

The Silent Storm: Understanding Hypertension

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Abstract:- Hypertension, commonly known as high blood pressure, is a chronic condition characterized by persistently elevated pressure within the blood vessels. Defined as blood pressure consistently exceeding 140/90 mmHg, hypertension poses a significant global health threat, affecting hundreds of millions worldwide. The exact cause of hypertension remains complex, a combination of genetic predisposition, environmental factors and lifestyle choices contribute to its development. Age, weight, diet, alcohol consumption, and lack of physical activity are well established risk factors. Development of Hypertension causes end-organ damage. Early diagnosis through regular BP monitoring is essential. Treatment strategies involve lifestyle modification alongside pharmacological treatment in more severe cases.

Untreated or poorly controlled hypertension can lead to a cascade of serious complications, including heart attack, stroke, kidney failure. According to JNC- 8, ACC guidelines pharmacological therapy is very effective in maintaining hypertension. These include ACE-i, ARBs, Diuretics, Calcium channel blockers, and Beta-blockers. The global prevalence of hypertension is alarming, with the number of affected individuals projected to rise further in the coming decades. Addressing this public health crisis requires a multi-pronged approach, focusing on public awareness, early diagnosis, effective treatment, and promoting healthy lifestyle choices. Research efforts should continue to unravel the complex mechanisms underlying hypertension and develop novel therapeutic strategies for improved prevention and management.

Keywords:- Hypertension, Serious Complications, Lifestyle, Prevention, Management.

I. INTRODUCTION

Hypertension is usually defined as persistently elevated arterial blood pressure (BP), which is very common in this generation. Although elevated blood pressure was anticipated to be “essential” for acceptable perfusion of vital organs during the early and middle 1900s. Some factors which cause hypertension include rotundity, in take of alcohol, tobacco consumption and biological inheritance. Blood pressure has a huge impact on both morbidity and mortality. However the heart and blood vessels can tolerate increased blood pressure

for months and eventually the heart may have a condition called hypertrophy, which may cause heart failure. The survey report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC7) classifies adult BP as shown below.

➤ Classification of Hypertension

Where first two are major and next four are less frequently found:

- Initial or Primary (essential) Hypertension
- Secondary Hypertension
- Isolated Systolic Hypertension
- Malignant Hypertension
- Resistant Hypertension
- Hypertension During gestation period¹

High or raised blood pressure is a major global health risk: It's responsible for millions of deaths annually and significantly increasing cardiovascular disease. Early detection and treatment are crucial: High blood pressure can affect individuals of all ages, and early intervention can significantly reduce future health risks. Suboptimal control remains a challenge: Despite available treatment options, many people with hypertension don't achieve adequate blood pressure control. New approaches like innovative technologies in health care department have majorly change the community by improving screening, detection, and management of hypertension.^{2,3}

Some common complications which are associated with controlled hypertension are ischemic and ischemic stroke, intracranial hemorrhage, left ventricular hypertrophy, heart failure, ischemic heart complaint, and habitual order complaint. Many surveys have been done to determine which antihypertensive specifics ameliorate cardiovascular mortality and also to determine the target blood pressure in cases with multiple comorbidities.⁴

The hypertensive heart condition generally refers to a constellation of changes in the left ventricle, left atrium, and coronary artery as a result of habitual blood pressure elevation. It increases the pressure on the heart for converting structural and functional changes in the myocardium. Morbidity and mortality significantly increase with cases of left ventricular hypertrophy, however current treatment follows standard hypertension guidelines as the goods of

pharmacotherapy on retrogression of left ventricular hypertrophy has unclear benefits. Essential hypertension is generally a no symptom complaint and it cannot be diagnosed based on one elevated BP measurement. A diagnosis of such hypertension stage is only possible with the elevated BP values from the normal of two or more BP measurements, present during two or more clinical encounters. Hypertensive heart complaints chronically raise blood pressure. It's a long-term condition that develops over multitudinous times. Chronic high blood pressure puts a strain on your heart which eventually makes it emphatic to pump the blood. High blood pressure is observed more in women than men and it is a risk of heart failure.⁵

II. ETIOLOGY

The exact causes of primary hypertension are not known, but several factors and conditions may play a role in its development, including:

- Tobacco consumption
- Obese
- Lack of physical movement
- Salty food
- Stress
- Chronic renal failure
- Adrenal and thyroid disorders

➤ Primary Hypertension

Numerous potential mechanisms have been identified that contribute to the pathogenesis of essential hypertension. Genetic factors may play a role in the development of essential hypertension by affecting sodium balance or other BP regulating pathways.

➤ Secondary Hypertension

In secondary hypertension either a comorbid disease or drug is responsible for elevating blood pressure is much less common than primary hypertension. About 5% to 10% of people with high blood pressure have secondary hypertension. Drugs including OTC medication such as ibuprofen and pseudoephedrine can cause secondary hypertension. In most of these cases, renal dysfunction resulting from severe chronic kidney disease or Renovascular disease is a most common secondary cause. Secondary hypertension is classified into following categories:

- **Renal parenchymal disease:** It is the most frequent cause of secondary hypertension which includes various renal diseases such as diabetic nephropathy, interstitial renal parenchymal condition etc. Further majority cases of renal parenchymal conditions are set up to have hypertension and the prevalence of hypertension increases with the declining of renal parenchymal diseases.
- **Renovascular disease:** Hypertension due to renovascular diseases is a real reality and occurs due to stenosis of the unilateral or bilateral renal artery. Atherosclerosis is the cause of renal roadway stenosis in the elderly population, while the youngish population, especially ladies, are set up to have renal roadways stenosis due to fibromuscular

hyperplasia.

- **Vascular disorders:** Coarctation of the aorta is a high illustration of vascular diseases performing in secondary hypertension in youth, grown ups. The rare causes of secondary hypertension may include vasculitis of medium or large- sized arteries and arteriovenous fistula.⁹

➤ The following are the Medication that are used to Treat Secondary Hypertension:

- Amphetamines eg, dexamethylphenidate, dextroamphetamine, phendimetrazine
- Anti Vascular endothelial growth factor agents eg, sorafenib, sunitinib
- Corticosteroids eg, cortisone, methylprednisolone, hydrocortisone.
- Testosterone
- Non steroidal anti inflammatory drugs eg, Choline magnesium trisalicylate, diclofenac cyclooxygenase- 2
- Estrogen containing oral contraceptives

➤ Risk Factors

- Major risk factors: family history, alcohol consumption, excess sodium intake, obesity, sedentary lifestyle.
- Minor risk factors: age, increased intake of fats, deficiency in magnesium levels, calcium levels, smoking and stress.^{5,6}

III. EPIDEMIOLOGY

As for the World Health Organization 2012, of the estimated 57 million global deaths in 2008, 36 million were due to non-communicable diseases (NCDs). The largest proportion of NCD deaths is caused by heart diseases. In terms of attributable deaths, raised blood pressure is one of the leading behavioral and physiological risk factors to which 13% of global deaths are attributed. Hypertension is reported to be the 4th contributor to premature death in developed countries and the 7th in developing countries. Previous reports also suggest that the frequency of hypertension is rapidly increasing in developing countries and is one of the leading causes of death and disability.

In pre industrial organization, BP situations had narrow distribution with mean values that changed little with age and equaled around 150/75 mmHg, a value that presumably represents the normal BP for humans. Still in utmost contemporary organizations, systolic BP situations rise steadily and continuously with time in both men and women. Similar inordinate sodium consumption, inadequate input of salutary potassium, fat, alcohol consumption and physical activity. Other factors, similar as inheritable predilection or adverse intrauterine terrain have small but definite association with high BP situations in adulthood. Indeed modest rises in the main population BP lead to large increases in the absolute number of people with hypertension.^{1,7,8} The prevalence of secondary hypertension increases with worsening renal function and further than 2/3 of the cases with advanced habitual order complaints are set to have

hypertension. Treatment of underpinning endocrine abnormality generally resides in the cure of hypertension. Renovascular hypertension accounts for one of the cases with hypertension and it has by model age distribution.^{9,10,11}

The survey occur in the United States, hypertension alone had a huge rating for cardiovascular complaints- related deaths than any other adjustable threat factors and is alternate only to tobacco consuming as a preventable cause of death for any reason.¹²

➤ *Pathophysiology:*

The primary determinants of blood pressure are cardiac output and vascular compliance, with a high cardiac output and high systemic vascular resistance being the primary mechanisms of hypertension. Secondary hypertension is caused by factors that affect these determinants, such as renal parenchymal conditions. These conditions can lead to disabled renal function, resulting in intravascular volume expansion and an improper activation of the renin-angiotensin-aldosterone and sympathetic system.

Hypertension can worsen renal parenchymal conditions and increase their progression to end-stage renal disease. In cases with advanced renal parenchymal disease, blood pressure is dependent on intravascular volume, making fluid balance an important part of controlling blood pressure in chronic kidney disease. The causes of hypertension can be primary (essential) or secondary. Primary hypertension, which is more common, doesn't have a specific cause and is often linked to risk factors such as obesity, insulin resistance, high salt intake, excessive alcohol intake, sedentary lifestyle, and smoking. Secondary hypertension is caused by underlying conditions, such as chronic kidney disease, diabetes, pheochromocytoma, Cushing's syndrome, congenital adrenal hyperplasia, hyperthyroidism, hyperparathyroidism, pregnancy, and sleep apnea.

Endocrine disorders can significantly contribute to the development of hypertension, or high blood pressure, due to the impact of hormones on blood pressure regulation. The adrenal glands, in particular, can produce excessive amounts of hormones such as aldosterone, cortisol, or hormones similar to adrenaline, leading to hypertension. This is seen in primary aldosteronism, Cushing's syndrome, and pheochromocytoma, which are endocrine disorders that can result in hypertension. In primary aldosteronism, an overproduction of aldosterone can lead to volume expansion, while in Cushing's syndrome, high levels of cortisol can contribute to hypertension. In pheochromocytoma, elevated serum levels of adrenaline and noradrenaline can increase cardiac output and systemic vascular resistance, resulting in hypertension.

Additionally, endocrine disorders can affect the renin-angiotensin-aldosterone system (RAAS) and the sympathetic nervous system, leading to hypertension. For example, in renal artery stenosis, secondary hyperaldosteronism can play a major role in the development of hypertension. Overall, endocrine disorders can significantly contribute to the development of hypertension through various mechanisms,

including excess hormone production, volume expansion, and dysregulation of the RAAS and sympathetic nervous system.

➤ *Renin- Angiotensin - Aldosterone System:*

- Wide-ranging effects on BP regulation: The RAAS plays a significant role in regulating blood pressure through various mechanisms, including sodium retention, pressure natriuresis, vasoconstriction, and endothelial function.
- Pressure-volume homeostasis in the kidney: The RAAS is particularly crucial in maintaining kidney function by ensuring proper perfusion during volume depletion and suppressing its activity during volume overload.
- Cellular level presence: While the RAAS is most evident in the kidney, it's also present at the cellular level in various organs, suggesting broader implications beyond blood pressure control.
- Pathogenesis of hypertension: Dysregulation of the RAAS is implicated in the development of hypertension, highlighting its importance as a potential therapeutic target.

➤ *Genomic Effects (Modifying Gene Expression):*

- Increased ENaC expression: Aldosterone binds to the mineralocorticoid receptor in the cortical collecting duct, leading to increased expression of the epithelial sodium channel (ENaC). This channel promotes sodium reabsorption, increasing blood volume and consequently, blood pressure.

➤ *Non-Genomic Effects (Rapid Effects without Altering Gene Expression):*

- Direct activation of ENaC: Aldosterone can directly activate existing ENaC channels, bypassing the need for gene expression changes. This further boosts sodium reabsorption and contributes to hypertension.
- Non-epithelial effects: Aldosterone has additional effects beyond the kidney, contributing
- to endothelial abnormality and vasoconstriction. These include:
- Vascular smooth muscle cell augmentation: Increased cell growth in the blood vessel walls can narrow the vessels and raise blood pressure.
- Vascular remodeling: Changes in the structure and composition of blood vessels can impair their ability to relax and dilate, leading to hypertension.
- Fibrosis: Scarring within the blood vessel walls can further restrict blood flow and elevate pressure.
- Increased oxidative stress: Aldosterone can promote the production of harmful reactive oxygen species, damaging blood vessels and contributing to hypertension.

Natriuretic peptides, including atrial natriuretic peptide (ANP) and brain natriuretic peptide (BNP), play a crucial role in maintaining cardiovascular homeostasis and cardiac health. They have an impact not only on blood pressure regulation but also on glucose and lipid metabolism. The

summation of all metabolic activities of cardiac NPs, together with their cardiovascular and sodium balance effects may be very important in decreasing the overall cardiovascular risk. Therefore, the cardiac NPs system, with its two receptors and a neutralizing enzyme, might represent one of the main targets to treat these multiple related conditions and to reduce hypertension and metabolic-related cardiovascular risk. Natriuretic peptides raise glomerular filtration rate via an increase in efferent arteriolar in volume expanded countries and inhibit renal sodium reabsorption through both direct and indirect goods. Direct goods include dropped activity of Na – k – ATPase and the sodium glucose cotransporter in the proximal tubule and inhibition of the epithelial sodium channel in the distal nephron. Battery erotic peptide insufficiency also pre-disposes to insulin resistance and type 2 diabetes mellitus. Obesity is associated with natriuretic peptide insufficiency. Natriuretic peptides have remedial potential for the metabolic pattern, the metabolic pattern is a cluster of conditions (including high blood pressure, high fasting glucose situation, abdominal obesity, high triglycerides).

➤ *Sympathetic Nervous System:*

Baroreceptor that smell pressure changes of the circulatory system are house in varied location in the arterial tree, a crucial place being the carotid sinus the ballooned area at the base of the carotid artery just superior to bifurcation of the carotid artery. When the artery is stretched by elevated blood pressure nerve bundles projecting from the baroreceptors of the carotid sinus transmit a message to the brain to reduce sympathetic outflow of nerves. The sympathetic Nervous system is generally more triggered in persons with hypertension than in normotensive individuals. SNS excretion is also lesser in individuals with obesity, in men than in women, in younger than in aged persons, and in those with advanced kidney complaints. Among cases with hypertension, increased rigidity of hypertension is associated with adding situations of sympathetic exertion measured by micro neurography.

The degree of blood pressure elevation on a high salt diet is directly related to the degree of renal tubulointerstitial fibrosis and a decrease in glomerular filtration rate. This relationship suggests that catecholamines, influenced by hypertension, lead to renal interstitial injury and a salt-sensitive phenotype that persists even after sympathetic overactivity is no longer present. There is evidence indicating that sympathetic overactivity enhances salt sensitivity by reducing the activity of the WNK lysine protein kinase gene, which encodes a serine/threonine kinase that inhibits the thiazide-sensitive Na-Cl cotransporter, resulting in increased distal tubular sodium retention. These mechanisms have been recently examined in studies.¹

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overactivity enhances salt perceptivity owing to a reduction in exertion on the WNK lysine protein kinase gene which encodes serine/ threonine kinase that inhibits the thiazide-sensitive, Na-CL cotransporter, performing in increased distal tubular sodium retention. These mechanisms have been examined recently.¹

➤ *History:*

- Stroke: fatigue, numbness, or paralysis on one side of the body, difficulty speaking or understanding speech, abnormal vision, dizziness, or severe headache.
- Hypertensive encephalopathy: Severe headache, confusion, seizures, and coma.
- Acute pulmonary edema symptoms: During a physical examination, in addition to elevated blood pressure and occasional leg swelling (pedal edema), the doctor might look for signs suggestive of specific underlying causes of secondary hypertension, such as: Coarctation of the aorta: Narrowing of the main artery carrying blood from the heart. Signs include weak or delayed pulses in the wrists compared to the ankles, and significant differences in blood pressure readings between the arms or legs.
- Aortic valve disease: Abnormal narrowing or leaking of the heart valve between the left ventricle and the aorta. Signs include a heart murmur (swishing sound) heard with a stethoscope.
- Thyroid conditions: Overactive (hyperthyroidism) or underactive (hypothyroidism) thyroid gland can affect blood pressure. Signs of hyperthyroidism include weight loss, anxiety, tremors, and bulging eyes. Signs of hypothyroidism include fatigue, obesity, and cold intolerance.
- Polycystic kidney disease: Enlarged kidneys with multiple cysts.
- Endocrine diseases: Cushing's syndrome (excessive cortisol production), acromegaly (excess growth hormone), and Conn's syndrome (primary aldosteronism) can all cause high blood pressure. Signs may include weight gain, muscle weakness, skin changes, and high blood sugar.
- The presence of additional symptoms like excessive fatigue, sleep apnea, kidney stones, or bone problems can further point towards specific underlying causes.⁶
- Due to hypertension end- organ abnormality, refractory hypertensive state and sudden rise in blood pressure occurs in hypertensive individuals, who are stable on medication, are classical features of secondary hypertension.
- History of kidney failure, atherosclerotic cardiovascular complaint, and edema may warrant further evaluation of chronic kidney complaint (renal parenchymal complaint).
- History of continual urinary system infection, renal stone, critical or habitual abdominal pain hematuria and increasing risk of renal failure may direct toward autosomal dominant polycystic nephro complaint.
- Sniffing, weight gain and day somnolence could be reflective of hypopnea syndrome. Kidney stone, osteoporosis, depression and muscular deficiendcy present in hyperparathyroidism.¹²

➤ *Differential Diagnosis*

Once a person has been monitored and establish high blood pressure, ambulatory blood pressure monitoring (ABPM) is regarded as the most precise way to diagnose hypertension and is approved by guidelines to routinely confirm increased blood pressure readings. Ambulatory observers generally involve adjustable, automatic cuffs worn reluctantly that measure blood pressure every 15 to 30 minutes during the day and 15 the 60 minutes overnight. Advances in technology have permitted the development of new 'cuffless' BP monitoring devices which continuously detects BP without any disturbance. The American Heart Association (AHA) has raised concerns about the accuracy of smartphone blood pressure apps, indicating that mobile app-based blood pressure measurements are inaccurate 4 out of 5 times when tested. This highlights the importance of ensuring the reliability and accuracy of cuffless blood pressure monitoring devices that utilize smartphone or wearable detectors technology to estimate blood pressure from ECG signals. These devices typically consist of a wearable wristband that collects ECG signals and communicates with a smartphone via Bluetooth to provide continuous blood pressure monitoring. It is crucial to address the accuracy issues raised by the AHA to ensure the effectiveness and reliability of these innovative technologies in hypertension management.²

- Chronic kidney disease: This can lead to hypertension due to impaired ability to remove fluids and waste products from the blood.
- Autosomal dominant polycystic kidney disease (ADPKD) is a genetic disorder that causes cysts to form in the kidneys, impacting their function and potentially raising blood pressure, it is an inherited condition that affects both the kidneys.
- Primary aldosteronism: This condition arises from excessive aldosterone production by the adrenal glands, leading to sodium and water retention and high blood pressure.
- Cushing's syndrome: This results from overactive adrenal glands producing excessive cortisol, causing a range of symptoms including high blood pressure.
- Hyperthyroidism and hypothyroidism: Both thyroid disorders can affect blood pressure, with hyperthyroidism often causing high blood pressure and hypothyroidism sometimes contributing.
- Congenital adrenal hyperplasia (CAH): This group of genetic disorders disrupts adrenal hormone production, potentially leading to high blood pressure in some cases.
- Obstructive sleep apnea (OSA): This condition where breathing is repeatedly interrupted during sleep can contribute to high blood pressure.
- Pregnancy: Gestational hypertension can occur during pregnancy due to changes in blood flow and hormone levels.^{9,13} Before diagnosing hypertensive heart disease (HHD), it's crucial to rule out other potential causes of heart failure.

- ✓ Ischemic cardiomyopathy or coronary artery disease: It is indeed the most frequent cause of heart failure, often stemming from thinned or occlude coronary arteries that restrict blood flow to the coronary muscle.
- ✓ Hypertrophic cardiomyopathy: This condition involves thickening of the heart walls, making it harder for the heart to pump blood effectively.
- ✓ Cardiomyopathy due to other etiologies: Various factors can damage the heart muscle, including viral infections, certain medications, and toxins.
- ✓ Valvular disorders: Faulty heart valves can impede blood flow, leading to heart failure. Aortic stenosis, where the aortic valve narrows, is a common example.
- ✓ Sleep apnea: It is a sleep disorder, where repeated breathing is stops and starts during sleep, can put strain on the heart and contribute to heart failure.⁵

➤ *Treatment and Management*

The operation of secondary hypertension involves achieving acceptable control of blood pressure through a healthy lifestyle, appropriate antihypertensive medications, and addressing the underlying secondary causes mentioned. It is crucial to consult clinicians with experience in treating the root cause of hypertension. Identifying medications that can provoke hypertension is a critical aspect of managing secondary hypertension. In the following section, we will briefly discuss the management of the more common causes of secondary hypertension.

➤ *Renal Parenchyma Complaint:*

Diabetic nephropathy, habitual glomerulonephritis, glomerulosclerosis, and autosomal dominant polycystic kidney complaint (ADPKD) leads to secondary hypertension and all these conditions can cause chronic kidney complaint (CKD). Hypertension is set up in further than 2/3 of the cases with CKD and it quickens its development to kidney failure. So it is vitally important to achieve good hypertension control in the community.

Presently, habitual kidney complaint is cureless and the primary goal of the operation is to treat the reversible causes which is the main cause for the progression of advanced kidney complaint. Acceptable hypertension control is a necessary element of operation and present guidelines suggest renin- angiotensin (RA) antagonists as the preferred medication that is used in treating hypertension in CKD¹⁴. The RA- occlusion medicines not only maintain hypertension but also helps in the development of CKD, especially in occurrence of proteinuria.

➤ *Vascular Hypertension*

Coarctation of the aorta is the crucial cause of vascular hypertension in the youngish population. The choice of antihypertensive medicines for this population depends on the other coexisting conditions, still, the definite treatment is the percutaneous or surgical correction of the coarctation. Correction of coarctation at an early age leads to better long-term outcomes, but approximately one- third of the cases remain hypertensive even after surgical correction of the coarctation of the aorta.¹⁵

In order to treat secondary hypertension due to vasculitides, medicines such as corticosteroids, or other immunosuppressant agents along with antihypertensive medicine are recommended.^{9,16}

The operation of hypertension subdivides into pharmacological and nonpharmacological operation.

- Non-pharmacological and life operations are recommended for all individuals with raised BPs anyhow of age, gender, comorbidities, or cardiovascular threat status.

Weight loss is judicious if rotundity is present, however optimum BMI and optimal weight range are still unknown. Weight loss alone can affect the decline of over 5 to 20 mm Hg in systolic blood pressure. Smoking may not impact directly on blood pressure however helps in distracting long-term sequelae. Changes in lifestyle alone can regard for over to a 15% reduction in all cardiovascular-affiliated events. Pharmacological therapy plays a crucial role in managing hypertension and preventing its complications. Here's a breakdown of the main drug classes used, along with some insights into their mechanisms of action and considerations for use:

➤ *Angiotensin-Converting Enzyme Inhibitors (ACEi):*

- **Mechanism of action:** ACEi prevents the change of angiotensin I to angiotensin II, a potent vasoconstrictor that elevates blood pressure.
- **Benefits:** Lower blood pressure, improve blood flow, and protect against kidney damage.
- **Considerations:** May not be suitable for pregnant or breastfeeding women, people with certain kidney or autoimmune diseases, or those with a history of angioedema.

➤ *Angiotensin Receptor Blockers (ARBs):*

- **Mechanism of action:** ARBs directly block angiotensin II from binding to its receptors, preventing blood vessel constriction and lowering blood pressure.
- **Benefits:** Similar to ACEi but may be better tolerated by people with certain side effects from ACEi.
- **Considerations:** Not recommended for pregnant women and may increase potassium levels in some individuals.

➤ *Diuretics (Usually Thiazides):*

- **Mechanism of action:** Increase urine output and sodium excretion, reducing blood volume and pressure.
- **Benefits:** Effective for lowering blood pressure and often used in combination with other medications.
- **Considerations:** Can cause dehydration, electrolyte imbalance, and increased urination.

➤ *Calcium Channel Blockers (CCBs):*

- **Mechanism of action:** Relax blood vessel walls by blocking calcium channels, leading to improved blood flow and reduced pressure.
- **Benefits:** Effective for lowering blood pressure, particularly in people with angina or migraines.
- **Considerations:** May cause dizziness, ankle swelling, and constipation.

➤ *Beta-Blockers (BBs):*

- **Mechanism of action:** Gradually slow down the heart rate and reduce the force of heart contractions, decreased in the blood pressure.
- **Benefits:** Effective for lowering blood pressure and helpful for managing anxiety and tremors.
- **Considerations:** May not be suitable for people with asthma, COPD, or heart failure.

It's recommended to remember that the choice of medication for hypertension should be individualized based on various factors like age, race, comorbidities, and overall health. JNC-8, ACC, and ESH guidelines provide recommendations for different clinical scenarios. Consulting a healthcare professional is important for determining the most applicable treatment.

➤ *Here are some Additional Insights on the JNC-8 Recommendations:*

- **Emphasis on lower blood pressure targets:** Compared to previous guidelines, JNC-8 recommends stricter blood pressure control, especially for individuals with diabetes and those aged 18-59 years. Even the slight changes in blood pressure can impact on reduction of risk for cardiovascular events.
- **Importance of individualization:** While the recommendations provide general guidance, medicines are recommended based on patients specific needs and health records and also with the consideration of side effects, interactions with other medications, and cost.
- **Rationale for Preferred Medication Choices:**
 - ✓ Thiazide diuretics: They are first-line therapy for most patients due to their effectiveness and affordability.
 - ✓ CCBs: They are particularly beneficial for individuals with angina, migraines, or certain heart rhythm abnormalities.
 - ✓ ACEi/ARBs: They are preferred in patients with CKD or diabetes due to their protective effects on kidney function and overall cardiovascular health.
 - ✓ Racial differences: The recommendation for thiazide diuretic and CCB combination in the Black population is based on studies showing that ACEi/ARBs may be less effective in lowering blood pressure in this group.

- Importance of CKD management: JNC-8 emphasizes the importance of starting or including ACEi/ARBs in all CKD patients, regardless of race or diabetes status, due to their kidney-protective effects.
- *Here are some Observations on the ACC Recommendations:*
 - ✓ Focus on ASCVD risk: Similar to JNC-8, the ACC emphasizes assessing an individual's 10-year ASCVD risk before initiating medication. This personalized approach ensures that high-risk individuals receive adequate treatment even if their blood pressure falls within the "normal" range.
 - ✓ Lower initiation threshold for high-risk individuals: ACC recommends starting treatment at lower blood pressure levels for individuals with diabetes, CKD, ASCVD, or those with a high ASCVD risk. This aligns with the growing evidence highlighting the benefits of stricter blood pressure control in high-risk groups.
 - ✓ Stricter target blood pressure goal: Compared to JNC-8's recommended target of <140/90 mmHg for most patients, the ACC aims for a goal of <130/80 mmHg, even for those without additional risk factors. This reflects the ACC's commitment to optimizing cardiovascular health and minimizing future complications.

Overall, the ACC recommendations appear more aggressive in terms of initiating medication and achieving stricter blood pressure control compared to JNC-8. This highlights the ongoing debate about the optimal approach to managing hypertension, with different guidelines weighing the risks and benefits of stricter versus more conservative approaches. Ultimately, based on patients specific risk factors the treatment are decided, health status, and preferences. Consulting a healthcare professional who can interpret both JNC-8 and ACC recommendations and tailor a treatment plan based on your individual needs is crucial for optimal hypertension management.

➤ *ESC / ESH Recommends the Following:*

- Focus on hypertension grades: ESC/ESH focuses on hypertension grades (i.e., severity) rather than specific blood pressure readings for initiating treatment. This approach recognizes that individuals with higher grades of hypertension, even at slightly lower blood pressure values, already show signs of organ damage and require medication.
- Proactive approach for grade 2 and 3 hypertension: For individuals with grade 2 or 3 hypertension (defined as SBP \geq 160 mmHg or DBP \geq 100 mmHg or SBP \geq 140 mmHg and DBP \geq 90 mmHg), regardless of their ASCVD risk, the ESC/ESH recommends immediate initiation of pharmacological therapy. This reflects the increased risk of complications associated with these higher blood pressure levels.
- Targeted approach for grade 1 hypertension: For individuals with grade 1 hypertension (SBP 130-139 mmHg or DBP 85-89 mmHg), pharmacological therapy

is recommended based on the presence of HMOD or high CVD risk. This individualized approach balances the potential benefits of medication against potential side effects, recognizing that not everyone with grade 1 hypertension needs immediate treatment.¹²

Overall, the ESC /ESH recommendations appear more proactive than JNC-8 and ACC in terms of initiating medication for higher grades of hypertension and for those with HMOD. However, they also emphasize a personalized approach for grade 1 hypertension, considering individual risk factors and response to lifestyle interventions.

- Emphasis on first-line choices: The importance of specific first-line medications for different patient populations which guarantees the individual receive the most effective and appropriate treatment based on their medical records and comorbidities.
- Thiazide diuretics as the cornerstone: Emphasis on thiazide diuretics as the first-line choice for most patients aligns with current guidelines and reflects their proven effectiveness and affordability.
- ACEi/ARBs for specific populations: Highlighting the importance of ACEi/ARBs for patients with effective diabetes or chronic kidney disease is important, as these medications offer additional benefits beyond just blood pressure control in these groups.
- Beta-blockers for specific indications: Clarifying that beta-blockers are not currently recommended for isolated hypertension but play a crucial role in managing other conditions like heart failure and atrial fibrillation is accurate and essential information.
- Limited role of vasodilators: The limited role of vasodilators like hydralazine and their use only as a last resort in specific situations.
- Combination therapy for difficult cases: Emphasizing the need for two or more medications in certain cases, especially stage 2 hypertension, is important for achieving optimal blood pressure control.

Overall, it provides a valuable overview of the key principles in using medications for hypertension management. It is important to remember that this information should not be interpreted as a substitute for professional medical advice. Consulting a healthcare professional is crucial for determining the best treatment plan for your individual case, taking into account your specific medical history, risk factors, and response to therapy.⁵

➤ *Prognosis:*

Hypertensive heart disease (HHD) is a major cause of global morbidity and mortality, with high blood pressure being the main risk factor. It is a progressive condition that carries a significantly increased threat of cardiovascular death and can lead to various cardiovascular conditions such as coronary artery disease, congestive heart failure, atrial fibrillation, cerebrovascular disease, peripheral arterial disease, aortic aneurysm, and chronic kidney disease. The prognosis of HHD is variable and depends on several factors, including the specific manifestations of the disease, the

presence of other cardiovascular conditions or risk factors, and other comorbid conditions. Cardiovascular risk calculators are available to stratify patients into high or low risk for cardiovascular events. Specific manifestations of HHD, such as heart failure or atrial fibrillation, carry a significantly increased risk of cardiovascular mortality. Diastolic heart failure, in particular, confers a similar risk and morbidity to systolic heart failure, with 6-month mortality observed as high as 16.5%..^{5,17}

For the development of CVD and mortality HTN is consider the most common threat factor. Since it impacts more than 60% of the people over the age of 60 in the present world, most of the studies have concentrated on issues in aged cases. Still, it in late nonage age is associated with increased cardiovascular causes of death in middle age, as compared with people with lower BP. In other words, HTN is no longer a complaint of the senior. As in aged persons, a sedentary life and obesity are contributing factors to HTN in late nonage.¹⁹

The continuous relation between adding BP and increased morbidity and mortality has been explained at all stages. Similarly the treatment of elevated SBP has been shown to significantly reduce total mortality, CVD, coronary heart complaint- related mortality, and stroke.²⁰ Although after the age 50 SBP appears to be a better predictor of events than DBP, high DBP is associated with increased CVD threat and is more generally elevated in cases less than 50 times of age, compared with aged cases. Accordingly, SBP assumes indeed lesser significance as a threat factor starting at adulthood.^{18,21}

Resistance to medication: Secondary hypertension can be difficult to control with medication alone if the underlying cause isn't addressed.

Early complications: It can lead to early damage in organs like the heart, kidneys, and brain, especially in young individuals.

Cardiovascular risks: Increased risk of cardiovascular events like heart attack or stroke. **Optimism:**

Favorable prognosis: Early diagnosis and treatment of the underlying cause can significantly improve the outlook for people with secondary hypertension.

This highlights the importance of: Thorough investigation: Identifying the underlying cause through detailed history, physical examination, and potentially further tests.

Targeted treatment: Addressing the root cause alongside managing blood pressure with medication.

Early intervention: Prompt diagnosis and treatment can prevent or minimize organ damage and improve long-term health outcomes.⁹

Large- scale meta-analyses have also shown the rising CVD and vascular complaint threat with a rise in systolic and diastolic blood pressures, with nearly doubling of the threat of death from heart complaint and stroke with rising SBP of as important as 20 and DBP of 10 mm Hg. The prognosis depends on blood pressure control and is favorable only if the blood pressures attain acceptable control; still, complications may develop in some cases as hypertension is a progressive complaint.

Acceptable control and life measures only serve to delay the development and progression of sequelae similar to habitual kidney complaint and renal failure¹².

➤ *Complications:*

The following complications have been reported with unchecked hypertension in multiple large- scale population trials.

- Coronary heart complaint (CHD)
- Myocardial infarction (MI) 3. Hypertensive encephalopathy
- Renal failure, acute versus habitual
- Supplemental arterial complaint
- Atrial fibrillation
- Aortic aneurysm
- Death (generally due to coronary heart complaint, vascular complaint, or stroke- related).¹²

Complications of HTN impact the vasculature, heart, brain, feathens, and eyes. Detailed complications include atherosclerotic vascular complaint, CAD, cerebrovascular complaint, renal complaint including ESRD, and retinal hemorrhages.

IV. PATIENT COUNSELING

➤ *Patient Education:*

- Educating patients about the risks of uncontrolled blood pressure is crucial for motivating them to adhere to treatment plans and lifestyle changes.
- Emphasize the long-term consequences of HTN, including its role as a major risk factor for heart disease, stroke, and other complications.

➤ *Home Blood Pressure Monitoring:*

Affordable automatic blood pressure cuffs empower patients to actively monitor their BP at home, providing valuable data for both patient and healthcare professionals.

- Daily logs allow for tracking trends and identifying potential spikes or periods of poor control.
- This empowers patients and improves compliance with treatment.

➤ *Lifestyle Modifications:*

- Addressing modifiable risk factors is crucial for managing HTN alongside medication.

- Smoking cessation, reducing alcohol intake, increasing physical activity, and adopting a low-sodium diet are key modifiable factors.
- Studies show that lifestyle changes can offer significant cardiovascular benefits, sometimes even exceeding the impact of medication alone.⁵

➤ *Combined Approach:*

- The ideal approach combines pharmacological therapy with lifestyle modifications for optimal blood pressure control and long-term health outcomes.
- Identifying and addressing specific lifestyle factors like weight loss or stress management can further enhance treatment effectiveness.

➤ *Patient Responsibility and Monitoring:*

- The importance of healthy lifestyle practices alongside medication adherence and regular home blood pressure monitoring. This patient-centered approach provides essential data for managing the condition effectively.
- Promptly notifying the healthcare provider about new symptoms or changes in blood pressure readings allows for swift evaluation and potential adjustments to the treatment plan.⁹

➤ *Comprehensive Management Strategies:*

- Recognizing hypertension as a chronic condition requiring long-term care and ongoing management is crucial. Providing systematic lifestyle modifications and pharmacological therapy empowers patients to actively participate in their care.
- Emphasizing weight increasing issues, regular physical exercise, and cutting down of alcohol/tobacco consumption as a key strategies for reducing cardiovascular risks associated with hypertension is accurate and vital information.

➤ *Perioperative Implications:*

- The possibility of first discovering hypertension during the perioperative period is an important point. Open communication between the anesthesia provider, surgeon, and primary care physician is essential in such situations.
- Highlighting the potentially life-changing impact of referring patients for antihypertensive treatment during the perioperative period underscores the critical role healthcare professionals play in early detection and intervention.¹²

It occasionally occurs that HTN is first detected during the perioperative period. The anesthesia provider must bandy such a circumstance with the surgeon and/ or the primary care provider. Complications of undressed HTN can be ruinous, so the occasion to relate cases for antihypertensive treatment could be life- changing.¹⁸

➤ *Need for New Technology:*

- Development of new devices with advanced algorithms specifically designed for accurate BP measurement in AF is crucial.
- These devices should undergo rigorous validation studies in AF patients to confirm their accuracy and effectiveness.

➤ *Children: Long Standing Recognition of Childhood Hypertension:*

- The 1977 NHLBI report identified early detection and management of pediatric hypertension as a critical frontier. This underscores the longstanding awareness of this issue.

➤ *Current Shortcomings in Diagnosis and Management:*

The alarming reality that hypertension in children often goes undiagnosed due to lack of familiarity among clinicians and limitations in existing methods. This emphasizes the need for improved approaches.

• *Potential of New Technology:*

The technologies discussed previously could play a significant role in overcoming these challenges, but with specific considerations for the pediatric population. So, the researchers can emphasize the critical need for thorough validation of new technologies for children, considering their unique physiology and differences in vasculature and arm size compared to adults.

➤ *New Universal Standard as a Step Forward:*

The positive impact of the new universal standard in providing recommendations for improved assessment and diagnosis of pediatric hypertension. This shows progress in addressing the longstanding need for better tools and awareness.²

➤ *Awareness and Diagnosis:*

- Public campaigns have raised awareness about hypertension and its link to cardiovascular problems.
- However, many people remain unaware due to the often asymptomatic nature of the condition.
- Healthcare providers, including nurse practitioners, should encourage regular blood pressure monitoring, particularly through ambulatory methods.

➤ *Lifestyle Modifications:*

- Before resorting to medication, lifestyle changes like weight loss, reduced salt intake, and smoking cessation should be encouraged.
- These adjustments can significantly improve blood pressure control similar to introducing new drugs.

➤ *Pharmacotherapy:*

- When medication becomes necessary, a thiazide diuretic is often the first choice.

- Diuretics, calcium channel blockers, and renin-angiotensin system blockers can work synergistically for better control.
- Maxing out the dose of one medication might not be as effective as adding another class of drug if blood pressure remains high.
- Some antihypertensive drugs offer additional benefits beyond lowering blood pressure, like losartan's role in slowing down diabetic kidney disease.
- *Chronotherapy:*
Taking certain medications at specific times throughout the day, known as chronotherapy, has shown to reduce cardiovascular risks.⁵

V. CONCLUSION

Hypertension poses a significant threat to global health, silently impacting millions worldwide. Its ability to progress unnoticed for years underscores the importance of public awareness and early diagnosis. While there's no instant cure, a multi-pronged approach focusing on lifestyle modifications, effective treatment, and ongoing research offers hope for mitigating its impact. Its consequences are far-reaching and posing a major risk for cardiovascular diseases. Providing access to early diagnosis and appropriate treatment, including personalized medication regimens, for effective blood pressure control. Investing in research to gain a deeper understanding of the underlying mechanisms of hypertension and develop novel therapeutic strategies for improved prevention and management.

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- *Conflict of Interest*

Authors do not have any conflict of interest with any individual.

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