NAME: MABEOKWU MARYANN ONYINYECHUKWU

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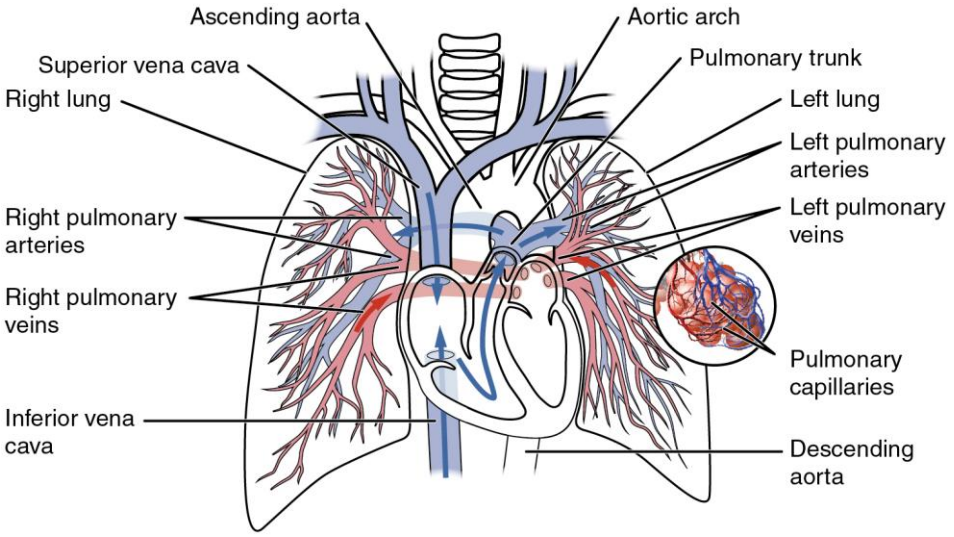
DEPARTMENT: MEDICINE AND SURGERY

COURSE: PHYSIOLOGY

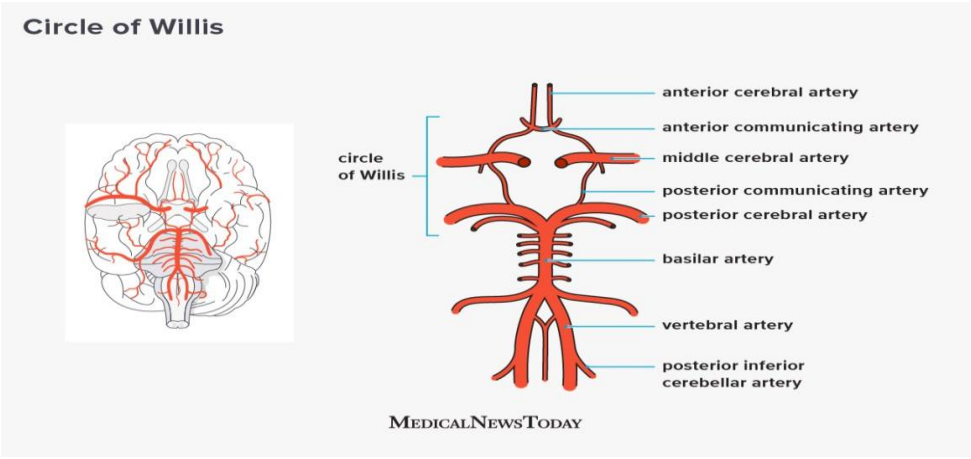
1. Discuss the long term regulation of mean arterial blood pressure: In each cardiac cycle arterial blood pressure fluctuates between diastolic and systolic pressure. However, the body behaves from day to day as if it regulated the mean arterial blood pressure, which is the average between diastolic and systolic pressures. Such regulation is achieved by interdependent adjustments of only 3 parameters: Heart rate (HR), ventricular stroke volume (SV) and total peripheral vascular resistance (TPVR). These are related as follows: HR - SV = Cardiac Output (CO); CO - TPVR = Mean Arterial Blood Pressure. The regulatory system includes stretch-sensitive sensors, central nervous integrators/evaluators and neuro-humoral effector mechanisms. Central nervous integration and evaluation of incoming signals occurs mostly in the pons/medulla regions of the midbrain. The most important effector mechanisms are the parasympathetic and sympathetic divisions of the autonomic nervous system, the renin-angiotensin system and vasopressin. Short-term regulation of arterial blood pressure is dominated by the baroreceptor mechanism, whereby pressure is sensed by both cardio-pulmonary nerve endings and stretch-sensitive cells in renal afferent arterioles. Long-term regulation involves mainly the regulation of extracellular fluid volume by pressure natriuresis mechanisms residing in the kidney and by widespread actions of angiotensin 2. Studies in hypertensives have suggested that the long-term-controlled variable is not arterial blood pressure, but the balance between intake and output of fluid and electrolytes. If the kidney requires a higher perfusion pressure to achieve that balance then daily blood pressure regulation occurs around an appropriately higher set point.

2. Write short notes on the following:
    a. Pulmonary circulation: this is the portion of the circulatory system that carries deoxygenated blood away from the right

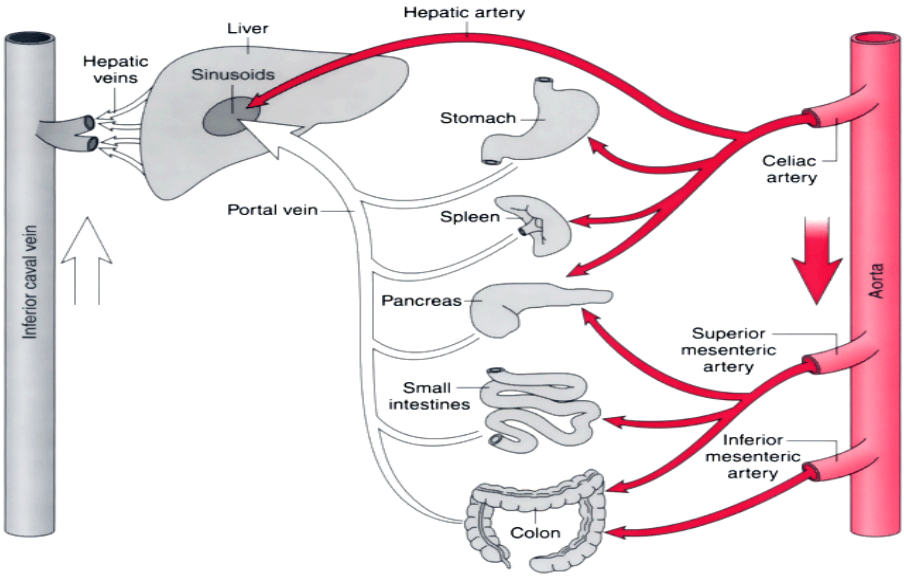
ventricle to the lungs and returns oxygenated blood to the left atrium and ventricle of the heart.



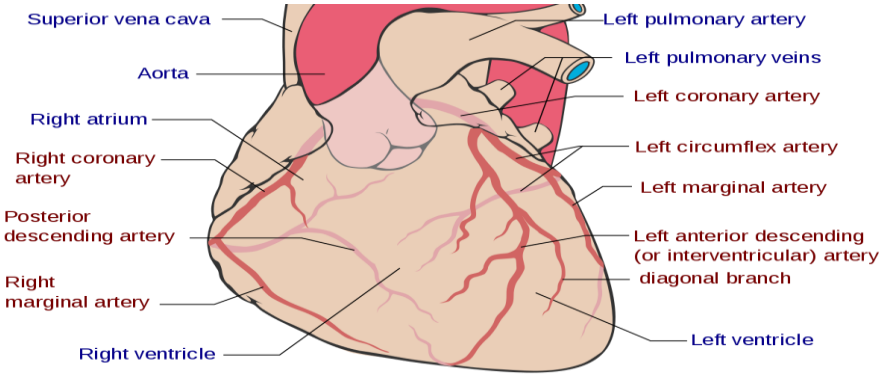
b. Circle of Willis: is the joining area of several arteries at the inferior portion of the brain. At the circle of Willis, the internal carotid arteries branch into smaller arteries that supply oxygenated blood to over 80% of the cerebrum.



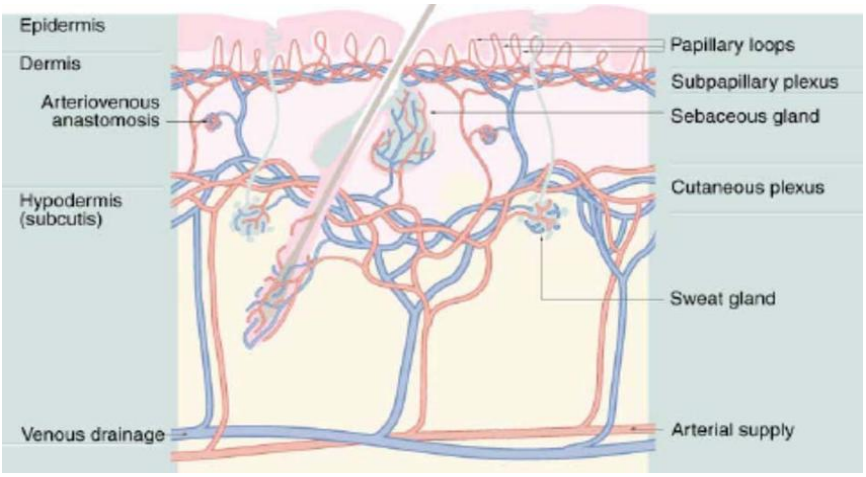
c. Splanchnic circulation: this describes the blood flow to the abdominal gastrointestinal organs including the stomach, liver, spleen, pancreas, small intestine and large intestine. It comprises three major branches of the abdominal aorta; the coeliac artery; superior mesenteric artery and inferior mesenteric artery.



d. Coronary circulation: this is the circulation of blood in the blood vessels that supply the heart muscle. Coronary arteries supply oxygenated blood to the heart muscle, and cardiac veins drain away the blood once it has been deoxygenated.



e. Cutaneous circulation: this 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. Discuss the cardiovascular adjustment that occurs during exercise: cardiovascular adjustments that occur during exercise include;
    i. Increased cardiac output: increased pumping capacity of heart due to increase of heart rate and stroke volume which is caused by reduction of parasympathetic nervous system activity, increased sympathetic nervous system activity and increase in the circulation of adrenaline hormone thus enhancing delivery of oxygen and fuel to working muscles.
    ii. Increased muscle blood flow: blood vessels in muscles dilate due to the demand of oxygen by working muscles therefore increasing local blood flow.
    iii. Decreased blood flow to kidneys, liver and gut: blood flow is redirected towards working muscles.