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Research Article

Immediate Effect of Alternate Nostril Breathing on Blood Pressure and Heart Rate Variability in Primary Hypertension- A Single Group Pilot Study

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Background: Primary hypertension has become a public health burden. Management includes lifestyle modification to anti-hypertensive medication. Also non pharmacological management such as yoga showed a strong impact in managing hypertension. One of the important aspects of yogic practices is "Pranayama". Pranayama practice can increases parasympathetic tone, decreases sympathetic activity, improves cardio-vascular & respiratory functions, decreases the effect of stress & strain on the body. Present study aimed at evaluating and understanding the immediate effect of Alternate Nostril Breathing on blood pressure & HRV in primary hypertension Methods: Previously diagnosed subjects of hypertension were screened and 30 primary hypertensive participants aged 25-50 years were recruited according to the inclusion and exclusion criteria of this study. Participants performed a 15 minutes session of Alternate Nostril Breathing. Baseline and post-intervention data were collected 2 minutes before and 2 minutes after the intervention. Following the data extraction, Data were assessed for normality and homogeneity. Analysis was done using t-tests and non-parametric tests. Result: The study demonstrated a significant decrease in LF and LF/HF Ratio and significant increase in HF and showed significant decrease in blood pressure immediately after the practice of alternate nostril breathing. Interpretation And Conclusion: The results suggested a significant decrease in sympathetic activity and shifted the sympathovagal balance toward parasympathetic dominance immediately after practicing Alternate Nostril Breathing. We can conclude that Alternate Nostril Breathing is effective in reducing Blood Pressure & LF & LF/HF ratio in primary hypertension.

Keywords: Primary hypertension, Pranayama, Alternate Nostril Breathing, Heart Rate Variability, Blood Pressure.

INTRODUCTION

Hypertension is defined as a persistent elevation in systemic arterial blood pressure resulting from complex and interrelating etiologies.[1] It is mainly classified as primary and secondary hypertension. Primary hypertension accounts for 90-95 % of adult case and can develop as a result of environmental or genetic factor and secondary hypertension has multiple etiologies, including renal, vascular, and endocrine causes and accounts about 2- 10 % of the cases.[2] Primary hypertension remains a major modifiable risk factor for cardiovascular disease.[3] It is usually asymptomatic during the first 15–20 years. With the time, elevated arterial pressure can damage the cardiovascular system.[4] Cardiovascular complications of hypertension are more prevalent with the higher levels of blood pressure.[5] The prevention and management of hypertension is major public health challenges in today's world. From past few decades, different classes of antihypertensive drugs are developed and tested in a vast population. By lowering arterial pressure can remarkably reduce cardiovascular problems and its mortality rates.[6] Recent evidence suggests that reduction of the blood pressure by 5-6 mmHg can decrease the risk of stroke by 40%, coronary heart disease by 15-20%, and reduces the possibility of dementia, heart failure, and

mortality of cardiovascular disease. [7] Less than 40% of treated hypertensive has their blood pressures controlled by using antihypertensive drugs. For each class of antihypertensive drugs, blood pressure response varies among patients. A sizable minority of subjects (10–20%) experiences no decrease or a paradoxical increase in blood pressure. Due to pharmacodynamic differences such inter individual variation in response reflects the variety of pathophysiological mechanisms contributing to hypertension.[8] Life style modifications are highly recommended either as a primary prevention or as a therapy with or without drug for controlling hypertension. Most of the lifestyle interventions including regular aerobic exercises, dietary sodium reduction and weight loss of 10 kg usually results in blood pressure reduction in the range of 4-10 mm Hg .[9] There is a growing body of research on non-pharmacological treatment modalities such as complementary and alternative medicine (CAM) for reducing blood pressure. Among CAM, yogic techniques are non- invasive, easy to practice and cost effective interventions that do not have any appreciable side effects.[10] Yoga is one among the important entities in complementary and alternative medicine which can be used effectively in reducing hypertension.[11] Yoga is an intriguing therapy in the management of elevated blood pressure because of its combination of gentle physical activity, slowed regulated breathing, and meditation.[12] Among yogic techniques, *pranayamas* (control over breathing) appears to have a better benefit ratio for lowering blood pressure. *Pranayama* practice does not cost anything with specific equipment and places, which increase its applicability.[13] Breath is a dynamic bridge between body and mind and thus any life experiences can distort breathing pattern. Pranayama is the art of control of breath which helps in bringing the conscious awareness to breathing and the reshaping of breathing habits and patterns.[14] Pranayama includes three phases: "*Puraka*" (inhalation);"*kumbhaka*" (retention) and "*rechaka*" (exhalation) that can be either fast or slow.[15] Alternate nostril breathing (ANB)/Nadisudhi pranayama is one of the most common yogic breathing techniques and involves breathing through one nostril at a time while closing the other nostril manually. A normal nasal cycle consists of alternate phases of congestion and decongestion of nasal tissue based on predominance of parasympathetic or sympathetic tone and breathing alternately through each nostril helps to restore the balance of autonomic nervous system.[16] Among various yoga breathing techniques, alternate nostril breathing has been specifically demonstrated to promote reduction in blood pressure both systolic and diastolic.[17] To the best of our knowledge there is no study done on the immediate effects of Alternate Nostril Breathing on Primary hypertensive patients. Hence the study is planned which aims to evaluate the immediate effect of Alternate Nostril Breathing on blood Pressure and Heart Rate Variability in subjects with Primary hypertension.

AIM:

To see the immediate effect of Alternate Nostril Breathing on Blood Pressure & Heart Rate variability in subjects with Primary Hypertension.

METHODOLOGY

Pre-diagnosed subjects of primary HTN based on examination and diagnosis made as per the Indian Guidelines on Hypertension (I.G.H) – III, 2013[18] (Table 1) were assigned in this study. Thirty potential subjects of both the genders were recruited in this study. Subjects of either gender with age of 25 to 50years who are primary hypertensive individuals with or without medication and who are willing to join the study are included. Participants were excluded if they have Cardiac conditions like Ischemic Heart Disease (IHD), who have undergone cardiac procedures like Percutaneous Trans luminal Coronary Angioplasty (PTCA) with or without stenting, Coronary Artery Bypass Graft (CABG) surgery[19,] also all the female subjects during their menstrual cycle, as menstruation is known to influence the circulatory and humoral dynamics.[20, 21] Subjects having co-existing morbidity like Type 2 Diabetes Mellitus, Hypercholesteremia.[22] A prior permission was obtained from the Institutional Ethical committee of SDM College of Naturopathy and Yogic sciences for conducting this study (n=30).The study was executed at Anveshana, Research Lab, SDM Yoga and Nature Cure Hospital, Shanthivana Subjects were verbally explained in detail about the procedure, study objectives, study methods and all the rights of the subject pertaining to the conduction of the study. A

signed informed consent was obtained from each subject before the commencement of the intervention.

Demographic Details of The Subjects

Total Participants completing the study	30
Gender distribution	Male :19, Female :11
Age range	25 to 50 years
Age (Mean ±SD) in yrs	Male: 38.38 ± 8.04, Female: 42.27 ± 5.06

Study Design:

214 Hypertensive patients were screened from inpatient facility of SDM Yoga and Nature Cure Hospital, Shanthivana, Dharmasthala out of which 30 subjects who met the inclusion criteria were taken for the study. The detailed instructions and guidance was provided to practice the intervention. HRV was recorded in the form of electrocardiogram [EKG] using standard bipolar limb lead II configuration and an AC amplifier with 1.5 Hz high pass filter and 75 Hz low pass filter settings (Biopac MP 36, USA). The sampling rate taken was 1024 Hz. HRV was recorded for 10 minutes, before and after the intervention which was 2 minutes, performed by highly-trained Biopac lab instructor.

Alternate Nostril Breathing

Subjects were made to sit comfortably with hands in *chin mudra*. Concentrate on the breath for 15 seconds. Keep the head and spine upright and relax the whole body and close the eyes. Adopt *nasagra mudra* with the right hand and place the left hand on the knee in *chin mudra*. Close the right nostril with the thumb and breathe in through the left nostril Close the left nostril with the ring finger, release the pressure of the thumb on the right nostril and while breathing out through the right nostril. At the end of inhalation close the right nostril, open the left nostril and exhale through the left nostril. This is one round. Practiced it for 15 minutes.[23]

Statistical Method and Data Analysis

The raw data obtained from each subject in each recording session were tabulated separately. The group‘s median, mean, standard deviation and *p* values were calculated for all the variables to see the distribution and normality assumption. Data were analyzed using IBM SPSS 21.0. The data was checked for Normality of difference/change scores from pretest to posttest of various parameters in the study by Shapiro Wilk’s test. The paired sample t test was used to check whether pre and post averages of these variables are same or not. The non-parametric version of paired sample t test i.e. Wilcoxon Signed Rant test is adopted whenever the normality assumption is violated. Statistical analysis was done using SPSS statistics version 25. The level of statistical significance considered is $p \leq 0.05$ for the analysis and interpretation.

RESULT

The present study was conducted to evaluate immediate effect of Alternate Nostril Breathing on blood pressure and HRV in primary hypertension individuals, 30 subjects of both the gender with age group 25-50 years were recruited. The mean age of male subjects was 38.38± 8.04 and mean age of female subject was 42.27± 5.06. Height, weight and BMI of subjects were 165.9 ±8.8, 74.8±9.8, 27.09±2.2. The Shapiro Wilk test was used assess the normality assumption of all the variables in the current study. Pre and Post SBP, Mean RR, Mean HR, LF, HF follow normal distribution, while other variables violate this assumption. Hence the paired sample t test is used in case normally distributed variables to check the difference in their means and Wilcoxon Signed rank test is used in case of non normal data to check the difference in their medians.

Autonomic Variable	**Test Statistic**		**p value**		**Name of the test**
	Pre	**Post**	**Pre**	**Post**	
SBP	0.97319	0.94267	0.6295	0.1073	Paired sample t test
DBP	0.89574	0.93881	0.006619	0.0844	Wilcoxon Signed Rank test
Mean RR	0.93862	0.93456	0.08351	0.0649	Paired sample t test

Mean HR	0.96824	0.98777	0.4922	0.9746	Paired sample t test
RMSSD	0.91112	0.9673	0.01588	0.4681	Wilcoxon Signed Rank test
NN50	0.91606	0.91007	0.0212	0.0146	Wilcoxon Signed Rank test
pNN50	0.66967	0.74645	0.0000	0.0000	Wilcoxon Signed Rank test
LF	0.96819	0.94768	0.4909	0.1465	Paired sample t test
HF	0.9729	0.96515	0.6211	0.4163	Paired sample t test
LF/HF	0.39532	0.6586	0.0000	0.0000	Wilcoxon Signed Rank test

Systolic Blood Pressure

The mean pretest and posttest score of SBP in the study was 137.66 ± 12.61and 122.6 ±12.40 respectively and showed a significant decrease in SBP (P<0.05).

Time point	Mean	S. D	I. Q. R	*P* Value	
				One Tail	Two Tail
Pre-test	137.667	12.617	17.5	0.0000	0.000 *
Post test	122.6	12.408	21.5		*Alt: greater*

Diastolic Blood Pressure

The mean pretest and posttest score of DBP in the present study is 87.53 ±11.5 and 79.86 ± 9.321 respectively, showed a significant decrease in DBP (P <0.05).

Time point	Mean	S. D	I.Q. R	*P* Value	
				One Tail	Two Tail
Pre-test	87.533	11.503	13	0.0000	0.000
Post test	79.867	9.321	14		*Alt: greater*

Mean RR

The mean pretest and posttest score of Mean RR in current study 8157.03 ±98.27 and 862.43 ± 90.11 respectively, showed a significant increase in Mean RR (P<0.05).

Time point	Mean	S. D	I.Q. R	*P* Value	
				One Tail	Two Tail
Pre-test	815.033	98.275	145	0.0000	0.000
Post test	862.433	90.115	146.75		*Alt: less*

Mean HR

The mean pretest and posttest score of Mean HR is 77.93 ±9.20 and 73.16 ± 7.38 respectively, showed a significant decrease in Mean HR (P <0.05)

Time point	Mean	S. D	I.Q. R	*P* Value	
				One Tail	Two Tail
Pre test	77.933	9.206	13	0.0000	0.000
Post test	73.167	7.386	10.75		*Alt: greater*

RMMSD

The mean pretest and posttest score of RMMSD is 38.06 ±19.95 and 43.78 ± 21.41 respectively, showed

a significant increase in RMMSD (P <0.05) after the intervention.

Time point	Mean	S. D	I.Q. R	*P* Value	
				One Tail	Two Tail
Pre test	38.06	19.955	25.425	0.0007425	0.0003712
Post test	43.783	21.412	35.55		*Alt: less*

NN50

The mean pretest and posttest score of NN50 is 20.63 ± 16.31 and 24.86 ±18.21 respectively, showed a significant increase in NN50 (P <0.05) after the intervention

Time point	Mean	S. D	I.Q. R	*P* Value	
				One Tail	Two Tail
Pre test	20.633	16.310	25.5	0.003137	0.001569
Post test	24.86	18.21	28		*Alt: less*

pNN50

The mean pretest and posttest score of PNN50 is 7.88 ± 9.75 and 10.90 ±10.39 respectively, showed a significant increase in PNN50 (P <0.05) after the intervention

LF

The mean pretest and posttest score of LF is 55.15 ±17.30 and 49.76 ± 19.76 respectively, showed a significant decrease in LF (P <0.05) after the intervention.

Time point	Mean	S. D	I. Q. R	*P* Value	
				One Tail	Two Tail
Pre test	55.15	17.305	19.825	0.0004247	0.0002123
Post test	49.764	19.763	27.735		*Alt: greater*

HF

The mean pretest and posttest score of HF is 44.03 ±17.90 and 47.94 ± 19.43 respectively, showed a significant increase in HF (P <0.05) after the intervention.

Time point	Mean	S.D	I. Q. R	*P* Value	
				One Tail	Two Tail
Pre test	44.031	17.904	23.3225	0.002211	0.001105
Post test	47.94	19.438	26.742		*Alt: less*

LF/HF

The mean pretest and posttest score of LF/HF is 2.20 ±3.94 and 1.52 ± 1.6 5 respectively, showed a significant decrease in LF/HF (P <0.05) after the intervention.

Time point	Mean	S.D	I. Q. R	*P* Value	
				One Tail	Two Tail
Pre test	2.207	3.945	0.76	0.001769	0.0008846
Post test	1.522	1.659	0.86		*Alt: greater*

Overall the finding indicates that a single 15-minute session of Alternate Nostril Breathing (ANB) produced significant improvements in cardiovascular and autonomic parameters among individuals with primary hypertension. Systolic blood pressure (SBP), diastolic blood pressure (DBP), heart rate (HR), low-frequency (LF) power, and the LF/HF ratio decreased significantly ($p < .05$). In contrast, the mean R–R interval, root mean square of successive differences (RMSSD), NN50, pNN50, and high-frequency (HF) power increased significantly ($p < .05$). These findings indicate that ANB was associated with improved heart rate variability (HRV), characterized by enhanced parasympathetic activity and improved sympathovagal balance following the intervention.

DISCUSSION

The present study showed a significant change in SBP, DBP and HRV after a 15 mins practice of Alternate Nostril Breathing in primary hypertensive. SBP (determined by the cardiac output) & DBP (associated with peripheral resistance and lung inflation which decreases the systemic vascular resistance) [24, 25] changed significantly in alternate nostril breathing is ($p<0.00$). Significant change in BP indices and HR after the practice of Alternate Nostril Breathing can attribute to the balance between sympathetic and parasympathetic system. Breathing through a particular nostril can activate sympathetic (right nostril) and parasympathetic (left nostril) branches of ANS through a pathway which connects the nasal meatus and different hypothalamic nucleus there by the practice of ANB creates a balance between both sympathetic and parasympathetic system thus reduces blood pressure.[26] Time-domain HRV measures, including the R–R interval, NN50, pNN50, and RMSSD, are well-recognized indicators of vagal modulation. In the present study, the R–R interval, NN50, and pNN50 values increased significantly immediately after the intervention ($p < 0.05$), suggesting enhanced parasympathetic activity. In the frequency-domain analysis, the LF component, which reflects cardiac sympathetic modulation, and the LF/HF ratio, an indicator of sympathovagal balance, showed a significant reduction ($p < 0.05$). Conversely, the HF component increased significantly, indicating enhanced parasympathetic activation following the intervention. These findings demonstrate a significant improvement in heart rate variability (HRV) after the intervention, reflecting a shift toward greater parasympathetic dominance[27]. Alternate Nostril Breathing can be considered as slow breathing pranayama. Slow breathing affects the sympathoexcitation[28] that can enhance the baroreceptor sensitivity by central inhibitory rhythm resulting in reduced sympathetic activity consequently decreases the blood pressure. [29] In Alternate Nostril Breathing, both SBP and DBP, HR, LF and LF/HF ratio reduced significantly whereas Mean RR, RMMSD, NN50, PNN50 and HF increased significantly indicates parasympathetic arousal over sympathetic dominance. Hence we conclude that Alternate Nostril Breathing is effective tool in maintaining blood pressure and significant changes in HRV and can be used as adjunct therapy in treating primary hypertension.

CONCLUSION

The present study demonstrated a significant reduction in sympathetic activity, accompanied by a shift in sympathovagal balance toward vagal predominance, immediately following the practice of alternate nostril breathing. These findings indicate that alternate nostril breathing is associated with improved heart rate variability and a reduction in blood pressure among individuals with primary hypertension. The observed autonomic modulation suggests that this non-invasive breathing technique may have potential therapeutic value in both routine and clinical settings where acute blood pressure reduction is desirable. Consequently, alternate nostril breathing may be considered a useful adjunct to conventional management strategies for primary hypertension, with the potential to improve autonomic regulation and reduce cardiovascular risk. Further large-scale, long-term studies are warranted to confirm these findings and establish its clinical efficacy.

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