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18/MHS01/188

200L

MEDICINE AND SURGERY

PHS 201

QUESTION I: Discuss the long-term regulation of mean arterial blood pressure.

Mean arterial blood pressure refers to the average force exerted by blood on the arterial walls. The long-term regulation involves the *Renin Angiotensin Aldosterone System (RAAS).* The *RAAS* is a hormonal system responsible for the long-term regulation of blood pressure and fluid balance in the body, it consists of 3 hormones: *Renin, Angiotensin II and Aldosterone*. It occurs in several stages:

- Renin Release: The first stage of the RAAS is the release of *renin*. Renin is released from the granular cells of the renal juxtaglomerular apparatus (JGA) in response to one of the following conditions:
    i. Sympathetic stimulation of the JGA
    ii. Reduced NaCl delivery to the distal tubule as detected by the macula densa cells.
    iii. Reduced perfusion pressure as detected by the baroreceptor reflex in the afferent arteriole.
- Production of Angiotensin II: *Angiotensinogen* is a precursor protein produced by the liver, renin cleaves to it to form *Angiotensin I*. *Angiotensin Converting Enzyme (ACE)* is released by the surface of the pulmonary, renal and capillary endothelium. It acts on Angiotensin I, converting it to *Angiotensin II*. Angiotensin II binds to several receptors in the body to carry out several activities:

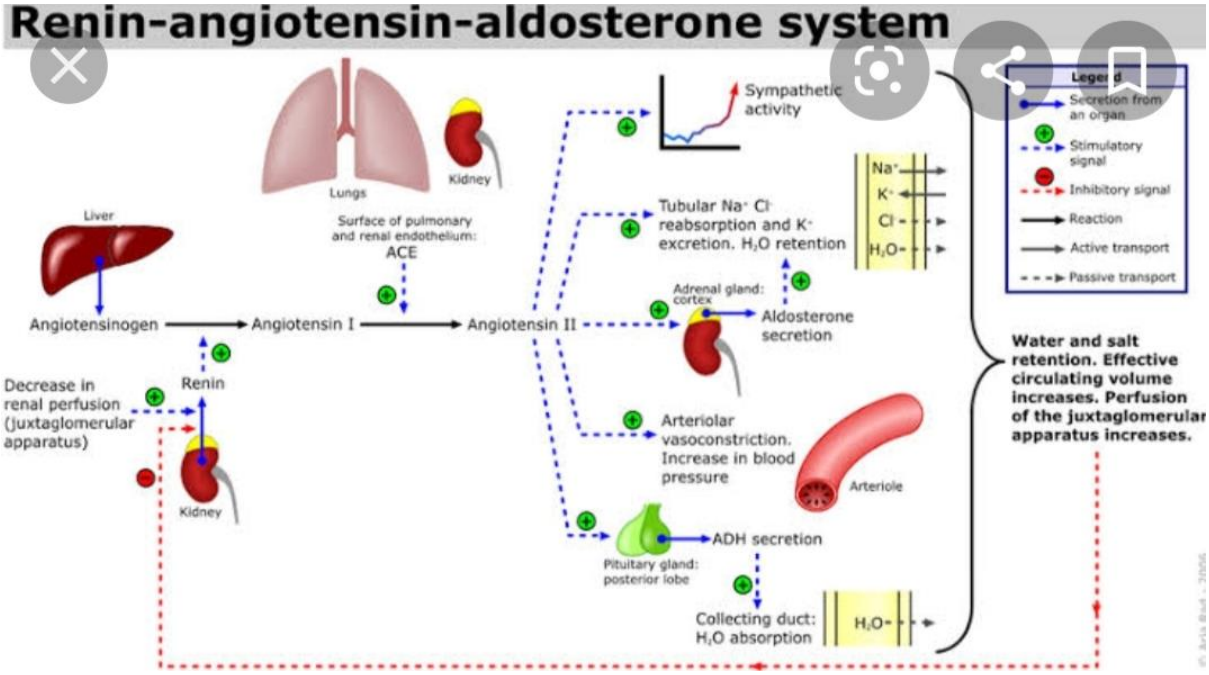
Receptors	Effects
i. Arteriole	Vasoconstriction
ii. Kidney	Na+ and water absorption
iii. Sympathetic Nervous System	Stimulation of *Noradrenaline (NA)*
iv. Adrenal cortex	Initiates the release of *Aldosterone*
v. Hypothalamus	Increased thirst sensation. Stimulates the release of *ADH*

- Effects of Angiotensin II
    a. Cardiovascular Effect: Angiotensin II acts on the systemic arterioles, inducing vasoconstriction. This in turn increases blood pressure.

b. Neural Effect: Angiotensin II acts on the SNS, stimulating the release of Noradrenaline from the adrenal medulla, which is related to the 'flight' or 'fright' response. Angiotensin II also acts on the hypothalamus, increasing thirst sensation which increases the level of water in the body. It also acts on the posterior lobe of the pituitary gland stimulating the release of *Anti-Diuretic Hormone (ADH).*

c. Renal Effect: Angiotensin II acts on the kidney stimulating Na+ and water absorption.

d. Adrenal Effect: Angiotensin II acts on the adrenal cortex, stimulating the release of Aldosterone, which acts on the principal cells of the collecting ducts of the nephron, increasing Na+ and water absorption.



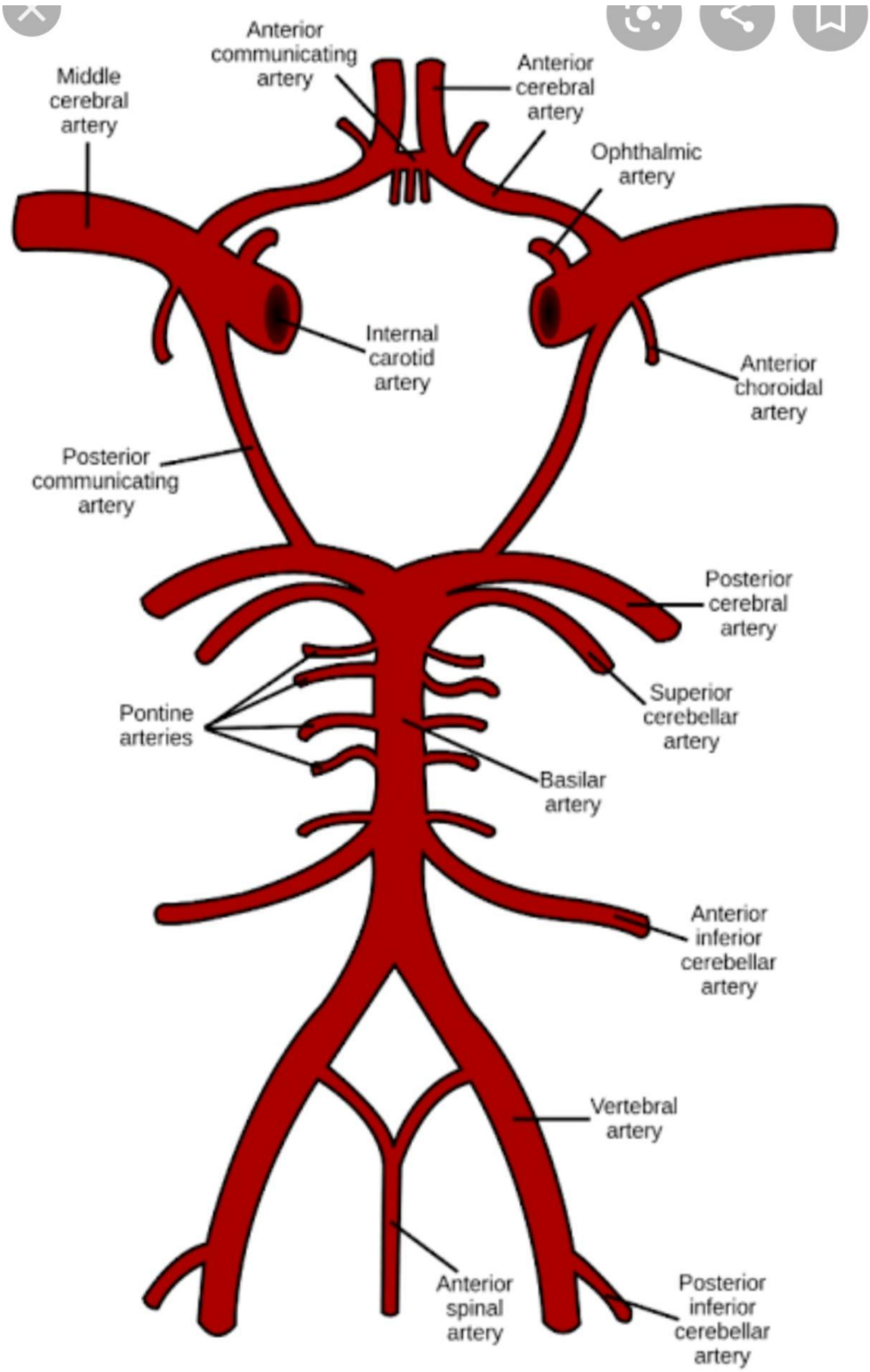
Clinical Relevance

ACE inhibitors: These are hypertensive and heart failure drugs. They inhibit the action of ACE, reducing the effects of Angiotensin II in the body; hence reducing blood pressure.

QUESTION II: Write short notes on the following:

- *Pulmonary Circulation*: This 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.

- *Circle of Willis*: The Circle of Willis encircles the stalk of the pituitary gland and provides important communications between the blood supply of the forebrain and the hindbrain. The Circle of Willis begins to form when the right and left internal carotid artery (ICA) enters the cranial cavity and each one divides into 2 main braches: The anterior cerebral artery (ACA) and middle cerebral artery (MCA). The ACAs are then united and blood can cross flow by the anterior communicating (ACOM) artery. The ACAs supply most midline portions of the frontal lobes and superior medial parietal lobes. The MCAs supply most of the lateral surface of the hemisphere, except the superior portion of the parietal lobe (via ACA) and the inferior portion of the temporal and occipital lobe. The ACAs, ACOM, and MCAs form the anterior half. Posteriorly, the basilar artery (BA), formed by the left and right vertebral arteries, branches into a left and right posterior cerebral artery (PCA), forming the posterior circulation. The PCAs mostly supply blood to the occipital lobe and the inferior portion of the temporal lobe.


Anterior communicating artery
Middle cerebral artery
Anterior cerebral artery
Ophthalmic artery
Internal carotid artery
Anterior choroidal artery
Posterior communicating artery
Posterior cerebral artery
Superior cerebellar artery
Pontine arteries
Basilar artery
Anterior inferior cerebellar artery
Vertebral artery
Anterior spinal artery
Posterior inferior cerebellar artery

- *Splachnic Circulation*: This describes the blood flow to the abdominal GIT 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.
- *Coronary Circulation*: It 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.
- *Cutaneous Circulation*: This is the circulation and blood supply to 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 (AVAs) instead of capillaries. AVAs serve a role in temperature regulation.

QUESTION III: Discuss the cardiovascular adjustment that occurs during exercise?

a. Action: Pre-exercise response
    - ✓ Co-ordination: Activation of motor cortex and higher brain.
    - ✓ Response: Increased HR.
b. Action: Exercise
    - ✓ Co-ordination: Continued sympathetic adrenergic outflow
    - ✓ Response: Concomitant constriction of musculature (in inactive tissues).