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The study of usefulness of deep breathing exercise on blood pressure in pre-hypertensive and hypertensive patients

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Abstract

Introduction: With modern life style, in the present environmental conditions the prevalence of prehypertension & hypertension is high and is a significant risk factor for cardiovascular diseases and cerebrovascular accidents. Deep breathing exercise is a useful non– pharmacological adjunct in lowering blood pressure and heart rate.

Aim and Objective: To evaluate the effectiveness of deep breathing on blood pressure parameters in patients with prehypertension and hypertension.

Materials and Method: The study group I comprised of 60 pre-hypertensive participants in the age group 30-50 years & group II with another 60 hypertensive patients attending NCD (non-communicable disease) clinic at Kanyakumari Govt. Medical College Hospital. Both the pre-hypertensive & hypertensive groups consist of a control group with 30 participants and experimental group with 30 participants. The experimental group participants were taught and insisted to practice deep breathing exercise regularly. The blood pressure and heart rate were monitored at 0, 4, 8, 12 week intervals in both the experimental and control group.

Results: Data is analysed using paired and unpaired 't' test. A highly significant reduction in both systolic and diastolic blood pressure was found in the experimental group compared with the control group individuals. Beneficial effect started to appear at 4 weeks.

Conclusion: Regular practice of deep breathing exercise is effective in reducing systolic and diastolic blood pressure by enhancing parasympathetic activity and reducing sympathetic excitability.

Keywords: Deep breathing training, Systolic BP, Diastolic BP, Autonomic function.

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Introduction

Systemic Arterial Hypertension, is a multifactorial disease which represents an independent, significant risk factor in the occurrence of cardiovascular diseases and cerebral vascular accidents.(1) With modern life style changes in urban as well as in town cities of India, we are currently in the midst of a 'Non Communicable Disease Epidemic'. According to the WHO, one in three people world over suffer from high blood pressure. In India, the number of hypertensive individuals is anticipated to nearly double from 118 million in 2000 to 213 million by 2025. As per recent estimates there are approximately 140 million hypertensives, 31.8 million coronary artery disease & 1.2 million stroke patients.(2) Beginning at 115/75 mm Hg, CVD risk doubles for each increment of 20/10 mm Hg. 'The JNC 7 Report' insists that pre-hypertensive individuals require health-promoting lifestyle modifications to prevent the progressive rise in blood pressure and cardiovascular disease.(3)

A multidisciplinary approach, comprising clinical, pharmacological treatment and non-pharmacological intervention is more effective in optimal control of blood pressure. Deep and slow-paced diaphragmatic controlled breathing is useful in lowering blood pressure & has been reported in several studies, suggesting that reduction of respiratory rate lowers blood pressure by stimulating cardiovascular reflexes. Henceforth our study is undertaken with the objective to assess & compare the blood pressure in pre-hypertensive and hypertensive participants before and after deep breathing exercise in the experimental group and in control group, also, to compare blood pressure of subjects between control and experimental group after intervention.

Materials and Method

The present study is a hospital based, interventional study. For the study, in group I, 60 pre-hypertensive individuals attending NCD (non-communicable disease) clinic in Kanyakumari Government Medical College hospital were recruited. Among them 30 participants were taken as control and 30 were included in experimental group. Similarly, in group II, 60 hypertensive participants were recruited with 30 in control group and another 30 in experimental group.

Inclusion criteria:

- Age group 30 to 50 years, female participants
- Hypertensive patients - systolic BP >140 and <180 mmHg & diastolic BP >90 and <110 mmHg, or those using anti-hypertensive medication and BP <180/110 mmHg.

- Pre-hypertensive patients – Systolic BP from 120 to139 mm of Hg or diastolic BP from 80 to 89 mm of Hg

Exclusion criteria: Patients with chronic respiratory disease, chronic kidney disease, coronary artery disease, secondary hypertension, malignant hypertension.

Institutional Ethical committee approval was obtained. The protocol was explained to the study participants, informed consent was obtained and questionnaire was provided to collect the required data. They were advised to avoid consumption of tea / coffee 12 hours prior to reporting. The participants were made to sit comfortably for 10 minutes. Height in meters and weight in kilograms were measured and BMI calculated. Then they were allowed to rest supine for fifteen minutes. Blood pressure was recorded using sphygmomanometer following the standard technique. The same trained personnel recorded the blood pressure on all occasions. Initially baseline parameters like heart rate and blood pressure were recorded.

Estimation of blood glucose, serum lipid was done. Following this, participants in the experimental group were given training on deep breathing exercise –deep inspiration for 5 seconds and slow prolonged expiration for next 5 seconds; at a rate of 6 breaths/min. Patients were instructed to perform the exercise regularly twice a day (morning & evening) for 10 min for 12 weeks. The control group was excluded from deep breathing exercise training. All the subjects were reassessed after 4 weeks, 8 weeks & 12 weeks.

Statistical analysis: The results were tabulated in Microsoft Office Excel sheet and statistical analysis was done using GraphPad software. The change of blood pressure parameters at 0, 4, 8 and 12 weeks were compared within the group (control and experimental) and in between the groups. The within-group analysis was done by paired 't' test, inter-group analysis was done by unpaired 't' test. The p value < 0.05 was considered to be significant.

Results

Table 1: Physical characteristics of pre-hypertensive & hypertensive participants in control and experimental group

Parameters	Pre-hypertensive		Hypertensive	
	Control	Experimental	Control	Experimental
Age (years)	40.7± 5.0	39.4 ± 5.4	46 ± 4.2	46.2 ± 4.2
Height (cm)	159.3 ± 3.3	157.5 ± 2.5	159.8 ± 3.6	124 ± 6.5
Weight (kg)	59.9 ±6	64.8 ± 6	62.6 ± 8.3	80.3 ±4.4
BMI	23.5 ±3.1	25.7 ± 3.1	25 ± 4.3	27 ± 4.84

Table 2: Comparison of blood pressures in control group of pre hypertensive & hypertensive participants at various weeks

Parameters	Pre-hypertensive participants				Hypertensive participants			
	Initial reading (mm Hg)	4 week (mm Hg)	8 week (mm Hg)	12 week (mm Hg)	Initial reading (mm Hg)	4 week (mm Hg)	8 week (mm Hg)	12 week (mm Hg)
Systolic BP	133.2 ± 4.8	132.5 ± 5.5	130.6 ± 4.7	130.9 ± 4.8	148 ± 8.42	146 ± 10.1	144.6 ± 9	143.8 ± 7.8
Diastolic BP	86.7 ± 6.4	87 ± 5.9	84.9 ± 5.3	84.1 ± 4.4	90 ± 10.2	91 ± 8.2	87.4 ± 9.7	87.5 ± 8
Mean arterial pressure	102.6 ± 5.3	102.2 ± 4.1	100.1 ± 3.7	99 ± 5	109 ± 8	109.5 ± 7	106.5 ± 7.5	106.3 ± 6.8

Table 3: Comparison of blood pressures in pre-hypertensive experimental group before & after exercise at various weeks

Parameters	Initial reading (mm Hg)	After exercise		
		4 weeks (mm Hg)	8 weeks(mm Hg)	12 weeks(mm Hg)
Systolic blood pressure	129.5 ± 5.8	127.3 ± 6.4 **	127.3 ± 5.8**	121.9 ± 4.1**
Diastolic blood pressure	85 ± 7	81.9 ± 5**	80.8 ± 5.6**	77.9 ± 4.8**
Mean arterial pressure	99.8 ± 5.1	97 ± 4.1**	96.3 ± 4.5**	92.6 ± 3.7**

*p value <0.05 **p value <0.001

Table 4: Comparison of blood pressures in hypertensive experimental group before & after exercise at various weeks

Parameters	Initial reading (mm Hg)	After exercise		
		4 weeks (mm Hg)	8 weeks(mm Hg)	12 weeks(mm Hg)
Systolic blood pressure	139.1 ±14	133.2 ± 12 **	128.1 ± 9.4**	123.8 ± 6.5**
Diastolic blood pressure	91.7± 9.4	88.1 ± 9.5**	83.9 ± 7.6**	80.3 ± 4.4**
Mean arterial pressure	107.5 ± 10.1	103.1 ± 9.4**	98.6 ± 7.3**	94.8 ± 4.5**

*p value < 0.05 **p value < 0.001

Table 5: Comparison of parameters between pre-hypertensive control & experimental groups at various weeks

Parameters	4 week (mm Hg)		8 week (mm Hg)		12 week (mm Hg)	
	Experimental	Control	Experimental	Control	Experimental	Control
Systolic BP	127.3 ± 6.4**	132.5 ± 5.5	127.3 ± 5.8**	130.6 ± 4.7	121.9 ± 4.1**	130.9 ± 4.8
Diastolic BP	81.9 ± 5 **	87 ± 5.9	80.8 ± 5.6**	84.9 ± 5.3	77.9 ± 4.8**	84.1 ± 4.4
Mean arterial pressure	97 ± 4.1**	102.2 ± 4.1	96.3 ± 4.5**	100.1 ± 3.7	92.6 ± 3.7**	99 ± 5

*p value <0.05 **p value <0.001

Table 6: Comparison of parameters between hypertensive control & experimental group at various weeks

Parameters	4 week (mm Hg)		8 week (mm Hg)		12 week (mm Hg)	
	Experimental	Control	Experimental	Control	Experimental	Control
Systolic BP	133.2 ± 12**	146 ± 10.1	128.1 ± 9.4**	144.6 ± 9	123.8 ± 6.5**	143.8 ± 7.8
Diastolic BP	88.1 ± 9.5**	91 ± 8.2	83.9 ± 7.6**	87.4 ± 9.7	80.3 ± 4.4**	87.5 ± 8
Mean arterial pressure	103.1 ± 9.4**	109.5 ± 7	98.6 ± 7.3**	106.5 ± 7.5	94.8 ± 4.5**	106.3 ± 6.8

*p value <0.05 **p value <0.001

Both the control group and the experimental group are age matched (Table 1). The mean BMI of the pre hypertensives in control group is 23.5 ±3.1 kg/m2 and the experimental group is 25.7 ± 3.1 kg/m2. In the hypertensive group, mean BMI is 25 ± 4.3 kg/m2 in control group and 27 ± 4.84 kg/m2 in experimental group. From Table 2 it is noted that in pre-hypertensive and hypertensive control group participants when comparing the blood pressure parameters of initial reading with 4, 8 and 12 week reading, it is not statistically significant. In pre-hypertensive and hypertensive experimental group participants, before and after exercise (Table 3, 4) there is statistically significant reduction in systolic, diastolic and mean arterial pressure at 4, 8 and 12 weeks. Also there is highly significant reduction in blood pressure in the experimental group of pre-hypertensive & hypertensive individuals compared with their respective control group in all the weeks (Table 5, 6).

Discussion

From our study it is clearly evident that there is no statistically significant difference existing between the initial reading & 4, 8 and 12 week reading in the control group. This result is in par with the studies done by Kaur Amandeep et al,[4] Kaur Harneet et al,[5] who have also proved that there is no significant reduction in blood pressure among the control group patients. However there is a significant reduction in all the blood pressure parameters in the prehypertensive and hypertensive experimental group before and after exercise as early as 4 weeks. Various researchers have demonstrated that hypertension occurs due to sympathetic hyperactivity and parasympathetic withdrawal. A study done by Chako N. Joseph et al has concluded that slow breathing at 6 cycles /min reduced blood pressure in hypertensive patients.[6] 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. Similar study done by Kaur Harneet et al in pre-hypertensives has confirmed that slow breathing plays a significant role in reducing the blood pressure and heart rate in normal BMI and overweight subjects with prehypertension.[5]

Further there is significant reduction in blood pressure in the experimental group pre-hypertensive & hypertensive individuals when compared with the control group at 4, 8 and 12 weeks. This can be explained as - the lung inflation which increases with decreasing respiratory rate, stimulates slowly adapting pulmonary stretch receptors and this physiological reflex modulation serves as an input to the medulla and is integrated with the information about blood pressure level generated by arterial baroreceptors[7] and as an acute response to blood pressure elevation and / or lung

inflation, vasodilation occurs in a number of vascular territories, such as the limbs, skin, muscles, kidney and splanchnic vascular bed.[8] This implies that slow breathing brings about a generalized decrease in the excitatory pathways regulating respiratory and cardiovascular system.[9] Also with slow deep breathing at 6 cycles/min, by physiological neural modulation, impulses from the respiratory center stop inhibiting the cardiovagal center and thus increases the vagal tone. This leads to slowing of heart rate and reduction in blood pressure as suggested by Pal G etal.[10]

It is important to highlight that respiratory and cardiovascular systems share similar control mechanisms, thus alterations in one system will modify the functioning of the other.[11] In essential hypertension, the sympathetic hyperactivity is associated with a generalized enhancement of the excitatory pathways, leading not only to sympathetic vasoconstriction, but also chemoreflex activation.[12,13] Therefore, any modification in the respiratory control would also produce changes in the cardiovascular function.

Various researches have proved that regular practice of slow deep and rhythmic breathing increases parasympathetic tone, decreases sympathetic activity, improves cardiovascular and respiratory functions, decreases the effect of stress and strain on the body thus improving physical and mental health.[14,15] Subjects with essential hypertension have shallow respiration with an enhanced chemoreflex sensitivity. Our study shows that deep breathing leads to a decrease in the central chemoreflex sensitivity which in turn depresses the vasomotor center. This reduces the sympathetic outflow, causing peripheral arteriolar vasodilatation, decreasing peripheral vascular resistance and thus reducing diastolic blood pressure. The decrease in sympathetic discharge further decreases the tone of venules with increases in its capacitance, decrease in mean systemic filling pressure, decrease in venous return and thus lowering the systolic blood pressure.

Conclusion

Hence we conclude that practicing deep breathing exercise enhances parasympathetic activity, vagal tone and decreases the sympathetic excitability, thereby effectively reducing the blood pressure. Moreover our study has shown that practicing regular deep breathing exercise 10 minutes twice a day has significantly reduced both the systolic, diastolic blood pressure & mean arterial pressure from 4 weeks. Thus deep breathing exercise is appropriate as a primary preventive strategy to achieve blood pressure control in pre-hypertensive subjects. It can be emphasized as a non-pharmacologic adjunct in hypertensive patients along with drug treatment. Deep breathing exercise together with other life style modifications can definitely ensure a healthy living in pre-hypertensive and hypertensive individuals.

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