DOI: https://doi.org/10.54393/pbmj.v6i04.858

PAKISTAN BIOMEDICAL JOURNAL

https://www.pakistanbmj.com/journal/index.php/pbmj/index

Volume 6, Issue 4 (April 2023)

Review Article

Hypertension: Causes, Symptoms, Treatment and Prevention

Sumaira Mazhar[1], Uzma Rafi[1*] and Asma Noreen[1]

[1]Department of Microbiology, Lahore Garrison University, Lahore, Pakistan

ARTICLE INFO

Key Words:

Hypertension, Cardiovascular Disorders, Hearing Impairment, Obesity

How to Cite:

Mazhar, S. ., Rafi, U. ., & Noreen, A. (2023). Hypertension: Causes, Symptoms, Treatment and Prevention: Hypertension: Treatment and Prevention. Pakistan BioMedical Journal, 6(04). https://doi.org/10.54393/pbmj.v6i04.858

***Corresponding Author:**

Uzma Rafi

Department of Microbiology, Lahore Garrison University, Lahore, Pakistan

uzmazeeshan@lgu.edu.pk

Received Date: 23rd March, 2023

Acceptance Date: 25th April, 2023

Published Date: 30th April, 2023

ABSTRACT

Hypertension "the silent killer is a common and significant disorder that can lead to many health complications. World health organization (WHO) declared the hypertension as the major cause of early mortality as it is directly or indirectly associated with risks of cardiovascular disorders, stroke, angina, kidney failure, diabetes and many more. The major causes of hypertension include obesity, decrease in physical activities, smoking and alcohol consumption. High blood pressure, possibly related to the age associated with the hearing impairment because of the subsequent vasoconstriction. After arthritis and hypertension, hearing loss is one of the most continual health issues of the older persons. Demographic factors and lifestyles are usually the variable factors due to which prevalence of arterial hypertension differs worldwide. These factors include nutritional habits and physical activities. A large number of antihypertensive and lipid-lowering drugs are being used to treat hypertension but it has been proved that changes in lifestyle are an easy way to treat hypertension.

INTRODUCTION

Hypertension is often called "the silent killer" because generally it has no any symptoms until major complications develop. Hypertension is a very frequent and major condition that can lead to many health problems or complicate. The risk of the cardiovascular mortality and morbidity is directly associated with hypertension. Risks of kidney failure, stroke, angina, early death or heart failure from a cause of cardiovascular are directly associated with hypertension [1]. Hypertension is estimated as one of the main issues of early death, according to World health organization (WHO).The relative risks of stroke as well as heart disease strongly associated with blood pressure. The people that aged 80 to 90 had a lower risk of 33 %. The People that aged 50 to59 had the risk of stroke (62%). High blood pressure is a risk factor for many different diseases, including heart disease, stroke, and kidney disease [2]. Hearing impairment is a very highly multifactorial process which is involving a multitude of extrinsic and intrinsic factors. A relationship between poor hearings in old age cardiovascular disease was proposed almost 40 years ago. The issue has been also discussed for almost half a century. The nature of the blood vessel and the distance from the heart are two things depend upon the blood pressure of the blood vessels. Arterial system has more blood pressure as comparable to the venous system. This is because the artery walls are very thicker and very less elastic while the vein walls are very thin and elastic. Hypertension causes the arteries to become hard and thick due to which oxygen and blood flow to the heart slows, a heart attack occurs due to the blockage of blood flow to the heart [3]. The normal range of blood pressure is 120/80 mmHg. The maximum BP of systolic BP during the ventricular systole- 120 mmHg and

DOI: https://doi.org/10.54393/pbmj.v6i04.858

the range of systolic BP is 110-130 mm Hg. Is the least pressure of diastolic BP (DBP) is 80mmHg during the ventricular diastole and the range of 70-90 mmHg[4].

Family history is also associated with high risk of hypertension and hearing loss disease and it is reported in many studies that the risk is increased by two to seven folds due to family history of hypertension.

Causes

Obesity increases the risk of hypertension and heart diseases. Due to increase in BMI, the risk of hypertension also increases. Approximately 2.8 billion people have been reported to die due to obesity. In a study it was seen that a 10% increase in the body weight causes an increase in systolic blood pressure of about 7 mmHg [5]. Decrease in physical activities tend to have more risk of developing hypertension as compared to those who are physically fit [6].The use of tobacco is one of the major causes of hypertension. The lining of artery walls get damaged due to the chemicals that are present in tobacco. The arteries get narrow and increase the blood pressure [7]. Black have more risk of having hypertension as compared to the white. The prevalence of hypertension is about 13%in whites and about 23%in blacks[8]. The use of alcohol is also one of the risk factors for hypertension. Recent studies showed association of consumption of alcohol with hypertension and it may be a cause of essential hypertension[9].

Signs and Symptoms

High blood pressure, possibly related to the age associated with the hearing impairment because of the subsequent Vasoconstriction. Vasoconstriction of the inner ear blood vessels unfavorable effects on blood and supply oxygen in the inner part of the ear because the inner part of ear depend on oxidative metabolism, in the inner part of the ear the removal of oxygen is via to produce insufficiency in auditory sensitivity[10]. At least 28 million U.S. populations were hearing impairment. After arthritis and hypertension, hearing loss is one of the most continual health issues of the older persons. The effect of hearing loss on society will be increasing as baby boomers age because the age-specific prevalence of hearing loss and the number are increasing in older persons [11]. It was reported that there had a twofold accelerates in the speed at which men loss their hearing as compared to the women. It showed that gender and age are indeed related to the hearing impairment even in the groups without sign of hearing loss. It reported that males had a very significant age related drop in their hearing loss, while women did not show such patterns [12]. With aging, there are a higher number of chronic diseases. High blood pressure and hearing loss have very important prevalence in elderly populations. Since the study has shown that the arterial hypertension is an independent risk factor for the hearing loss[13].

Characteristics

Angiotensin-converting enzyme (ACE) gene is one of the entrant genes involved in rennin angiotensin-aldosterone system (RAAS). This system also involved to maintain the balance of fluid and electrolysis. The ACE enzyme involved the conversion of inactive angiotensin I into active angiotensin II. They also reduced bradykinin to sustain homeostasis of blood pressure [14]. Angiotensin I-converting enzyme (ACE) plays a vital role in the regulation of blood pressure and they consist of zinc metallopeptidase. Two types of homologous catalytic domains are present in the ACE. C-domains and N-domains, both are consisting of active catalytic sites. Which are suitable to cut bradykinin, and angiotensin I. The C-domain as compared to the N - domain of ACE is most efficient in cutting angiotensin I into vasopressor angiotensin II [15]. *ACE* is present as a membrane-bound enzyme in the different types of epithelial and endothelial cells, neuroepithelial cells and biological fluids in the form of circulating, such as amniotic, plasma and seminal fluids [16]. There are two isoforms of angiotensin converting enzyme. One of them is called somatic ACE because of its presence in the somatic tissue sit consist of very large proteins that is composed of 1300 amino acids. In the plasma membrane they are present in the soluble form, or it can be anchored through Tran's membrane domains in the plasma membrane. The other isoform is called as testicular form or germinal form. It is smaller proteins composed of 730 amino acids. Its molecular weight is 100-110KDa *ACE* gene of human is present on 17q23 chromosomes and it is about 21kb in size. Many different types of polymorphisms have been identified. There are about 160 polymorphisms whereas others are a result of a missense mutation. The most extensively studied of insertion/deletion polymorphism is present on the intron 25 and 26 exons. ACE II is a potent vasoconstrictor. It releases aldosterone by acting on the adrenal cortex and aldosterone in turn allows the kidney tubules to reabsorb more water and salts from urine [17]. The growth and proliferation of the cell are also stimulated by angiotensin11 by the help of different growth factors and cytokines [18]. The regulation of an angiotensin I-converting enzyme into angiotensin II then the cause the activation of the renin-angiotensin system which regulates the blood pressure. ACE has been associated with the cell proliferation, inflammation and angiogenesis. The most important system involved in the regulation of systemic blood pressure, glomerular filtration rate and renal blood flow is called the renin-angiotensin-aldosterone system. The renin–angiotensin system (RAS) or the renin–angiotensin–aldosterone system (RAAS) is hormone system which helps in the regulation of fluid balance and blood pressure. The angiotensin-converting

DOI: https://doi.org/10.54393/pbmj.v6i04.858

enzyme can cut other proteins, including bradykinin. Bradykinin causes blood vessels to dilate which cause blood pressure decreases. Inactivates bradykinin, cutting by the angiotensin-converting enzyme, which help with blood pressure increase [2]. The Figure 1 showed the renin angiotensin aldosterone system.

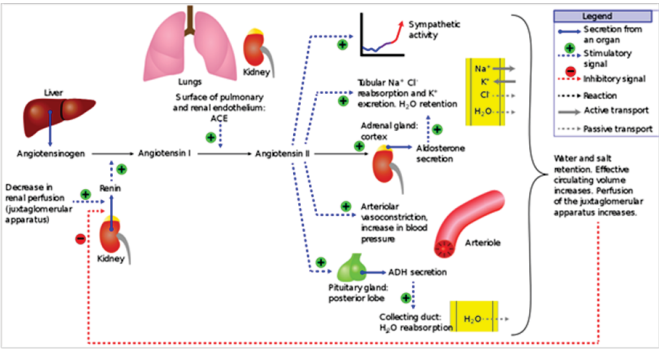

Figure 1: Renin angiotensin aldosterone system [19]

Wright and his colleagues were the first to report this polymorphism by using PCR reaction. A set of primers that flank the insertion sequence was used. Studies based on family showed that by using this PCR, there may be I/D heterozygote mistyping possibility. About 4% to 5% of I/D genotype can be mistyping, an extra PCR amplification reaction was made for confirmation of DD genotype that was obtained in first PCR, including insertion specific primer. Many studies use the combination of standard and confirmatory PCR reactions [20]. Different studies were made that association of ACE I/D polymorphism with diabetes mellitus. The Caucasians women failed to show any relationship between diabetes and ACEI/D polymorphism. As a result, *ACE* cannot be considered as an independent factor for diabetes [21]. *ACE* homologues have been found in rabbit, chimpanzee, mice and drosophila melanogaster. *ACE* gene is located in the Noncoding region due to which it becomes a functional variable. DD variant is through to be related to hypertension due to increase in level of *ACE* activity. Due to aging and abnormality in blood pressure, different variants showed different chances of developing hypertension. ACE I/D polymorphism is also associated with many other diseases such as diabetes mellitus, Alzheimer's disease, Parkinson's disease, diabetes retinopathy and cancer [21]. Two third of the United States population have controlled blood pressure at a threshold of 160/95 mmHg and the range in Canada in 49%. Spain showed 23% control rate while England showed 38%control in blood pressure [22]. The aim of this study is to determine the relationship between hearing loss and hypertension in Bahawalpur, Pakistan. In the interaction of angiotensin-converting enzyme (*ACE)* gene polymorphisms as modifiers, and the possible relationship between hearing loss and hypertension.

Classification

Basically, hypertension has two types, primary hypertension or secondary hypertension. Both types of hypertension account for about 90% of all hypertension cases. Primary hypertension is hypertension, which the cause is unknown this is also called essential hypertension. This is the most common type of hypertension [2]. Secondary hypertension is caused by another disease. It is due to hyperaldosteronism unrestricted levels of aldosterone hormone, which are causes kidneys to maintain higher amounts than normal amount of water and salts, which increases your blood pressure and increases your blood volume [23]. It is also known as renal hypertension. In this type of hypertension, once the root cause is treated, blood pressure usually returns to normal or is significantly lowered. Diseases that may be a cause for high blood pressure, alcohol addiction, thyroid dysfunction, sleep apnea, may be chronic kidney disease, and others [2]. Prehypertension is not considered as a disease, but it indicates that individuals suffering. Since it may have a risk of developing stage 3 and stage 4 hypertension [24]. There are four different types of stages of high blood pressure or hypertension [25] if your systolic blood pressure is between 140 and 159 or your diastolic pressure is between 90 and 99, you are considered to be in hypertension stage 1. If systolic blood pressure between140/90 or diastolic blood pressure is between 159/99 are considered as stage 2 or mild hypertension. If systolic blood pressure between160/100 or diastolic blood pressure is between 179/109 are considered as stage 3 or moderate hypertension. Stage 4 or severe hypertension is 180/110 or higher (Table 1).

Table 1: Classification of blood pressure [26]

Classification	Systolic BP (mmHg)	Diastolic BP (mmHg)
Stage 1 Normal	<120	<80
Stage 2 Prehypertension	120-139	80-89
Stage 3	140-159	90-99
Stage 4	>180	>110

Statistics

Demographic factors and lifestyles are usually the variable factors due to which prevalence of arterial hypertension differs worldwide. These factors include nutritional habits and physical activities. According to estimation this fluctuation is also due to geographic regions locations. In developing countries like Australia and US where literacy rate is quite high, hypertension increases from 62% to 72% [27]. In South Asian region, studies have found that most (53%, 71%, and 57%) of individuals taking medications for hypertension have uncontrolled BP in Bangladesh 53%, Pakistan 71%, and Sri Lanka 57%. The rate of hypertension is expected to rise in these developing countries due to

DOI: https://doi.org/10.54393/pbmj.v6i04.858

sociodemographic changes and low literacy rate and availability of healthcare facilities. This indicates the necessity for instant health care actions for targeting known hurdles and for enhancing approach to required hypertension care service, particularly in low socioeconomic status communities living in South Asia [28]. In South Asia, situation is quite alarming as developed country like China is estimated to have only 8% and India having 6% control rates in administrating hypertension. Currently, 1 billion people worldwide are estimated to have hypertension (>140/90 mmHg), it is predicted that this number will increase to 1.56 billion by 2025 [29]. In Pakistan same situation can be seen as National Health Survey calculated that hypertension affects 18% of adults and 33% of adults above 45 years old. Similar report shows that in Pakistan approximately 18% of people have hypertension and one out of three people (over the age of 40) are at high risk of wide range of diseases [29].

Treatment

Different studies have provided the magnitude of treatment of hypertension. Current studies have indicated that prescription in a population has changed due to changes in the pattern of anti-hypertensive drugs. For example, in USA, immediate aggravation in the ratio of anti-hypertensive prescription for angio-tensin converting enzyme-inhibitors and blockers of calcium channel and in the same way decrease ratio of prescription for diuretics [30]. At this moment studies are going on for antihypertensive and lipid-lowering treatment for preventing heart attack. But the surveillance system has given finite data for treating hypertension by changing lifestyle to some extent. Changes in lifestyle seem an easy way to treat hypertension and it attracts health care providers and patients both. However it is very hard to maintain the aims of this therapy [31]. For accomplishing these goals food should be consumed by hypersensitive patients that have low calories and salt content. Public education campaigns should be started for promoting healthy lifestyle, for example, good nutrition, modification in alcohol intake and physical activity should be increased. Health care providers should motivate patients and at the same time ensure that alternating lifestyle modification interventions instead of pharmacological therapy should not decrease level of hypertension control in population [31].

Prevention

To eradicate all hypertension related diseases in the population, preventive measures must be taken along with the treatment. Measures for primary prevention are similar and in use for non-pharmacological treatment of hypertension. Similarly, measures like reduction of risk accompany and boost each other. Many people in community are attracted to and pursue primary prevention measures because at least some change in blood pressure will yield fundamental health benefits.

Future perspectives

Genetic diversity plays a crucial role in response generation against antihypertensive medications. Genome-wide associations studies (GWAS) have increased our awareness in identify genes associated with the development of hypertension and expecting responses against antihypertensive agents. Genomic studies can provide more knowledge in the risk assessment and progression of diseases associated with hypertension.

CONCLUSIONS

Therefore lowering of blood pressure by 2 mm Hg generally in community can have vast outcome of annual decrease in stroke, coronary heart disease and all-causes of mortality of about 6%, 4% and 3% respectively [32]. In the same way, if a hypertension patient has a 2-3 mmHg average reduction in their high normal blood pressure, then it will result in a 25-50% reduction in the occurrence of hypertension. [33] This accessible prospective for the well-being gives primary prevention of hypertension its significance and make it an important target for the community.

Conflicts of Interest

The authors declare no conflict of interest.

Source of Funding

The authors received no financial support for the research, authorship and/or publication of this article.

REFERENCES

[1] Pálsson R and Patel UD. Cardiovascular complications of diabetic kidney disease. Advances in Chronic Kidney Disease. 2014 May; 21(3): 273-80. doi: 10.1053/j.ackd.2014.03.003.

[2] Berman HM, Westbrook J, Feng Z, Gilliland G, Bhat TN, Weissig H, *et al*. The protein data bank. Nucleic Acids Research. 2000 Jan; 28(1): 235-42. doi: 10.1093/nar/28.1.235.

[3] Bedir A, Arık N, Adam B, Kılınç K, Gümüş T, Güner E. Angiotensin converting enzyme gene polymorphism and activity in Turkish patients with essential hypertension. American Journal of Hypertension. 1999 Oct; 12(10): 1038-43. doi: 10.1016/S0895-7061(99)00096-5.

[4] Binder DK, Horton JC, Lawton MT, McDermott MW. Idiopathic intracranial hypertension. Neurosurgery. 2004 Mar; 54(3): 538-51. doi: 10.1227/01.NEU.0000109042.87246.3C.

[5] Diaz ME. Hypertension and obesity. Journal of Human

DOI: https://doi.org/10.54393/pbmj.v6i04.858

Hypertension. 2002 Mar; 16(1): S18-22. doi: 10.1038/sj.jhh.1001335.

[6] Diaz KM and Shimbo D. Physical activity and the prevention of hypertension. Current Hypertension Reports. 2013 Dec; 15(6): 659-68. doi: 10.1007/s11906-013-0386-8.

[7] Talbott EO, Findlay RC, Kuller LH, Lenkner LA, Matthews KA, Day RD, *et al.* Noise-induced hearing loss: a possible marker for high blood pressure in older noise-exposed populations. Journal of Occupational Medicine. 1990 Aug; 32: 690-7.

[8] Baudin B. New aspects on angiotensin-converting enzyme: from gene to disease. De Gruyter. 2002 Apr; 4(3): 256-65. doi: 10.1515/CCLM.2002.042.

[9] Okojie OM, Javed F, Chiwome L, Hamid P. Hypertension and Alcohol: A Mechanistic Approach. Cureus. 2020 Aug; 12(8): e10086. doi: 10.7759/cureus.10086.

[10] Mei X, Atturo F, Wadin K, Larsson S, Agrawal S, Ladak HM, Li H, Rask-Andersen H. Human inner ear blood supply revisited: the Uppsala collection of temporal bone—an international resource of education and collaboration. Upsala Journal of Medical Sciences. 2018 Jul; 123(3): 131-42. doi: 10.1080/03009734.2018.1492654.

[11] Ciorba A, Bianchini C, Pelucchi S, Pastore A. The impact of hearing loss on the quality of life of elderly adults. Clinical Interventions in Aging. 2012 Jun; 7: 159-63. doi: 10.2147/CIA.S26059.

[12] Dubno JR, Lee FS, Matthews LJ, Mills JH. Age-related and gender-related changes in monaural speech recognition. Journal of Speech, Language, and Hearing Research. 1997 Apr; 40(2): 444-52. doi: 10.1044/jslhr.4002.444.

[13] Eriksson U, Danilczyk U, Penninger JM. Just the beginning: novel functions for angiotensin-converting enzymes. Current Biology. 2002 Oct; 12(21): R745-52. doi: 10.1016/S0960-9822(02)01255-1.

[14] Hecker M, Pörsti I, Busse R. Mechanisms involved in the angiotensin II-independent hypotensive action of ACE inhibitors. Brazilian Journal of Medical and Biological Research= Revista Brasileira de Pesquisas Medicas e Biologicas. 1994 Aug; 27(8): 1917-21.

[15] Alves-Lopes R, Montezano AC, Neves KB, Harvey A, Rios FJ, Skiba DS, *et al.* Selective inhibition of the C-domain of ACE (angiotensin-converting enzyme) combined with inhibition of NEP (Neprilysin): a potential new therapy for hypertension. Hypertension. 2021 Sep; 78(3): 604-16. doi: 10.1161/HYPERTENSIONAHA.121.17041.

[16] Das M, Hartley JL, Soffers RL. Serum angiotensin-converting enzyme. Isolation and relationship to the pulmonary enzyme. Journal of Biological Chemistry. 1977 Feb; 252(4): 1316-9. doi: 10.1016/S0021-9258(17)40657-0.

[17] Scott JH, Menouar MA, Dunn RJ. Physiology, Aldosterone. Treasure Island (FL): StatPearls Publishing; 2023.

[18] Klahr S and Morrissey JJ. The role of vasoactive compounds, growth factors and cytokines in the progression of renal disease. Kidney International. 2000 Apr; 57: S7-14. doi: 10.1046/j.1523-1755.2000.07509.x.

[19] Paul M, Poyan Mehr A, Kreutz R. Physiology of local renin-angiotensin systems. Physiological Reviews. 2006 Jul; 86(3): 747-803. doi: 10.1152/Physrev. 00036. Pmid 16816138.

[20] Sayed-Tabatabaei FA, Oostra BA, Isaacs A, Van Duijn CM, Witteman JC. ACE polymorphisms. Circulation Research. 2006 May; 98(9): 1123-33. doi: 10.1161/01.RES.0000223145.74217.e7.

[21] Nawaz SK and Hasnain S. Pleiotropic effects of ACE polymorphism. Biochemia Medica. 2009 Feb; 19(1): 36-49. doi: 10.11613/BM.2009.004.

[22] Wolf-Maier K, Cooper RS, Kramer H, Banegas JR, Giampaoli S, Joffres MR, *et al.* Hypertension treatment and control in five European countries, Canada, and the United States. Hypertension. 2004 Jan; 43(1): 10-7. doi: 10.1161/01.HYP.0000103630.72812.10.

[23] Giles TD, Berk BC, Black HR, Cohn JN, Kostis JB, Izzo Jr JL, *et al.* Expanding the definition and classification of hypertension. The Journal of Clinical Hypertension. 2005 Sep; 7(9): 505-12. doi: 10.1111/j.1524-6175.2005.04769.x.

[24] Qureshi AI, Suri MF, Kirmani JF, Divani AA, Mohammad Y. Is prehypertension a risk factor for cardiovascular diseases? Stroke. 2005 Sep; 36(9): 1859-63. doi: 10.1161/01.STR.0000177495.45580.f1.

[25] Giles TD, Materson BJ, Cohn JN, Kostis JB. Definition and classification of hypertension: an update. The Journal of Clinical Hypertension. 2009 Nov; 11(11): 611-4. doi: 10.1111/j.1751-7176.2009.00179.x.

[26] Pickering TG, White WB, American Society of Hypertension Writing Group. When and how to use self (home) and ambulatory blood pressure monitoring. Journal of the American Society of Hypertension. 2008 May; 2(3): 119-24. doi: 10.1016/j.jash.2008.04.002.

[27] Jafar TH, Gandhi M, Jehan I, Naheed A, de Silva HA, Shahab H, *et al.* Determinants of uncontrolled hypertension in rural communities in South Asia—Bangladesh, Pakistan, and Sri Lanka. American Journal of Hypertension. 2018 Oct; 31(11): 1205-14.

DOI: https://doi.org/10.54393/pbmj.v6i04.858

doi: 10.1093/ajh/hpy071.

[28] Chow CK, Teo KK, Rangarajan S, Islam S, Gupta R, Avezum A, *et al.* Prevalence, awareness, treatment, and control of hypertension in rural and urban communities in high-, middle-, and low-income countries. JAMA. 2013 Sep; 310(9): 959-68. doi: 10.1001/jama.2013.184182.

[29] Saleem F, Hassali AA, Shafie AA. Hypertension in Pakistan: time to take some serious action. British Journal of General Practice. 2010 Jun; 60(575): 449-50. doi: 10.3399/bjgp10X502182.

[30] Gross TP, Wise RP, Knapp DE. Antihypertensive drug use. Trends in the United States from 1973 to 1985. Hypertension. 1989 May; 13(5_supplement): I113. doi: 10.1161/01.HYP.13.5_Suppl.I113.

[31] Cloher TP and Whelton PK. Physician approach to the recognition and initial management of hypertension: results of a statewide survey of Maryland physicians. Archives of Internal Medicine. 1986 Mar; 146(3): 529-33. doi: 10.1001/archinte.146.3.529.

[32] Stamler R. Implications of the INTERSALT study. Hypertension. 1991 Jan; 17(1_supplement): I16. doi: 10.1161/01.HYP.17.1_Suppl.I16.

[33] Hypertension Prevention Trial Research Group. The Hypertension Prevention Trial: three-year effects of dietary changes on blood pressure. Archives of Internal Medicine. 1990 Jan; 150(1): 153-62. doi: 10.1001/archinte.150.1.153.