

Role of Gokshuradi Kwatha in the Management of Hypertension: A Critical Review

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Abstract:

Hypertension is a condition that is vastly underreported, undiagnosed and irregularly treated due to lack of public awareness. It is an easily mitigable risk factor for many chronic and debilitating conditions including cardiovascular and kidney disorders, hence awareness and timely management are very important. According to ayurvedic classical texts every movement (both at macro or micro levels) in the body is performed by Vata dosha¹ which is classified into five subtypes². Among these Vyana vata is located in the heart and regulates movements throughout the body including systemic transport³. Hence vitiation of Vata dosha, specifically vyana vata, causes disorders of systemic circulation including Hypertension. Gokshuradi kwatha is a classical formulation mentioned in Bhaishajya Ratnawali (18th century) for treating systemic vata disorders⁴. In this article we review the ayurvedic literature as well as latest researches to analyse antihypertensive properties of Gokshuradi kwatha.

Keywords: Antihypertensive, Diuretic, Vasodilator, Lipid

Introduction

Hypertension involves both functional and structural disturbances in circulation of blood. This results in increased resistance to the flow, reflected as increased blood pressure. Pathophysiology of hypertension entails various mechanisms involving both genetic and environmental influencers. Most of the cases are however idiopathic, also known as essential hypertension. Genetic sensitivity to salt in individuals leading to increased salt absorption and volume expansion makes up for approximately 50% of the cases of hypertension⁵. Impaired response of the renin-angiotensin-aldosterone system (RAAS), and increased activation of the sympathetic nervous system contribute towards the development of increased total peripheral resistance and increased afterload. These mechanisms in turn result in increased systemic blood pressure i.e. Hypertension⁶. Management of hypertension aims at eliminating or controlling the causative factors and minimising the target organ damage (TOD)⁷ due to the condition.

Latest guidelines for pharmaceutical management of hypertension recommend inclusion of at least one of four major classes in the initial therapies namely; angiotensin-converting enzyme inhibitors (ACEI), angiotensin-receptor blockers (ARB), thiazide or thiazide-like diuretics, and calcium channel blockers (CCB). Beta-blockers (BB) are reserved for adults with compelling indications⁸

Samprapti (pathogenesis) of hypertension is described on the basis of principle of Tridosha in Ayurveda. Vitiation of vata dosha plays a dominant role in pathophysiology of hypertension. Kapha dosha in vitiated state is responsible for obstruction by occlusion of srotasa evident as the process of narrowing of blood

vessels due to deposition of cholesterol. This hinders in the normal function of Vata dosha and vitiates it further, leading to loss of elasticity or hardening of srotasa e.g. Atherosclerosis. Blood or rakta according to ayurveda is a dhatu (tissue) predominantly governed by pitta dosha. Vitiating of pitta leads to change in the properties of rakta dhatu thus affecting its volume, viscosity and flow resulting in vitiation of vata dosha; as disruption (increased or decreased velocity and turbulence) of normal movements vitiates vata dosha. Thus, according to ayurveda pathogenesis of hypertension involves all the three dosha (tridosha vyadhi), vata dosha being dominant⁹.

Therefore, therapeutic management of hypertension requires drugs that have pacifying effect on all the three dosha (tridosha shamaka) while specifically reversing the vitiation of vata dosha. Gokshuradi kwatha is an ayurvedic formulation documented in a compilatory ayurvedic text Bhaishajya Ratnawali, for the management of sarvanga gata vata (systemic vata disorders).

Drug review

Gokshuradi kwatha is a formulation composed of five herbal drugs namely, Gokshura (*Tribulus terrestris*), Eranda (*Ricinus communis*), Vacha (*Acorus calamus*), Rasna (*Pluchea lanceolata*) and Punarnava (*Boerhavia diffusa*). All the constituents are taken together with water and processed into kwatha (decoction)

Table 1: Contents of Gokshuradi Kwatha

	Gokshura¹⁰	Eranda¹¹	Vacha¹²	Rasna¹³	Punarnava¹⁴
Botanical name	<i>Tribulus terrestris</i>	<i>Ricinus communis</i>	<i>Acorus calamus</i>	<i>Pluchea lanceolata</i>	<i>Boerhavia diffusa</i>
Family	Zygophyllaceae	Euphorbiaceae	Acoraceae	Asteraceae	Nyctaginaceae
Part used	Root	Root	Rhizome	Leaves	Root
Proportion	1 Part	1 Part	1/8 Part	1 Part	1 Part

Method of Preparation of kwatha: All the constituents are processed to form a paste (kalka). Their paste is then mixed together and water is added. According to the classical texts the proportion of solid drugs and water while preparing the kwatha are 1: 16. This mixture is then boiled and reduced to 1/4th of the original liquid volume. For practical purpose the dried ingredients are processed into a coarse powder (yavakuta). It is soaked overnight in sixteen times of water and boiled in the morning to reduce it to 1/4th the initial volume. This is the method for using freshly made kwatha in patients.¹⁵

There are five basic classes of formulations (Panchavidha Kashaya kalpana) namely Swarsa (Expressed juice), Kalka (Paste), Kwatha (Decoction) Hima (Cold infusion) and Phanta (Hot infusion). Each formulation is lighter (laghu) than the preceding one. Many sub-formulations based on these five basic formulations, have also been mentioned in classical texts of ayurveda¹⁶. The varied classes of the formulations facilitate optimum drug delivery, ensure palatability and thus compliance in the patients. Chemical nature of the drug (Aushadhi) is an important factor in governing the type of formulation and method of preparation. Kwatha is widely used in general practice as it is of medium potency and can easily be stored as dry coarse powder (yavakuta)¹⁷.

Table 2. Properties of Contents of Gokshuradi Kwatha

Drugs	Gokshura mula ¹⁰	Eranda mula ¹¹	Vacha ¹²	Rasna ¹³	Punarnava ¹⁴
Rasa	Madhura	Madhura Kashaya	Katu Tikta	Tikta	Madhura Tikta Kashaya
Guna	Guru Snigdha	Tikshna Snigdha	Laghu Tikshna	Guru	Laghu Ruksha
Virya	Sheeta	Ushna	Ushna	Ushna	Ushna
Vipaka	Madhura	Madhura	Katu	Katu	Madhura
Dosha karma	Vata-pitta shamaka	Kapha-vata shamaka	Kapha-vata shamak	Kapha-vata shamak	Tridosha shamaka
Therapeutic uses	Vata-vyadhi Mutrakricchra	Vata-vyadhi	Manas roga Vata-vyadhi	Vata-vyadhi	Hridroga

Phytochemical profile:

Tribulus terrestris roots contain Flavonoids eg. Quercetin and Kaempferol derivatives. Roots also show presence of Saponins namely, Terestrinin B, Terestroside A, and Polianthoside D. Terestrinin J-T and terestrosin I are saponins constituents which were isolated from the whole plant. Alkaloids such as Harmine, Harmaline, Harmalol and Harmane are also found in roots. Other compounds present are Tribulusamide A & B, Tribulosin and Unique phenolic compounds.^{18,19}

Ricinus communis – The plant contains alkaloids, terpenoids, flavonoids, benzoic acid derivatives, coumarins, tocopherols, terpenoids and fatty acids. Phytochemical screening assays have also detected the presence of cardiac glycosides, phenolic compounds and tannins²⁰. Roots of the plant contain Indole-3-acetic acid other compounds are 3-O-Benzoyl-stigmasta-5,22-dien-3, beta-21-diol (Ricinusterryl benzoate)³³, Dipiperenoyl methyl ester methylene (Ricipiperanyl ester)³³, Erandone (33)³⁴, 3-alpha-Hydroxypentatriacont-14-en-26-one (Ricipentatriacontanol)³³, Lupeol (17)³⁴, 1-Oleio-2-palmitoglycerol phosphate³³, Quercetin-3-O-beta-D-glucopyranoside (isoquercetin, 25)³⁶, Quercetin 3-O-beta-Rutinoside (Rutin, 24)³⁶ and Kaempferol 3-O-beta-D- [6-O-acetylglucopyranosyl (1,3)-beta-D-galactopyranoside] (Ricinitin)³⁶²¹.

Acorus calamus – Presence of glycosides, flavonoids, saponins, tannins, polyphenolic compounds, mucilage, volatile oil and bitter principles was detected in the phytochemical profile of the plant. Other significant compounds are beta- asarone, camphene, calarene, alpha- selinene, s- cadinol, 4Terpineol, 2-Allyl-5-ethoxy-4- methoxyphenol, Epiudesmin, Lysidine, Spathulenol, Borneol, Furethyl ketone and Nonanoic Acid, 2,2,5,5-Tetramethyl-3-hexanol, The aromatic constituents specifically asarylaldehyde present in roots and asarone found in leaves render the smell of volatile oil²².

Pluchea lanceolata – Pluchine, Pleuchioside, Monoacetyl-pleuchioside, 3-Oxo-pleuchioside, Pleuchiol, Quercitrin, Isorhamnetin, Indole alkaloids, Phenol, Ascorbic acid, Neolupeol, Moretenol, Taraxasterol acetate, 5,7-dihydroxy-8-isobutylflavone, beta-Sitosterol, beta-Sitosterol glucoside, beta-Amyrin, beta-Amyrin acetate, alpha-Amyrin, beta-Amyrin caproate, Hesperidin, Taxifolin-3-arabinoside, Sorghumol acetate, Boehmerol, Sorghumol, Phloroglucinol, Chlorogenic acid, Methylated coumarins, Phenol, Ascorbic acid, Pluchea chromenone, Plucheasterolide, n-Tridecanyl-noctadecanoate, n-Nonadecanol Pleuchioside, Monoacetyl pleuchioside, Monoacetyl pleuchiol, 3-Oxo-pleuchiol²³.

Boerhavia diffusa - Root of Boerhavia diffusa contains Phenolic glycoside -Punarnavoside, C-Methyl flavone -Borhaavone, Isoflavone - 2'-O-Methyl abronisoflavone, Phenolic acid - trans-caftaric acid, Rotenoids - Boeravinones A, B, C, D, E, & F, Boeravinones G, H, Boeravinones I, J 9-O-Methyl-10-hydroxy coccineone E, Diffusarotenoid, 6-O-Demethyl- boeravinone H, 10-Demethyl boeravinone C, Coccineones E, B, Boeravinones M, P, Q, R & S, Xanthone -Boerhavine, Lignan - Liriodendrin, Syringaresinol mono-beta- D-glucoside, Purine nucleoside - Hypoxanthine-9-L- arabinofuranoside, Sterol - Boerhavisterol, Sterol ester - Boeravilanostenyl benzoate, Ecdysteroid - beta-Ecdysone, Fatty acid - Triacont-24-en-1-oic acid, Hydrocarbons - Boeradiffusene²⁴.

Table 3: Pharmacological Activity and Use in Ayurveda

Sl no.	Botanical name	Name in Ayurveda	Indications in Ayurveda	Pharmacological action
1	Tribulus terrestris	Gokshura	Vataroga, Hridroga, Prameha, Shvasa, Kasa, Shoola, Arsha, Ashmari, Mutrakrichra, Brihana, Vrishya ²⁵	Hypolipidemic action, Anti-hypertensive, Diuretic, Smooth muscle relaxant, Protection of myocardium against ischemia, Anti-inflammatory, Analgesic, Aphrodisiac, Anti-urolithic, Immunomodulatory, Antidiabetic, Anti-spasmodic, Antibacterial, Anti-helminthic, Anticancer, Hepatoprotective, Anti-depressant, Anxiolytic ^{26,27}
2	Ricinus communis	Eranda	Vataroga, Yakrit and Pleeha roga, Amavata, Mutrakrichra, Shvas, Kasa, Gulma, Kampa, Arsha, Udara roga ^{28,29}	Anti-diabetic, Anti dyslipidaemia, Anti-inflammatory, Antioxidant, Anti-cancer, Analgesic, Anticonvulsant, Antinociceptive, Hepatoprotective, Wound healing, Anti-ulcer, Anti-asthmatic, Laxative, Uterine contractant, Antibacterial, Antifungal, Regenerative for bones ^{30,31}
3	Acorus calamus	Vacha	Medhya, Vakprada, Svaraprada, Kanthya, Mala-Mutra vishodhana, Jantuhara, Unmada, Apasmar, Vatavyadhi, Shoola ^{32, 33} ,	Antihypertensive, Cardioprotective effects, Anti-inflammatory, Antioxidant, Anticonvulsant, Antidepressant, Neuro-protective, Anti-obesity, Anti-diabetic, Immunomodulatory ^{34,35}
4	Pluchea lanceolata	Rasna	Shopha, Vatarakta, Shvasa, Kasa, Visha, Jvara, Hikka, Amavata, Udara roga, Shoola, 80	Nephroprotective, Anti-inflammatory, Smooth muscle relaxant, Neuroprotective, Laxative ^{28,38} , Antioxidant ³⁹ , Antirheumatic

			Vataroga ³⁶ , Kampvata ³⁷	(Immunosuppressive ⁴⁰), Cardioprotective ⁴¹
5	Boerrhavia diffusa	Punarnava	Shopha, Pandu, Hridroga, Kasa, Urahkshata, Shula, Rakta Vikara, Udara roga, Pittaja roga ^{42,43,44} .	ACE-inhibiter, Vasodialator, Diuretic, Immunomodulator, Anticancer (cytotoxic & anti metastatic), Antidiabetic (hypoglycaemic), Anti- inflammatory, Hepatoprotective, Antioxidant, Anticonvulsant ⁴⁵

Discussion

Tribulus terrestris –Ayurvedic Pharmacopoeia of India recognizes the cardiogenic properties of root and fruit of Tribulus terrestris. Both the root and fruit have diuretic effects. It has also been used as an aphrodisiac, lithotriptic and urinary disinfectant in ayurvedic medicine. Classical ayurvedic texts use it to treat impotence, venereal diseases, sexual debility and urinary disorders²⁶. Extracts of Tribulus terrestris have been found to possess significant antihypertensive activity in rodent studies. These effects were attributed to a direct arterial smooth muscle relaxation possibly resulting from nitric oxide release and membrane hyperpolarization⁴⁶. These properties establish Gokshura as a therapeutic candidate in the management of hypertension.

Ricinus communis – Eranda has been used for the treatment of disorders of vata dosha in ayurveda. Hypertension is a disorder of Vyana vata hence Eranda is effective agent for the treatment of the condition. Root of the plant shows antidiabetic properties and has been effective on reducing blood glucose levels while also restoring lipid profile and liver and kidney functions. It also shows radical scavenging properties which help in curtailing free radical damage. Presence of flavonoids imparts antioxidant properties to this plant. It has been used as a purgative in ayurveda and other traditional medicine world-wide. Eranda has also been used as anti-inflammatory and analgesic for joint disorders. Additionally, the plant shows smooth muscle relaxant property and acts as a bronchodilator thus is also beneficial in asthma. This plant has a wide range of medicinal properties that counter the basic pathology of hypertension namely hyperlipidaemia, oxidative damage and inflammatory changes, hence proves to be useful in its management^{21,47}.

Acorus calamus – The plant has demonstrated hypolipidemic and diuretic properties. It also exhibits properties against urolithiasis. In addition to this it has anti-inflammatory, immunosuppressive, antiproliferative, cytoprotective, antimicrobial and anti-ulcer properties. Rhizome and roots of this plant are rich in a range of bioactive phenolic compounds with beneficial effects on the cardiovascular system. This plant termed as Vacha in Ayurveda has been traditionally used for management of a variety of inflammatory conditions, migraine, malaise and headache. It has also been used to improve age dependent decrease in learning capability. Additionally, it finds use as carminative, expectorant and antifungal agent. Sedative and hypotensive properties have also been documented which make Vacha an ideal candidate in management of hypertension^{22,34,35}.

Pluchea lanceolata –Termed as “Rasna” in ayurveda it is considered as Rasayana or anti- ageing drug. This was reiterated by recent studies showing prevention of oxidative damage and suppressive action on carcinogenesis in rodents. The plant has a broad spectrum of indications in ayurveda including, anti-inflammatory, potent antiarthritic, antipyretic, analgesic and laxative among others. In ayurvedic medicine it has been used for conditions like neuritis, sciatica and chronic inflammation of the nervous system.

Studies have reported that it inhibits both humoral and cell mediated immune responses. It also causes downregulation of proinflammatory cytokines, thus curtailing inflammation. It has a significant inhibitory effect on anti-cholinesterase activity. Therefore its role in the management of neurodegenerative ailments like Dementia and Alzheimer's disease has also been supported by studies. It shows an acetyl choline like action on heart due to the presence of sterol and other active phytoconstituents, which leads to a slower and regular heart rate. This action in association with cardioprotective, antioxidant and anti-inflammatory properties mitigate the processes responsible for atherosclerosis and hypertension. Thus, it can be concluded that the properties of Rasna can act against crucial steps of the pathogenesis that leads to hypertension^{23,39,40,41}.

Boerrhavia diffusa: This plant is termed as Punarnava in ayurveda and is used in different formulations for treating heart disease, ascites, anasarca, generalized tremors, facial palsy, paraplegia, anaemia, inflammation and disorders of spleen and liver. It is also is used in antiaging and management of mental disorders. It's immunomodulatory, vasodilatory and diuretic properties render it useful in wide range of medical conditions, especially in hypertension⁴⁵.

Conclusion

In ayurveda diseases are classified according to the involvement of dosha. Based on pathogenesis, hypertension is a condition involving vitiation of all three doshas with vata dosha playing a dominant role. Among the five classes of Vata, Vyana vata is responsible for control of circulation throughout the body. Hemodynamic stability is directly influenced by the physical and chemical characteristics of blood (rakta dhatu), which is inherently pitta predominant tissue. Optimal status of srotasa (channels eg vasculature) is governed by both kapha and vata dosha. Therefore, management of hypertension according to Ayurveda requires pacification of all three doshas and specially vata dosha. Gokshuradi kwatha is indicated in the management of sarvangagata vata disorders in the classical text Bhaishajya Ratnawali. Hypertension is a systemic (sarvangagata) condition hence sarvangagata or systemic pacification of vata dosha is required. Constituents of this formulation pacify all the three doshas vata, pitta and kapha. These have been used for mutra vikara (and urinary disorders) and treating disorders of vata, manas roga, hridroga and shotha among other local and systemic conditions. Recent researches have corroborated their properties eg diuretic, vasodilatory, hypolipidemic, anxiolytic and antioxidant actions among others needed to break the cycle of pathogenesis (samprapti chakra) of hypertension. Congruent findings in ancient and recent texts unequivocally establish the antihypertensive action of Gokshuradi kwath. Its use as an antihypertensive agent individually or in combination needs to be researched further to evaluate its efficacy in comparison to other prevalent antihypertensive drugs.

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