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Impact of pranayama and meditation on cardiovascular functions in asthmatics: prospective study

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Abstract
Introduction: Asana, pranayama, and meditation are three main techniques of yoga. Studies on long-term yogic practices have shown improvement in cardiovascular functions.
Aim: The aim was to study the short-term effects of pranayama and meditation on cardiovascular functions in asthmatics.
Material and Methods: It was a prospective interventional study done in a tertiary care centre in North India. It included 120 non-smoking patients, in the age group of 18-50 years, diagnosed with mild to moderate grades of asthma. They were randomized in two groups i.e. Group A (Yoga training group) and Group B (Control group). Yoga training group underwent 90 minutes daily yoga program for 4 weeks. Pre and post yoga cardiovascular functions were assessed by recording pulse rate, systolic blood pressure, diastolic blood pressure and mean blood pressure. The parameters were statistically analysed using SPSS 16 and p-value<0.005 was taken as normal.
Results: There was significant reduction in resting pulse rate, systolic blood pressure, diastolic blood pressure, and mean arterial blood pressure after practicing pranayama and meditation for 4 weeks
Conclusion: This study showed beneficial short term effects of regular pranayama and meditation practice on cardiovascular functions in asthmatics.

Keywords: pranayama, yoga, meditation, asthma, blood pressure, pulse rate

Introduction

Asthma is a chronic airway disease with psychosomatic imbalance and an increased vagal tone as one of the hypothesis for its etio-pathogenesis. Retraining breathing in asthma may have psychological benefits by increasing the patient's sense of control over their condition. Pranayama is believed to decrease the anxiety element. Yoga readjusts the autonomic imbalance and controls the rate of breathing and thus alters various physiological variables. These changes are attributed to the decreased sympathetic reactivity and relaxation of voluntary inspiratory and expiratory muscles.[1,2] Small study has demonstrated the benefit of yogasanas and breathing exercises on the autonomic and pulmonary functions, with drop in resting heart rate and blood pressure [3, 4] Another study has shown increase in the cardiac recovery index (CRI) assessed by the Harvard step test after 11 weeks of yoga training [5] A study done in NDA cadets demonstrated improvement in cardiorespiratory functions in NDA cadets trained in yogic practice, as compared to those undergoing physical training [6].
Studied have also demonstrated benefit of Raja Yoga meditation on respiratory system, cardiovascular system and lipid profile versus non-meditators [7].

Aim

This study was aimed to analyse the physiological effects of short term (4 weeks) combined practice of pranayama and meditation in influencing cardiovascular status in asthmatics.

Materials and Methods

The present study was conducted on one hundred and twenty patients of bronchial asthma, recruited from tertiary care centres in North India.

Inclusion criteria

1. Non-smokers in the age group of 18-50 years.
2. Mild to moderate grades of asthmatics were recruited as per National Asthma Education and Prevention Programme (NAEPP) [8]
3. No history of respiratory tract infections within the previous 6 weeks.
4. Non-engagement in any regular exercise/training prior to the study.
5. Regular attendance in the sessions and in performing the exercises. Dropouts were subsequently removed from this study.
6. Full written consent from all the patients.

Exclusion Criteria

1. Smokers

2. History of exercise induced asthma
3. History of tuberculosis, chronic obstructive airway disease and emphysema.
4. History of diabetes, hypertension, coronary artery disease, renal failure, congestive cardiac failure and cerebrovascular accidents
5. Pregnant females.
6. Patients with musculoskeletal deformities of the chest wall and / or orthopedic diseases where exercise was contraindicated.

Asthmatic patients who complied with the above mentioned criteria were randomized in two groups i.e. Group A and Group B, using permuted block randomization. To minimize the effect of environmental influences, Group A and Group B enrolment ran simultaneously. A written informed consent was taken from all the patients.

Group A: Yoga-Meditation training group

Group B: Control group

A detailed history and physical examination with special emphasis on pulse rate, blood pressure and respiratory system was done in all the group patients at baseline. All the subjects were under uniform dietary habits.

Group-A subjects were trained in Yogic exercises by a trained instructor. The training session included pranayama (45 minutes), short break (10 mins), lecture and short film on fundamentals in nutrition, stress management, meditation and yogic attitude in daily life (15 mins) and meditation (20 mins). The different types of pranayama practiced were – vibhagiya pranayama (sectional breathing), adama (kanista)-vibhagiya pranayama (diaphragmatic/abdominal breathing), madhyama-vibhagiya pranayama (thoracic/intercostal breathing), aadya (jesta)-vibhagiya pranayama (upper lobar/clavicular breathing), poorna-mudra pranayama (full yogic breathing), nadishuddi pranayama (alternate nostril breathing), kapalabhati kriya (cleansing breath), cooling pranayama, sitali pranayama, sitkari pranayama and the session was concluded by meditation. Patients were also instructed to practice yoga at home twice per day on all days of the week. All patients were instructed to remain on their prescribed treatment for asthma during the study. Patients were required to keep a day to day record of Yoga exercises practiced at home. Selections of days of training sessions was as per the convenience of patients. The subjects were instructed not to change their lifestyle or perform any other physical exercises during yoga training.

Both Group A and B patients has their cardiovascular evaluation including recoding of pulse rate and blood pressure done on their weekly visits and after 4 weeks. The subjects were asked to relax physically and mentally for 10 minutes in supine position in a silent room. In the same position, the pulse rate and the blood pressure were recorded.

Measurement of blood pressure and pulse rate: The pulse rate in beats per minute was recorded in the right radial artery by palpatory method for whole one minute. The systemic arterial blood pressure in millimeter of mercury (mm of Hg) was recorded with a sphygmomanometer (Diamond), in the right upper limb by auscultatory method. Similarly, three readings of each subject's pulse rate and systemic blood pressure were taken at an interval of 5 minutes each and average of the three values calculated. The mean arterial (blood) pressure (MAP=DBP+1/3PP) was also calculated.

Results were expressed as Mean ±SD. Student's t test was used to find the significance of study parameters by using SPSS 15.0 version. P value less than 0.05 was considered statistically significant.

Results

A total of one hundred and twenty patients were included in this study. The mean ages of subjects in Group A and B were 38.77 ± 9.92 (range- 20-50) years and 35.55 ± 10.62 (18-50) years, respectively ($p > 0.10$). There was a male preponderance in both the groups (34 in Group A and 37 in Group B). Most of them had milder form of asthma, 34 (56.67%) in Group A and 32 (53.33%) in Group B ($p > 0.10$). Mean duration of disease was 7.70 ± 5.54 (range 2 to 35) years in Group A and 6.57 ± 4.32 (range 2-18) years in Group B ($p > 0.10$).

In the present study, systolic blood pressure (SBP), diastolic blood pressure (DBP), pulse rate (PR), respiratory rate (RR) and chest expansion were compared between the two groups at baseline and at the end of 4 weeks. Both systolic and diastolic blood pressure decreased after 4 weeks of yoga training in Group A and increased in Group B, but the changes were statistically not significant.

On the other hand, pulse rate and respiratory rate showed significant decline over the 4 weeks' yoga training period, as compared to a decline in the control group which was statistically not significant. Pulse rate was higher in Group B subjects than in Group A subjects at both the periods of comparison. However at 4 weeks the difference between the two groups was statistically significant (81.05 ± 3.74 bpm vs. 83 ± 4.19 bpm, $p < 0.01$). Comparing within the groups, subjects of both the groups experienced a decrease in pulse rate, but this change was statistically significant only in Group a (82.40 ± 4.23 bpm to 81.05 ± 3.74 bpm, $p < 0.01$). Systolic blood pressure was lower in Group B subjects at baseline and at 2 weeks (113.83 ±9.58 mm Hg and 115 ±9.24 mm Hg respectively) compared to Group A subjects (116.80 ± 10.71 mm Hg and 115.53 ± 10.78 mm Hg respectively), but the differences were statistically significant ($p > 0.10$ in both cases).

Group A subjects experienced a fall in SBP from baseline (116.80 ± 10.71 mm Hg) to 4 weeks (115.53 ± 10.78 mm Hg), while Group B subjects mean SBP rise from baseline (113.83 ± 9.58 mm Hg) to 2 weeks (115 ± 9.24 mm Hg). However, none of showed statistical significance.

Diastolic blood pressure was found to be variable, with Group A subjects having higher values at baseline than Group B, and vice versa at 4 weeks. On comparing within the groups, Group A subjects had a fall in DBP from baseline to 4 weeks (73.70 ± 6.71 mm Hg to 72.83 ± 7.22 mm Hg), while Group B subjects had a rise in DBP during the same period (73.17 ± 6.47 mm Hg to 73.33 ± 7.28 mm Hg). However, none of the comparisons, either between the groups at various times or within the groups between the time periods, were found to be statistically significant. ($p > 0.10$ at all cases). Both males and females responded similarly to the yoga practice. When compared age wise, it revealed similar response to 4 weeks of pranayama and meditation practice in both age group ≤40 years and age group >40 years.

Tables

Table 1: Distribution According To Age

Age (years)	Group A		Group B	
	No.	%age	No.	%age
17-20	1	1.67	5	8.33
21-30	14	23.33	19	31.67
31-40	15	25.00	15	25.00
41-50	30	50.00	21	35.00
Total	60	100	60	100
Mean ± S.D.	38.77 ± 9.92		35.55 ± 10.62	
Range	20-50		17-50	

* t-value = 1.71 p> 0.10, NS

Table 2: Distribution According To Gender

Gender	Group A		Group B	
	No.	%age	No.	%age
Male	34	56.67	37	61.67
Female	26	43.33	23	38.33
Total	60	100	60	100

* χ^2 value = 0.31 p > 0.10, NS

Table 3: Distribution According To Duration of Disease

Duration (years)	Group A		Group B	
	No.	%age	No.	%age
1-2	1	1.67	11	18.33
3-4	18	30.00	17	28.33
5-6	15	25.00	7	11.67
7-8	13	21.67	6	10.00
9-10	2	3.33	7	11.67
11-12	1	1.67	5	8.33
13-14	3	5.00	5	8.33
15-16	4	6.67	1	1.67
17-18	1	1.67	1	1.67
19-20	1	1.67	0	0.00
>20	1	1.67	0	0.00
Total	60	100	60	100
Mean ± S.D.	7.70 ± 5.54		6.57 ± 4.32	
Range	2-35		2-18	

*t-value = 1.25 p > 0.10, NS

Table 4: Trends in Systolic Blood Pressure

Period	Systolic blood pressure (mm Hg)				t-value	p-value
	Group A		Group B			
	Mean	S.D.	Mean	S.D.		
Baseline	116.80	10.71	113.83	9.58	1.60	> 0.10, NS
4 Weeks	115.53	10.78	115.00	9.24	0.29	> 0.10, NS
Paired t-value	1.40		1.76			
p-value	> 0.10, NS		< 0.10, NS			

Table 5: Trends in Diastolic Blood Pressure

Period	Diastolic blood pressure (mm Hg)				t-value	p-value
	Group A		Group B			
	Mean	S.D.	Mean	S.D.		
Baseline	73.70	6.71	73.17	6.47	0.44	> 0.10, NS
4 Weeks	72.83	7.22	73.33	7.28	0.38	> 0.10, NS
Paired t-value	1.10		0.19			
p-value	> 0.10, NS		> 0.10, NS			

Table 6: Trends in Pulse Rate

Period	Pulse rate (beats per minute)				t-value	p-value
	Group A		Group B			
	Mean	S.D.	Mean	S.D.		
Baseline	82.40	4.23	83.35	4.47	1.20	> 0.10, NS
4 Weeks	81.05	3.74	83.00	4.19	2.69	< 0.01, S
Paired t-value	2.97		0.79			
p-value	< 0.01, S		> 0.10, NS			

Discussion

In the present study the decrease in resting pulse rate, systolic and diastolic blood pressure after the yoga practice is in accordance with the findings of other studies on physiological effects of yoga practice in healthy individuals [9] Similar reduction in resting PR and blood pressure after yoga practice were also reported in hypertensive patients [10, 11]. in asthmatic patients[3] and in diabetic patients [12].

A significant reduction in PR, SBP, and DBP with yoga, as seen in this study, can be attributed to modulation of autonomic activity with parasympathetic predominance and relatively reduced sympathetic tone. This autonomic modulation in yoga is mediated through modification of breathing patterns which triggers various central and autonomic mechanisms as well as mechanical and hemodynamic adjustments causing both tonic and phasic changes in cardiovascular functioning [13].

As a technique, pranayama can assume rather complex forms of breathing. But the essence of the practice is slow and deep breathing. Slow breathing induces a generalized decrease in the excitatory pathways regulating respiratory and cardiovascular systems. As respiratory and cardiovascular systems have similar control mechanisms, alteration in one system will modify the functioning of the other [14].

During slow and deep breathing lung inflates to the maximum. This stimulates pulmonary stretch receptors which bring about withdrawal of sympathetic tone in skeletal muscle blood vessels leading to widespread vasodilatation and decrease in peripheral resistance and thus decrease diastolic blood pressure.[11] Regular practice of yoga has showed improvement in baroreflex sensitivity and decrease in the sympathetic tone thereby restoring blood pressure to normal level in patients of essential hypertension [10, 11].

While practicing pranayama one concentrates on the act of breathing which removes attention from worries and "de-stresses" him. This stress-free state of mind evokes relaxed responses in which parasympathetic nerve activity overrides sympathetic activity [12].

Meditation by modifying the state of anxiety reduces stress-induced sympathetic over activity thereby decreasing arterial tone and peripheral resistance resulting in lowering of diastolic blood pressure and heart rate [13, 14].

Although a significant decline in resting pulse rate, SBP, DBP, and mean arterial BP after the yoga practice in the present study is in accordance with the findings of other studies on physiological effects of yoga practice in healthy individuals, the present study has some differences. The present study involved regular combined practice of pranayama and meditation for 4 weeks, whereas other studies

reported the effects of individual pranayama or meditation practice for minimum of 2 weeks to 6 months.

Most of the studies conducted so far have generalized their results irrespective of age and gender of the subjects. Very few studies have been conducted on subjects above 40 years in which age group, cardiovascular diseases are more prevalent. In the present study, an attempt was made to fill up these lacunae. Although the present study observed the clear short term benefits of pranayama and meditation, it remains to be assessed whether these changes persist after resuming normal respiration and whether long term practice will lead to stable modifications of cardiovascular control.

Conclusion

This study emphasis regular practice of pranayama and meditation for asthmatics, as even a short duration of 4 weeks is beneficial in improving the cardiovascular functions in them irrespective of age and gender.

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