ORIGINAL ARTICLE

Comparative Study of Deep Relaxation Technique and Aum Kara on Autonomic Nervous System Variables in Hypertensive Indians

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Abstract

Background: Hypertension is a chronic condition that progressively worsens. Lifestyle modifications and antihypertensive medications are among the strategies recommended to manage it. Nonpharmacological interventions like deep relaxation, Aum Kara chanting, and tuning have been found to help lower blood pressure, enhance cardiovascular function, reduce stress, and promote mental tranquility. This study examines the effects of Aum Kara and the deep relaxation technique (DRT) on autonomic variability in individuals with primary hypertension.

Methods: From a pool of 200 individuals screened for hypertension at SDM Hospital in Dharmasthala, 60 participants aged 25–50 were selected according to the study's inclusion and exclusion criteria. The enrolled participants were assigned to one of two groups: group 1 (DRT) or group 2 (Aum Kara) based on randomization tables. Each group underwent a 20-minute session, after which their data were evaluated.

Results: Systolic blood pressure (SBP), diastolic blood pressure (DBP), and heart rate (HR) decreased immediately after the interventions in both groups. The Aum Kara group demonstrated a decrease in heart rate and the LF/HF ratio compared to the DRT group ($p < 0.05$). Specifically, in the Aum Kara group, LF decreased and HF increased, showing statistical significance in comparison to the DRT group. A significant difference was noted in all HRV components between the groups upon comparison.

Conclusion: In the comparison of the two therapies' effects, Aum Kara chanting demonstrated a more significant immediate beneficial impact on the sympathovagal system balance compared to DRT.

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Introduction

According to the World Health Organization (WHO), hypertension is a medical condition of concern that has significant cardiac, neural, and renal morbidity. According to a recent estimate, 1.28 billion adults worldwide have a history of hypertension, with almost two-thirds of the affected individuals living in low- and middle-income countries. It is also estimated that nearly 46% of hypertensive adults are ignorant of their affliction. It is understandable that there should be a persistent increase in systemic arterial pressure over a specific level, and it should not be seen as a straightforward increase in blood pressure but rather as a gradual cardiovascular illness brought on by multiple interrelated causes. The accepted diagnostic criterion for hypertension is systolic blood pressure (SBP) <140 mm Hg or diastolic blood pressure (DBP) <90 mm Hg when checked on 2 consecutive days.[1]

Cardiovascular illnesses were responsible for 2.3 million fatalities in 1990 alone, and by 2020 that number had doubled. Hypertension affects 30.7% of the adult population in India and 23.7% of women.[2]

Several risk factors have been postulated to account for the onset and worsening of high blood pressure. The increased sympathetic drive is recognized as a crucial factor in the primary stages of developing hypertension, indicating that neurohormonal dysregulation could be crucial to its etiology, progression, and observed end-organ damage, such as increased arterial stiffness or left ventricular hypertrophy.[3] Lowering arterial blood pressure has been shown in studies to lessen cardiovascular morbidity and mortality.[4]

The prevention and treatment of hypertension present a significant health burden in contemporary society, and during the past few decades researchers and doctors have created and tested numerous classes of antihypertensive medications on a wide range of individuals with varying degrees of effectiveness.

However, long-term usage of antihypertensive medications may have a few negative effects on the body's physiological systems. Therefore, it is preferable to modify the hypertension treatment plan to include lifestyle treatments such as dietary changes, weight loss programs, physical activity, and stress reduction, all of which may help to accentuate the decrease in blood pressure of hypertensive people.[5]

Unfortunately, due to the high-cost barrier of these medications, a significant subset of the hypertensive population is either denied treatment or receives inadequate care, necessitating further reforms in the hypertensive treatment approach in a community setting. Yoga could be added as an additional treatment method to address these problems since it is nonpharmacological.[6] It is postulated that yoga's component of relaxation, which can be attained through meditation or other practices, causes deep relaxation in the mental state of the practitioner. Yoga, among other forms of alternative medicine, has therefore been used to cure some psychosomatic diseases.[7]

Deep relaxation technique (DRT) is a set of guided instructions that successfully lowers physiological arousal and results in changes in a variety of autonomic measurements.[8] Chanting the pranava mantra Aum Kara helps to soothe the mind and body and eliminates stress from the outside environment.

Deep relaxation and Aum Kara chanting effectively influence various autonomic measures in healthy as well as hypertensive individuals.[9,10] However, no studies have been done specifically to evaluate the immediate effects of DRT and Aum Kara chanting on

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autonomic variability in essential hypertension patients. Therefore, the primary objective of this study is to examine and compare the immediate effect of each of these two yogic techniques on parameters of heart rate variability (HRV), blood pressure, and heart rate. This will hopefully help to develop better recommendations for nonpharmacological interventions for hypertension.

Methods

Design

A factorial randomized controlled trial design was used in the study.

Participants and Allocation Ratio

The Institutional Ethics Committee of SDM College of Naturopathy and Yogic Science approved the conduct of the study (Reg. No. EC-409, dated 29/04/2020). Each subject gave signed informed consent before the commencement of the study. The study is registered under the Clinical Trial Registry of India (CTRI) with trial registration no. CTRI/2022/03/041230.

Two hundred hypertensive patients were screened, and 60 participants were randomized and allotted into two groups (group A for DRT and group B for Aum Kara) based on the inclusion and exclusion criteria. Randomization was carried out using computer-generated randomization for allocating the subjects into the two groups. Thirty subjects were allotted to the DRT group, and 30 subjects were allotted to the Aum Kara group.

Inclusion and Exclusion Criteria

Subjects were included from either gender, aged between 25 and 50 years, who were diagnosed with primary hypertension, on treatment, or treatment-naïve hypertensives. Excluded participants were those who had cardiac conditions like ischemic heart disease (IHD), had undergone cardiac procedures like percutaneous transluminal coronary angioplasty (PTCA), subjects with a history of stroke, coronary artery bypass graft (CABG) surgery,[11] patients with ear infection or deafness, cervical spondylosis, renal or adrenal involvement, female subjects during their menstrual cycle,[12,13] and those who had coexisting morbidity like type 2 diabetes mellitus or hypercholesterolemia.[14]

Methodology

The study was conducted at Anveshana Research Lab, SDM Yoga and Nature Cure Hospital, Shanthivana, for both groups. HRV was recorded with a standard lead II electrocardiogram. A high-pass filter of 1.5 Hz and a low-pass filter of 75 Hz was applied to the inputs (AD Power Lab 4/38, Australia). While recording, the sampling rate was kept at 1024 Hz, and a minimum duration of 10 minutes of ECG was recorded from each subject by a trained lab technician. The analog ECG was converted to a digital signal using a 12-bit analog-to-digital converter (ADC) with a 500 Hz sampling rate. The beat-to-beat heart rate was determined from the consecutive RR intervals. The recorded heartbeat data were visually examined for outliers and noise, and only noise-free segments of at least 5 minutes of data were included for analysis. Lab Chart v.8.1.21 was used to convert the raw data into a tachogram to derive the time-domain as well as the frequency-domain parameters of HRV.

Variables Measured

The frequency-domain and time-domain parameters of HRV were analyzed to fulfill the outcomes of the study. The low-frequency (LF) band power values of the HRV spectrum are thought to be indicators of cardiac sympathetic activity, while the high-frequency (HF) band power values are representative of parasympathetic activity. The ratio of the LF/HF power values is assumed to be representative of the sympathovagal balance.[15]

The following variables were analyzed in the time-domain analysis:

- The mean R-R interval (the rolling average of the instantaneous heart rate).
- RMSSD (the root mean square of the differences between adjacent RR intervals).
- pNN50 (proportion of NN50 divided by the total number of NN (R-R) intervals).[15]

In the frequency domain, the following components were analyzed:

- LF/HF ratio.
- Low-frequency power (LF nu).
- High-frequency power (HF nu).

Sample Size

The participants selected for the study were randomly assigned to group A (DRT) and group B (Aum Kara). The sample size was calculated by G*Power (version 3.1.9.7) software with standard effect size 0.8, $\alpha = 0.05$, power (1–ß error) = 0.85, as $n = 60$ using independent *t*-test.

Interventions

The baseline and postintervention assessments were done for the two groups for 7 minutes. Both SBP and DBP were taken 2 minutes before and 2 minutes after the intervention using a digital sphygmomanometer.

Group A (DRT): DRT is performed in 5 slowly practiced relaxation phases, guided by an audio tape, in 20 minutes with eyes closed.

- Phase 1. Relaxing each part of the body from the tip of the toes to the waist, followed by chanting "A-KARA" 3 times mentally.
- Phase 2. Relaxing each body part from the waist to the neck, followed by chanting "U-KARA" 3 times mentally.
- Phase 3. Relaxing head and neck, followed by chanting "M-KARA" 3 times mentally.
- Phase 4. Chanting "A-U-M" for 3 rounds mentally, letting the body fall to the ground with a feeling of "letting go" while chanting the whole word "AUM."
- Phase 5. Letting oneself feel apart from the physical body, becoming aware of expansion, and merging with limitless space.

Group B (Aum Kara): The subject was asked to lie down supine, legs apart and hands apart, with eyes closed. The subjects were asked to calm their mind with 1 minutes of breath awareness followed by 20 minutes of Aum Kara chanting.

Data Analysis

The median, mean, standard deviation, and *p*-values for each variable were calculated to check the distribution and normalcy assumption for both groups. The normal distribution of data for both groups was assessed by the Shapiro–Wilk test. Parametric tests such as the paired and independent-sample *t*-tests were utilized for the data that were normally distributed. Data that did not follow a normal distribution were tested with nonparametric tests like the Mann–Whitney *U* test and the Wilcoxon signed-rank test. Statistical Package for the Social Sciences (SPSS) Statistics (version 25) was used for all the statistical analysis. The statistical significance was set at $p \leq 0.05$ for the analysis and interpretation.

Results

The gender distribution in group A (DRT group) was 77% males and 23% females, with a mean age of 49.13 ± 6.64 years, while in group B (Aum Kara group), there were 80% males and 20% females, with a mean age of 49.40 ± 9.73 years, as shown in Table 1.

In group A (DRT), a significant decrease in the mean values of SBP ($p < 0.01$) was noted. However, there was no significant mean

reduction found in DBP ($p = 0.136$) when compared with baseline. Heart rate (HR) was found to have been significantly reduced ($p < 0.01$). In the time-domain analysis of HRV, there was a significant increase in the mean values of pNN50 ($p < 0.01$), mean RR ($p < 0.05$), and RMSSD ($p < 0.01$). In the frequency domain, LF and LF/HF ratio mean values were significantly reduced ($p < 0.01$) when compared to baseline, but there was a significant increase in the mean values of HF ($p < 0.01$), as shown in Table 2.

In group B (Aum Kara), there was a significant decrease in the mean values of SBP ($p < 0.01$), DBP ($p = 0.03$), and HR ($p < 0.01$) when compared with baseline. In the time domain, there was a significant increase in the mean values of pNN50 ($p < 0.01$), mean RR ($p < 0.01$), and RMSSD ($p < 0.01$). In the frequency domain, LF and LF/HF ratio mean values were significantly reduced ($p < 0.01$) when compared to baseline, but there was a significant increase in the mean values of HF ($p < 0.01$), as shown in Table 3.

In the comparative analysis between the groups, statistically significant changes were noted in all the variables of the time-domain and frequency-domain analysis of HRV ($p < 0.01$). However, there were no significant changes found in SBP, DBP, and HR between the two interventional arms (Table 4).

Discussion

Meditation and Aum Kara chanting have been practiced since ancient times, and the practice continues even in contemporary times. This would assume that the person practicing these methods is deriving some perceived benefits. The current study shows a significant change in the cardiac autonomic parameters, stress levels, heart rate, and blood pressure. However, this study could not discriminate between the blood pressure changes in the two groups, as both techniques have a common effector pathway, namely the cardiac sympathovagal balance. HRV measures have also been used as markers of stress, and the changes noted in the study could postulate the beneficial role of these meditation techniques in stress, in addition to the effect on the cardiovascular system.[16]

Progressive conscious muscle relaxation and slow breathing, such as Aum Kara chanting, have been shown to smoothen blood flow patterns with their concomitant effect on the shearing forces on the vessel wall.[17] This could potentially enhance blood flow and decrease the occurrence of endothelial dysfunction.

Several cases have been reported about progressive alteration in sympathovagal balance in primary hypertension.[18] Therefore, any intervention that promotes or regresses these changes may be beneficial to the patient. The two methods used in this study showed significant beneficial changes in the HRV variability that suggest accentuation of the parasympathetic system. A long-term study is required to assess whether these changes can be sustained even after the cessation of these maneuvers.

In both groups, time-domain measures like pNN50, RMSSD, and mean RR significantly increased from baseline after the interventions, indicating that there is increased parasympathetic activity. RMSSD is normally used to measure vagally mediated changes in HRV.[19] pNN50, the percentage of adjacent NN intervals that varies from each other by >50 ms, indicates enhanced regulation of the cardiac activity, which in turn suggests parasympathetic dominance.

Changes observed in the frequency-domain measures of HRV also suggest attenuation of cardiac sympathetic activity and vagal dominance, due to the observed changes in HF, LF, and LF/HF ratio.[19]

In the Aum Kara group, there were enhanced changes noted in blood pressure, heart rate, and HRV measures compared to the DRT group. The peculiarity of the word AUM is that it has the potential to enhance mindfulness, lead the mind toward calmness, and evoke a positive vibration of divine feeling, the cosmic positive energy helping to create internal homeostasis, which is reflected as a vagal predominance of the sympathovagal balance.[20] The word

Table 1: Demographic variables at baseline characteristics between groups

Parameter	*DRT (group A) (n = 30)*	*Aum Kara (group B) (n = 30)*	*p-value*
Age (years)	49.40 ± 9.73	49.13 ± 6.64	0.539
Gender [*n* (%)]			
Male	24 (80)	23 (77)	
Female	6 (20)	7 (23)	

Age is shown as mean ± SD

Table 2: Comparison of pre- and posttest values within group A (DRT)

Parameter	*Pretest values (mean ± SD)*	*Posttest values (mean ± SD)*	*p-value*
Blood pressure			
SBP (mm Hg)	131.16 ± 15.02	125.63 ± 13.53	<0.01**
DBP (mm Hg)	81.96 ± 13.77	79.9 ± 12.24	0.136
HR	74.9 ± 10.25	69.26 ± 8.49	<0.01**
HRV			
1. Frequency domain			
LF/HF ratio	1.9 ± 1.64	1.26 ± 1.05	<0.01**
LF (nu)	55.13 ± 20.80	47.57 ± 19.74	<0.01**
HF (nu)	44.86 ± 19.68	52.43 ± 18.47	<0.01**
2. Time domain			
pNN50	0.12 ± 0.26	0.422 ± 0.31	<0.01**
Mean RR	798.78 ± 88.84	803.43 ± 87.85	<0.05*
RMSSD	25.41 ± 16.77	33.69 ± 18.54	<0.01**

All values were analyzed using Wilcoxon signed-rank test; **Highly significant; *significant; DBP, diastolic blood pressure; HR, heart rate; Mean RR, mean of R-R interval; NN50, consecutive normal sinus (NN) intervals exceeds 50 ms; pNN50, the fraction of consecutive NN intervals that differ by >50 ms; RMSSD, the square root of the mean squared difference between adjacent N-N intervals; SBP, systolic blood pressure; SD, standard deviation

Table 3: Comparison of pre- and posttest values within group B (Aum Kara)

Parameter	*Pretest values (mean ± SD)*	*Posttest values (mean ± SD)*	*p-value*
Blood pressure			
SBP (mm Hg)	133.56 ± 13.28	124.66 ± 12.59	<0.01**
DBP (mm Hg)	81.66 ± 9.67	76.56 ± 7.93	0.03*
HR	75.7 ± 10.25	71.33 ± 10.16	0.01**
HRV			
1. Frequency domain			
LF/HF ratio	1.51 ± 0.762	0.55 ± 0.24	<0.01**
LF (nu)	57.49 ± 10.56	34.10 ± 10.33	<0.01**
HF (nu)	42.50 ± 9.78	65.89 ± 9.24	<0.01**
2. Time domain			
pNN50	829.30 ± 125.92	881.16 ± 132.39	<0.01**
Mean RR	0.14 ± 0.21	0.91 ± 0.56	<0.01**
RMSSD	27.44 ± 16.14	45.15 ± 18.80	<0.01**

All values were analyzed using Wilcoxon signed-rank test; **Highly significant; *significant; DBP, diastolic blood pressure; HR, heart rate; Mean RR, mean of R-R interval; NN50, consecutive normal sinus (NN) intervals exceeds 50 ms; pNN50, the fraction of consecutive NN intervals that differ by >50 ms; RMSSD, the square root of the mean squared difference between adjacent N-N intervals; SBP, systolic blood pressure; SD, standard deviation

Table 4: Comparison delta (Δ) changes in each group

	DRT (mean ± SD)	*Aum Kara (mean ± SD)*	*p-value*
Blood pressure			
SBP (mm Hg)	5.53 ± 7.47	8.9 ± 6.90	0.051
DBP (mm Hg)	2.06 ± 6.53	5.1 ± 8.67	0.197
HR	5.63 ± 8.07	4.36 ± 4.84	0.772
HRV			
1. Frequency domain			
LF/HF ratio	0.63 ± 0.73	0.96 ± 0.61	0.02*
LF (nu)	7.56 ± 6.29	−23.39 ± 6.68	<0.01**
HF (nu)	−7.12 ± 5.88	52.43 ± 19.74	<0.01**
2. Time domain			
pNN50	−4.65 ± 10.38	−51.85 ± 34.95	<0.01**
Mean RR	−0.30 ± 0.27	−0.76 ± 0.50	<0.01**
RMSSD	−8.28 ± 7.62	−17.70 ± 9.22	<0.01**

All values were analyzed using Mann–Whitney *U* Test; **Highly significant; *significant; DBP, diastolic blood pressure; HR, heart rate; Mean RR, mean of R-R interval; NN50, consecutive normal sinus (NN) intervals exceeds 50 ms; pNN50, the fraction of consecutive NN intervals that differ by >50 ms; RMSSD, the square root of the mean squared difference between adjacent N-N intervals; SBP, systolic blood pressure; SD, standard deviation

AUM is believed to be a primordial cosmic sound and the totality of all sounds, which facilitate a better mindset with optimum relaxation and help to synchronize increased cardiovascular rhythm with enhanced baroreflex sensitivity.[21] It is also believed that the laryngeal vibrations caused by AUM chanting are conducted through the laryngeal and auricular branches of the vagus nerve, giving stimulation to the vagal centers, causing deactivation of the limbic system, and autonomic modulation toward parasympathetic dominance.[22]

There is a transition toward the parasympathetic domain of the sympathovagal balance, as evidenced by the change in HRV measures, which could be due to an attenuation of the sympathetic nervous system or an activation of the parasympathetic nervous system.[23] This effect is more pronounced in the Aum Kara group, as it is believed that Aum Kara is the best way to obtain peace of mind, spiritual calmness, and steadiness in brain wave activity.[24] The positive changes in the HRV measures are believed to be due to the direct and indirect connection of mantra chanting vibrations with the nervous system at various levels, limbic system deactivation, and vagus nerve stimulation.[24] This could, in turn, decrease the secretion of neurotransmitters causing the classical fight, fright, or flight response and increase the respiratory sinus arrhythmia.[25] The results of this study suggest that the traditional yogic measures (Aum Kara) evoke more positive changes than modern (DRT) techniques.

However, this study was not powered to explore the sustained effects of meditation and relaxation techniques.

Conclusion

There is a significant change in HRV observed in both groups, yet in comparison to the postintervention values of both groups, the Aum Kara group shows more parasympathetic dominance compared to the DRT group. Both relaxation techniques immediately affect heart rate and blood pressure reduction, but Aum Kara is the more potent and effective therapeutic measure for managing blood pressure in primary hypertensive individuals.

Data Availability

The dataset of this study can be obtained from the corresponding authors on request.

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