superior part of the cerebellum
- Short pontine branches: branch of the basilar artery to the pons
- Posterior cerebral arteries (right and left)- major branch of the basilar artery to the inferior surfaces of the temporal and occipital lobes.

- Posterior communicating arteries (right and left): branch of the basilar artery that connects posterior cerebral artery(posterior circulation) with the internal carotid artery(anterior circulation)
- Anterior cerebral arteries (left and right): major branch of the internal carotid artery to the cingulate gyrus , superior frontal gyrus all the way back to the region of the para central lobule.
- Middle cerebral artery: continuation of the internal carotid artery to the temporal lobe and inferior surfaces of the frontal and parietal lobes.



Splanchnic circulation

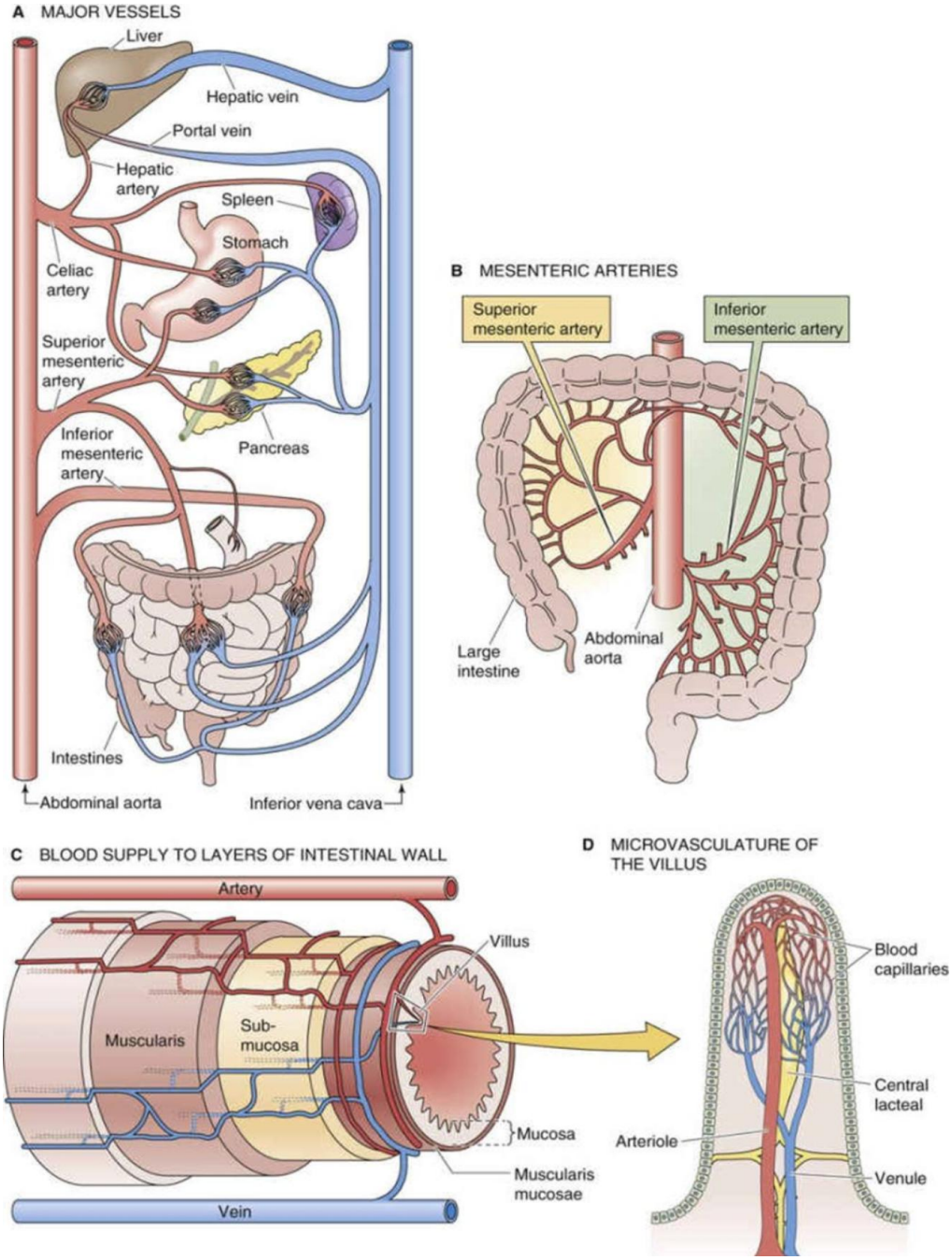
This describes the circulation of blood through organs of the G.I.T and its accessory organs. Its major arteries stem off from the abdominal aorta and they include the celiac trunk, superior and inferior mesenteric arteries.

The **celiac trunk** supplies derivatives of the foregut which include the liver , stomach, gallbladder, proximal duodenum, spleen oesophagus and most of the pancreas.

The **superior mesenteric artery** supplies derivatives of the mid gut and they include the distal duodenum, jejuno-ileum, the ascending colon, proximal 2/3 of the transverse colon, colon, caecum and appendix.

Inferior mesenteric artery supplies derivatives of the hind gut- distal 1/3 of the transverse colon, descending colon, sigmoid colon, upper anal canal and the rectum.

The superior mesenteric, inferior mesenteric and splenic veins converge to form the portal vein. This is a blood vessel that carries blood from the G.I.T, gallbladder, pancreas and spleen to the liver.



Coronary circulation

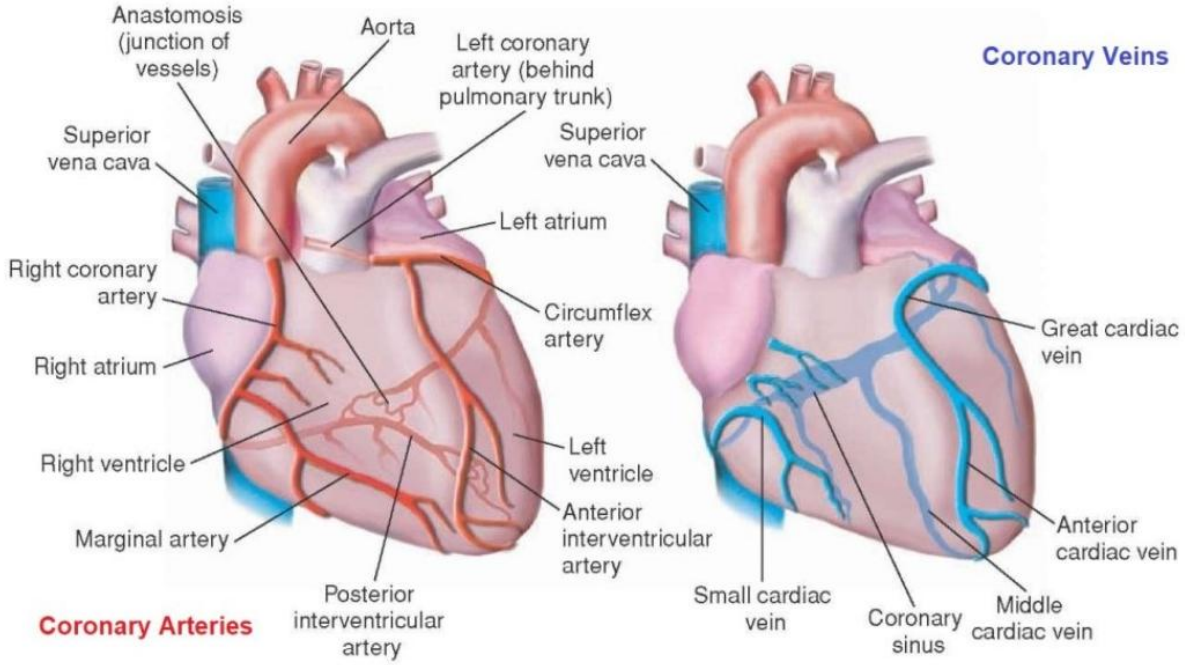
Coronary circulation is the concerned with the circulation of blood through its blood vessels to the musculature of the heart.

The left and right coronary arteries stem off from the semi lunar valves of the aorta. The left coronary artery bifurcation into the **left anterior descending artery** and the **circumflex a**rtery and they are concerned with the circulation of blood through the left atrium, left ventricle, the AV node and most of the atrioventricular septum.

Major branches of the right coronary artery as the **right marginal artery** and the **posterior descending artery** which supplies the right atrium and right ventricle.

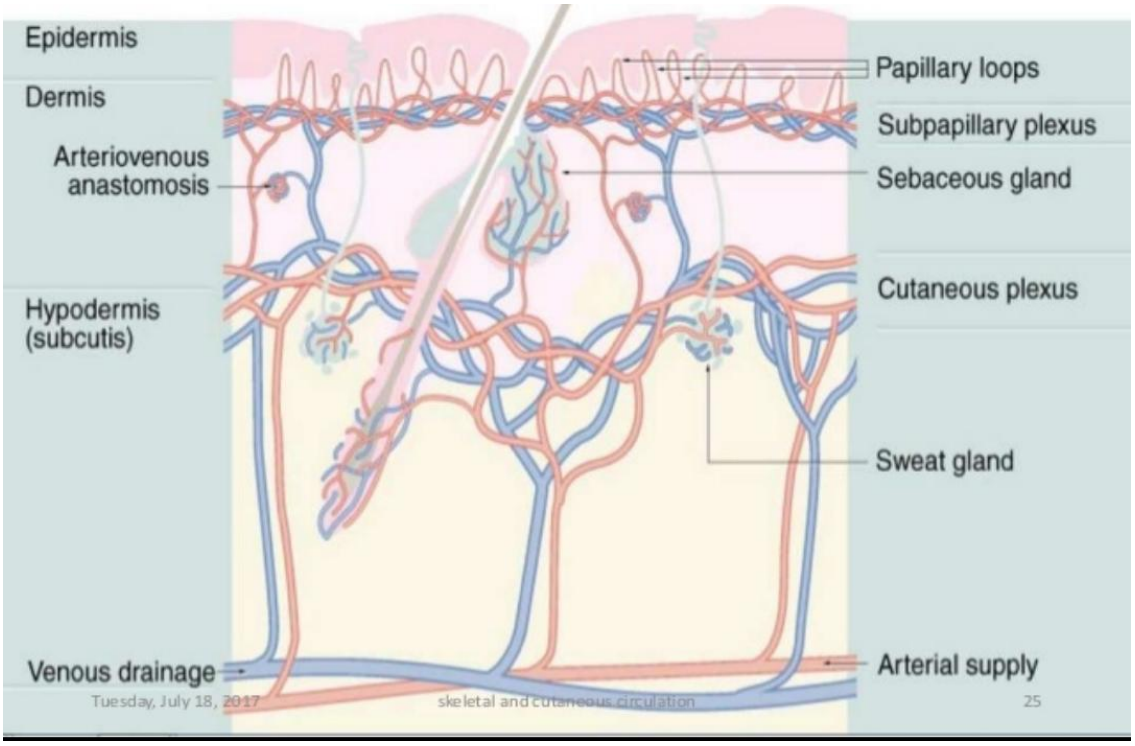
The left anterior descending artery is drained by the **great cardiac vein**, the posterior descending artery draining into the **middle cardiac vein** and the right marginal artery into the **small cardiac vein.** These veins converge in the **coronary sinus** located deep in the posterior of the right atrium; whereas some veins drain directly into the right atrium.

Interruptions of coronary circulation quickly cause heart attacks, in which the heart muscle is damaged by oxygen starvation. Because the rest of the body, and most especially the 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.



Cutaneous circulation

The cutaneous circulation is the circulation 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.



3.Discuss the cardiovascular adjustment that occurs during exercise.

- Increased cardiac output:

  Increased pumping capacity of heart enhancing delivery of oxygen and fuel to working muscles. This is due to a reduction of parasympathetic nervous system activity and increase in sympathetic nervous system activity.

  The integrated response to severe exercise involves four to five fold increase in cardiac output which are due properly to an increase in heart

rate and to a lesser extent stroke volume.

- Increase muscle blood flow

  Blood vessels in muscles dilate to increase local blood flow.
- Decreased blood flow to kidneys, liver and gut

  Shunts blood flow to working muscles