

STUDY OF PULMONARY AND AUTONOMIC FUNCTIONS OF ASTHMA PATIENTS AFTER YOGA TRAINING

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Abstract: "The concept of yoga is helpful for the treatment of Bronchial Asthma", has created a great interest in the medical research field. In order to investigate whether autonomic functions and pulmonary functions are improved in asthma patients after short term yoga training, a study was conducted with nine diagnosed bronchial asthma patients. Yoga training was given for seven days in a camp in Adhyatma Sadhna Kendra, New Delhi. The autonomic function tests to measure the parasympathetic reactivity (Deep Breathing test, Valsalva Manouever), Sympathetic reactivity (Hand Grip test, Cold Pressure test), and pulmonary function tests FVC, FEV₁, PEFR, PIF, BHT and CE were recorded before and after yoga training. The resting heart rate after yoga training ($P < 0.05$) was significantly decreased ($89.55 \pm 18.46/\text{min}$ to $76.22 \pm 16.44/\text{min}$). The sympathetic reactivity was reduced following yoga training as indicated by significant ($P < 0.01$) reduction in DBP after HGT. There was no change in parasympathetic reactivity. The FVC, FEV₁, PEFR did not show any significant change. The PIF ($P < 0.01$), BHT ($P < 0.01$) and CE ($P < 0.01$) showed significant improvement. The results closely indicated the reduction in sympathetic reactivity and improvement in the pulmonary ventilation by way of relaxation of voluntary inspiratory and expiratory muscles. The "comprehensive yogic life style change programme for patients of Bronchial Asthma" have shown significant benefit even within a short period.

Key words : yoga asthma autonomic function test

INTRODUCTION

Electrophysiological, biochemical and psychological studies on the effect of regular practice of yoga asana and pranayamas have revealed physical and mental well being. In Bronchial Asthma the airway resistance is increased due to inflammatory allergic and psychological factors. Meti and Srinivasan (1) have shown that yoga practice has curative effect in Bronchial Asthma patients. Their study showed that Paranyama may alter the airway reactivity in Asthmatic subjects as indicated by

increased dose of histamine required to provide a 20% reduction in forced expiratory volume in 1st second. A very short term practice of 7 days of nonconventional therapy like Kunjal, Jalneti, Pranayama and Yoga Asana and Netikriya as therapeutic procedure for the treatment of Bronchial Asthma has already been reported by several authors (2). In an extensive study on 188 asthma patients for 8 years by Vincent et al (2) have shown significant improvement in general health, symptoms, medication requirement, asthma attacks and other

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respiratory crisis. Yogic practices which are of mild form are considered useful for positive health and advocated for use in treatment and prevention of asthma (3). The classical work conducted by Nagarathna and Nagendra (4) have shown significant improvement in number of asthma attacks and scores in asthma patients undergoing yoga training. Improvement in the pulmonary functions after yoga treatment in asthma patients may be the contributing factor (5, 6, 7). The subjective improvement in all the patients occurred due to ease in breathing associated with decreased air way resistance after yogic treatment (6). Bronchial asthma is a functional disorder and has a psychosomatic basis. Autonomic imbalance may contribute to possible increase in the airway reactivity (8). These may be a characteristic increased parasympathetic activity. A study conducted on asthma patients who underwent yoga training revealed an almost equal distribution of patients having sympathetic, normal and parasympathetic range of score. Six patients having sympathetic predominant scores showed a shift to normal range while one patient changed to parasympathetic side at the end of treatment period (9). The relaxation sessions facilitated by biofeed back have also shown reduction in airway resistance (10). There is thus a need to examine the value of short term yogic intervention in influencing pulmonary functions by altering the autonomic status of asthma patients. The present investigations were undertaken to determine the effect of continued effect of Kriya, Pranayama, Asanas, and relaxation on Pulmonary Function Tests and Autonomic Function Tests of Asthma patients.

METHODS

The study was conducted on nine diagnosed cases of Asthma (6 males and 3 female with age range of 12-60 yrs) patients having average disease duration of 13.55 yrs. These subjects were in remission phase of asthma. The patients were

from AIIMS (New Delhi) OPD receiving treatment in the Chest Clinic. The diagnosis was based on paroxysms of dyspnea, wheezing and cough which improved either spontaneously or with drug therapy. The study was explained to the patients and their signed informed consent was taken according to the ethical principles of Indian Council of Medical Research, New Delhi. All the patients were nonsmoker. They were routinely scanned out for cardiac problems, diabetes and rheumatoid arthritis as these can alter the autonomic parameters. The patients were taken to Yoga Training Camp (Adhyatma Sadhana Kendra, Chattarpur, New Delhi) for one week. All the patients served as their own control.

Training in yoga: All the patients received same yoga training. These consisted of different yoga Asanas, (Padmasana, Tadasana, Utkatasana, Chakrasana, Trikonasana and Bhujangasana), Pranayamas (voluntary regulation of respiration), Nadi Shodhan, Bhramari, Anuloma vilomas, Preksha Dhayan and lectures on the philosophy of yoga. The asanas and pranayamas practices were scheduled twice a day morning and evening for one hour in each session, 14 sessions for 7 days. The patients started their schedule early in the morning at 4 a. m. All the patients were kept under same non spicy diet and in the same environmental condition with maximum relaxation. The patients were asked to continue their medicine and were advised to record the change in drug dosages.

Parameters: The autonomic functions (AFT) and pulmonary function (PFT) were assessed prior to the yoga training and at the end of one week of practice. Both the autonomic and pulmonary function tests were non-invasive. The tests were done 2 hr after meals and they were instructed to avoid caffeine beverages atleast two hours before tests. All the autonomic function tests were done with 2 min interval.

The Autonomic Function Tests: Status of autonomic reactivity was assessed by using four autonomic function tests (11). The EKG and stethographic record of respiration were obtained on two channel Polyrite (Instrument and Chemicals Pvt. Ltd., Ambala, India). The EKG in standard Limb lead II was continuously monitored through all the tests. The patients were explained the whole procedure and monitored, while measurements were being taken. Before any test the base line cardiorespiratory parameters (HR, RR and BP) were recorded in respective tests.

Deep Breathing Test (DBT): The patients were asked to sit quietly on the stool. Then they were asked to take deep inspiration and expiration at a rate of six breaths per min (3 sec inspiration, 2 sec pause, 3 sec expiration and 2 sec pause). The recording of EKG and respiration was done on the Polyrite. The parasympathetic reactivity was measured by calculating E : I (Expiration : Inspiration) ratio.

$$E : I \text{ ratio} = \frac{\text{Maximum R-R interval during Expiration}}{\text{Minimum R-R interval during Inspiration}}$$

Valsalva maneuver: The Valsalva maneuver comprises of abrupt transient voluntary elevation of intrathoracic and intra-abdominal pressures provoked by straining. Straining is initiated at the end of normal inspiration (11). Standard Valsalva maneuver was carried out by the patients by expiring forcefully through a mouth

piece attached to a manometer to generate pressure of 40 mm of Hg and maintaining this level for 15 sec. The heart rate responses were recorded on the Polyrite before, during and 30 sec after the maneuver. From the records, Valsalva ratio was calculated using the formula.

$$\text{Valsalva ratio} = \frac{\text{Longest R-R interval after maneuver}}{\text{Shortest R-R interval during maneuver}}$$

Hang Grip Test (HGT): This is a sympathetic test. The patients were asked to grip the dynamometer with their dominant hand at 30% of their maximum voluntary capacity. The blood pressure and heart rate changes were taken as the difference between resting reading and reading before release of hand grip.

Cold Pressure Test (CPT): It is a sympathetic test. The patients were asked to immerse their right hand in cold water at 10° C upto the wrist for 1 min. The BP and HR were recorded at 1 min and 2.5 min (13). Changes in HR and BP were calculated as the difference between the resting value and value obtained just before taking out the hand from cold water.

Pulmonary Function Tests: The pulmonary function tests were assessed by using transfer test machine (P.K. Morgan, Pvt. Ltd., Chatham Kent, England). The patients were acclimatized to the laboratory for 10 min. The level of the mouth piece was adjusted so that the patient was comfortable and the neck was not flexed or

TABLE I: Shows sympathetic activity tests of asthma patients pre and post yoga training.

| Tests | Systolic BP mm of Hg | Diastolic BP mm of Hg |
|--------------|----------------------|-----------------------|
| HGT | | |
| Basal Prey | 118 ± 17.91 | 79.55 ± 11.17 |
| During Prey | 141.33 ± 27.05 | 99.33 ± 20.27 |
| Basal Posty | 116.66 ± 16.15 | 77.11 ± 8.55 |
| During posty | 113.66 ± 31.73 | 88.77 ± 19.37* |
| CPT | | |
| Basal prey | 120.00 ± 19.44 | 81.33 ± 14.28 |
| During prey | 135.11 ± 31.17 | 94.44 ± 26.16 |
| Basal posty | 116.66 ± 18.02 | 78.00 ± 11.18* |
| During posty | 128.55 ± 27.21 | 86.44 ± 15.47 |

Prey = Pre yoga training *P<.05

Postt = Post yoga training

TABLE II : Showing pulmonary function tests of asthma patients pre and post yoga training.

| Parameters | Pre yoga | Post yoga |
|------------------|-----------------------|-------------------------|
| FVC | 2.10 ± 0.65 L/min | 1.73 ± 0.41 L/min |
| FEV ₁ | 1.51 ± 0.34 L/1st sec | 1.45 ± 0.39 L/1st sec |
| PEFR | 5.79 ± 1.20 L/min | 6.5 ± 1.65 L/min |
| BHT | 24.88 ± 8.08 Sec | 34.88 ± 9.42 Sec** |
| PIF | 3.38 ± 1.68 L/min | 5.38 ± 1.88 L/min** |
| CE | 84.17 ± 9.54 cm/min | 87.73 ± 10.34 cm/min*** |

**P <.0.01
***P <.0.001

extended too much. Patients were then subjected to pulmonary function tests including forced vital capacity (FVC), forced expiratory volume in 1st second (FEV₁) peak expiratory flow rate (PEFR), Peak inspiratory flow rate (PIF), Breath holding time (BHT) and chest expansion (CE). The PEFR was measured by the Pink City Flow Meter and CE was measured by the measuring tape.

For analysis the students paired 't' test was used to determine the differences between visit I and visit II with P < 0.05 being the level of significance.

RESULTS

In this study two different parameters were studied namely autonomic and pulmonary parameters. The results of the parameters are given separately in Table I and II. All the nine asthma patients underwent autonomic and pulmonary function tests before and after yoga training for one week. During 1st visit seven patients were on bronchodilator (in the form of inhaler and tablets) and two were on medicines. During training only two were taking inhalers (one patient for 3 times a day for one day, who was otherwise taking atleast 8 puffs in a day regularly and one patient for only once in a day, who used to take thrice in a day previously). Rest of the patients were without any medication. They were feeling subjectively better after completing camp during visit II.

Autonomic parameters :

Baseline cardio-respiratory data: The mean baseline resting heart rate (BHR) of patients in

visit I was 89.55 ± 18.46/min, and in visit II it decreased to 76.22 ± 16.44/min. The slowing of HR was statistically significant (P < 0.05). There was no significant differences in baseline resting respiration of patients in visit I and visit II (21.77 ± 3.38 and 22.66 ± 4.0/min respectively). The baseline systolic and diastolic BP was also not changed after yoga training (Fig. 1).

Effect on parasympathetic reactivity: The E:I ratio was similar in both the visits. The VR values of the patients in visit I and visit II were

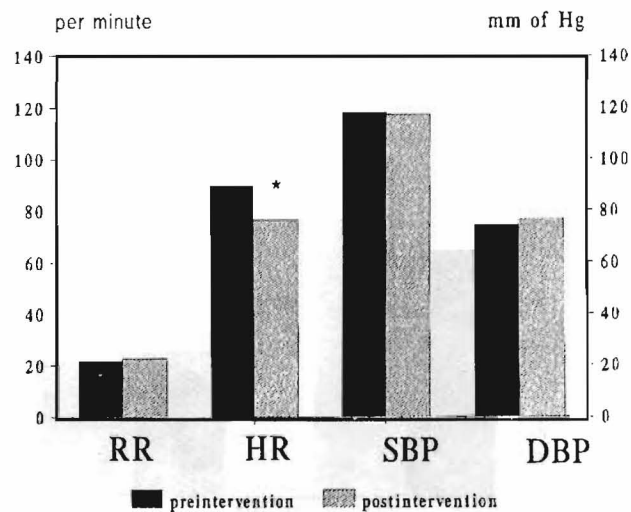


Fig. 1 : Bar diagram showing baseline Respiratory rate(RR), Heart rate(HR), systolic and diastolic blood pressure(SBP, DBP) pre yoga and post yoga intervention respectively.

similar and were also not altered after yoga training. Yoga training significantly reduced the HR response after HGT ($P < 0.01$) (Fig. 2).

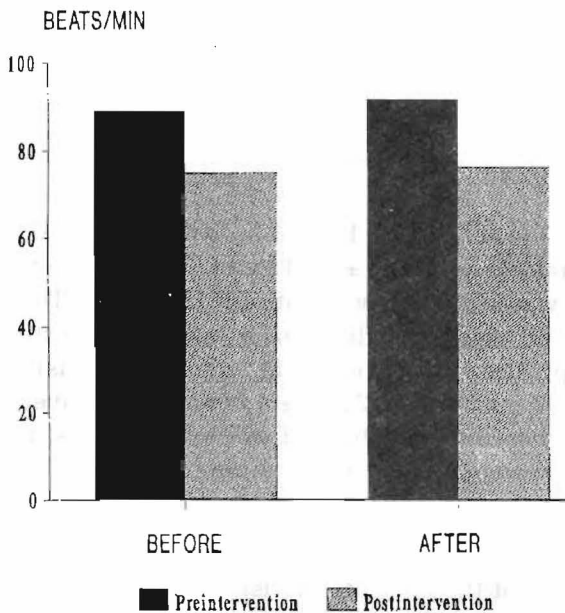


Fig. 2: Bar diagram showing heart rate after Hand Grip test pre yoga and post yoga respectively.

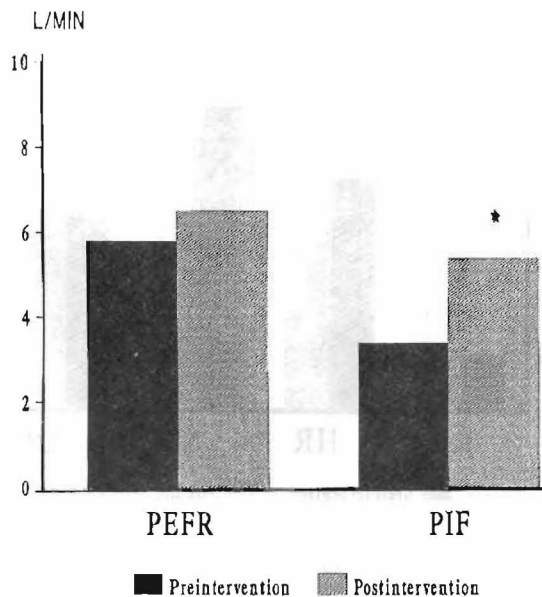


Fig. 3: Bar diagram showing peak expiratory flow rate and peak inspiratory flow rate pre yoga and post yoga respectively.

Effect on sympathetic reactivity: Yoga training significantly reduced the hypertensive effect of HGT as indicated by the DBP reduction after HGT in visit II ($P < 0.05$). Response in visit I and visit II before and after CPT, did not show any significant change (Table I).

Pulmonary parameters: The mean \pm SD for FVC, FEV₁, PEFR, PIF, BHT and CE before and after yoga training are given in Table II. In visit II the patients showed significant improvement in three of the pulmonary function tests in peak inspiratory flow rate (PIF) (from 3.38 ± 1.68 to 5.38 ± 1.88 L/min, $P < 0.01$), breath holding time (BHT), (24.88 ± 8.06 sec to 31.88 ± 9.42 sec, $P < 0.01$) and CE (84.17 ± 9.54 cm to 87.73 ± 10.34 cm, $P < 0.001$). There was no significant changes in FVC, FEV₁ and PEFR in comparing the values between visit I and visit II (Table II) (Fig. 3 and 4).

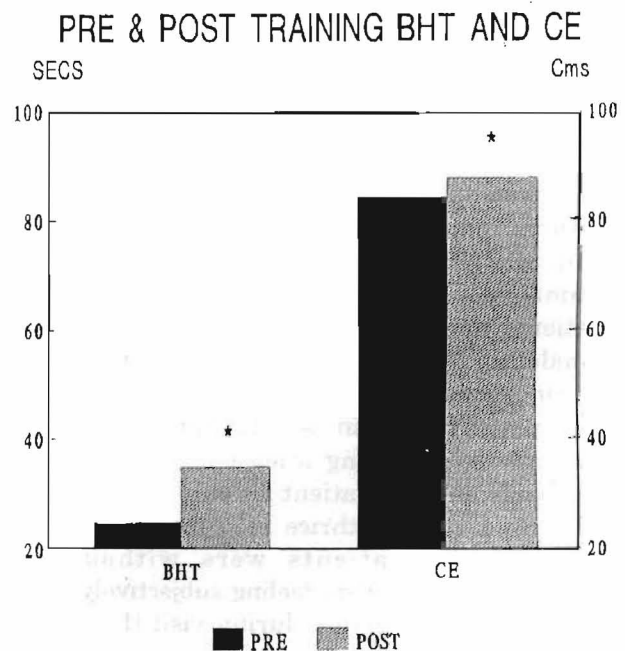


Fig. 4: Bar diagram showing breath holding time and chest expansion pre yoga and post yoga respectively.

DISCUSSION

We have found almost normal parasympathetic and higher sympathetic functions in asthma patients. The elevated sympathetic function in asthma patients were similar to that reported earlier. The link between autonomic and pulmonary function in asthma patients after yoga training have shown a strong association (14). Patients having predominant sympathetic scores showed a shift to normal range and 7 of them stopped medicine completely at the end of treatment with profound alleviation of symptoms and feeling of well being. Gharote et al (9) made similar observations in asthma patients. In our study, seven out of nine patients were on medicine at the beginning of yoga camp and only two had taken the inhaler puffs which was lesser in number than their routine. The observed significant reduction in resting HR after yogic training is most probably due to decreased sympathetic activity. We measured the HR from 10 second EKG strip and respiratory influences were eliminated. As E:I and Valsalva ratio showed no changes between visits, it indicates that there is no change in parasympathetic reactivity in comparison with sympathetic which is decreased. Although vagal parasympathetic pathways are predominant for HR and sympathetic pathways plays a major part in BP (12).

The measure of sympathetic function via sustained hand grip have shown significant lowering of diastolic BP response in visit II (Table I).

However, in cold pressure test, the sympathetic reactivity marker have shown no significant change in BP, but reduction in HR response. These observations point towards reduced sympathetic activity and responses are similar to 'Relaxation Response' (10). It is evident from present investigation that yoga when practised together with meditation produced maximum effects on sympathetic autonomic activities (10).

The ventilatory parameter such as FVC and FEV₁ were not altered although earlier workers have shown significant improvement in these functions (2, 5, 15). The PEF_R did show a small increase in visit II (5.79 ± 1.20 L/min, 6.5 ± 1.65 L/min). Similar to the finding of other workers (4, 10). One possible explanation could be that the structural damage of lung in these patients due to long standing asthma did not allow functional ventilatory improvement. On examining the individual data all the patients did show an increase in PEF_R, it could be due to high intra-individual variations that the average value was not significant. Thus a larger sample size will be helpful in confirming our findings. The breath holding time, peak inspiratory flow rate and chest expansion showed significant increase after yoga training. Yoga practice is non-vigorous, yet it helped to improve the physical endurance of patients (16).

Abundant objective data now exist indicating that psychological factors can interact with the asthmatic diathesis to worsen or improve the course of the disease. The mechanisms of these interaction are not well understood. The psychosomatic imbalance in many patients with asthma play some role in modifying the airway resistance (6) associated with emotional disturbances and accompanied by generalised and localised muscle tension, including that of the voluntary respiratory musculature. This increased muscle tension may be precipitating concomitant factors that perhaps aggravate the asthmatic syndrome. The relaxation of skeletal muscle resulted in increased chest expansion, breath holding time and peak inspiratory flow rate, which lead to improvement and subjective well being in all the subjects. The above training of yoga is expected to give delayed effects rather than immediate effects on body functions as they are supposed to work on nervous system and the psychological aspect of the patients as reported by others (5). From our results, it is evident that yoga asanas and pranayamas have a vital role to play in the immediate management

of bronchial asthma. There might be bronchodilatation by correcting their abnormal breathing patterns and reducing the muscle tone of inspiratory and expiratory muscles. Due to improved breathing pattern respiratory bronchioles may be widened and perfusion of a large number of alveoli can be carried out efficiently. Yoga alongwith Dhyana appears to result in somatic musculature relaxation finally resulting in reduction in airway resistance thus relieving the patients of asthma by giving them subjective well being. Further deep and controlled breathing desensitization of the sensory nerve endings may occur and this inturn might have helped to reduce the allergic condition to the environment.

The "Comprehensive yogic life style change programme for patients of bronchial Asthma" have shown significant benefit even within a

very short period. We are hopeful about the long term effectiveness of the programme in controlling as well as curing the disease.

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