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Physiology assignment answer;

1. **Long-term regulation of mean arterial blood pressure**: The long-term level of arterial pressure is dependent on the relationship between arterial pressure and the urinary output of salt and water, which, in turn, is affected by a number of factors, including renal sympathetic nerve activity (RSNA). Some mechanisms within the brain that can influence RSNA focusing particularly on hypothalamic mechanisms are the a.) Paraventricular nucleus (PVN) in the hypothalamus which contributes to the sustained increased level of RSNA that occurs in conditions such as heart failure and neurogenic hypertension. b.) The dorsomedial hypothalamic nucleus (DMH) also exerts a powerful influence over sympathetic activity, including RSNA, there is no evidence it is an important component of the central pathways that produce long-term changes in arterial pressure, Nevertheless, it is possible that repeated episodic activation of this pathway could lead to vascular hypertrophy and, thus, sustained changes in vascular resistance and arterial pressure. C.) Central resetting of the baroreceptor–sympathetic reflex may be an important component of the mechanisms causing sustained changes in RSNA. However, little is known about the cellular mechanisms that could cause such resetting.
2. a. **Pulmonary circulation**: system of blood vessels that forms a closed circuit between the heart and the lungs, it is also known as **lesser circulation**. Deoxygenated blood from the lower half of the body enters the heart from the inferior vena cava while deoxygenated blood from the upper body is delivered to the heart via the superior vena cava. Both the superior vena cava and inferior vena cava empty blood into the right atrium. In the lungs, blood diverges into the numerous pulmonary capillaries where it releases carbon dioxide and is replenished with oxygen. Once fully saturated with oxygen, the blood is transported via the pulmonary vein into the left atrium which pumps

blood through the mitral valve and into the left ventricle. With a powerful contraction, the left ventricle expels oxygen-rich blood through the aortic valve and into the aorta: This is the beginning of systemic circulation.

b. **Circle of Willis** :The circle of Willis (also called Willis' circle, loop of Willis, cerebral arterial circle, and Willis polygon) is a circulatory anastomosis that supplies blood to the brain and surrounding structures. It is named after Thomas Willis (1621–1675), an English physician. It is incomplete in most individuals, although wide variations exist. Saccular aneurysms, the most common type of aneurysm, originate in and around the circle of Willis at the branching points of blood vessels. Aneurysms also occur more commonly in association with anomalies of the circle of Willis. For example, atresia of one proximal anterior cerebral artery may be associated with an aneurysm on the opposite, or dominant, anterior cerebral artery. The most common sites are the anterior communicating, posterior communicating, and middle cerebral arteries, depending on the particular study population. Approximately 85–90% of aneurysms occur in the anterior circulation, whereas only 10–15% occur in the posterior circulation. The internal carotid artery divides at the base of the brain to become the middle cerebral artery (which passes laterally) and anterior cerebral artery (passing anteriorly and medially). The MCA receives 80% of the carotid blood flow and the ACA receives 20%.The MCA supplies the lateral surface of the cerebral hemisphere, whereas the ACA supplies the medial surface as far back as the parieto-occipital sulcus. The posterior cerebral artery is the terminal branch of the basilar artery. The territory of the PCA includes the occipital lobe and the inferior surface of the temporal lobe.

c. **Splanchnic Circulation:** The splanchnic circulation is composed of gastric, small intestinal, colonic, pancreatic, hepatic, and splenic circulations, arranged in parallel with one another. The three major arteries that supply the splanchnic organs, coeliac and superior and inferior mesenteric, give rise to smaller arteries that anastomose extensively. The circulation of some splanchnic organs is complicated by the existence of an intramural circulation. Redistribution of total blood flow between intramural vascular circuits may be as important as total blood flow. Under physiological conditions, blood flow in the splanchnic circulation is controlled via intrinsic (myogenic and metabolic) and extrinsic (autonomic and humoral) mechanisms. Extrinsic factors include general hemodynamic conditions of the cardiovascular system, autonomic nervous system, and circulating neurohumoral agents. Intrinsic mechanisms include special properties of the vasculature, local metabolites, intrinsic nerves, paracrine substances, and local hormones. Disorders of the splanchnic circulation may contribute to the multi-organ dysfunction syndrome and vice versa, A number of techniques used in anesthesia and critical care influence the distribution of blood flow in the splanchnic circulation.

d. **Coronary circulation**: it is part of the systemic circulatory system that supplies blood to and provides drainage from the tissues of the heart. In the human heart, two coronary arteries arise from the aorta just beyond the semilunar valves; during diastole, 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, which drains into the right atrium. Therefore its circulation is of major importance not only to its own tissues but to the entire body and even the level of consciousness of the brain from moment to moment. Interruptions of coronary circulation quickly cause heart attacks (myocardial infarctions), in which the heart muscle is damaged by oxygen starvation. Such interruptions are usually caused by ischemic heart disease (coronary artery disease) and sometimes by 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. Some of the circulating blood volume in the skin will flow through will flow through arteriovenous anastomoses (AVAs) instead of capillaries and drain the skin. These allow the shunt of blood directly into the venous plexus of the skin, without it passing through capillaries. Since AVAs contain no capillary section, they are not involved in transport of nutrients to/from the tissues, but instead play a major role in temperature regulation. AVAs serve a role in temperature regulation, The blood flow through AVAs is heavily influenced by the sympathetic nervous system. Any changes in core temperature are detected by the thermoregulatory center in the hypothalamus. It regulates temperature by altering the level of sympathetic outflow to the cutaneous vessels, to return temperature to its normal range: In high core temperatures sympathetic innervation is decreased, reducing the vasomotor tone in the AVAs and more blood flows through the AVAs and reaches the venous plexus (close to the surface of the skin), increasing heat loss to reduce core temperature.. In low core temperatures: Sympathetic innervation is increased, increasing the vasomotor tone in the AVAs and less blood flows to the apical skin (of nose, lips, ears, hands and feet), reducing heat loss to increase the core temperature.

3. **The cardiovascular adjustment that occurs during exercise responds** is predictably to the increased demands of exercise. With few exceptions, the cardiovascular response to exercise is directly proportional to the skeletal muscle oxygen demands for any given rate of work, and oxygen uptake ($\dot{V}O2$) increases linearly with increasing rates of work. During exercise, efficient delivery of oxygen to working skeletal and cardiac muscles is vital for maintenance of ATP production by aerobic mechanisms. The equine cardiovascular response to increased demand for oxygen delivery during exercise contributes largely to the over 35-fold increases in oxygen uptake that occur during submaximal exercise. Cardiac output during exercise increases greatly owing to the relatively high heart rates that are achieved during exercise. it is remarkable that exercise heart rates six to seven times resting values are not associated with a fall in stroke volume, which is maintained by splenic contraction, increased venous return, and increased myocardial contractibility. Despite the great changes in cardiac output, increases in blood pressure during exercise are maintained within relatively smaller limits, as both pulmonary and systemic vascular resistance to blood flow is reduced. Improvements in hemoglobin concentrations in blood during exercise after training are recognized, but at maximal exercise, hypoxemia may reduce arterial oxygen content. More effective redistribution of cardiac output to muscles by increased capillarization and more efficient oxygen diffusion to cells may also be an important means of increasing oxygen uptake after training.