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Hypertension: A Review of Disease Pathophysiology, Diagnosis, and Management

Jan Mohammad*, Satpal Kushwaha, Tanya Sharma and Ranjan Kumar Singh

Faculty of Pharmaceutical Sciences, Mewar University, Chittorgarh, Rajasthan-312901

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***Corresponding Author:**
Jan Mohammad
Faculty of Pharmaceutical sciences Mewar University, Chittorgarh, Rajasthan-312901, India.
Email: rxsingh41800557@gmail.com

ABSTRACT

Hypertension is a leading cause of cardiovascular disease and premature death Worldwide. Owing to the wide spread use of an anti-hypertension medication, global means blood pressure. The Hypertension has increased especially in low and middle income countries (LMIC) Variations in levels of risk factors for hypertension such as high sodium intake, low potassium intake, alcohol consumption, physical inactivity and unhealthy diet ,may act as some of the regional cause of hypertension. Understanding the epidemiology of hypertension will significantly reduce the burden of associated illness and mortality. Initiatives such as the National High Blood Pressure Education Program (NHBPEP) have significantly reduced the morbidity and mortality associated with hypertension in the United States by raising knowledge of the condition from 51% between 1976 and 1980 to 70% between 1999 and 2000. Age-adjusted stroke mortality rates have decreased by almost 60% since 1972, while coronary heart disease death rates have decreased by roughly 50%. It is anticipated that the WHO's recent efforts to combat non-communicable diseases would reduce the number of high blood pressure-related illnesses and fatalities worldwide.

Introduction

Persistently raised arterial blood pressure, which happens when the force of blood on the vessel walls stays higher than usual over time, is the hallmark of hypertension, a chronic medical illness. It is commonly described as having a systolic blood pressure of at least 140 mmHg and/or a diastolic blood pressure of at least 90 mmHg on several readings. One of the most prevalent non-communicable diseases in the world, hypertension is a significant risk factor for cardiovascular problems such heart failure, stroke, ischaemic heart disease, and chronic kidney disease. It is known as the "silent killer" because it frequently shows no symptoms in the early stages and is typically found during routine screening or after problems arises. (1)

Due to ageing populations, sedentary lifestyles, poor diets, obesity, and stress, the burden of hypertension is rising worldwide. Over one billion people worldwide suffer with hypertension, which is a major cause of

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early mortality, according to the World Health Organization. Reducing problems requires early diagnosis, lifestyle changes, and proper medication. Major organisations like the American Heart Association and the European Society of Cardiology have created evidence-based management guidelines that prioritise prevention, routine monitoring, and customised treatment plans. Harrison's Principles of Internal Medicine and other standard medical textbooks likewise characterise hypertension as a complex condition impacted by both environmental and hereditary factors.(2)

Globally, hypertension is the primary cause of cardiovascular disease and early mortality. Over the past forty years, the global mean blood pressure (BP) has either remained steady or slightly dropped due to the widespread use of antihypertensive drugs. In contrast, hypertension has become more common, particularly in low- and middle-income countries (LMICs). According to estimates, 31.1% of individuals (1.39 billion) globally suffered with hypertension in 2010. Adults with hypertension were more common in LMICs (31.5%, 1.04 billion people) than in high-income nations (28.5%, 349 million individuals).(3)

Pathophysiology

The primary cause is a persistent elevation in systemic vascular resistance resulting from alterations in blood vessels and diminished capacity to dilate them. Over time, neurohormonal activation, such as the renin-angiotensin-aldosterone system and the sympathetic nervous system, along with less sodium excretion, causes the pressure-natriuretic curve to change. This makes the kidneys think that a higher blood pressure is normal High blood pressure that lasts for a long time can cause left ventricular hypertrophy, stiff arteries, and poor endothelial function, all of which make high blood pressure worse. (4)

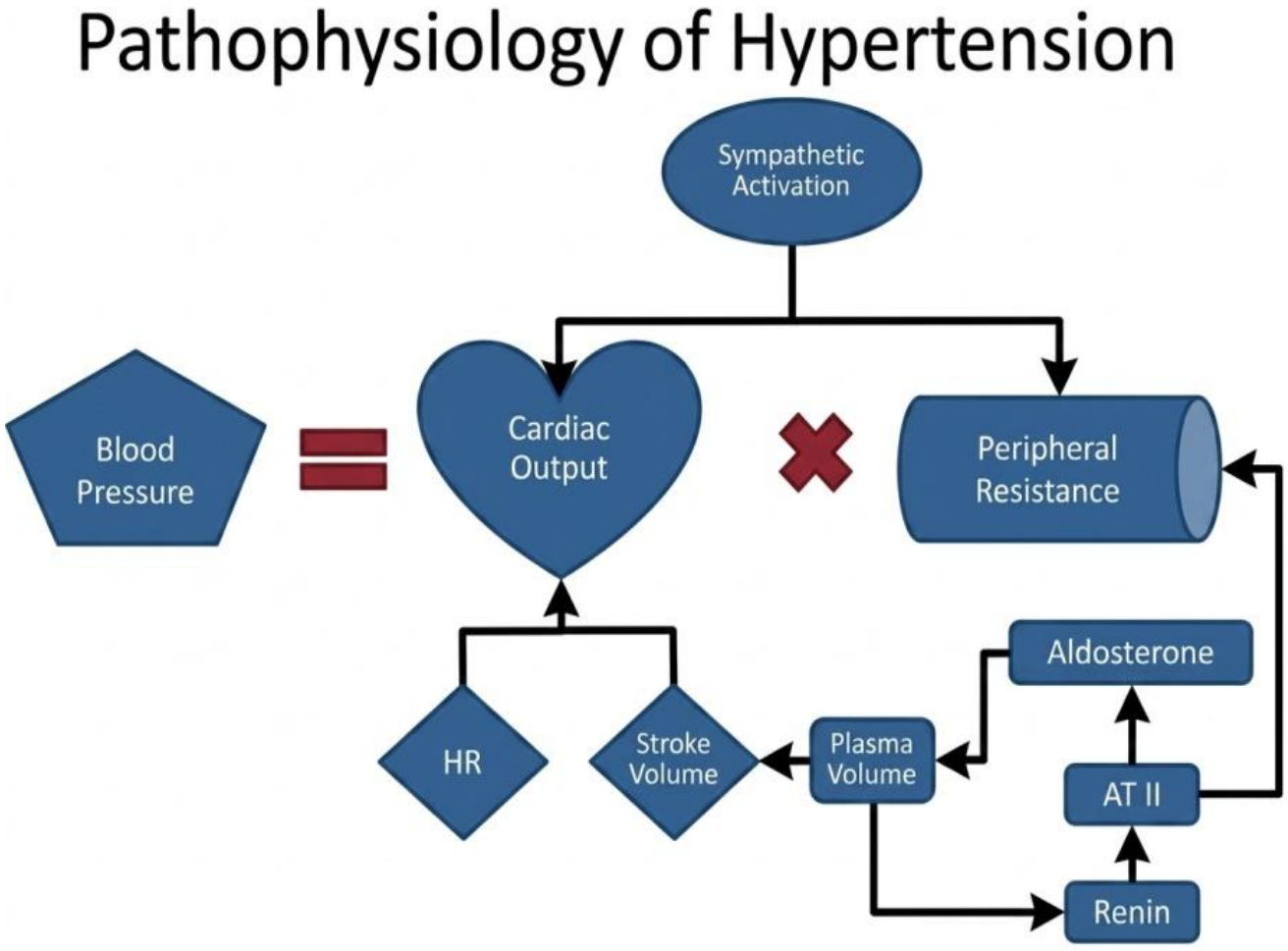

Figure 1: Pathophysiology of hypertension

Clinical presentation

Most patients do not show symptoms and are diagnosed during routine check-ups. When symptoms do occur, they are usually vague: headache, dizziness, visual changes, palpitations, or shortness of breath during activity. Hypertensive urgency or emergency may cause chest pain, neurological problems, breathing difficulties, changes in mental status, or signs of damage to organs like encephalopathy, acute kidney injury, or pulmonary edema.

In both industrialized and developing countries, including our own, arterial hypertension is the main independent risk factor for the development of cardiovascular disease and mortality.

Approximately 50% of myocardial infarction cases and 60% of cerebrovascular occurrences are caused by high blood pressure. According to the World Health Organization, individuals without antihypertensive medication who have a systolic blood pressure of 140 mmHg or higher and/or a diastolic blood pressure of 90 mmHg or higher are considered to have arterial hypertension.(5)

Pathological findings

Chronic hypertension causes hyaline arteriolosclerosis in small arteries and concentric left ventricular hypertrophy in the heart. In cases of malignant hypertension, one can see hyperplastic "onion-skin" arteriolosclerosis and fibroid necrosis, often accompanied by retinal flame haemorrhages and papilledema. In the kidneys, prolonged hypertension leads to nephrosclerosis with smaller, shrunken kidneys. (6)

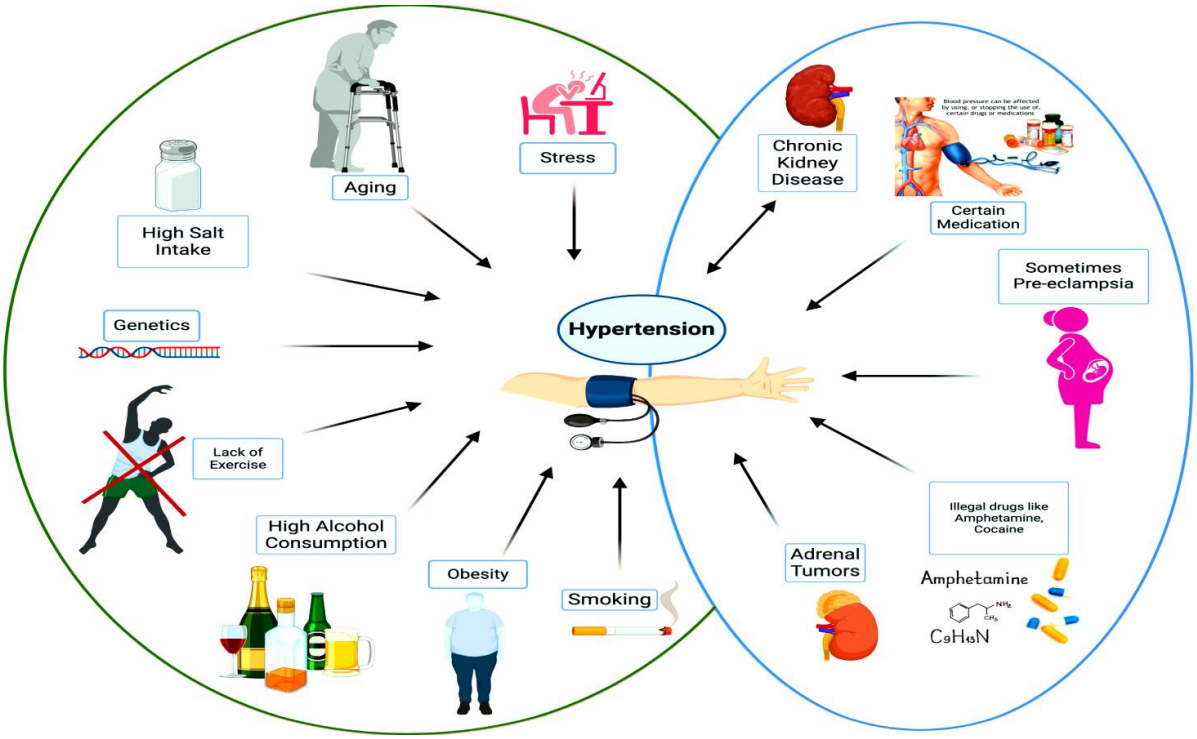

Figure 2: The incidence and severity of hypertension are influenced by an individual's unique living circumstances. Stress, excessive salt consumption, and smoking are among the factors that cause hypertension and are shown in red on the left. On the right side, in blue, are additional causes of hypertension, such as adrenal tumors, medicines, pregnancy, and chronic kidney disease.

Diagnosis

Clinical assessment, bolstered by laboratory and imaging tests, is the basis for diagnosis. The foundation for recognising distinctive indications and symptoms is still a thorough history and physical examination. Blood tests and certain biomarkers are examples of laboratory examinations that aid in confirming the suspected

ailment and determining its severity. Differential diagnosis is aided by structural and functional insights provided by imaging modalities like CT, MRI, ultrasound, and X-ray. For conclusive confirmation, histopathology analysis or molecular diagnostic methods can be necessary in some circumstances. For proper management, better patient outcomes, and a reduction in complications and disease progression, early and precise diagnosis is crucial. (7)

Common cut-offs used for adults:

- Normal: <120/<80 mmHg
- Elevated (pre-hypertension, ACC/AHA): 120–129/<80 mmHg
- Stage 1 hypertension: 130–139 or 80–89 mmHg
- Stage 2 hypertension: ≥140 or ≥90 mmHg

The initial workup typically includes serum creatinine/eGFR, electrolytes, fasting glucose or HbA1c, fasting lipid panel, urinalysis (looking for protein or blood), and ECG; echocardiography may be considered if left ventricular hypertrophy is suspected. It's important to look for secondary causes if hypertension appears early, suddenly, is resistant to treatment, or if there are clear clinical signs- Normal: <120/<80 mmHg

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Treatment

Persistently high arterial blood pressure is the hallmark of hypertension, a chronic illness that raises the risk of cardiovascular conditions like stroke, myocardial infarction, and renal failure. Lifestyle changes are the first step in management and are advised for all patients, regardless of severity. These include following the DASH diet, cutting back on sodium in the diet, getting regular exercise, controlling weight, quitting smoking, and limiting alcohol intake. Pharmacological treatment is started when lifestyle changes are not enough to reach the desired blood pressure, which is typically less than 130/80 mmHg in high-risk patients. Thiazide diuretics like hydrochlorothiazide, ACE inhibitors like enalapril, angiotensin receptor blockers like losartan, and calcium channel blockers like amlodipine are examples of first-line antihypertensive medications. Combination therapy is frequently necessary to attain sufficient blood pressure control.(9)

Patient-specific characteristics like age, risk profile, and comorbidities influence the choice of treatment. For instance, beta blockers or medications like Labetalol are utilised during pregnancy, whereas ACE inhibitors or ARBs are recommended for patients with diabetes or chronic renal disease. Additional medications, such as mineralocorticoid receptor antagonists, may be necessary for resistant hypertension. Major clinical guidelines from the American Heart Association, European Society of Cardiology, and World Health Organization support these therapeutic approaches(10). The National Institute for Health and Care Excellence and Harrison's Principles of Internal Medicine are two standard medical references that offer comprehensive evidence-based guidelines for the treatment of hypertension. (11) In recent years, research in the field of nanomedicine has produced encouraging results. The science that integrates chemistry, medicine, and nanotechnology is called nanomedicine. With the specific aim of enhancing drug delivery to the brain, numerous types of nanomedicine-based drug delivery devices are presently being researched.(12) This

research examines key components of innovative medication delivery systems and their many categories. Novel Drug Delivery Systems (NDDS), which were first developed many years ago, have recently made significant progress. NDDS has benefits over traditional dose forms, such as better treatment outcomes. NDDS is selected to introduce novel concepts into the regulated market under the new patent system. In recent years, numerous forms of microparticles, nanoparticles, osmotically modulated systems, transdermal therapeutic systems, aquasomes, dendrimers, multiple emulsions, micro-emulsions, liposomes, niosomes, pharmacophores, self-regulating systems, and brain-targeted delivery systems have been developed.(13) Traditional medicine remains essential in the management of diarrhoea, with herbal medicines serving as the foundation of treatment in several communities.(14)

Lifestyle changes include

- Reducing sodium intake, following a DASH-style diet, and losing weight if needed
- Engaging in regular aerobic exercise; timing workouts with individual chronotype can slightly improve heart health for adults at risk (15)
- Limiting alcohol consumption, quitting smoking, and managing stress
- Culinary medicine approaches that teach cooking and dietary skills can significantly help with blood pressure control and adherence.

First-line medications for uncomplicated primary hypertension include:

- Thiazide diuretics (such as chlorthalidone 12.5–25 mg daily)
- ACE inhibitors (like lisinopril 10–40 mg daily)
- ARBs (like losartan 50–100 mg daily)
- Dihydropyridine calcium channel blockers (such as amlodipine 5–10 mg daily) (16)

Medication choice depends on age, race or ethnicity, other health conditions, and tolerability. Patients with diabetes, chronic kidney disease, or coronary artery disease benefit from ACE inhibitors or ARBs. Black patients without chronic kidney disease often respond better to thiazides or calcium channel blockers. The target is usually less than 130/80 mmHg for most high-risk patients, balancing benefits with potential side effects.(17)

Team-based and system-based strategies, such as shared tasks and digital tools, can improve hypertension control in settings with limited resources. AI-driven risk prediction, blood pressure pattern analysis, and decision support are emerging tools for management. (18)

Risk factors

Non-modifiable factors include age, family history, race or ethnicity (with higher prevalence and severity in Black populations), and male sex during midlife. (19)

Modifiable factors include obesity, high sodium and low potassium diets, lack of exercise, excessive alcohol use, obstructive sleep apnea, chronic stress, and unhealthy eating patterns.

Comorbidities like diabetes, chronic kidney disease, dyslipidaemia, and metabolic syndrome are closely linked and increase risk dramatically. (20)

Prevention

Since the condition is heavily impacted by modifiable environmental and behavioural factors, the primary focus of hypertension prevention is lifestyle adjustment and early risk reduction strategies. (21) It is highly advised to adopt a healthy eating pattern, such as the DASH diet, which is defined by a high consumption of fruits, vegetables, whole grains, and low-fat dairy products with reduced sodium and saturated fat. Increased potassium consumption and sodium restriction play a major role in population-level blood pressure regulation(22) . Frequent exercise, such as at least 150 minutes a week of moderate-intensity aerobic

exercise, helps maintain body weight and vascular health, and it has been demonstrated that losing weight in overweight people dramatically lowers blood pressure. Reducing alcohol intake and abstaining from tobacco usage help lower the cardiovascular risk of hypertension. Additionally, stress-reduction methods like yoga, meditation, and getting enough sleep are crucial in reducing sympathetic hyperactivity. (11)Timely preventive measures are made possible by early screening and identification of people at risk, such as those with diabetes, obesity, or a family history of hypertension. Policies that promote healthy lifestyles and lower the amount of salt in processed foods are crucial for lowering the population's overall burden of hypertension at the public health level.(23)

Complications and prognosis

Poorly managed hypertension speeds up atherosclerosis and is a key reason for:

- Cardiovascular issues such as left ventricular hypertrophy, heart failure (especially heart failure with preserved ejection fraction), coronary artery disease, heart attacks, and atrial fibrillation.
- Cerebrovascular events such as ischemic strokes, intracerebral haemorrhage's, and vascular dementia. (24)
- Kidney problems including chronic kidney disease and end-stage renal disease
- Other complications like aortic aneurysms or dissections, hypertensive retinopathy, and peripheral artery disease. (25)

Prognosis is strongly influenced by the level and duration of blood pressure elevation and the overall burden of risk factors. Achieving recommended blood pressure targets greatly reduces the risk of heart attacks, strokes, heart failure, and cardiovascular-related death. (26)

Conclusion

Hypertension is a major global public health issue and a leading cause of heart-related illness and death. Its many causes include genetic, environmental, and lifestyle factors. Because of this, early detection and on-going management are crucial. We can effectively control hypertension through lifestyle changes and the right medications that fit each patient's needs. Public health efforts, awareness programs, and regular screenings are vital in lowering the impact of this disease. With prompt action and sticking to treatments, we can greatly reduce the risk of complications, which improves overall quality of life and long-term outcomes.

References:

1. Sega R, Facchetti R, Bombelli M, Cesana G, Corrao G, Grassi G, et al. Prognostic value of ambulatory and home blood pressures compared with office blood pressure in the general population: Follow-up results from the Pressioni Arteriose Monitorate e Loro Associazioni (PAMELA) study. Circulation [Internet]. 2005;111(14):1777–83. Available from: http://circ.ahajournals.org/
2. Caro JJ, Salas M, Speckman JL, Raggio G, Jackson JD. Persistence with treatment for hypertension in actual practice. C Can Med Assoc J. 1999;160(1):31–7.
3. Mills KT, Stefanescu A, He J. The global epidemiology of hypertension. Nat Rev Nephrol [Internet]. 2020;16(4):223–37. Available from: http://dx.doi.org/10.1038/s41581-019-0244-2
4. Goupil R, Tsuyuki RT, Santesso N, Terenzi KA, Habert J, Cheng G, et al. Hypertension Canada guideline for the diagnosis and treatment of hypertension in adults in primary care. Can Pharm J. 2025;158(4):188–205.
5. Salkic S, BaticMujanovic O, Ljuca F, Brkic S. Clinical Presentation of Hypertensive Crises in Emergency Medical Services. Mater Socio Medica. 2014;26(1):12.
6. Zhang W, Xu M, Feng Y, Mao Z, Yan Z. The Effect of Procrastination on Physical Exercise among College Students—The Chain Effect of Exercise Commitment and Action Control. Int J

Ment Health Promot. 2024;26(8):611–22.

7. Ezquerro L, Coimbra R, Bauluz B, Núñez-Lahuerta C, Román-Berdiel T, Moreno-Azanza M. Large dinosaur egg accumulations and their significance for understanding nesting behaviour. Geosci Front. 2024 Sep 1;15(5).
8. Reynolds K, Gu D, Muntner P, Kusek JW, Chen J, Wu X, et al. A population-based, prospective study of blood pressure and risk for end-stage renal disease in China. J Am Soc Nephrol. 2007;18(6):1928–35.
9. Gu D, Kelly TN, Wu X, Chen J, Duan X, Huang JF, et al. Blood pressure and risk of cardiovascular disease in chinese men and women. Am J Hypertens. 2008 Mar;21(3):265–72.
10. Forouzanfar MH, Liu P, Roth GA, Ng M, Biryukov S, Marczak L, et al. Global burden of hypertension and systolic blood pressure of at least 110 to 115mmHg, 1990-2015. JAMA - J Am Med Assoc. 2017;317(2):165–82.
11. Dorans KS, Mills KT, Liu Y, He J. Trends in prevalence and control of hypertension according to the 2017 American College of Cardiology/American Heart Association (ACC/AHA) guideline. J Am Heart Assoc. 2018;7(11):1–12.
12. J Pavan Kumar, Chennnu MM Prasada Rao, Ranjan Kumar Singh, Ajay Garg, Tanniru Rajeswari. A comprehensive review on blood brain delivery methods using nanotechnology. Trop J Pharm Life Sci. 2024;11(3):43–52.
13. Mantun Prasad Gupta*, Ranjan Kumar Singh, Rajeswari Tanniru, Chennu Mm Prasada Rao Ag. The New Paradigm in Drug Discovery: Novel Drug Delivery System. Indian J Nov … [Internet]. 2013;1(1):47–9. Available from: http://www.ijndd.com/apr-jun2013/5. Short Communication_IJNDD Apr-Jun 2013_103-107_NAREN DHIREN.pdf
14. Ranjan Kumar Singh*1, Satpal Kushwaha2, Mantun Prasad Gupta3, Ajay Garg4, Dr. Vaibhav Saxena5 FA, 1, 2 6. Pharmacological Assessment Of Medicinal Flora With Antidiarrheal Properties : Integrating Traditional Wisdom. Int J Pharm Res Med Plants. 2025;01(December):1–10.
15. Fariba Samadian, Nooshin Dalili, Ali Jamalian. Lifestyle Modifications to Prevent and Control Hypertension - PubMed. Iran J Kidney Dis [Internet]. 2016;10(5):237–63. Available from: https://pubmed.ncbi.nlm.nih.gov/27721223/
16. SOKOLOW M, PERLOFF D. The Prognosis of Essential Hypertension Treated Conservatively. Circulation. 1961;23(5):697–713.
17. Kenning I. Health Care Guideline : Complete initial assessment : Hypertens Diagnosis Treat. 2014;(15).
18. Addo J, Smeeth L, Leon DA. Hypertension in sub-Saharan Africa: A systematic review. Hypertension. 2007;50(6):1012–8.
19. Kirabo A, Harrison DG. Hypertension as a Risk Factor for Atherosclerosis. Atheroscler Risks, Mech Ther. 2015;63–75.
20. Oparil S, Schmieder RE. New Approaches in the Treatment of Hypertension. Circ Res. 2015;116(6):1074–95.
21. Reynolds K, Gu D, Muntner P, Kusek JW, Chen J, Wu X, et al. A population-based, prospective study of blood pressure and risk for end-stage renal disease in China. J Am Soc Nephrol. 2007;18(6):1928–35.
22. Kokiwar PR, Gupta SS, Durge PM. Prevalence of hypertension in a rural community of Central India. J Assoc Physicians India. 2012;60(6):26–9.
23. Sander JWAS. Some Aspects of Prognosis in the Epilepsies: A Review. Epilepsia. 1993;34(6):1007–16.
24. Essien IO. Hypertension - An Overview. Ibom Med J Vol4. 2011;4(1).

25. Can H, Diagnose W, Heart C. How Can We Diagnose Coronary Heart Disease in Hypertensive Patients? Hypertension. 1987;10(5):467–72.
26. Leishman AWD. Observations on prognosis in hypertension. Br Med J. 1953;1(4820):1131–5.

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