Review Article

RENIN – ANGIOTENSIN ALDOSTERONE SYSTEM (RAAS)

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Abstract

In the control of arterial blood pressure, fluid, and electrolyte balance, the renin-angiotensin-aldosterone system (RAAS) plays a very important role. Juxtaglomerular (JG) cells secrete renin which converts angiotensinogen to angiotensin 1 which is further changed into angiotensin II by angiotensin-converting enzyme (ACE) located in endothelial cells of the lung capillaries. Angiotensin II exerts its actions to regulate blood pressure, fluid, and electrolyte balance.

Key Words: Renin, Angiotensinogen, Blood Pressure

INTRODUCTION

Renin-Angiotensin Aldosterone System (RAAS) is very important in the regulation of arterial blood pressure and fluid-electrolyte balance.[1,2]

Juxta Glomerular Cells (JG Cells) of the kidney are modified smooth muscle fibers present in the wall of afferent arterioles near the glomeruli.[3-5] Renin is formed and stored in these cells. JG cells release renin into general circulation when arterial blood pressure falls.[6] Renin acts on a plasma protein angiotensinogen (synthesized in the liver) to form angiotensin I.[7,8] Renin circulates in the blood for 30 minutes to 1 hour and continues to form angiotensin I.[9]

Circulating angiotensinogen is an alpha 2 globulin in the plasma. Its levels are increased by cortisol, thyroid hormones, estrogens, several cytokines and angiotensin II.[3] Angiotensin I has a mild vasoconstrictor activity. Angiotensin I is converted within a few seconds to minutes into angiotensin II (octapeptide) by the Angiotensin Converting Enzyme (ACE) present in endothelial cells of lungs capillaries.[9,10] The kidney and blood vessels also contain this enzyme.[8] (Figure-1)

Juxtaglomerular cells are innervated by renal sympathetic nerves. When these cells are stimulated, there is release of renin.[11] When blood pressure falls, glomerular filtration rate decreases and concentration of NaCl at macula densa decreases. This causes the release of renin from JG cells.[8] By regulating sodium balance and plasma volume and being potent vasocomtrictor, it contributes to the regulation of blood pressure.[12,13]

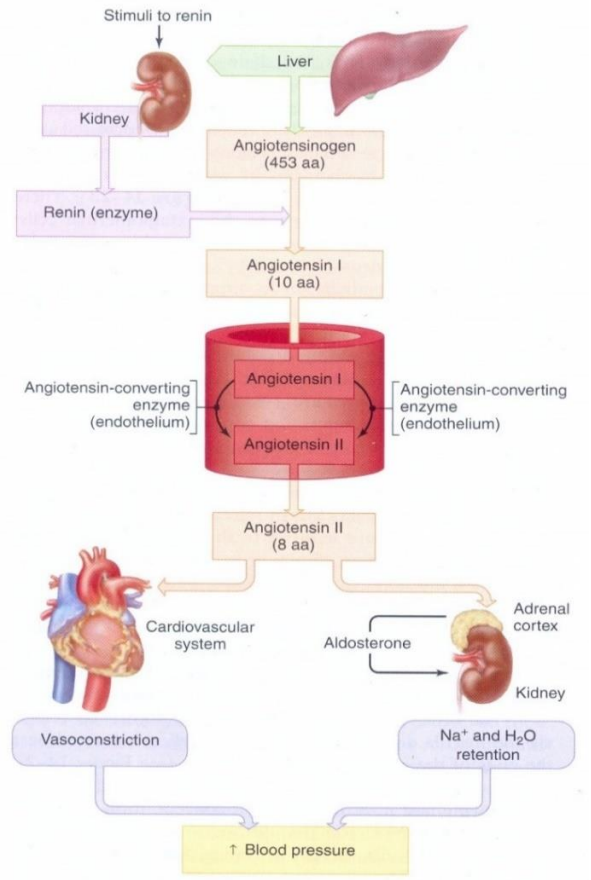

Figure-1. Renin-Angiotensin System[9]

Renin secretion is inversely proportional to NaCl concentration in distal renal tubules.[2]

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Angiotensin II remains in the blood for 1-2 minutes as it is rapidly inhibiter by the enzyme angiotensinase present in blood and tissues.[1]

Angiotensin II receptors. In the human body, two types of angiotensin II receptors are present; AT_1 and AT_2. AT_1 are further of 2 types. AT_{1A} and AT_{1B}. AT_{1A} are present in blood vessel walls and brain and these mediate most of effects of angiotensin II. AT_{1B} is found in anterior pituitary and adrenal cortex.[14] An excess of angiotensin II down regulates vascular receptors (AT_{1A}) and upregulates the adrenocortical receptors (AT_{1B}).[14-16]

Physiological actions of Angiotensin II. Angiotensin II causes arteriolar vasoconstriction and a rise in arterial blood pressure. It is a 4-8 times more potent vasoconstrictor as compared to nor-epinephrine. Angiotensin II acts on zona glomerulosa of the adrenal cortex to release aldosterone. It is the major controller of aldosterone secretion. It facilitates release of nor-epinephrine from postganglionic sympathetic neurons and has a direct effect on renal tubules to increase Na^+ reabsorption. It stimulates thirst center in the brain to increase water intake. It also increases secretion of vasopressin (ADH) from hypothalamo-neurohypophyseal system. These actions of angiotensin II increase Na^+ and water reabsorption from renal tubules to increase blood pressure.[1,3]

Angiotensin III is also active in zona glomerulosa of adrenal cortex. Renin – angiotensin system has a role in maintaining normal blood pressure despite large variations in salt intake.[1] Several signal pathways including Angiotensin II are known to trigger synthesis and degradation of collagen fibers in the heart leading to its remodeling, which may be manifested as cardiac dysfunction /cardiac failure.[17]

Inhibition of renin angiotensin aldosterone system

Inhibitors of prostaglandin synthesis such as indomethacin and beta-adrenergic blockers such as propranolol reduce renin secretion. Pepstatin and enalkirem prevent conversion of angiotensinogens into angiotensin 1.[18-21] Angiotensin-converting enzyme (ACE) inhibitors such as catapril and enalapril prevent the conversion of angiotensin 1 to angiotensin II.[22,23] Saralasin is an analog of angiotensin II and is a competitive inhibitor of action of angiotensin II on both AT_1 and AT_2 receptors.[24]

Losartan (DUP – 753) selectively blocks AT_1 receptors on vascular smooth muscle and adrenal cortex.[25-28] These drugs are used in the management of high blood pressure and heart failure.[29]

CONCLUSION

The control of blood pressure, water and electrolyte balance involves renin angiotensin aldosterone system.

AUTHOR'S CONTRIBUTION

HJQ: Conception of idea and writing
NH: Review critically

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