



Original Research Article (Clinical)

Effect of *Brahmi vati* and *Sarpagandha Ghana vati* in management of essential hypertension – A randomized, double blind, clinical study



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ABSTRACT

Background: Essential hypertension (EHTN) is emerging as one of the most prevalent disorder with high rate of complications, morbidity and mortality. *Brahmi vati*, an Ayurvedic medicine is explored for its efficacy in the management of EHTN.

Objective: To evaluate the efficacy of *Brahmi vati* and *sarpagandha Ghana vati* in the management of EHTN.

Methods: Total 68 patients meeting the JNC 7 criteria of EHTN of age group 20 to 60 years of either sex participated in the study. They were randomly divided into two groups, group A received capsule *Brahmi vati* 500 mg and group B capsule *Sarpagandha Ghana vati* 500 mg respectively twice a day for 30 days. Assessments were done through various variables like systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP), lipid profiles, Hamilton anxiety rating scale, 2 weeks sleep diary, serum creatinine, hemoglobin, total leukocyte count and erythrocyte sedimentation rate. Follow up visit was on every 15th day. **Results:** Study showed that both *Brahmi vati* and *Sarpagandha Ghana vati* produced improvement in most of the variables and were comparable. Improvements were seen in various variables like SBP, DBP, MAP, Hamilton anxiety rating scale, subjective sleep profiles and total cholesterol. However *Brahmi vati* showed increase in weight and Body Mass Index (BMI). *Sarpagandha Ghana vati* produced reduction in total cholesterol and LDL. Both groups showed good safety profile evaluated through the assessment of serum creatinine levels.

Conclusion: Clinical efficacy of *Sarpagandha Ghana vati* and *Brahmi vati* on EHTN showed that both were effective, safe and comparable.

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1. Introduction

Hypertension (HTN) being a chronic non-communicable disease constitutes an important public health challenge because of its prevalence and concomitant increase in the risk of cardiovascular diseases [1]. In India 14 % of people suffer from HTN and majority of them have essential hypertension (EHTN) [2]. Systolic blood pressure (SBP) above 140 mm of Hg and diastolic blood pressure (DBP) above 90 mm of Hg is the diagnostic criteria of HTN [3]. For every 20 mm Hg systolic or 10 mm Hg diastolic increase in blood pressure (BP), there is a doubling of mortality from both ischemic heart disease and stroke [3]. Even pre-HTN values of 130–139/85–89 mm Hg are associated

with more than two-fold increase in cardiovascular disease risk as compared with those with BP levels below 120/80 mmHg [4]. It is responsible for 9.4 million deaths and 7 % of disability adjusted life years in 2010 [5]. The global burden of HTN is anticipated to increase by 60% to affect approximately 29.2 % of adult population that accounts to 1.56 billion adults worldwide by 2025 [6].

The current therapeutic strategy involves use of various pharmacological agents like β blockers, ACE inhibitors, calcium channel blockers, α blockers and diuretics. However use of these drugs is affected because various hindrances like side-effects and cost-effectiveness [7]. In more than 66 % of patients, blood pressure cannot be controlled with one drug and requires two or more anti-hypertensives [8]. Even with these medications, only 34 % of hypertensives have blood pressure controlled below 140/90 mm of Hg [3]. Studies have shown that incidence of use of complementary

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and alternative system of medicine in chronic disorders is as high as 48 % in patient population [9]. Hence there is a dire need to search for safe and effective medications. Ayurveda is a rich reservoir of knowledge and has huge amount of experience based information documented. However, Ayurveda therapeutics is poorly investigated for its possible role in the management of EHTN. *Brahmi* (*Bacopa monnieri* (L.) Pennell) and its products have been widely explored for its *medhya* (nootropic) effects, used in *nidravikara* (sleep disorders) and *manoroga* (psychiatric disorders) [10]. *Brahmi vati* [11] has various ingredients which have *medhya* (nootropic), *rasayana* (rejuvenative), *nidrajanana* (sleep promoting), *shothahara* (anti-inflammatory) and *hrudya* (cardiotrophic) effects. *Sarpagandha Ghana vati* [12,13] is one of the widely studied Ayurveda preparation in EHTN. However effective management of EHTN still eludes the medical fraternity [3]. So the present study was designed to study the efficacy of *Brahmi vati* in the management of EHTN. Also, Comparative study on efficacy was undertaken with a standard drug *Sarpagandha Ghana Vati*.

2. Materials and methods

The patients attending outpatient department of the institute were recruited for the study. The CONSORT statement guidelines [14] have been followed in reporting the outcomes of the study.

2.1. Subjects

Total 68 patients diagnosed as EHTN as per JNC 7 [3] criteria were recruited from patients visiting outpatient department of KLEU Shri BMK Ayurveda Hospital Belgaum, Karnataka, India.

Inclusion Criteria:

The patients of either sex between 20 and 70 years age were included in the study.

Exclusion Criteria:

The patients with Ischemic heart disease (IHD), Coronary heart disease (CHD) and coarctation of aorta, renal failure; those having any endocrine disease, patient with hypertension complications (e.g. hypertensive encephalopathy, cerebral haemorrhage, convulsive seizure); those with malignant hypertension; pregnant and lactating female patients and patient on treatment for hypertension since 1 month, were excluded from the study.

Screening Methods:

All patients included in this study were examined thoroughly and data was recorded systematically. Various laboratory and Ayurveda variables like *Prakriti* were assessed. Laboratory investigations were carried out at Clinical Laboratory, KLEU BMK Ayurveda Mahavidyalaya, Belagavi in all patients at baseline and on 30th day of intervention.

2.2. Research design

The study was a randomized, double-blind, parallel group comparative design clinical study. The scholars involved in randomization, distribution and administration of study articles were independent from the investigators. Computer generated random numbers were utilized for the study. Block size was 4. The patients were allocated in control and intervention groups in 1:1 ratio. A pilot study was conducted on 4 patients each from both groups. Mean arterial pressure was calculated at base line. The sample size was 34 in each group under 5 % alpha error and 90 % power of test.

Intervention:

All the patients were randomly divided into two groups: group A and group B. Group A (n = 34) received *Brahmi vati* [11] capsules 500 mg BD while Group B (n = 34) received *Sarpagandha Ghana vati* [12]

capsules 500 mg BD. Both groups received their respective interventions with water after food intake. Both the interventions are from classical text books of Ayurveda. Dosage of interventions were as per respective classical literature [11,12]. The ingredients of *Brahmi vati* were procured from authentic distributors and capsules were prepared in GMP approved KLE Ayurveda Pharmacy, Belgaum as per standard procedures. *Sarpagandha Ghana vati* were procured from AYU KALP UAP Pharmacy, Ahmedabad, India free of cost and capsules were prepared in GMP approved KLE Ayurveda Pharmacy, Belgaum, Karnataka, India as per standard procedures. Duration of intervention was 30 days with follow-up on every 15th day. The nature and design of the study were explained to patients, and informed consent was obtained. The study was approved by the Institutional Ethics Committee (Protocol Id – BMK/12/PG/KC/03, KLEU BMK Ayurveda Mahavidyalaya Belagavi, Date of Approval – 18.10.2013. CTRI Registration Number – CTRI/2015/08/006120). Data collection was from August 2013 to July 2015. During the study, patients were asked to adhere to the treatment protocol and report any adverse events to the investigators at the earliest. Any manifestations either existing or new during the course of intervention that cause considerable distress were screened for possible adverse events.

2.3. Criteria for assessment

Primary Outcomes:

Systolic blood pressure, diastolic blood pressure, mean arterial pressure were primary outcomes. They were recorded by following standard operating procedures.

Secondary Outcomes:

The secondary outcomes were Hamilton Anxiety Rating Scale [15], Lipid profiles [Total cholesterol, Triglycerides, High Density Lipoproteins (HDL), Low Density Lipoproteins (LDL)], Haemoglobin, WBC-Total Count, Differential count, Erythrocyte Sedimentation Rate (ESR); two weeks sleep diary [16], sleep onset latency, intermittent awakenings in sleep, sleep duration, day time drowsiness, and serum creatinine.

2.4. Statistical methods

Statistical analysis was carried out using SPSS Version 20.0. Homogeneity of data across the groups was evaluated by the χ^2 test. Comparison of groups across different time points was carried out by two way repeated measure Analysis of Variance (rmANOVA) with Bonferroni post-hoc test. Comparison of within groups at two time points was analyzed by paired t-test. Comparison of groups at a time point was through independent sample t-test. Effect size calculated by Partial Eta Square method was used to assess the effect of treatment through the outcome from baseline to 30th and 60th day of treatment. The criteria used for interpreting effect size measures were as follows: 0–0.2 minimal, 0.2–0.5 as small, 0.5–0.8 as medium, and above 0.8 as large effect size [17]. Values are reported as mean \pm standard deviation. All tests were considered statistically significant at $p < 0.05$.

3. Results

A total of 68 patients participated in the study. No patients in either groups reported any adverse effects. No patient dropped out of our study (Fig. 1).

3.1. Subject characteristics

The mean age ($p = 0.221$), gender ($p = 0.947$), socio-economic status ($p = 0.055$), education ($p = 0.838$), food ($p = 0.06$) were comparable between groups (Table 1). Clinical variables like *Prakriti*

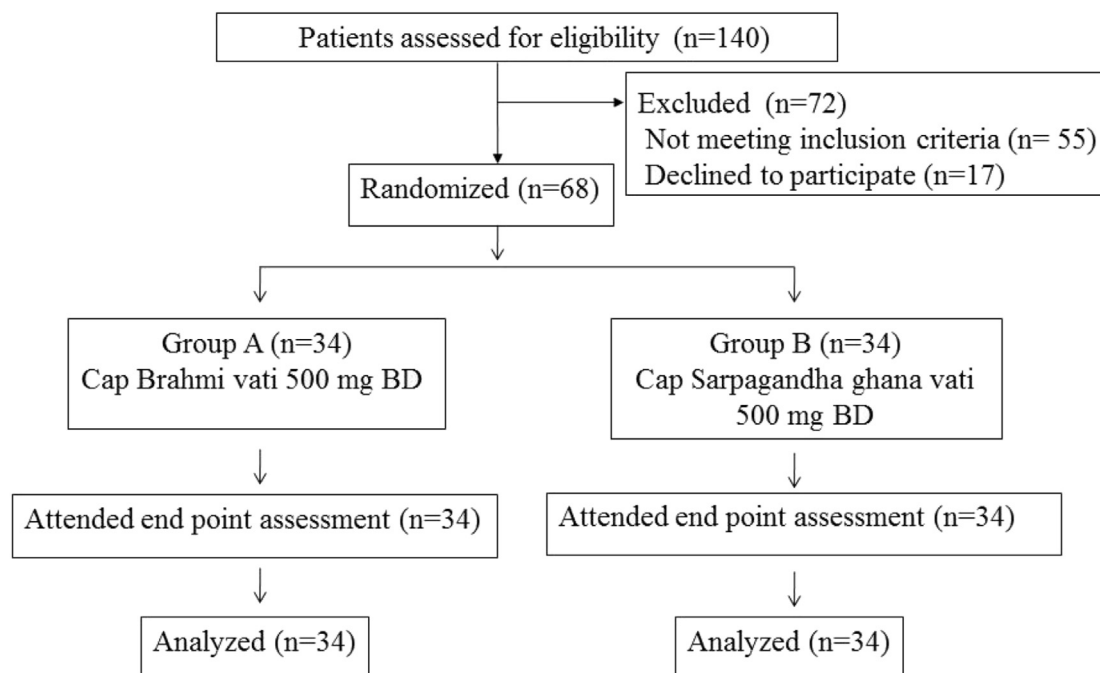


Fig. 1. CONSORT flow chart.

($p = 0.950$), weight ($p = 0.583$), BMI ($p = 0.867$), duration of illness ($p = 0.221$), and history of sleep disturbance ($p = 0.203$) of the patients were comparable in both the groups (Table 1). Clinical assessments like SBP, DBP, mean arterial pressure, total score of Hamilton Anxiety rating scale (Fig. 2), lipid profiles (Total cholesterol, Triglycerides (Fig. 3), LDL, HDL), sleep variables (duration of sleep, sleep onset latency (Fig. 4), intermittent awakenings in sleep, day time drowsiness) hemoglobin, serum creatinine, ESR, WBC total count at baseline were comparable between the groups (Table 2).

3.2. Primary outcome

The study showed that improvement in both groups was comparable in SBP, DBP and mean arterial pressure. However, within-group comparison showed significant improvement in both the groups on all these three variables at all the three time points. Both interventions produced significant reduction in SBP at 15th day ($p < 0.001$), 30th day ($p < 0.001$) and 15–30th day ($p = 0.002$) of treatment. DBP showed significant reduction ($p < 0.001$) at both

Table 1

Patient profile: Expressed in Mean, standard deviations (S.D.) and percentage.

S. No	Clinical Profile	Group A		Group B		Total	p value
		No.	%	No.	%		
1	Age (yrs)	38.94 ± 11.74		42.57 ± 12.63		40.78 ± 12.24	0.221
2	Sex	Male	8 (23.5%)	9 (26.4%)	17 (25%)	0.779	
		Female	26 (76.4%)	25 (73.5%)	51 (75%)		
3	Socio Economic Status	Poor	0 (0%)	4 (11.7%)	4 (5.8%)	0.055	
		Middle class	30 (88.2%)	29 (85.2%)	59 (86.7%)		
		Higher Middle class	4 (11.7%)	1 (2.9%)	5 (7.3%)		
4	Food	Vegetarian	24 (68.5%)	30 (88.2%)	54 (79.4%)	0.072	
		Mixed	10 (29.4%)	4 (11.7%)	14 (20.5%)		
5	Educational Status	Illiterate	10 (29.4%)	15 (44.1%)	25 (%)	0.775	
		Primary	1 (2.9%)	1 (2.9%)	2 (2.9%)		
		Secondary	9 (26.4%)	8 (23.5%)	17 (25%)		
		Graduate	13 (38.2%)	9 (26.4%)	22 (32.3%)		
		Post Graduate	1 (2.9%)	1 (2.9%)	2 (2.9%)		
6	Prakurti (Body constitution)	Vata	8 (23.52%)	8 (23.52%)	16(23.5%)	0.926	
		Pitta	6 (17.64%)	9 (26.4%)	15(22.%)		
		Kapha	2 (5.88%)	2 (5.88%)	4(5.8%)		
		Vata pitta	1 (2.94%)	1 (2.94%)	2(2.9%)		
		Vata kapha	17 (0.5%)	14 (41.1%)	31(45.5%)		
7	Sleep disturbance	Yes	27 (79.4%)	23 (67.6%)	50(73.5%)	0.272	
		No	7 (20.5%)	11 (32.3%)			
8	Duration of illness (In Days)	38.94 ± 11.74		42.57 ± 12.63		40.74 ± 12.28	0.221
9	Weight	59.99 ± 8.65		61.28 ± 10.65			0.583
10	BMI	22.52 ± 2.86		22.68 ± 3.47			0.867
11	Drop outs	0 (0%)		0 (0%)		0%	
12	Study completed	34 (100%)		34 (100%)		68 (100%)	
13	Total	34		34		68	

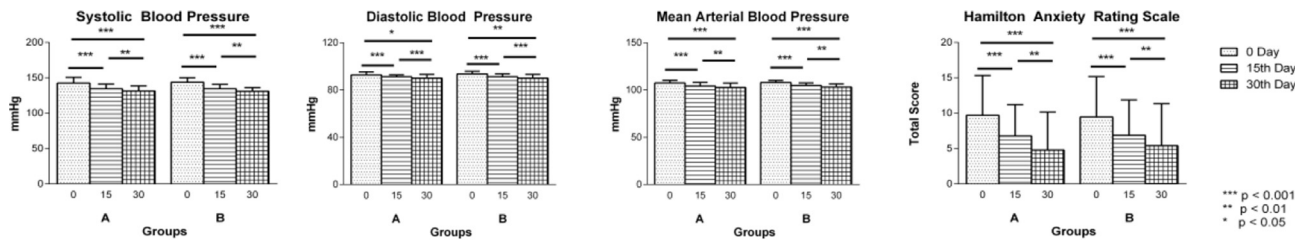


Fig. 2. Changes in blood pressure parameters in group A (n = 34) and group B (n = 34) as assessed on 0 (baseline), 15th and 30th day of intervention: a. Systolic Blood Pressure, b. Diastolic Blood Pressure, c. Mean Arterial Blood Pressure d. Hamilton Anxiety Rating Scale. Results are expressed in Mean \pm standard deviation. Level of significance is * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

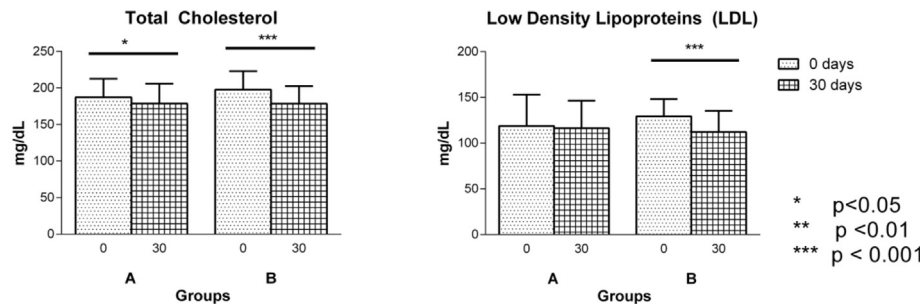


Fig. 3. Changes in parameters in group A (n = 34) and group B (n = 34) as assessed on 0 (baseline), 15th and 30th day of intervention: a. Total Cholesterol, b. Low Density Lipoproteins (LDL). Results are expressed in Mean \pm standard deviation. Level of significance is * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

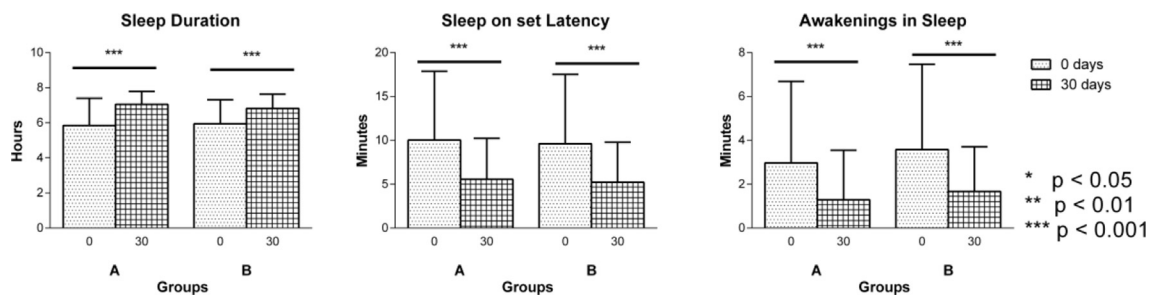


Fig. 4. Changes in sleep parameters in group A (n = 34) and group B (n = 34) as assessed on 0 (baseline) and 30th day of intervention: a. Sleep Duration, b. Sleep Onset Latency, c. Awakenings in Sleep. Results are expressed in Mean \pm standard deviation. Level of significance is * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

0–15th day and 0–30th day; however at 15–30th day, improvement in group A ($p = 0.028$) and group B ($p = 0.018$) was different. Mean arterial pressure improvement in both groups was significant ($p < 0.001$) at both 0–15th and 0–30th day of treatment. Improvements were also noted at 15–30th day of intervention in group A ($p = 0.012$) and group B ($p = 0.005$) (Fig. 2).

3.3. Secondary outcomes

Both the interventions were comparable in all secondary outcome variables when compared between the groups. However, within group comparison showed considerable outcomes in both groups. Interventions produced significant linear improvement in Hamilton Anxiety Rating scale scores at all three time points in both groups ($p < 0.001$); significant changes were noted in pre and post comparison at total cholesterol profiles (group A – $p = 0.04$, group B – $p < 0.001$), LDL (group B – $p < 0.001$), sleep profiles like sleep duration (group A and B – $p < 0.001$). Non significant improvements were observed in Sleep onset latency (group A, $p = 0.05$ & group B, $p = 0.06$). Day time drowsiness showed reduction (group A-73.03%, group B-64.02%). Significant changes in few parameters were noted in individual groups like Haemoglobin reduction in

group B ($p = 0.037$), serum creatinine reduction in group B ($p = 0.024$), weight gain in group A ($p = 0.007$), Body Mass Index (BMI) improvement in group A ($p = 0.013$) (Tables 3 and 4) (Figs. 3 and 4).

Effect size comparison showed that medium size effect in variables like BMI, weight, HDL, LDL, serum creatinine and small effect size was observed in SBP, DBP, Hamilton Anxiety rating scores, sleep duration, hemoglobin, ESR.

4. Discussion

The study showed that *Brahmi vati* was comparable to *Sarpagandha Ghana vati* in the management of EHTN in all the aspects, thus failed to reject the null hypothesis. *Brahmi vati* showed *brahmnika* effect (increase in weight and increase in BMI) and *medohara* (decreasing total cholesterol) while *Sarpagandha Ghana vati* produced *apatrapana* (debilitating therapy) and *medohara* effect by decreasing hemoglobin, total cholesterol, LDL levels. Both drugs improved variables like SBP, DBP, mean arterial pressure, decreased Hamilton Anxiety Rating scale score, improved sleep duration, decreased sleep onset latency, decreased intermittent wakefulness in sleep, decreased day time drowsiness (group A – 73.03%, group B – 64.02%) and also decrease in serum creatinine.

Table 2

Effect of interventions on weight, BMI, lipid profiles, haemoglobin, serum creatinine, ESR, total count. Expressed in Mean and standard deviations (S.D.).

Sl. No	Parameter	Intervention period	Group A	Group B	p	Effect size (0–30 days)
1	Weight in kg	0 day	59.99 ± 8.65	61.28 ± 10.65	0.583	0.80
		30 day	60.16 ± 8.63	59.63 ± 14.85	0.608	
		p	0.007	0.374		
2	Body mass index (BMI)	0 day	22.52 ± 2.86	22.68 ± 3.47	0.867	0.71
		30 day	22.58 ± 2.87	22.74 ± 3.43	0.837	
		p	0.013	0.060		
3	Total cholesterol (in mg/dL)	0 day	187.14 ± 25.47	197.55 ± 25.49	0.107	0.41
		30 day	178.67 ± 27.26	178.35 ± 24.12	0.502	
		p	0.045	<0.001		
4	Triglycerides (in mg/dL)	0 day	118.52 ± 38.47	120.02 ± 41.31	0.992	0.09
		30 day	114.94 ± 28.17	119.38 ± 30.50	0.896	
		p	0.529	0.916		
5	High density lipoprotein (HDL) (in mg/dL)	0 day	38.85 ± 4.06	41.50 ± 4.94	0.022	0.53
		30 day	39.76 ± 4.04	39.73 ± 4.01	0.976	
		p	0.212	0.083		
6	Low density lipoprotein (LDL) (in mg/dL)	0 day	118.73 ± 34.40	129.26 ± 19.00	0.225	0.50
		30 day	116.20 ± 30.28	112.14 ± 23.05	0.536	
		p	0.634	<0.001		
7	Hemoglobin (in mg/dL)	0 day	12.18 ± 1.66	12.51 ± 1.85	0.530	0.38
		30 day	12.10 ± 1.50	11.97 ± 1.93	0.748	
		p	0.654	0.037		
8	Serum creatinine (in mg/dl)	0 day	0.84 ± 0.13	0.90 ± 0.15	0.098	0.57
		30 day	0.86 ± 0.11	0.83 ± 0.10	0.239	
		p	0.247	0.027		
9	ESR (mm/h)	0 day	22.82 ± 11.83	21.20 ± 11.32	0.566	0.22
		30 day	20.61 ± 10.20	21.02 ± 10.59	0.871	
		p	0.133	0.916		
10	Total count (cells/mm ³)	0 day	7158.82 ± 1394.82	7876.47 ± 1634.85	0.085	0.04
		30 day	7058.82 ± 1353.13	7850.00 ± 1526.18	0.027	
		p	0.709	0.933		

Table 3

Ingredients of *Brahmi vati*.

S. No	Sanskrit name	Latin name	Form	Proportion
1.	<i>Brahmi</i>	<i>Bacopa monnieri</i>	Powder	2
2.	<i>Shankhpushpi</i>	<i>Convolvulus pluricaulis</i> Choiss	Powder	2
3.	<i>Gojihva</i>	<i>Onosma bracteatum</i> Wall.	Powder	2
4.	<i>Vaca</i>	<i>Acorus calamus</i> Linn.	Powder	1
5.	<i>Swarna Makshika</i>	Copper pyrite and Iron pyrite	Powder	1
6.	<i>Rasa Sindoor</i>	Sulphide of mercury	Powder	1
7.	<i>Krishna Marich</i>	<i>Piper nigrum</i> Linn	Powder	1/2
8.	<i>Jatamansi</i>	<i>Nardostachys jatamansi</i> Dc	Decoction	quantity sufficient for trituration

Both the drugs showed high safety margins as there were no adverse drug reactions/events reported and also serum creatinine levels were in physiological ranges and even showed significant decrease post interventions suggestive of an improved renal function.

Majority of the patients (n = 66) were suffering from stage 1 HTN and few were with stage 2 HTN (n = 2). Patients noticed

Table 4

Ingredients of *Sarpagandha Ghana vati*.

S. No	Sanskrit name	Latin name	Form	Proportion
1.	<i>Sarpagandha</i>	<i>Rauwolfia serpentina</i> Benth Ex. Kurz	Powder	10
2.	<i>Jatamansi</i>	<i>Nardostachys jatamansi</i> Dc	Powder	1
3.	<i>Parasika yavani</i>	<i>Hyoscyamus niger</i> Linn	Powder	2
4.	<i>Pippalimula</i>	<i>Piper longum</i> Linn.	Powder	1/2
5.	<i>Bhanga</i>	<i>Cannabis sativa</i> Linn.	Powder	1

symptoms which could be related to HTN since 60 days. All the patients were diagnosed with HTN for the first time and had not received treatment for HTN earlier. Co-morbidity of sleep disturbance was in 72.4% patients and day time drowsiness was in 68.11% patients. Sub-components of lipid profile are expressed in desirable, borderline and high risk ranges. Our study revealed that patients in borderline and high risk ranges were 33.3% in total cholesterol, 18.8% in triglycerides, 94.2% in HDL, 43.5% in LDL. Cumulatively patients with all sub-components in desirable range were 2.8%, at least one parameter in border line range were 76.8% and at least one parameter in high risk range were 20.2% suggesting high association of HTN and dyslipidemia.

Brahmi vati showed beneficial effect on variables related blood pressure like SBP, DBP and mean arterial pressure. SBP rises throughout the age where as DBP rises till 50 yrs of age and then it may remain same or fall later [18]. DBP usually refers to peripheral resistance and is a potent risk factor for cardiovascular diseases till 50 yrs of age. However, SBP represents the most common form of HTN and is important [19] as it reduces total mortality, cardiovascular mortality, stroke, and heart failure events [20]. Mean arterial pressure is perfusion pressure seen by organs in the body and has higher importance in patients of essential HTN [21]. Improvement in these variables has a greater consequence in the long term management of EHTN.

Brahmi vati also showed significant decrease in total score of Hamilton anxiety rating scale, total cholesterol levels, intermittent awakenings in sleep, day time drowsiness, serum creatinine levels. Increase in sleep duration, weight and BMI were also observed. However weight and BMI were in normal range (<25 Kg/m²) before & after intervention. Duration of sleep in healthy adults is 7–9 h per night [22,23], however average sleep in group A was 5.5 hours/night showing sleep deficiency. *Brahmi vati* intervention showed increase in sleep duration to 7.03 hours/night which was in the normal range. Trends of improvement in Sleep onset latency was

observed with decrease from 10 min to 7 min. Normal sleep on set latency is less than 10 min and in the study group it was in the higher range and was reduced to normal range. Awakenings in sleep were significantly decreased from 3 to 1 min. Day time drowsiness was decreased by 73 %. Thus *Brahmi vati* showed improvement in sleep maintenance and duration of sleep. Grossly it had sleep promotive & restorative effect. Similar results were also seen in *Sarpagandha Ghana vati*, increased sleep duration from 5.57 h to 6.49 h, trends of decrease in sleep onset latency from 9 to 6 min, decrease in awakening in sleep from 3 to 1 min. Decrease in day time drowsiness was by 64 %.

Sleep disturbance, dyslipidemias and anxiety have closer association with HTN. Short sleep duration is associated with HTN [24]. Short sleep duration (≤ 5 h/night) was associated with a 60 % higher risk of self-reported incident HTN over an 8 to 10 year follow-up period [25]. Co-morbidity of dyslipidemia in EHTN was 30.7 % and patients with these 2 conditions were found to have 3 to 4 times the prevalence of myocardial infarction than patients with either condition alone, and 2 to 3 times the prevalences of coronary artery disease, peripheral artery disease, and cerebrovascular disease [26]. Meta-analysis study has shown there is association between anxiety and increased risk of HTN [27]. Either these can be co-morbidity or risk factors for development of HTN. Dyslipidemias and HTN form the important criteria for diagnosis of metabolic syndrome as per the NCEP ATP III definition [28]. Activation of the hypothalamic–pituitary–adrenal axis and the sympathetic nervous system as seen in insomnia may predispose to HTN development [29]. Same reasoning is applicable for other components like anxiety and dyslipidemias.

Brahmi vati is a formulation (Table 3) with drugs reportedly having activity on HTN, central nervous system, cardiovascular system, diuretic activity etc. Ingredients like *Brahmi* (*B. monnieri* (L.) Pennell) has anxiolytic effects, anticonvulsive action, antioxidant activity, adaptogenic activity cardiac depressive activity on left ventricular contractility, heart rate and coronary flow similar to that of quinidine on heart [30]. Clinical study on *Nardostachys jatamansi* has shown significant improvement in EHTN [31] which exhibit anti-oxidant [32] anti ischemic [33] and anti-arrhythmic [34] potential. It also increases the HDL levels which are protective lipids [35]. *Sankhapushpi* (*Convolvulus pluricaulis* Choisy) has anxiolytic activity [36]. *Vacha* (*Acorus calamus* Linn) has calcium inhibitory effect and diuretic activity which may potentiate Na^+ excretion in HTN [37]. *Krishna maricha* (*Piper nigrum* Linn.) in dose-dependent manner when administered intravenously decreases pressure in arteries in normotensive anesthetized rats [38]. *Rasa sindhoora* has augmenting antihypertensive effect [39].

Sarpagandha Ghana vati is a formulation (Table 4) with ingredients like *Sarpagandha* (*Rauvolfia serpentina* L. Benth. ex Kurz) having antihypertensive activity due to reserpine and has depressant action on central nervous system and peripheral nervous system by binding to catecholamine storage vesicles present in the nerve cell [40]. *Parasika yavani* (*Hyoscyamus niger*) crude extract caused a dose-dependent (10–100 mg/kg) fall in the arterial blood pressure (BP) of rats under anesthesia [41]. *Jatamansi* (*Nardostachys jatamansi* DC) with chemical ingredient like jatamansone have reported to possess anti-arrhythmic and antihypertensive activity [42]. Dehydro pipernonaline isolated from *Pippali* (*Piper longum* Linn.) has coronary vaso-relaxant activity [43]. Narcotic Drugs and Psychotropic Substances Act of India-1985 [44] allows use of *Bhanga* for medicinal and research purpose. The main psychoactive cannabinoid is Δ^9 -tetrahydrocannabinol (THC) and it acts through CB1 receptors that are present in brain, peripheral nerves and autonomic nervous system [45]. Studies have shown beneficial role of *Cannabis* in various diseases like Alzheimer's disease [46], anorexia and weight loss in Acquired Immuno Deficiency

Syndrome [47] and Spasticity due to multiple sclerosis [48]. *Bhanga* (*Cannabis sativa* Linn.) has cardioprotective activity and coronary vessels dilation effect mainly due to endocannabinoids [49]. In spite of legal restrictions all over the world, cannabis is the most widely used illicit recreational drug in the world [50]. Long term use is associated with addictions [51], anxiety, depression [52]. However, Ayurveda uses processed *bhanga* [53] for therapeutic use and its long term effects needs to be studied.

Various Ayurveda formulations and herbal drugs have shown their efficacy in the management of EHTN. *Shankhapushpyadi Ghana vati* (*Anabhoota* yoga) and *Sarpagandha Ghana vati* (without *bhanga*) were effective and comparable [13]. Another study showed that both *trivrutadi yoga virechana* and *Dashamoola kwatha kaala basti* with add on *Arjunadi Ghana vati* had antihypertensive effect and were comparable [54]. *Brahmyadi churna* [55], *Shilajatu* [55], *Chandramaradi yoga* [56] were also effective. Other herbals that showed antihypertensive activity are *Allium sativum* (Garlic) [57], *Zingiber officinale* (Ginger) [58], *Sarpagandha* [59], *Cassia occidentalis* (Kasamarda) [60], *Annona muricata* [61], *Achillea wilhelmsii* C [62] and *Coleus forskohlii* [63]. However, none of these studies have assessed the efficacy of drug in multiple domains as attempted in the current study. Few of these studies have methodological constraints like inadequate sample size etc.

The present study has various merits like it was double blind, randomized study. Variables were from multiple domains like blood pressure, qualitative sleep profile, lipid profiles, creatinine levels, anxiety and blood profiles. Limitations of the study were the lack of use of gold standard control drug mainly from biomedicine. Average level of ambulatory blood pressure assessment would have given better picture of HTN. Patients were predominantly of stage 1 HTN in our study; however drugs effect on stage 2 needs to be evaluated. Sleep assessment through both subjective and objective variables would have been beneficial. Longer duration intervention can throw more light on anti-hypertensive potential of these formulations.

5. Conclusion

The present study showed that both the drugs were comparable in management of EHTN. Ayurveda drugs could demonstrate action on variables of multiple domains and showed to be a comprehensive management strategy for EHTN. Both drugs appeared to be safe as assessed through serum creatinine levels and absence of any adverse drug reactions. *Brahmi vati* has *bhrumhaniya* (nourishing), *medohara* (anti-dyslipidemic), *chittodwegahara* (anxiolytic), *nidrajanana* (sleep promoting) effect along with antihypertensive effect. *Sarpagandha* also has *medohara*, *chittodwegahara*, *nidrajanana* effect and antihypertensive effect. Hence both drugs can be incorporated into comprehensive treatment strategy of HTN.

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Conflict of interest

None.

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