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Treatment And Mechanisms Of Action Of Some Medicinal Plants For Managing Hypertension

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ABSTRACT

Elevated blood pressure is officially referred to as hypertension. It's dangerous because it puts undue strain on the heart and encourages atherosclerosis, which raises the risk of heart disease and stroke. In addition to these conditions, hypertension can cause blindness, kidney damage, and congestive heart failure. Conventional antihypertensive drugs usually have a lot of side effects. Because of their greater body compatibility and less side effects, Herbal remedies are utilised in primary care by between 75 and 80 percent of the world's population who live in impoverished nations. In the past thirty years, a great deal of study has been conducted on native plants that have hypotensive and hypertensive therapeutic properties. While certain medicinal plants have been shown to have antihypertensive and hypotensive properties, others have not. Modern medicine should be integrated with the knowledge of Ayurveda, and more studies are required to verify the effectiveness and elucidate the safety profile of herbal remedies for lowering blood pressure. People with cardiovascular disorders—which can be caused by diseases of the heart and blood vessels are treated using medicinal plants. Hypertension raises the risk of a heart attack and stroke, which also damages the heart and accelerates atherosclerosis. These disorders are treated with a variety of drugs, however standard antihypertensive medications frequently have several side effects. Active substances found in medicinal plants can be used to treat hypertension since they have pharmacological and preventative properties. An overview of medicinal plants with hypotensive or antihypertensive properties can be found in this article.

Keywords: - Hypertension, Medicinal Plants, Hypertension Management, Cardiovascular diseases

1. INTRODUCTION

Cardiovascular diseases (CVDs) pose a significant public health challenge globally, contributing substantially to morbidity and premature mortality. Hypertension, often termed the silent killer, represents a key factor in the pathogenesis of CVDs, leading to adverse outcomes such as acute myocardial infarction.[1,2] The intricate interplay of genetic and environmental factors disrupts blood pressure regulation, culminating in high blood pressure, a condition associated with approximately 16.5% of annual fatalities worldwide. Projections indicate a worrisome trend, with an estimated 1.56 billion adults anticipated to suffer from hypertension by 2025.[3,4]
Diagnostic criteria for hypertension typically involve multiple precise blood pressure readings, with thresholds set at systolic blood pressure (SBP) ≥140 mm Hg and diastolic blood pressure (DBP) ≥90 mm Hg while seated. The pharmacological armamentarium against hypertension includes diverse classes of antihypertensive agents such as diuretics, sympatholytics, ACE inhibitors, calcium channel blockers, and vasodilators. However, the employment of these medications is marred by a spectrum of adverse effects ranging from muscle cramps to kidney failure, underscoring the imperative for exploring alternative therapeutic modalities.[5,6]
Traditional medicine, particularly herbal remedies, has garnered attention for its perceived compatibility with the human body, cost-effectiveness, and purportedly lower incidence of adverse effects. Approximately 75–80% of the global population, particularly in impoverished regions, relies on herbal medicines for primary healthcare needs. Drawing from ancient healing traditions like Persian medicine, which elucidates the role of humoral balance in disease etiology and advocates lifestyle modifications alongside herbal interventions, contemporary research endeavors have delved into the therapeutic potential of medicinal plants.[7,8]
The classification and management of hypertension hinge on nuanced diagnostic parameters and severity stratification. Optimal blood pressure is defined by systolic readings <120 mm Hg and diastolic readings <80 mm Hg, as per established guidelines. High normality and isolated systolic hypertension delineate intermediate categories with varying SBP and DBP thresholds.[9,10] Severity grading, encompassing mild, moderate, and severe hypertension, is contingent upon the extent of blood pressure elevation. Isolated systolic hypertension is delineated into distinct subtypes based on systolic readings, while primary and secondary hypertension represent divergent etiopathogenic entities, with the former primarily influenced by diet, lifestyle, and age, and the latter often secondary to underlying medical conditions such as diabetes and renal impairment.[11,12]
The diagnostic complexity inherent in discerning the underlying cause of hypertension poses a formidable challenge to effective management strategies. Primary hypertension predominates, affecting 90–95% of individuals with hypertension, highlighting the imperative for comprehensive evaluation to delineate contributory factors and optimize therapeutic approaches.[13,14]
In conclusion, hypertension emerges as a multifaceted global health concern, necessitating a comprehensive understanding of its pathophysiology, diagnostic nuances, and therapeutic modalities. Integrating conventional pharmacotherapy with complementary and alternative interventions, particularly herbal medicine rooted in ancient healing traditions, holds promise in mitigating the burgeoning burden of hypertension and its associated cardiovascular sequelae.[15,16]

2. CLASSIFICATION

Hypertension (HTN) diagnosis and classification hinge on the assessment of systolic and diastolic blood pressure values, delineating pressure levels during cardiac contraction (systole) and relaxation (diastole) respectively. When these measurements exceed established norms for the individual's age, pre-hypertension or hypertension is diagnosed, underscoring the significance of precise blood pressure monitoring in clinical practice.[17,18]
Various subtypes of HTN exist, each characterized by distinct hemodynamic profiles. Isolated systolic hypertension (ISH) is prevalent among the elderly, typified by elevated systolic pressure alongside normal diastolic readings. This subtype underscores the importance of discerning subtle alterations in blood pressure dynamics, particularly in aging populations susceptible to vascular stiffness and arterial remodeling.[19,20]
Classification protocols for HTN involve averaging blood pressure readings across multiple clinical encounters to establish diagnostic thresholds. Individuals aged 50 and above with consistent systolic readings of 140 mmHg or higher, or diastolic readings of 90 mmHg or higher, are typically classified as hypertensive. Moreover, patients with comorbid conditions such as renal disease or diabetes warrant heightened vigilance, with blood pressure thresholds set lower at 130/80 mmHg to mitigate cardiovascular risk.[21,22]
Resistant hypertension poses a formidable clinical challenge, denoting inadequate blood pressure control despite pharmacological intervention. This phenomenon underscores the multifactorial nature of hypertension

and necessitates a comprehensive evaluation to identify underlying contributors and optimize therapeutic strategies.[23,24]

Exercise-induced hypertension represents a transient elevation in blood pressure during physical exertion, with post-activity systolic values often peaking between 200 and 230 mmHg. Notably, engaging in exercise while hypertensive may exacerbate resting blood pressure levels, highlighting the intricate interplay between lifestyle factors and cardiovascular health.[25,26]

In summary, the classification and management of hypertension entail meticulous assessment of blood pressure parameters, considering age, comorbidities, and lifestyle factors to tailor therapeutic interventions effectively. Additionally, recognition of subtle variations in blood pressure dynamics, such as isolated systolic hypertension and exercise-induced hypertension, underscores the complexity of HTN management and the importance of individualized care approaches.[27,28]

3. Pathophysiology

Hypertension arises from a complex interplay of physiological mechanisms, including heightened activity of the renin-angiotensin-aldosterone system (RAAS), sympathetic nervous system stimulation, and vasopressin release. Inflammatory processes, dysregulated G protein-coupled receptor signaling, and secretion of vasoactive peptides by endothelial and smooth muscle cells further contribute to its pathogenesis.[29,30] Vascular remodeling, characterized by decreased vascular diameter and increased vascular stiffness, plays a central role in hypertension. This remodeling involves vascular smooth muscle cell (VSMC) hyperplasia and hypertrophy, alongside dysregulation in calcium homeostasis and endothelial nitric oxide synthase (eNOS) activity. Additionally, angiotensin II (Ang II) promotes cell cycle progression, exacerbating vascular changes. Genetic disorders affecting renal sodium handling and arterial smooth muscle function, as well as hormonal and neurogenic vasoconstriction, represent additional factors contributing to hypertension's multifaceted etiology. Addressing vascular stiffness alongside peripheral vascular resistance modulation is crucial in managing hypertension and its associated complications like atherosclerosis.[31,32]

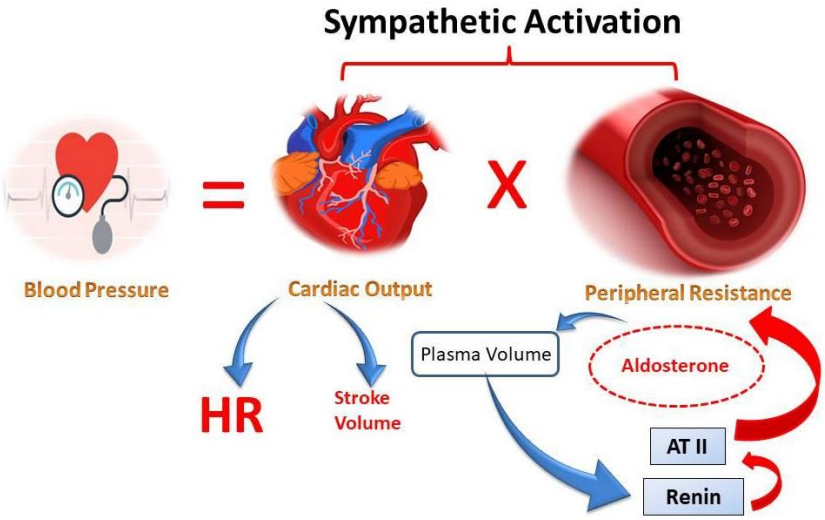

Figure 1. Pathophysiology

4. Herbal medicines used for the treatment of hypertension

The use of medicinal plants in managing hypertension is gaining attention due to concerns regarding adverse effects associated with some antihypertensive medications. Scientific research suggests lifestyle adjustments and the utilization of appropriate medicinal plants as potential strategies for treating hypertension.[33,34] Several herbs and spices contain secondary metabolites with antihypertensive properties, often exerting their effects through mechanisms such as stimulating the eNOS-NO signaling pathway, suppressing endothelial permeability, and activating angiogenesis. These actions demonstrate antioxidant, anti-inflammatory, and anti-apoptotic properties, making medicinal plants a promising avenue for hypertension management.[35,36]

1. Carum Copticum

Carum copticum, known for its calcium channel-blocking properties, shows potential in controlling blood pressure and heart rate. Studies indicate that the aqueous-methanolic extract of C. copticum seeds reduces heart rates and blood pressure in normotensive rats, with bradycardia observed at higher doses. Further research is needed to determine optimal dosages and assess its efficacy in clinical settings.[37,38.]

Figure 2. Carum Copticum

2. Tribulus Terrestris

Tribulus terrestris, commonly used in herbal remedies for hypertension, exhibits vasodilatory effects, reducing blood pressure in spontaneously hypertensive rats. Its diuretic qualities and inhibition of H2O2 production and vascular smooth muscle cell proliferation contribute to its antihypertensive effects. However, additional studies are necessary to validate its efficacy and safety for human use.[39,40]

Figure 3. Tribulus terrestris

3. Nigella Sativa

Nigella sativa, traditionally known as the "seed of blessing," has shown promising results in reducing blood pressure, particularly in male patients with moderate hypertension. Its ability to inhibit calcium channels leads to vasorelaxation, attributed to its diuretic, antioxidant, and anti-inflammatory properties. Further clinical trials are warranted to establish its effectiveness in hypertension management.[41,42]

Figure 4. Nigella Sativa

4. Rhynchophylla Uncaria

Cat's claw, utilized in traditional Chinese medicine, demonstrates hypotensive effects attributed to the indole alkaloid hirsutine, which targets voltage-dependent calcium channels. Its ability to reduce intracellular calcium levels contributes to its antihypertensive properties. However, more research is needed to elucidate its mechanisms of action and evaluate its safety profile.[43,44]

Figure 5. Rhynchophylla Uncaria

5. Apium Graveolens

Celery seed extract has been shown to reduce blood pressure in hypertensive rats by decreasing circulating catecholamine levels and lowering vascular resistance. Its high flavonoid concentration provides antioxidant properties, contributing to its efficacy as an antihypertensive agent. Further studies are necessary to determine its potential clinical applications and optimal dosages.[45,46]

Figure 6. Apium Graveolens

6. Cassia Absus

Alkaloids derived from Cassia absus seeds have demonstrated hypotensive effects in rats, with increased dosages leading to reductions in heart rate. Tachyphylaxis occurs with repeated injections at the same dose, indicating the need for further investigation into its long-term effects and safety profile.[47,48] medicinal plants offer promising potential in the management of hypertension due to their antihypertensive properties and perceived safety compared to conventional medications. However, further research is essential to validate their efficacy, determine optimal dosages, and assess their long-term safety and potential interactions with other medications. Integration of herbal remedies with conventional treatments may provide a comprehensive approach to hypertension management, benefiting individuals worldwide.[49,50]

Figure 7. Cassia Absus

7. Daucus carota

Carrots have been traditionally utilized for their antihypertensive properties, attributed to their rich antioxidant content and potassium levels. Studies suggest that bioactive compounds DC-2 and DC-3 found in Daucus carota can decrease arterial blood pressure by obstructing calcium channels. However, further research is necessary to validate these findings in clinical settings and explore the optimal dosage and formulation for medicinal use.[51,52]

Figure 8. Daucus carota

8. Theobroma cacao

Cocoa, particularly in the form of dark chocolate, has been associated with lower blood pressure due to its flavonoid content. These compounds enhance nitric oxide production, leading to vasodilation and improved endothelial function. While consumption of cocoa products has demonstrated modest reductions in blood pressure, additional studies are required to determine the long-term efficacy and potential adverse effects of regular consumption.[53,54]

Figure 9. Theobroma cacao

9. Cassia occidentalis

The leaves of Cassia occidentalis exhibit antihypertensive effects possibly by inhibiting calcium absorption and reducing oxidative stress. However, further research is warranted to elucidate its mechanism of action and evaluate its safety profile, as well as to determine optimal dosages for therapeutic use.[55,56]

Figure 10. Cassia occidentalis

10. Coriandrum sativum

Coriander seeds possess antioxidant properties and have been shown to lower blood pressure through calcium channel blocking mechanisms. While initial studies demonstrate promising results, additional research is necessary to ascertain its efficacy, safety, and appropriate dosage for clinical applications.[57,58]

Figure 11. Coriandrum sativum

11. Apocynum venetum

Flavonoids and quercetin derivatives present in dogbane leaves exhibit vasorelaxation properties, potentially reducing blood pressure by enhancing nitric oxide production. Further investigation is needed to validate these findings and determine the optimal formulation and dosage for therapeutic use.[59,60]

Figure 12. Apocynum venetum

12. Cynanchum wilfordii

Ethanolic extracts of Cynanchum wilfordii have shown promise in reducing blood pressure by activating Akt and enhancing nitric oxide production. However, further studies are required to understand its mechanisms fully and evaluate its safety and efficacy in clinical settings.[61,62]

Figure 13. Cynanchum wilfordii

13. Peganum harmala

Peganum harmala contains harmala alkaloids, which have been implicated in vasodilation through increased nitric oxide synthesis. While initial research suggests potential antihypertensive effects, further studies are needed to confirm these findings and assess its safety for medicinal use.[63,64]

Figure 14. Peganum harmala

14. Stephania Tetrandra

Stephania tetrandra contains tetrandrine, an alkaloid with antioxidant and anti-inflammatory properties that may contribute to its antihypertensive effects. However, additional research is required to elucidate its mechanisms of action and evaluate its safety and efficacy.[65,66]

Figure 15. Stephania Tetrandra

15. Lepidium sativum

Garden cress exhibits hypotensive effects and promotes diuresis, possibly through its antioxidant properties. Further studies are needed to validate its antihypertensive effects and assess its safety for long-term use.[67,68]

Figure 16. Lepidium sativum

16. Tropaeolum majus

Hydroethanolic extracts of garden nasturtium have demonstrated potential in reducing blood pressure, possibly through diuretic effects and inhibition of ACE levels. However, additional research is needed to confirm these findings and determine optimal dosages for therapeutic use.[69,70]

Figure 17. Tropaeolum majus

17. Allium sativum

Garlic supplements have shown significant reductions in blood pressure, attributed to various mechanisms including ACE inhibition, vasodilation, and antioxidant effects. However, further research is needed to standardize dosage and formulations for clinical use.[71,72]

Figure 18. Allium sativum

18. Plantago ovata

Preliminary studies suggest that Indian Plantago may lower blood pressure, but further research is needed to validate these findings and determine optimal dosages for therapeutic use.[73]

Figure 19. Plantago ovata

19. Rauwolfia serpentina

Rauwolfia serpentina contains serpentine, a potent antihypertensive alkaloid. While historically used for hypertension treatment, further research is necessary to assess its safety and efficacy compared to modern antihypertensive medications.[74,75]

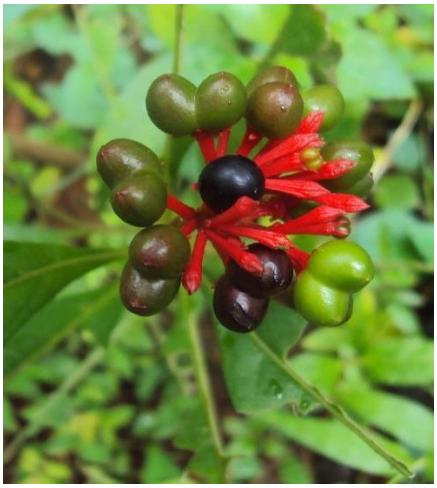

Figure 20. Rauwolfia serpentina

20. Moringa oleifera

Moringa oleifera exhibits antihypertensive effects attributed to its antioxidant components. However, further research is needed to understand its mechanisms of action and evaluate its safety and efficacy for hypertension management.[76,77]

Figure 21. Moringa oleifera

21. Allium cepa

Onions contain organo-sulfur compounds and quercetin, which may contribute to their antihypertensive effects. Further research is needed to elucidate their mechanisms of action and assess their safety and efficacy in clinical settings.[78,79]

Figure 22. Allium cepa

22. Ephedra sinica

Ephedra sinica contains ephedrine, a sympathomimetic compound with potential blood pressure-lowering effects. However, due to safety concerns and potential adverse effects, further research is needed to evaluate its risk-benefit profile for hypertension management.[80,81]

Figure 23. Ephedra sinica

23. Hibiscus sabdariffa

Hibiscus sabdariffa has shown promise in lowering blood pressure, possibly through its vasodilatory effects. Further research is needed to confirm these findings and determine optimal dosages for therapeutic use.[82,83]

Figure 24. Hibiscus sabdariffa

24. Ginkgo biloba

Ginkgo biloba exhibits vasodilatory effects attributed to its flavonoids and glycosides. While commonly used for various vascular conditions, further research is needed to evaluate its efficacy and safety for hypertension management.[84,85]

Figure 25. Ginkgo biloba

5. Future aspect

Medicinal plants offer promising avenues for the management of hypertension, with various compounds demonstrating potential antihypertensive effects. However, further research is needed to validate their efficacy, elucidate their mechanisms of action, and assess their safety for clinical use. Standardization of dosage and formulations, along with long-term randomized studies, will be crucial for the development of novel herbal drugs for hypertension in the future.[86,87]

6. Conclusion

Eighty percent of primary health care providers in underdeveloped nations utilize herbal medications. Because they are less likely to cause adverse effects, safer, more culturally acceptable, and more reasonably priced than other products, natural health care is thought to be the best option. The three lifestyle modifications that can help lower blood pressure are diet, exercise, and stress. Avicenna's impact on the discipline of cardiology was immense, and his contribution to the advancement of cardiological research was particularly noteworthy. Numerous illnesses and conditions related to the heart were defined by Avicenna in the third volume of the Canon of Medicine. Though it can be controlled or outright banned, hypothyroidism (HTN) is one of the most common disorders in the world and presents numerous challenges for those who have it. To control high blood pressure, a variety of easy strategies can be used, including medication, lifestyle modifications, or both.

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