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COURSE: PHYSIOLOGY

Discuss long term regulation of mean arterial blood pressure

While changes to the Systemic Vascular Resistance (SVR) can transiently affect the systemic arterial pressure, arterial pressures tend to return to their original baseline within hours even if the changes to SVR are maintained. A variety of empirical studies have demonstrated that long-term control of the systemic arterial pressure over timescales of days, weeks, and months is principally regulated by the kidneys and is not dependent on changes to the systemic vasculature. The capacity of the kidneys to control arterial pressure depends on their ability to modify the extracellular fluid (ECF) volume which in a healthy individual determines the total blood volume.

The kidneys respond to changes in systemic arterial pressure by modifying their urinary excretion of sodium and water. When arterial pressures are elevated, renal urinary excretion of sodium and water increases; conversely, when arterial pressures are deficient, renal urinary excretion of sodium and water decreases. Nevertheless, this relationship between systemic arterial pressures and renal urinary excretion is largely independent of the SVR; consequently, whether or not the SVR is high or low, the kidneys will respond as described above by matching their urinary excretion to the effective systemic arterial pressure.

As described more fully in ECF volume regulation the capacity of the kidneys to regulate urinary salt and water excretion allows these organs to regulate the total ECF volume which, as discussed below, is a major determinant of systemic arterial pressure in healthy individuals. Taken together, the relationship between arterial pressure, renal salt and water excretion, and ECF volume resembles a negative feedback control circuit in which changes to arterial pressure modulate renal sodium and water excretion which in turn affect ECF volume and thus modulate arterial pressure. Once again, this negative feedback appears to act completely independently of the SVR and explains why changes to the SVR can only affect arterial pressures transiently.

While a rapid increase in SVR will immediately boost the blood pressure, the kidneys will respond by progressively excreting salt and water, thus reducing the ECF volume and thus causing a slow decline in arterial pressure. Conversely, while a rapid decrease in SVR will immediately reduce the blood pressure, the kidneys will respond by retaining more salt and water than that ingested, thus increasing the ECF volume and thus causing a slow increase in the arterial pressure.

Write short notes on the following

pulmonary circulation is the portion of the circulatory system which carries deoxygenated blood away from the right ventricle, to the lungs, and returns oxygenated blood to the left atrium and ventricle of the heart. The term pulmonary circulation is readily paired and contrasted with the systemic circulation. The vessels of the pulmonary circulation are the pulmonary arteries and the pulmonary veins.

Circle of Willis encircles the stalk of the pituitary gland and provides important communications between the blood supply of the forebrain and hindbrain (i.e. between the internal carotid and vertebro-basilar systems following obliteration of primitive embryonic connections). Although a complete circle of Willis is present in some individuals, it is rarely seen radiographically in its entirety; anatomical variations are very common and a well-developed communication between each of its parts is identified in less than half of the population.

Splanchnic circulation is composed of the blood flow originating from the celiac, superior mesenteric, and inferior mesenteric arteries and is distributed to all abdominal viscera. The splanchnic circulation comprises the gastric, small intestinal, colonic, pancreatic, hepatic, and splenic circulations. They are arranged in parallel and fed by the celiac artery and the superior and inferior mesenteric arteries.

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. 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 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.

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. AVAs serve a role in temperature regulation.

Discuss cardiovascular adjustments that occurs during exercise

A.Increased cardiac output. Increased pumping capacity of the heart enhancing delivery of oxygen and fuel to working muscles

B. Increased muscle blood flow. Blood vessels in muscles dilate, increasing local blood flow

C. Decreased blood flow to kidney, liver and gut. Redirects blood flow to working muscles.