Indian J Physiol Pharmacol 2012; 56(1): 63–68

EFFECT OF YOGA PRACTICES ON PULMONARY FUNCTION TESTS INCLUDING TRANSFER FACTOR OF LUNG FOR CARBON MONOXIDE (TLCO) IN ASTHMA PATIENTS

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(Received on January 22, 2011)

Abstract : Prana is the energy, when the self-energizing force embraces the body with extension and expansion and control, it is pranayama. It may affect the milieu at the bronchioles and the alveoli particularly at the alveolo-capillary membrane to facilitate diffusion and transport of gases. It may also increase oxygenation at tissue level. Aim of our study is to compare pulmonary functions and diffusion capacity in patients of bronchial asthma before and after yogic intervention of 2 months. Sixty stable asthmatic-patients were randomized into two groups i.e group 1 (Yoga training group) and group 2 (control group). Each group included thirty patients. Lung functions were recorded on all patients at baseline, and then after two months. Group 1 subjects showed a statistically significant improvement ($P<0.001$) in Transfer factor of the lung for carbon monoxide (TLCO), forced vital capacity (FVC), forced expiratory volume in 1st sec (FEV_1), peak expiratory flow rate (PEFR), maximum voluntary ventilation (MVV) and slow vital capacity (SVC) after yoga practice. Quality of life also increased significantly. It was concluded that pranayama & yoga breathing and stretching postures are used to increase respiratory stamina, relax the chest muscles, expand the lungs, raise energy levels, and calm the body.

Key words : asthma yoga

INTRODUCTION

Bronchial asthma besides being a chronic inflammatory disease of the airways also has psychosomatic imbalance and an increased vagal tone as its etiopathogenesis (1, 2).

Yoga is an ancient discipline, which by increased mental and physical control of the body, aims to affect union of the soul with a universal spirit. Yoga is taught in many steps of which one, pranayama, deals explicitly with control of breathing and its synergy. Pranayama is widely believed to be helpful in the management of asthma, and beneficial effects of yogic methods, which

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include pranayama, have been reported in uncontrolled and open studies (3-8). Nagarathna and Nagendra have shown significant improvement in numbers of asthma attacks in asthma patients undergoing yoga training as compared to the control (4). Studies have been conducted to understand the changes occurring during various yogic exercises. A study on the efficacy of yoga on the management of bronchial asthma demonstrated that yoga results in measurable improvement in subjective as well as objective outcomes in bronchial asthma (9). Studies done by several researchers showed that regular practice of yoga lead to significant improvement in pulmonary function which include increase in peak expiratory flow rate (PEFR), vital capacity (VC), forced vital capacity (FVC), forced expiratory volume in 1st sec (FEV_1), maximum mid expiratory flow rate (MMFR). It decreases weekly number of attacks of asthma, symptom scores and scores for the drug treatment (10, 11, 12). In the present study diffusion capacity as well as the quality of life was also assessed. This yogic regimen may change the milieu at the bronchioles and the alveoli particularly at the alveolo-capillary membrane to facilitate diffusion and transport. Main objective was to see the effect of yogic techniques on diffusion capacity in asthma patients, so it is included in this proposed study.

MATERIAL AND METHODS

The study was conducted on 60 diagnosed stable patients of bronchial asthma of either sex having disease duration of more than one year. The patients were recruited from the medicine outpatient department (OPD) of GTB hospital, Delhi. The diagnosis was based on paroxysms of dyspnoea, wheezing and cough, which improved either spontaneously or with drug therapy. Non smokers, in the age group of 18-60 years with mild to moderate grades of bronchial asthma as per GINA (Global Initiative for asthma) guidelines (Mild- FEV_1>80% predicted, Moderate-FEV_1 = 60-80% predicted) were included. Subjects with a history of an exacerbation or respiratory tract infections, current smokers, pregnant or lactating women or any other disorder were excluded. The medication for asthma was kept same throughout the study period. The study was explained to the patients and their signed informed consent was taken. Ethical clearance was also obtained from UCMS ethical committee.

Patients were randomized into the following two groups: Group 1 (Yoga training group) and Group 2 (control group). Yoga includes Pranayama (30-35 min), asanas (10 min), meditation (10 min) and life style modification.

1. Pranayama: Bhastrika (slow and deep inhalation and exhalation for 2 min), Anulom-Vilom (alternate nostril breathing while sitting in sukhasana for 15 min), Kapalbhati (forceful expulsion of the breath by contracting the abdomen for 10 min), Bahaya pranayama (deep, slow and complete breath and hold the breath for 10 sec for 4 times), Bhramri (deep and slow breath and slowly exhale while producing sound like bee for 5 times), Udgit Om uchcharan (inhale slowly, deeply and chanting Om while exhaling for 5 times) (13).
2. Suryanamaskar (Sun Salutation Pose).

3. Asanas:

Tadasana (Palmtree pose)

Paschimotansana (Front Leaning Pose)

Mandukasana (Frog pose)

Patients came to yoga centre in the department of physiology, University College of Medical Sciences, Delhi for 5-6 days initially, for getting proper yoga training by a yoga expert. Thereafter they were practicing yoga for an average of 40-50 min daily at home for 2 months. In between this period they were called to the yoga centre regularly after every 7 days to see as to whether they were doing the yogic exercises properly. Lifestyle modification was assessed by giving them proper diet chart to follow, in which they were instructed to take more fruits and vegetables, avoid drinking alcohol and smoking, proper sleeping of 7-8 hours.

Subjects were asked to keep their daily records of breathing exercises, medication use and asthma symptom severity during day and night, plus activity limitations due to asthma. All the patients received same yoga training.

Parameters : The pulmonary function tests were assessed prior to yoga training and at the end of 2 months of yoga. The pulmonary function tests were carried out on each stable subject using computerised medisoft instrument (HYP'AIR compact). The patients were acclimatized to the laboratory for 10 min. The level of the mouth piece was adjusted so that the patient was comfortable. Adequate demonstration was given till subject has comprehended the instructions. Pulmonary function tests were carried out in the morning between 9:30 am to 11 am.

Patients were than subjected to pulmonary function tests including Transfer factor of the lung for carbon monoxide-TLCO (ml/mm Hg/min)., Forced Vital Capacity - FVC (1), Forced Expiratory Volume in first second – FEV_1 (1), Ratio of FEV_1/FVC (%) expressed in percentage, Peak Expiratory Flow Rate – PEFR (l/sec), Maximum Voluntary Ventilation – MVV (l/min), Slow vital capacity – SVC (1). A total of 3 tests were carried out and the best of the three fulfilling the criteria of reproducibility and vitality were considered for analysis.

Quality of life was measured by using a self-administered Asthma Quality of Life Questionnaire (AQLQ) which is available in bilingual form, i.e. English and Hindi (14).

The AQLQ is a 32-item disease specific questionnaire that has been validated to measure the problems that adult patients with asthma experience in their daily lives Questionnaire has 32 items in four domains: activity limitation (11 items), symptoms (12 items), emotional function (5 items), and environmental stimuli (4 items). The response options for each of the 32 items are on 7 point scale, where 1 indicates maximal impairment and 7 indicates no impairment. At each visit, patients were asked to recall what impairment they would have experienced during the previous 2 week and to respond using 7-point response option. The response was recorded. For each of the 32 items in the Asthma Quality of Life Questionnaire, patients were asked to recall what impairment they had experienced during the previous 2 week and to respond using 7-point response options. The score for each sub-domain was also calculated as the

mean score for items pertaining to that sub-domain.

Data was analyzed by one-way ANOVA and Tukey Krammer post-hoc test.

RESULTS

Four subjects withdrew from the study; one found the lung exercises to be inconvenient, and three had respiratory tract infection. Hence complete data are presented for 60 subjects. Pulmonary parameters were improved from baseline values.

The mean±SD of TLCO FVC, FEV_1, FEV_1/FVC, MVV, SVC, PEFR and FEF25-75% in group 1 before and after yoga practices are given in table 1. While in group 2 i.e control group do not showed much changes when compared with group 1. After yoga the patients showed significant improvement in TLCO from 21.25±4.75 ml/mmHg/min to 23.35±4.47 ml/mm Hg/min FVC from 3.23±0.93 1 to 3.43±0.93 1, FEV1 from 2.80±0.71 1 to 2.80±0.71 1, FEVI/FVC from 81.35±7.08% to 82.19±5.24%, PEFR from 5.53±1.46 l/sec to 6.41±1.03 l/sec MVV from 74.31±20.11 l/min to 85.33±24.42 l/min, SVC from 2.84±0.80 1 to 3.20±0.83 1, thus showing significant improvement in

TABLE I: Showing pulmonary function tests of asthma patients at baseline and after 2 months.

Parameter	*Control group*		*Yoga group*		*P value*
	Pre (n=15)	*Post (n=15)*	*Pre (n=15)*	*Post (n=15)*	
BMI	22.81±3.15	22.63±3.09	22.94±4.38*	22.23±436#	f<0.05
TLCO	21.71±5.77	21.30±6.88	21.25±4.75*	23.35±4.47#	f<0.001
FVC	3.55±0.79	3.60±0.81	3.23±0.93*	3.43±0.93#	f<0.001
FEV_1	2.76±0.59	2.80±0.58	2.62±0.67*	2.80±0.71#	f<0.001
FEV_1/FVC	77.32±3.31	79.41±3.56	81.35±7.08*	82.19±5.24#	f 0.05
MVV	75.86±20.11	74.84±26.11	74.31±20.11*	85.33±24.42#	f<0.001
SVC	3.24±0.88	3.29±0.77	2.84±0.80*	3.20±0.83#	f<0.001
PEFR	6.00±1.74	6.26±1.48	5.53±1.46*	6.41±1.03#	f<0.001
	3.65±1.24	5.34±6.67	3.11±0.92*	3.38±0.86#	f>0.10

Data presented are mean±SD. Analysis of data was done by one-way ANOVA and post-hoc by Tukey-Krammer test. The * depicts pre yoga group comparison with control pre and the # depicts post yoga group comparison with control post and the f depicts pre yoga comparison with post yoga. *P>0.001, #P>0.001, f P<0.001.

TABLE II: Showing Quality of life in asthma patients at baseline and after 2 months.

Quality of life	*Control group*		*Yoga group*		*P value*
	Pre (n=15)	*Post (n=15)*	*Pre (n=15)*	*Post (n=15)*	
Symptom domain	4.31±0.94	4.75±1.07	4.56±0.43*	6.21±0.63#	f<0.001
Activity domain	4.18±0.77	4.57±0.64	4.38±0.91*	6.01±0.73#	f<0.001
Emotion domain	3.32±0.59	3.80±0.95	4.16±0.73*	5.58±0.82#	f<0.001
Environment domain	3.18±0.65	3.46±0.87	3.80±1.13*	4.80±1.07#	f<0.001

Data presented are mean±SD. Analysis of data was done by one-way ANOVA and post-hoc by Tukey-Krammer test. The * depicts pre yoga group comparison with control pre and the # depicts post yoga group comparison with control post and the f depicts pre yoga comparison with post yoga. *P>0.001; #P<0.001; f P<0.001.

Pulmonary parameters as compared to baseline, P<0.001. The mean±SD of Quality of life- Symptom domain from 4.56±0.43 to 6.21±0.63, activity domain from 4.38±0.91 to 6.03±0.73, emotion domain from 4.16±0.73 to 5.58±0.82, environment domain from 3.80±1.13 to 4.80±1.07 thus, showing significant improvement in quality of life.

DISCUSSION

Yoga has been used to treat respiratory problems in Hindu cultures for centuries, but has received little attention from physicians. Several studies have claimed yoga techniques to be helpful in the treatment of asthma (3-9), but virtually we have'nt come across any study in India showing the effect of yoga on diffusion capacity in asthma patients. The mechanism by which yoga may affect diffusion capacity can be- pranayama; a well regulated breathing exercise increasing the depth of breathing as compared to normal breathing. By doing so, it expands the lungs more than during normal breathing and thus recruiting previously closed alveoli which results in increased surface area of respiratory membrane and air diffusion across the membrane. Due to improved breathing pattern respiratory bronchioles may be widened and perfusion of a large number of alveoli can be carried out effectively (15). The mechanisms by which changes in respiratory functions occur are: Yoga exercises improve respiratory breathing capacity by increasing chest wall expansion and forced expiratory lung volumes (16). Yoga improves lung capacity, a significant increase in the oxygen consumption 15 to 25% (17, 18). It is also known that yoga appears to result in somatic muscular relaxation finally resulting in reduction in airway resistance; it also increases the compliance of lung. Yoga asanas, which are the controlled stretching postures, aid pranayama by enhancing the strength of respiratory muscles, diaphragm and upper abdominal muscles. Previously, it was reported that yoga training for 6 months improved lung function, respiratory muscle strength & endurance in healthy subjects (19). However different yoga training produced different results on the cardiopulmonary function in young healthy Indians (20). Our results are comparable with Nagarthana & Nagendra which showed significant increase in peak flow rate & decrease in number of asthma attack. They have suggested that yoga techniques reduce psychological over activity and emotional instability, and thereby reduce efferent vagal discharge (5). Significant increase in FEV_1, FEV_1/FVC, PEFR & $FEF_{25-75\%}$ was also observed by various authors after yoga intervention (10, 11, 21). Our findings indicate that yoga exercises may lead to overall improvement, as at entry point of the study, patients taking average 2 puff of $ß_2$ agonist a day, was reduced after 2 months of yoga. S Cooper et al suggests that Buteyko breathing technique can improve symptoms and reduce bronchodilator use in patients of asthma, but lung functions does not change significantly (22).

Pranayama may have psychophysiological benefits by increasing the patient's sense of control over stress and thus aids in reducing their autonomic arousal factors. Yoga stabilizes autonomic equilibrium with a tendency towards parasympathetic dominance rather than stress-induced sympathetic dominance. Yoga therapy readjusts the autonomic imbalance, controls the rate of breathing and relaxes the voluntary inspiratory and expiratory muscles, which results in decreased sympathetic reactivity (23, 24).

In conclusion, the reduction in psychological hyper-reactivity and emotional instability achieved by yoga can reduce efferent vagal reactivity, which has been recognised as the mediator of the psychosomatic factor in asthma.

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