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Review

Hypertension and its management through pharmacotherapy and phytotherapy: A review article

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Abstract

Hypertension remains one of the leading modifiable risk factors for cardiovascular morbidity and mortality worldwide. Despite improvements in awareness and therapeutic options, its global prevalence continues to rise, particularly in low- and middle-income countries where lifestyle transitions and limited healthcare access hinder effective management. The review asses the prevalence and associated comorbidities of hypertension and their risk factor and also discuss advances in its management through pharmacotherapy and emerging Phyto therapeutic interventions. Recent studies and clinical guidelines from PubMed, WHO, and international hypertension societies were reviewed, focusing on prevalence data, management guidelines, and the pharmacological and Phyto therapeutic approaches to blood pressure control. Current estimates indicate that more than 1.4 billion adults worldwide have hypertension, with the highest burden in developing nations. Urban populations in South Asia exhibit prevalence rates exceeding 35%, with Pakistan showing uncontrolled hypertension in nearly half of diagnosed patients. Pharmacological management using diuretics, ACE inhibitors, angiotensin receptor blockers, calcium channel blockers, and beta-blockers remains the cornerstone of therapy. Recent interest in phytotherapy, including Hibiscus sabdariffa, *Allium sativum* (garlic), and green tea extracts, demonstrates modest but significant blood pressure lowering effects through antioxidant, vasorelaxant, and diuretic mechanisms. An integrated management approach combining evidence-based pharmacotherapy, lifestyle modification, and scientifically validated Phyto therapeutic agents may improve blood pressure control and reduce cardiovascular risk, particularly in resource-limited settings.

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1 Introduction: The prevalence of high blood pressure in the urban population of Asian countries is between 15-35%, while; the people living in rural areas are two to three times less influenced by it than the population of urban areas. The overall frequency differs all around the globe, and the minimum frequency was observed in rural areas of India (i.e. 6.8% and 3.4% in men) while the maximum frequency was noticed in Poland, i.e. around 73% in women and 69% in men[1,2]. The most widely acknowledged modifiable risk factor for cardiovascular, cerebrovascular, and renal illnesses is hypertension, which is a major global public health concern due to its prevalence and related comorbidities. According to the Joint National Commission's hypertension guidelines, the entire population 60 years of age or over should aim for a systolic blood pressure of less than 150 mmHg and a diastolic blood pressure of less than 90 mmHg. However, the target diastolic blood pressure in a population under 60 is less than 90 mmHg. Less than 140 mmHg is the target systolic blood pressure[3]. In people of age 18 years or above it and who are already suffering from diabetes mellitus or chronic kidney disease, the goal of management should be 140mmHg for systolic BP, and 90mmHg for diastolic blood pressure is advised [4].

Every year, over seven million individuals worldwide suffer with hypertension, which continues to be a major cause of illness and mortality. Fifth. Its frequency is between 20% and 50% in the majority of developed countries[5]. Fifth. According to projections, one billion people worldwide had hypertension in 2000; by 2025, this number is expected to increase to almost 1.56 billion. It is estimated that 18% of Pakistanis over the age of 15 have hypertension. In comparison to urban people (21.6%), the rate is somewhat lower in rural areas (16.2%)[6]. The percentage of people with appropriately managed blood pressure is still startlingly low despite this common occurrence[7]. According to reports, less than 3% of Pakistan's 5.5 million men and 5.3 million women who suffer from hypertension are able to effectively regulate their blood pressure, and nearly 70% of these people are uninformed that they have the ailment. Additionally, around one-third of Pakistanis over 45 have high blood pressure [9]. The American Heart Association states that up to the age of 45, males are more likely than women to have hypertension[8]. After that, the gender difference closes and the frequency become about equal between the ages of 45 and 64. In Pakistan, provincial data reveal considerable variation in prevalence rates: in Baluchistan, hypertension affects 25.3% of men and 41.4% of women; in Khyber Pakhtunkhwa, 23.7% of men and 28.4% of women are hypertensive; while in Punjab, prevalence is relatively lower, with 17.3% in men and 16.4% in women [9].

The prevalence of hypertension is 19% in male and 9.9% in the female of Sindh province [10]. According to some of the foremost guidelines, it is suggested that high blood pressure is detected when a systolic BP of an individual in the clinic or the office is greater than 140 mm hg and their diastolic BP is greater than 90 mmHg after constant checkups.

In contrast, segregated high SBP or systolic hypertension is common in the elderly population or children and is explained as escalated systolic blood pressure (i.e. more than 140 mmHg) while having low diastolic blood pressure (less than 90 mmHg). Systolic hypertension is the most frequent type of primary hypertension in children, young adults and adolescents. Those diagnosed with primary hypertension should receive proper management because elevated blood pressure may cause several comorbidities and death. Blood pressure trends have demonstrated an apparent transference of escalated blood pressure from high to low-income countries with approximately 1 billion in low, middle-income countries and nearly 350 million people, along with hypertension in high-income countries [11,12].

2 Hypertension, associated Comorbidities and their Risk factor: There are certain few disease conditions that, when associated with hypertension, worsened the health of the patient; these associated comorbidities are:

2.1 Cardiovascular diseases: Every 10 mmHg rise in diastolic blood pressure or every 20 mmHg increase in systolic blood pressure roughly doubles the risk of developing cardiovascular diseases (CVDs)[13]. Over time, myocardial thickness and stiffness result from the enormous strain that high blood pressure puts on the heart. According to research, people with hypertension are almost 2.03 times more likely than people with normal blood pressure to acquire cardiovascular problems[13]. Because a rise in systolic blood pressure increases left ventricular afterload and a decrease in diastolic blood pressure reduces coronary perfusion, increased arterial stiffness increases cardiovascular morbidity and death[14].

Moreover, hypertension is closely associated with indicators of cardiovascular organ damage, such as left ventricular hypertrophy (LVH). LVH is commonly regarded as a long-term outcome of uncontrolled hypertension; however, some evidence suggests that an increase in left ventricular mass may precede the onset of hypertension [14]. In Pakistan, the estimated burden of ischemic heart disease (IHD) is approximately 5.09 million cases, with a higher prevalence observed among men compared to women [15]. A strong epidemiological association exists between hypertension and coronary artery disease (CAD), accounting for nearly 25–30% of all acute myocardial infarctions [16].

2.2 Stroke: Stroke is one of the main causes of long-term disability and the third most common cause of mortality in the majority of Western countries. An estimated 200 people per 100,000 people in the US have their first stroke every year[3]. In contrast, the estimated yearly incidence of stroke in Pakistan is around 250 per 100,000 people. Approximately 15

million individuals worldwide suffer from stroke each year, and over 5.5 million of those fatalities are documented[17,18].

Numerous research has looked at hypertension as a significant stroke risk factor. In one such research, individuals with clinical signs of stroke were included, and additional risk factors such smoking, cardiovascular conditions, dyslipidemia, and diabetes mellitus were found. The most important risk factor for both hemorrhagic and ischemic stroke among them was found to be hypertension. 51 of the 91 individuals in the study 35 men and 16 women had hypertension. People between the ages of 51 and 70 accounted for the bulk of stroke cases. [19].

The incidence of stroke in patients with hypertension was the subject of another study carried out at Liaquat University of Health and Medical Sciences, Pakistan. A total of 100 participants 64 men and 36 women were evaluated. Serum creatinine, blood urea, blood glucose, blood pressure, electrocardiograms, brain CT scans, and other diagnostic tests were carried out [20,21]. Cerebral bleeding and infarction were detected as hyperdense and hypodense areas on CT imaging, respectively. Patients with unverified CT scan results or stroke caused by other risk factors were not included. According to the study, hypertension was linked to 74 out of 100 stroke instances, and 36 of these individuals had severe hypertension. The hypothalamus and putamen were the most commonly damaged anatomical areas in hemorrhagic stroke, whereas the internal capsule and corona radiata were most commonly affected in ischemic stroke. The results showed that hypertension is a crucial factor in the development of both forms of stroke and that hemorrhagic stroke is less common than ischemic stroke [20,21].

2.2 Diabetes Mellitus: Inadequate care of either illness can raise the risk of cardiovascular and other systemic consequences since diabetes mellitus and hypertension are closely related conditions[22]. Diabetes patients' morbidity and death are greatly increased by elevated blood pressure[23]. An estimated three million people in the US suffer from both diabetes and hypertension at the same time. Patients with diabetes have hypertension almost twice as commonly as people without the disease, and new research suggests that people with hypertension are also more likely to have diabetes [24].

It was estimated that 6.4% of adults worldwide had diabetes in 2010, affecting around 285 million people. By 2030, that number is expected to increase to 7.7%, affecting about 439 million people. It is estimated that 64% of diabetes individuals in Pakistan have high blood pressure. According to the Pakistan National Blindness and Visual Impairment Survey (2003), 15% of those with diabetes showed indications of retinopathy, while those with hypertension were at greater risk[25]. Hypertension is additionally implicated in the development of renal failure and retinopathy [25]. If diabetic retinopathy, a frequent microvascular consequence of diabetes mellitus, is not treated, it can cause significant vision impairment[26,27].

Research comparing the outcomes of hypertensive and normotensive diabetics examined the prevalence of diabetic retinopathy in hypertensive diabetic patients. Of the 200 subjects, 93 had non-hypertension diabetes and 107 had hypertensive diabetes. Among individuals with diabetes, the overall prevalence of retinopathy and hypertension was 51% and 53.5%, respectively. The substantial correlation between hypertension and retinopathy in diabetes was demonstrated by the fact that retinopathy was more common in hypertensive diabetic patients than in their normotensive counterparts[28,29].

Hassan et al. analyzed lipid profiles, HbA1c, and retinopathy in diabetic patients visiting government clinics and hospitals in Faisalabad, Pakistan. According to reports, the prevalence of retinopathy was 41.1%, and it was significantly greater in people whose HbA1c levels were more than 8%. The development of retinopathy was highly correlated with factors including smoking, hypertension, the length of diabetes, and patient age[30]. Similarly, Khanzada et al. 31 investigated the incidence of diabetic retinopathy in patients at Liaquat University of Health and Medical Sciences' Ophthalmology Department in Hyderabad, Pakistan. The prevalence of diabetic retinopathy was 40.94% among 244 individuals (149 men and 95 females) over the age of thirty. Patients between the ages of 40 and 60 and those with diabetes for more than 13 years were most likely to have the problem[31].

Group A (normoglycemic, normotensive with cataract), Group B (hypertensive with cataract), Group C (diabetic with cataract), and Group D (diabetic, hypertensive with cataract) were the groups into which the participants were divided. Results showed that diabetes mellitus and hypertension are both controllable risk factors that considerably increase the likelihood of developing senile cataract. Furthermore, Mashud et al. [32] examined 100 diabetic individuals between the ages of 40 and 70 at Sir Syed Hospital in Karachi to determine whether hypertension is a risk factor for diabetic retinopathy. According to the study, participants with diabetic retinopathy had significantly higher blood pressure than those without the condition. The prevalence of retinopathy was shown to be significantly correlated with hypertension, supporting the idea that high blood pressure accelerates microvascular problems in diabetes[32].

2.3 Hypertension and renal diseases: Hypertension can have devastating effects on the blood vessels of the kidney minimizing their propensity to work correctly. If the force at which blood flows in the vessels is high, it will stretch the vessels of the whole body, ultimately leading to the exhaustion and weakness of the blood vessels, including those present in the kidney. Hypertension is considered the second leading cause of renal failure in the US, and the rate at which renal failure due to hypertension occurs had increased by 7.7%. In Pakistan, hypertension is considered the third

leading cause of chronic kidney diseases accounts for 14.6% of study patients; however, diabetic nephropathy accounts for 22% [33]. Hypertension is considered one of the most critical risk factors for the progression and development of any chronic kidney disease and albuminuria [34].

3 Management of hypertension: Making modifications in lifestyle such as taking a healthy diet, quitting smoking, exercise, and meditation can prevent the individual from developing high blood pressure and also aids in decreasing the risk of several other life-threatening conditions such as stroke, heart attack, and chronic kidney disease. Moreover, lifestyle modifications presumed to be the 1st line management of high blood pressure, and they also increase the efficacy of antihypertensive drugs. Unger et al., the study on management should be to decrease the blood pressure if it is more than 140/90 mm Hg and bring it back to less than 130/90 mm Hg [35]. However, some of the pharmacological treatment approaches are discussed below in pharmacological management which is mentioned in table 1.

3.1 Pharmacological management: Recent studies from more than a hundred countries propose that generally <50% of hypertensive adults take medicines for reducing their high blood pressure, and it is even though the fact that a variation in blood pressure of 20/10 mm Hg is linked with a 50% of alteration in risk of cardiovascular diseases. [36] β- blockers and renin-angiotensin system blockers, regardless of blood pressure levels with or devoid of calcium channel blockers, are considered 1stline anti-hypertensive management [37].

4 Hypertension and its management with alternative medicines

4.1 *Rauwolfia serpentine*: It is used in India's medicines for hundreds of years to treat various diseases, including malaria, insect bites, snake bites, dysentery, feverish conditions, abdominal pain, mental illnesses, and uterine stimulation. *Rauwolfia serpentine* is also known as Chandrika and Sarpagandha in manuscripts of India all in all as 1000 BC. Approximately 50 patients were treated with primary hypertension by rauwolfia, and they are reported in the study conducted by [38]. More than 80% of patients experienced a fall in their systolic blood pressure, while nearly 80% have experienced a fall in their diastolic blood pressure. Another study conducted by [39] reported the herb to be efficacious in nearly 90% of research participants by decreasing the systolic blood pressure up to 40mmHg. In another study, reserpine induces a prominent drop in blood pressure with few hours of administration. The product of rauwolfia did not produce any serious adverse effects. However, it may cause bradycardia, sedation, nasal congestion. Hypotension and nightmares occasionally while it was not addictive as its intake can be stopped at any time. Its prolonged use for several months can cause depression; moreover, its exceptionally massive doses can cause convulsions, Parkinson's like symptoms and extrapyramidal reactions. There is a possibility that rauwolfia can interact with diuretics, antidepressants, antipsychotics drugs, ephedra, cardiac glycosides, alcohol, MAO inhibitors, levodopa and propranolol. There is no association between cancer and reserpine; additionally, none of the toxicogenic effects of reserpine has been revealed[40,41]. The summary of alternative treatment of hypertension mentioned in table 2.

4.2 *Allium sativum* (Garlic): It has been used as a medicine and a substance to flavor food for more than 5000 years and is used to treat any disease and maintain health because it is one of the most primitive documented herbs. Hippocrates, the father of modern medicine, recorded garlic as a diuretic with its cardiovascular effects; the herb has classically been utilized to maintain gastrointestinal health and strengthen the immune system. Garlic has also been shown to have the properties of lowering blood pressure among hypertensive patients almost by 8-9mmhg in systolic blood pressure and 6-7mmhg in diastolic blood pressure. However, it only remarkably reduces blood pressure in patients with hypertension and does not affect people with normal blood pressure. The main active compound in mature garlic extract is S-allylcysteine which is firm and standardizable and has been established to be highly endurable. The more significant clinical trials observing the effects of garlic on blood pressure utilized either mature garlic extract or garlic powder. The adverse reactions caused by garlic include flatulence and gastro esophageal reflux; its high dose should be avoided in patients taking antithrombotic medications. Mechanism of action for garlic includes arbitration of intracellular nitric oxide and production of hydrogen sulfide gas, additionally block the production of angiotensin II which encourages vasodilatation and thus decreases the blood pressure[42,43,44,45].

4.3 Cinnamon*:* Cinnamon is among those few herbs that can reduce blood pressure; it has been utilized as a traditional medicine in China for the past hundred years. The herb belongs to the family *Lauraceae*. Its data from clinical trials suggest that it has antihyperlipidemic, anti-inflammatory, antioxidants, antimicrobial, anti-tumor, immuno-modulatory and cardioprotective effects. Many other types of research also shown its beneficial effects on patients with type 2 diabetes mellitus and high blood pressure. Practically the bark of various species of *cinnamon* among the most vital and common spices used globally, not only for cooking but also as medicines *cinnamon* is a spice that has a distinct and pleasant smell; it is a good source of calcium, iron and manganese. It can aid in alleviating the pain of indigestion and toothaches; furthermore, it is highly disinfected as it has a high content of phenol that makes it effective against tooth pain and as a remedy for mouth wash and to freshen the breath.

Moreover, cinnamon is a coagulant and ceases bleeding; its bark is usually used as a spice, but its essential oils have significant properties, including anti-fungal, anti-bacterial, antioxidant, anti-inflammatory, anti-diabetic, anti-parasitic and anti-cancer activities. *Cinnamon* seems to reduce blood pressure in investigations conducted upon animals. According to the study, cinnamaldehyde produces low blood pressure effects. Furthermore, it prevents high blood pressure in both types of diabetes mellitus. Cinnamon, combined with garlic, also decreases blood pressure as *cinnamon* contains cinnamaldehyde, and garlic contains allicin; both have blood pressure reducing properties [46,47].

4.4 *Annona muricata L.:* *Annona muricata L.* also known as soursop, Graviola, or *Guvanabana* which are edible fruit widely cultivated across the different regions of the world [48]. The aqueous extract of *Annona muricata* shows an ACE inhibitory effect. The pericarp extract showed the highest ACE inhibitory effect as compared to pulp and seed extract [49]. *Annona muricate* shows a significant decrease the blood pressure in rats but a strong synergistic effect with *Persea americana* to exhibit antihypertensive activity [50]. *Annona muricata* exhibit the antihyperlipidemic activity significantly reduced the serum level of triglycerides, serum total cholesterol very low-density lipoproteins, low density lipoprotein and a significant increase in the level of high-density lipoprotein and antiatherogenic index[51]. Intravenous administration of *Annona muricata* leaf extract to the rat dose-dependent reduction in systolic blood pressure (SBP), diastolic blood pressure (DBP), and mean arterial pressure (MAP). Heart rate was not increasing significantly with dose increase hence there is no effect on heart rate[52].

4.5 *Avena sativa L.:* *Avena sativa* commonly known as Oats mostly consumed as a source of soluble and studies show the benefits of consumption of dietary fiber specially B-glucan from oats[53]. A recent study exhibit demonstrates the beneficial effects of oat lowering blood pressure with hypertensive and obese patients[54]. *Avena sativa* exhibits the ACE inhibitory activity and is used as an antihypertensive [55]. *Avena sativa* and their constituents are reported to possess the lowering of blood pressure and lowering of blood cholesterol [56]. Oat exhibit the inhibition of Renin Angiotensin Aldosterone system (RAAS) and ACE-1 inhibition. Oat protein isolates from all seven types of oat plant and in vitro study conducted for renin inhibition activity. Barra oat shows the highest level of renin inhibition[57]. *Avena sativa* also show the cardioprotective activity against the isoproterenol induced myocardial infarction in rats. Avena seed extract was injected in rats and histopathological studies was performed which indicates that lowered the level of alkaline phosphatase (ALP), lactate dehydrogenase (LDH), thiobarbituric acid reactive substances (TBARS) level and creatinine phosphokinase (CK-MB)[58].

4.6 *Apium graveolens:* *Apium graveolens* also known as celery or wild celery and used as a traditional medicine of Morelos state to avoid toothache and treat Diarrhea, hypertension, and broncho-pulmonary disease. The extract of *Apium graveolens* acts on the endothelial layer o and is effective as a vasorelaxant activity and potential antihypertensive activity[55]. The combination of celery extract and captopril might be beneficial for the treatment of hypertension; celery extract causes an increase in the plasma level of captopril and enhance the efficacy of captopril [59]. The celery and garlic extract was administered as the constituents of both drug pharmacological test results showed systolic blood pressure and diastolic blood pressure decreased significantly[60]. The ethanolic extract of *Apium graveolens* was given in hyperlipidemia induced through olive oil in rats and standard drug atorvastatin used the results reveal the Apium graveolens with dose dependent inhibited the total cholesterol (TC), low density lipoproteins (LDL), triglycerides (TG) and significantly increase the High-density lipoproteins (HDL)[61]. The seed extract of celery was given to the albino rats which shows the significant changes in lipid profile. Extract showed the significant reduced the level of low-density lipoproteins (LDL), triglycerides (TG), serum total cholesterol (TC) and also significant increase the level of high-density lipoproteins (HDL)[62].

4.7 *Camelia sinensis*: *Camellia sinensis* commonly known as the tea plant which are mostly available in the form of black tea and green tea which are manufactured by the leaves and buds of *Camellia sinensis* [63]. A study was conducted with camellia oil the experimental result showed reduced the level of angiotensin converting enzyme ACE, endothelin, renin and angiotensin II in serum[64]. *Camellia sinensis* exhibit the antihypertensive activity with randomized clinical trial show the significant reduction of the systolic blood pressure (SPB) and diastolic blood pressure (DBP)[65]. Hyperlipidemia is associated with heart disease and leading cause of death in the world. *Camellia sinensis* also exhibit antihyperlipidemic activity which reduced the level of LDL.VLDL cholesterol and triglycerides but increase the HDL level in serum [66] which mentioned in figure 1.

5 Clinical Trial of Antihypertensive Herbs: *Hibiscus sabdariffa L. (Malvaceae)* is used as antihypertensive in different countries. Pharmacological work demonstrated that the plant shows diuretic and ACE Inhibitor activity. The randomized controlled trial was conducted for stage I and stage II hypertensive patients the result showed absolute reduced the blood pressure (17.14mmHg SBP and 11.97mmHg DBP)[68]. Aged garlic extract was prepared and conduct the randomized placebo-controlled dose response trial of 12 weeks. The result showed that the aged garlic showed the antihypertensive activity with reducing mean systolic blood pressure 11.8±5.4mmHg but not significantly

changes in diastolic blood pressure. Aged garlic clinical trial suggest that can be effective and acceptable treatment of uncontrolled hypertension [69]. The randomized placebo-controlled dose response trial of 12 weeks was conducted with the administration of aged garlic extract. The result exhibit reduction of blood pressure as well as significant reduction of low-density lipoproteins (LDL), total cholesterol and apolipoproteins was observed [70]. The powder of the garlic was used for the randomized double-blind placebo-controlled for the treatment of hypertension and non-alcoholic fatty liver disease patients. The 15 weeks' trial was continued and result showed the reduction of blood pressure and also beneficial for non-alcoholic fatty liver disease and cardiovascular disorders[69] the extract of *camellia sinensis* was given the obese patients with prehypertension. The 500mg dose of extract was given in the form capsule. The blood pressure measured after 24 hours the day and night both reading showed the significant decrease SBP (-3.61±1.23mmHg) and DBP (1.90±1.66mmHg)[70].

Conclusion: Persistently raised blood pressure may lead to the damage of various body organs, including vital organs, and sometimes it may become life-threatening or fatal. Its global burden is increasing day by day due to some abysmal changes in our lifestyles such as decrease activity and exercise, increase salt intake, smoking and alcohol. Pakistan has to make better strategies to enhance the prevention of hypertension, which requires a functional strategy of action to prevent and enhance existing policies against high blood pressure. Though we establish numerous minors to intermediate-scale research from all over the country that assessed the hypertension prevalence, there is no country wide research on hypertension prevalence. People should have to take steps to decrease their burden by making changes in lifestyles by performing surveys, early detection, and medication to prevent any severe or life-threatening complications in later life.

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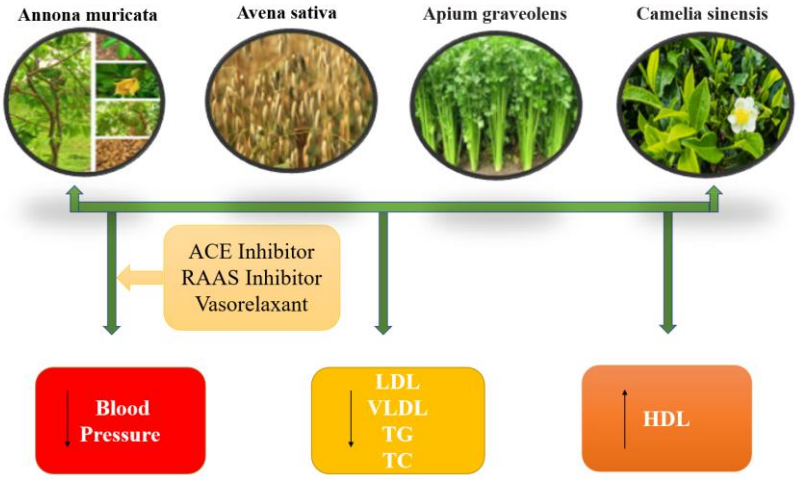

Figure 1. Antihypertensive Plants and their Mechanism of Action

Table 1. Conditions of hypertension with treatment approach

Conditions	Treatment approaches
Heart failure	Cholesterol reducing drugs and anti-platelets with acetylsalicylic acid is advised in high blood cholesterol and hypertension. High blood pressure and high blood cholesterol are considered predisposing factors of myocardial infarction with decreased and preserved ejection fraction. The death rate is enhanced in patients with heart failure along with high blood pressure. β-blockers, renin-angiotensin system blockers, and antagonists of mineralocorticoid receptor are all efficient in improving clinical consequence in cases with diagnosed Heart Failure with Reduced Ejection Fraction. At the same time, for diuretics, the proof is bounded to the improvement of symptoms only [22]
Chronic kidney disease or albuminuria	Renin-angiotensin system blockers or inhibitors are 1stline medicines because they decrease albuminuria and control blood pressure. Diuretics and calcium channel blockers can be included. Blood electrolytes, microalbuminuria and estimated glomerular filtration rates should be monitored simultaneously [23]
Blood cholesterol disorders	Initially, the blood pressure should be decreased by renin-angiotensin system blockers (i.e. angiotensin receptor blockers) and calcium channel blockers. Then statins (with or without cholesterol absorption inhibitor) would be given as statins are the drug of choice for the management of high blood cholesterol.[11]
Stroke	Calcium channel blockers, renin-angiotensin system blockers, and diuretics are 1st line management. While antithrombotic management is regularly advised for ischemic stroke, whereas in case of hemorrhagic stroke, it would not be advised that even if there is a need, it would have to be considered with extreme caution and only if there is a need for solid indication[22] moreover, cholesterol-reducing drugs are also advised and are necessary in case of ischemic stroke

Diabetes	The management of hypertension with diabetes mellitus should include lipid and blood-glucose-lowering medicines. Moreover, the management strategy should consist of renin-angiotensin system blockers or a combination of diuretic, calcium channel blockers and RAS blockers. If the patient has increased levels of low-density lipoproteins in the blood, then statins should also be added.

Table 2. Antihypertensive Plants Effects and their Mechanism of Action

Plant	Family	Mechanism of Action	Effects	References
Rauwolfia serpentine	*Apocynaceae*	Diuretic	Antihypertensive	39
Allium sativum	*Amaryllidaceae*	ACE Inhibitor Vasodilator	Antihypertensive Cardioprotective	42
Cinnamon	*Lauraceae*		Antihypertensive Cardioprotective	44
Annona muricata	*Annonaceae*	ACE Inhibitor Reduced level of TC, LDL, TG But Increase HDL	Antihypertensive Cardioprotective Antihyperlipidemic Antiatherogenic	47,48
Avena sativa	*Gramineae*	ACE I Inhibitor RAAS Inhibitor Reduced level of ALP, LDH, TBARS, CK-MB, Cholesterol lowering	Antihypertensive Cardioprotective Antihyperlipidemic	49, 52
Apium graveolens	*Umbelliferae*	Vasorelaxant Reduced level of TC, LDL, TG But Increase HDL	Antihypertensive Antihyperlipidemic	54,55
Camelia sinensis	*Theaceae*	Reduced level of ACE, Endothelin, RAAS, LDL, VLDL, TC, TG.	Antihypertensive Antihyperlipidemic	58,59