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PATHOGENESIS OF HYPERTENSTION- A REVIEW

S. Palani[1*], Nisha Mary Joseph[2], Edao Tesa Keliyo[1] and Yonatan Tegene[1]

[1]College of Medicine and Health Sciences, Jijiga University, Ethiopia.
[2]School of Pharmacy, College of Health Sciences, Addis Ababa University, Ethiopia.

***Corresponding Author: Dr. S. Palani**
College of Medicine and Health Sciences, Jijiga University, Ethiopia.

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ABSTRACT

This article reviews about the pathogenesis of hypertension. Blood pressure is a measure of the force that the circulating blood exerts on the walls of the main arteries. Hypertension is a chronic condition, increasing in developing and developed countries. Hypertension is mainly associated with alteration in people lifestyle in the modern world and the changing food habits. Hypertension is a major risk factor for cardiovascular disease. Patients with hypertension should also target organ damage and cardiovascular disease including left ventricular hypertrophy, atherosclerosis, myocardial infarction, angina pectoris, coronary revascularization, congestive heart failure, stroke or transient ischemic attack, peripheral arterial disease, nephropathy, and retinopathy. The higher the systolic or diastolic blood pressure, higher the risk of cardiovascular morbidity and mortality. The activation of renin-angiotensin-aldosterone system (RAAS) is one of the main pathogenesis of hypertension. Sympathetic nervous system and genetics also plays an important role in the pathogenesis of hypertension.

KEYWORDS: Hypertension, Renin, Angiotensin, Aldosterone.

INTRODUCTION

Patients with hypertension should also be evaluated for target organ damage and clinical cardiovascular disease including left ventricular hypertrophy, prior myocardial infarction, angina pectoris, prior coronary revascularization, congestive heart failure, stroke or transient ischemic attack, peripheral arterial disease, nephropathy, and retinopathy.[1-4] Untreated hypertension is usually associated with a progressive rise in blood pressure. Older persons are more likely to have hypertension and isolated systolic hypertension, to have target organ damage and clinical cardiovascular disease, and to develop new cardiovascular events. Blood pressure is a measure of the force that the circulating blood exerts on the walls of the main arteries. The pressure wave transmitted along the arteries with each heartbeat is easily felt as the pulse—the highest (systolic) pressure is created by the heart contracting and the lowest (diastolic) pressure is measured as the heart fills. High blood pressure, also called "hypertension," is a serious medical condition. The higher the systolic or diastolic blood pressure, the higher the risk of cardiovascular morbidity and mortality.[5] Increased systolic blood pressure and pulse pressure are stronger risk factors for cardiovascular morbidity and mortality in older persons than is increased diastolic blood pressure.[6]

Hypertension occurs when the force of the blood pumping through the arteries is too strong. When heart beats, it pushes blood through arteries to the rest of the body. When the blood pushes harder against the walls of arteries, blood pressure goes up. Blood pressure may be different at different times of the day. It is usually higher when you first wake up, after you exercise, or when you are under stress. Having higher blood pressure for short amounts of time is normal. However, blood pressure stays high for most of the time; it can cause serious health problems. Lowering your blood pressure decreases your chance of heart attack, heart failure, stroke, and other health problems. In the healthy young adult, the pressure at the top of each pulse, called the systolic pressure, is about 120 mm Hg. At the lowest point of each pulse, called the diastolic pressure, it is about 80 mm Hg. The difference between these two pressures, about 40 mm Hg, is called the pulse pressure. Increased sympathetic nervous system activity increases blood pressure and contributes to the development and maintenance of hypertension through stimulation of the heart, peripheral vasculature, and kidneys, causing increased cardiac output, increased vascular resistance, and fluid retention.[7] Autonomic imbalance (increased sympathetic tone accompanied by reduced parasympathetic tone) has been associated with many metabolic, hemodynamic, trophic, and rheologic abnormalities that result in increased cardiovascular morbidity and mortality.[8]

Blood Pressure Category	Systolic mm Hg (upper #)		Diastolic mm Hg (lower #)
Normal	less than 120	and	less than 80
Prehypertension	120 – 139	or	80 – 89
High Blood Pressure (Hypertension) Stage 1	140 – 159	or	90 – 99
High Blood Pressure (Hypertension) Stage 2	160 or higher	or	100 or higher
Hypertensive Crisis (Emergency care needed)	Higher than 180	or	Higher than 110

Pathogenesis of hypertension

Hypertension, with a prevalence of up to 30% throughout the world, is increasing in incidence in more affluent and aging populations. Because it is totally asymptomatic, it has been named the "silent killer," as it is the major contributor-or risk factor-to cardiovascular morbidity and mortality.[9] The activation of renin-angiotensin-aldosterone system (RAAS) is one of the main pathogenesis of hypertension. RAAS (Figure-1) physiologically regulates the arterial pressure and sodium balance. The RAAS is considered as an endocrine system with angiotensinogen, produced in the liver that is cleaved by Renin released from renal juxta glomerular cells and then angiotensin I is cleaved by angiotensin-converting enzyme activity of the lungs (microvasculature of alveoli) into the active form of angiotensin II. Angiotensin II binds to specific receptors in adrenal cortex, resulting in release of aldosterone.[10] The RAAS, one of the most important hormonal systems, oversees the functions of cardiovascular, renal, and adrenal glands by regulating blood pressure, fluid volume, and sodium and potassium balance. Renin, an active proteolytic enzyme, is first synthesized as an inactive preprohormone (prorenin), undergoes subsequent proteolytic changes in the afferent arterioles of renal glomerulus, and then is released into circulation. In the circulation, proteolytic and nonproteolytic mechanisms cleave prorenin to the active renin.[11] Renin is a circulating enzyme that participates in maintaining extracellular volume, and arterial vasoconstriction. Renin contributes to regulation of the blood pressure. Renin is released from juxta glomerular cells, which is located in the afferent arterioles of the kidney. The release of renin is stimulated by slight changes such as decrease in renal perfusion, sympathetic nerve stimulation (catecholamines), and the extrarenal factors changes such as sodium, chloride and potassium.[12] Renin regulates the initial, rate-limiting step of the RAAS by cleaving the N-terminal portion of a large molecular weight globulin, angiotensinogen, to form the biologically inert decapeptide Ang I. Then the inactive decapeptide Ang I is hydrolysed by Angiotensin-converting enzyme (ACE) to form Ang II. Angiotensin II is an octapeptide, powerful vasoconstrictor and stimulates the production of aldosterone, which, in turn, increases renal sodium reabsorption, and closes the regulatory feedback loop. Ang II acts via specific receptors called AT receptors. Activation of receptors results in vasoconstriction, sodium retention, aldosterone secretion, cellular proliferation, superoxide formation, inflammation and thrombosis. By contrast AT2 receptors results in potentially beneficial vasodilatory and antiproliferative effects but promotes apoptosis.[13] AT_1 receptors can be found in organ systems that play key roles in blood pressure homeostasis, including the heart, kidney, blood vessels, adrenal glands, and cardiovascular control centers in the brain. In the vascular system, stimulation of AT_1 receptors causes potent vasoconstriction. In the adrenal cortex, their activation stimulates the release of aldosterone. Aldosterone promoting sodium reabsorption in the mineralocorticoid-responsive segments of the distal nephron.[14] Genetic also plays an important role in pathogenesis of hypertension. Single genes can have major effects of blood pressure. Single gene mutations cause Mendelian forms of high blood pressure. Mutations in 10 genes that cause Mendelian forms (monogenic forms of hypertension) of human hypertension and these mutations alter blood pressure by altering renal salt mechanism.[15-16] Increased sympathetic nervous system activity increases blood pressure by stimulating the heart, peripheral vasculature, kidneys, causing increased cardiac output, increased vascular resistance and fluid retention. Increased sympathetic activity in hypertension involves alteration

in baroreflex and chemoreflex. Arterial baroreceptors are reset to a higher pressure in hypertensive patients. Baroreceptors are situated in the carotid sinus, aortic arch, pulmonary arteries. The increase in arterial blood pressure stimulates the baroreceptors and depresses the activity of the vasomotor center that is followed by lowering the sympathetic activity resulting in peripheral vasodilatation, lowering heart rate and normalising the blood pressure. Chemoreceptor's react to changes in PO2 of blood flowing towards the aortic and carotid bodies.[17-18]

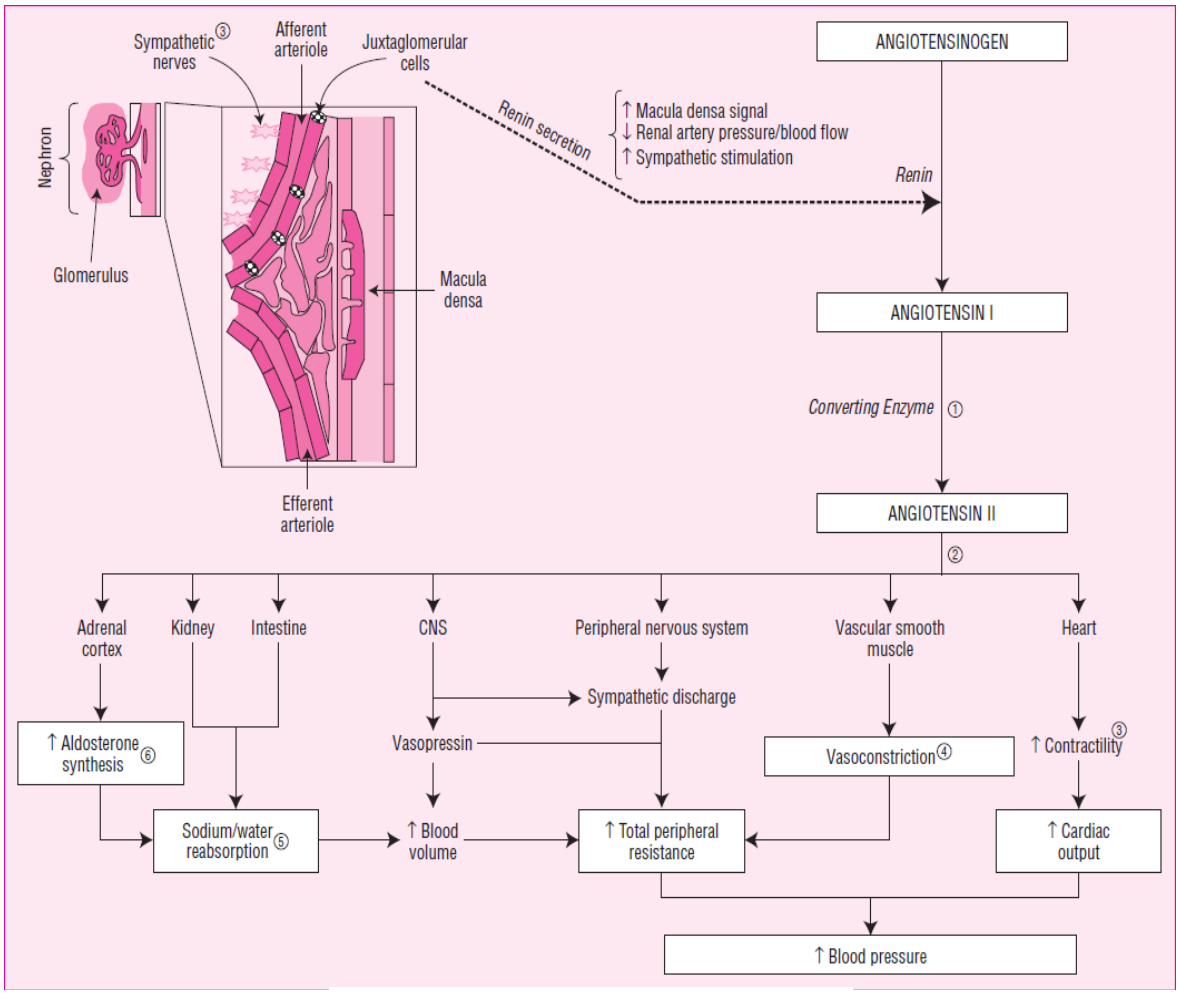

Fig 1: Renin-Angiotensin-Aldosterone system.

CONCLUSION

Hypertension is one of the most common chronic diseases affecting more than 1 billion people worldwide. Hypertension is a major risk factor for myocardial infarction, stroke, heart failure and renal failure. Treatment of hypertension can be done with antihypertensive drugs like Angiotensin Converting Enzyme inhibitors, Angiotensin II receptor blockers; β Blockers, Calcium channel blockers, Diuretics, α1 Blockers, Central α2 agonists, direct arterial vasodilators reduces the risk factors related to hypertension.

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