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Dr. Poonam Nagori
Sr. Demonstrator, Department
of Physiology, Jhalawar
Medical College, Jhalawar,
Rajasthan, India

Dr. Shashikant Agarwal
Sr. Professor, Department of
Physiology, Jhalawar Medical
College, Jhalawar, Rajasthan,
India

Dr. Ishrat Khan
Sr. Demonstrator, Department
of Physiology, Jhalawar
Medical College, Jhalawar,
Rajasthan, India

Dr. Himanshu Sharma
Sr. Demonstrator, Department
of Physiology, Jhalawar
Medical College, Jhalawar,
Rajasthan, India

Corresponding Author:
Dr. Poonam Nagori
Sr. Demonstrator, Department
of Physiology, Jhalawar
Medical College, Jhalawar,
Rajasthan, India

Study the effect of different types of Pranayams on physiological parameters in hypertensive patients

Dr. Poonam Nagori, Dr. Shashikant Agarwal, Dr. Ishrat Khan and Dr. Himanshu Sharma

Abstract

Background: Hypertension is the most common cardiovascular disease affecting more than one billion people worldwide. Yogic exercises (Asana, Pranayama and Meditation) have beneficial effects on hypertension.

Aims & Objectives: Study the effect of different types of pranayam on physiological parameters in stage-1(Systolic Blood Pressure 140–159 mmHg and Diastolic Blood Pressure 90–99 mmHg) Hypertension patients.

Materials & Methods: The study was conducted on 150 hypertensive patients aged 30-50 years, who were on salt reduction and antihypertensive drugs. They were randomized into three subgroups: subgroup 1a and 1b doing 20 and 30 min. pranayam respectively for 3 months and control group not doing any type of pranayam. Systolic blood pressure (mmHg), diastolic blood pressure (mmHg), and heart rate (beats per minutes) and valsava ratio of all patients were assessed at day 1 and monthly for 3 months. The data were analyzed using paired t' test and ANOVA test by SPSS 20.0 Software (trial Version).

Results: In the present study, there were significant reduction in mean values of systolic blood pressure(133.28 ± 3.65), diastolic blood pressure (88.80 ± 1.89), heart rate rate (71.98 ± 3.1) and VR (1.42 ± 0.049) after 3 months of pranayam practices in study group as compared to control group in whom mean values of the systolic blood pressure (138.06 ± 3.24), diastolic blood pressure (91.24 ± 2.00), and heart rate rate (76.48 ± 3.43) and VR (1.38 ± 0.02) was noted after 3 months. From the present study it was observed that a significant reduction in the systolic blood pressure, diastolic blood pressure and heart rate and increase VR in all the subjects ($p < 0.001$). but this decrease is more in subjects those who are doing pranayam. The results of present study indicate that yoga has beneficial effect on reduction of high blood pressure & dose of anti-hypertensive drug also.

Conclusion: Yoga and meditation should be recommended as an adjuvant therapy along with medication (anti-hypertensive drugs) to tilt the autonomic balance to parasympathetic dominance to get relieved from hypertensive symptoms.

Keywords: Pranayam, hypertension, blood pressure and heart rate, valsava ratio

Introduction

Hypertension, a “psychological classical silent killer” is the hallmark of various cardiovascular disorders. Hypertension would become a greater global burden in the next 15 - 20 years. Hypertension is an important and growing public health challenge worldwide. Hypertension refers to a condition in which value of systolic blood pressure is more than 140mmHg and diastolic blood pressure is above 90mmHg [1]. Hypertension is one of the most common health disorders prevalent worldwide and is a major risk factor for stroke, coronary

artery disease and organ failure. Increased sympathetic activity, enhanced cardiovascular reactivity and reduced parasympathetic tone have been strongly implicated in the pathogenesis of atherosclerosis, cardiovascular disease and insulin resistance which are leading causes of death and disability worldwide [2]. In the modern era, human beings are facing much stress in day-to-day life which leads to lifestyle diseases such as hypertension, diabetes mellitus, and Psychiatric disorders [3]. Lifestyle factors such as poor diet, obesity, physical activity, and smoking are risk factors for the development of hypertension. As a result, management of hypertension must be begun by modifying these lifestyle factors.

Yoga is one of the promotive, preventive as well as curative means for many such stress-related diseases [4]. Hypertension is a common disorder affecting 15% of adult population in India. Modern medicines can treat hypertension in long run but they have side effects. So during last few decades, yoga has got incorporated into modern medicine itself [5-8].

Yoga has been originated in 5000 BC. It is an ancient philosophical and religious tradition. Because of increasing incidence of lifestyle diseases such as obesity, hypertension, cardiovascular diseases, and diabetes mellitus due to urbanization and faulty lifestyle and psychological stress, yoga is incorporated into modern medicine since few decades [9]. Yoga is a psychosomatic spiritual discipline for achieving union & harmony between our mind, body and soul. Yoga is mind body technique which involves relaxation, meditation and a set of physical exercises performed in synchronized with breathing [10].

Yoga is one of the most powerful drugless systems of treatment. It is having its own concept of wellness which has been scientifically understood and presented by many. Yoga can be adopted as lifestyle for promoting our physical and mental health [11]. Yoga can be modulate functions of these two limbs of Autonomic nervous system to maintain the balance and harmony by that way homeostasis of the physiological systems is maintained. The parasympathetic stimulation calming the cardiovascular activity while sympathetic stimulation increases cardiovascular activities. Specific yogasana are playing very important role in autonomic balance and by that way gives relief from hypertension and achieves other benefits in visceral function [12].

Yoga and pranayama are beneficial for the treatment of cardiopulmonary diseases, autonomic nervous system imbalances, and psychologic or stress-related disorders [13]. It is known that regular practice of breathing exercises (pranayama) increases parasympathetic tone, decreases sympathetic activity, and improves cardiovascular functions [14].

Increased physical activity in the practice of yoga is associated with more favourable lipid profile. It increases hepatic lipase and lipoprotein lipase at the cellular level. This could effect metabolism of lipoprotein and lead to an increase uptake of triglyceride by the adipose tissue. Meditation is believed to bring about a stable autonomic balance and improve biochemical and hormonal profile [15].

Anulom-viloma Pranayama/alternate nostril breathing is one of the common yogic breathing techniques and involves breathing through one nostril at a time while closing the other nostril manually. The normal nasal cycle consists of alternating phases of congestion and decongestion of nasal tissue based on predominance of parasympathetic or sympathetic tone. Breathing alternately through each nostril helps to restore autonomic nervous system balance [16]. A recent classification recommends blood pressure criteria for defining normal blood pressure, pre-hypertension, hypertension (stages I and II), and isolated systolic hypertension, which is a common occurrence among the elderly. Generally hypertension defined as systolic and/or diastolic blood pressure consistently >95th percentile for age, sex, and height. Blood pressures between the 90th and 95th percentiles are considered pre-hypertensive and are an indication for lifestyle interventions [17].

Table 1: JNC 7 Classification of Hypertension

Blood Pressure Classification	Systolic, mmHg	Diastolic, mmHg
Normal	<120	and <80
Pre-hypertension	120–139	or 80–89
Stage 1 hypertension	140–159	or 90–99
Stage 2 hypertension	>160	or >100

Material and Method

Present study was Randomized Experimental study. The study was conducted on 150 Stage I Hypertensive patients aged 30-50 yrs of both sexes. Study group and control group randomly selected from Medicine OPD of SRG hospital Jhalawar. Out of 150 patients 50 Patients were control (1c) who were not doing any type of Pranayam. Rest 100 Patients were subdivided into 2 subgroups 1a and 1b having 50 patients in each group. Patients in subgroup 1a was doing Anulom Vilom Pranayam for 10 minute, Bhramari Pranayam up to 3 cycles and Slow and deep breathing Pranayam for rest of the time till 20 minute. Patients in subgroup 1b was doing Anulom Vilom Pranayam for 15 minutes, Bhramari Pranayam for 5 cycles and Slow and deep breathing for rest of the till 30 minutes. Patients in subgroup 1c is not doing any type of pranayam. Each Subgroup was compared with Control (1c) and with other groups. This group of 150 Stage I Primary Hypertensive patients would continue on the prescribed treatment by the Physician. Patients were practiced all above Pranayam under guidance of a yoga trainer regularly for 3 months.

Inclusion criteria

1. Stage-1 Hypertensive patients
2. Subjects between 30-50yrs
3. Subjects giving informed and written consent.
4. Exclusion criteria

5. Subject with any other pre-diagnosed cardiac disease
6. Subjects with any major pulmonary, renal, endocrinal and neurological diseases.

Parameters measured

Measurement of Blood Pressure- Systolic and diastolic blood pressure, Heart rate and Valsalva Ratio were recorded before the study and after 3 months of study.

Measurement of Blood Pressure

Blood pressure was be measured by auscultatory method in sitting position in the right arm with the help of Mercury sphygmomanometer (Diamond) and Littman stethoscope. Before recording the blood pressure, subjects were allowed to rest for 5 minutes in a quiet room to reduce the anxiety. The onset of sounds is taken as indicative of systolic blood pressure and disappearance of sound as indicative of diastolic blood pressure.

Resting Heart Rate

Lead II of the ECG was selected for measuring heart rate

Measurement of Valsalva Ratio (HR response valsalva manoeuvre)

Subject will be made to sit comfortably in a stool with ECG leads attached and asked to exhale forcefully with closed nostrils through the mouthpiece of a mercury

sphygmomanometer and to maintain pressure in the manometer up to 40 mmHg for 15 seconds. ECG recordings were taken during the manoeuvre (15 sec) and continued for 45 seconds after the manoeuvre. The ratio of the longest R-R interval after the strain to the shortest R-R interval during the strain will give the valsalva ratio. A ratio of greater than 1.45 is normal, 1.20 to 1.45 is border line and less than 1.20 is abnormal [18].

Procedure of Pranayam

Anuloma-viloma (Alternate nostril breathing) Pranayama practice the subject was asked to relax 5secs before starting and instructed to inhale through the left nostril while keeping the right nostril closed with the thumb of right hand. Retain the breath for a few seconds and exhale from the right nostril with the middle and ring fingers closing the left nostril. Then, once again inhale through the right nostril. Finally, exhale out through the left nostril while closing your right nostril with the thumb [19]. Bhramari Pranayam first directed the study group to inhale deeply through both the nostrils maximum for about 5sec and then immediately the subjects were instructed to exhale slowly through both the nostrils for about maximum of 15sec keeping two index fingers on the external auditory canal. During exhalation the subject must chant the word "O-U Mamma" with a humming nasal sound mimicking the sound of a humming bee, so that the laryngeal wall and the inner walls of the nostril mildly vibrate. These steps complete one cycle of Bhramari Pranayam [19]. Slow and deep breathing- Breath slowly and deeply through the nose and inhale for ± 3 seconds (maximum 5 seconds), feel. Hold breath for ± 3 seconds (maximum 5 seconds). Gently exhale slowly through the mouth for 5 seconds [20]. On taking detail history, all subjects were non-alcoholic,

non-smokers, not taking any drug other than antihypertensive medicine and were having similar dietary habits, physical and mental activities in working and home atmosphere. Prior to the pranayam training basal readings were taken and the procedure was explained, history of fainting attack was asked, ill-fitting dentures were removed and then the subjects were made to Pranayam practice. 3 months of Pranayam Training was given to the subjects in Department of Physiology, Jhalawar Medical College, Jhalawar. in the morning hrs for 30 min between 8 AM to 10 AM. Subjects were advised to come empty stomach for Pranayam training.

The parameters were measured on 1st day and after 3 months of the study in both the study and control sub groups. The study subgroups were asked to take Pranayam training along with anti-hypertensive drug treatment. The schedule of Pranayam training was explained to all participants and after three days practice session, the actual practice of Pranayam was introduced. Control group were taking medicine under similar conditions of the study. The pharmacotherapy to both the groups was continued and any changes in doses were recorded during the study.

Statistical analysis

Statistical analysis of data is done by help of SPSS 20.0 Software (trial Version). Paired -T test and One Way ANOVA test is use in data analysis. P value <0.05 is consider as significant. One Way ANOVA: It is used to find variation between more than two groups mean. P-value of <0.05 was considered significant and a P-value of >0.05 was considered not significant. Heart rate, Systolic BP & Diastolic BP and Valsalva Ratio analyse before & after intervention in all the subgroups and all these compare with control subgroup also.

Results

Table 2: Comparison of Basal mean SBP, DBP, HR and VR in group – 1.

Basal	Group 1a Mean \pm SD	Group 1b Mean \pm SD	Group 1c Mean \pm SD	F Value	P Value
SBP (mmHg)	148.88 \pm 3.18	149.54 \pm 3.65	149.12 \pm 3.15	0.500	0.608
DBP (mmHg)	93.64 \pm 2.57	94.16 \pm 2.31	94.12 \pm 2.50	0.687	0.505
HR (beats/min.)	83.18 \pm 2.81	83.98 \pm 2.50	83.18 \pm 2.81	1.450	0.238
VR	1.36 \pm 0.03	1.36 \pm 0.03	1.37 \pm 0.03	0.478	0.621

Table - 2 showing Basal mean SBP, DBP, HR and VR of all the subgroups. By applying ANOVA test we got P value 0.608, 0.505, 0.238 and 0.621 respectively showing no

statistical significance. Hence the basal parameters are almost same in all the subgroups of group 1.

Table 3: Comparison of Mean SBP, DBP, HR and VR before and after 3 Months of pranayam in subgroup – 1a

Group 1a(50) (20 Min. Pranayam)	Basal (Mean \pm SD)	After 3 months (Mean \pm SD)	't' Value	P Value
SBP (mm/hg)	148.88 \pm 3.18	133.28 \pm 3.65	26.69	<0.0001
DBP (mm/hg)	93.64 \pm 2.57	89.64 \pm 2.84	14.28	<0.0001
HR (beats/min)	83.18 \pm 2.81	72.92 \pm 1.84	26.13	<0.0001
VR	1.36 \pm 0.035	1.41 \pm 0.048	5.62	<0.0001

Table 4: Comparison of Mean SBP, DBP, HR and VR in before and after 3 Months of pranayam in subgroup – 1b

Group 1b(50) (30 Min. Pranayam)	Basal (Mean \pm SD)	After 3 months (Mean \pm SD)	't' Value	P Value
SBP (mm/hg)	149.54 \pm 3.65	132.12 \pm 3.18	44.52	<0.0001
DBP (mm/hg)	94.16 \pm 2.31	88.80 \pm 1.89	23.87	<0.0001
HR (beats/min)	83.98 \pm 2.50	71.98 \pm 3.1	28.63	<0.0001
VR	1.36 \pm 0.036	1.42 \pm 0.049	6.47	<0.0001

Table 5: Comparison of Mean SBP, DBP, HR and VR in before and after 3 Months in subgroup – 1c

Group 2c (50) (Not doing Pranayam)	Basal (Mean±SD)	After 3 months (Mean±SD)	't' Value	P Value
SBP (mm/hg)	149.12 ± 3.15	138.06 ± 3.24	24.08	< 0.0001
DBP (mm/hg)	94.12 ± 2.50	91.24 ± 2.00	21.04	< 0.0001
HR (beats/min)	83.18 ± 2.81	76.48 ± 3.43	11.67	< 0.0001
VR	1.37 ± 0.039	1.38 ± 0.02	3.32	< 0.0006

Study findings of our study illustrates that there was significant decrease in mean value of SBP, DBP, HR while mean VR is increased in all the subgroups. But this decrease is more in 2a and 2b subgroup as compared to control subgroup. There is no significant difference between 2a subgroup and 2b subgroup in mean SBP, DBP, HR and VR. Dose of the anti- hypertensive drugs was reduced in most of the patients of study group.

Discussion

Hypertension is a multifactorial disease in which arterial pressure is persistently high without an identifiable cause. The pathogenesis of hypertension is not fully understood. Blood pressure is mainly dependant on cardiac output and total peripheral resistance. The possible mechanism is believed to be sympathetic nervous system over activity and consequent increase in peripheral vascular resistance. In addition, direct pressor effect by the sympathetic nervous system and catecholamine released from the adrenal medulla may also be involved. Hypertrophy of systemic arterioles may represent an adaptive response to chronically elevated blood pressure and may perpetuate systemic hypertension. Inappropriately high sympathetic nervous outflow from central nervous system is also believed to be an important component in the pathophysiology of acute and chronic hypertension which in turn increases cardiac output and peripheral resistance.

Blood pressure is one of vital parameter for one's health. Lifestyle, diet and exercise are fundamental elements to control blood pressure. Regulation of blood pressure is normally an involuntary process controlled by sympathetic nervous system and hypothalamus. Stimulation of posterior and lateral parts of hypothalamus activates the sympathetic nervous system. Repeated sympathetic stimulation via hypothalamus has been shown to produce sustained systemic hypertension. The cerebral cortex can be trained to influence the blood pressure. This effect is likely to be mediated through the hypothalamus. Hypothalamus is also closely related to limbic system which plays an important role in emotional and instinctual behaviour. Since many manifestations of emotional changes like anger involve sympathetic responses, all these parts of the brain are likely to have some effect on the blood pressure. Stress too is likely to influence blood pressure through these pathways. Since, cerebral cortex is necessary for all voluntary actions, voluntary reduction of stress may be achieved by training the cerebral cortex [21]. Our study illustrates that there is significant decrease in mean value of SBP, DBP, HR while mean VR is increased in all the subgroups. But this decrease is more in 1a and 1b subgroup as compared to control subgroup. There is no significant difference between 1a subgroup and 1b subgroup in mean SBP, DBP, HR and VR. Khanam *et al.* reported that it is well known that yoga training decreases PR and BP. Environmental conditions and variety of behavioural factors such as stress, anxiety, affective and attitudinal dispositions of the individual influence the cardiovascular responses. Yogic exercise

involves physical, mental and spiritual task in a comprehensive manner. It also brings about the behavioural changes. Yoga in long duration affects hypothalamus and brings about decrease in the systolic and diastolic BP through its influence on vasomotor centre, which leads to reduction in sympathetic tone and peripheral resistance [22]. Wenger *et al.* reported Yoga involves pranayama i.e. voluntary alteration of the breathing pattern and scientists working on yoga found increased parasympathetic tone in yoga practitioners especially trained in pranayama [23]. The present study consistent with the study done by Ray *et al.* and they reported yoga training for two months resulted in a significant decrease in basal Peripheral resistance and Blood pressure [24].

The present study also consistent with the study done by Chako N. Joseph *et al.* has concluded that slow breathing at 6 cycles /min reduced blood pressure in hypertensive patients. They have reasoned that the reduction in blood pressure following slow breathing is associated with an increase in the vagal arm of baroreflex sensitivity, reduction in sympathetic activity, indicating a change in autonomic balance [25]. Slow breathing increases baroreflex sensitivity and reduces sympathetic activity and chemoreflex activation, it suggest a potentially beneficial effect in hypertension. The baroreflex is the system in the body that regulates blood pressure by controlling heart rate, strength of heart contractions, and diameter of blood vessels. Slow breathing reduces blood pressure and enhances baroreflex sensitivity in hypertensive patients. These effects appear potentially beneficial in the management of hypertension [26-28]. Additionally, slow breathing may reduce sympathetic activity by enhancing central inhibitory rhythms [29] and consequently decrease the blood pressure while enhancing the baroreflex. Furthermore, the increase in tidal volume activates the Hering–Breuer reflex which in turn reduces the chemoreflex sensitivity and thus might enhance the baroreflex with an additional effect on reducing blood pressure and sympathetic activity [30]. Other studies, Adhana *et al.* (2013), McElroy *et al.* (2013) and Lee *et al.* (2008) supported the current study results and Kaushik *et al.* (2006) added that slow breathing modality increased the parasympathetic tone resulting in a fall in systolic blood pressure, diastolic blood pressure and heart rate [31-34]. Slow pace Bhramari Pranayama and Anuloma-viloma Pranayama influence the heart rate and blood pressure through the parasympathetic dominance had been reported in our previous study. Most studies also reported that Bhramari pranayama produced gamma wave indicating parasympathetic dominance [35]. Vibration of the nasal/laryngeal mucous membrane during exhalation along with the humming of “O-U-Mmmma” caused reflex apnoea by switching off inspiratory centre which causes bradycardia through chemoreceptor sinu-aortic mechanism [36].

Conclusion

We conclude, that in Pranayam practice with

antihypertensive drugs were found more effective in reducing SBP, DBP, HR, and increasing VR. In Stage I hypertensive patients the requirement of the dose of antihypertensive drugs in majority of the hypertensive patients got reduced and it was found to have beneficial effect on cardiovascular autonomic regulation and tends to normalize it. This significant result proved that the practice of Slow and deep breathing, Anuloma-Viloma and Bhramari pranayama gives good result to maintain normal blood pressure, cardiac vagal modulation, parasympathetic dominance and also to reduce the stress level that we get in our day to day life.

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