Research Article

Effect of Pranayama on cardiopulmonary functions and serum MDA levels

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Abstract

Yoga, pranayama, trascedental meditation are age old ancient Indian techniques known for providing a better way of living. They are claimed to improve status of body and mind. There are some evidences that pranayama produces relaxation responses which are beneficial in reducing blood pressure and stress. The present study has been undertaken with aim to study effect of praanyama on autonomic functions as well as on the indicators of stress phenomenon i.e. malondialdehyde levels (MDA levels). The study was conducted in government medical college, Aurangabad in 74 healthy subjects who were given 2 months pranayama training. Different cardiopulmonary parameters i.e. blood pressure, respiratory rate, pulse rate and MDA levels were estimated before and after training. It was observed that the pulse rate, respiratory rate and blood pressure were significantly decreased indicating physical relaxation of body. While MDA levels also were found to be significantly decreased after pranayama training indicating a reduced oxidative stress.

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INTRODUCTION

"Take it easy" the yogi says and now psychologist and physiologists are listening. Effectiveness of age old practice of meditation and pranayama in relaxation has been widely accepted today[1]. The physiological evidences seem consistent with the claim that it reduces high blood pressure, reduces heart rate and premature ventricular tachycardia. Free radical injury is one of the casual factors in some diseases and psychological stress[2]. Malondialdyhyde (MDA) levels indirectly indicate concentration of free radicals in serum[3]. The sequential univalent reduction of oxygen produces an excess of superoxide, hydrogen peroxide and hydroxyl radicals. Unless these reactive reagents are rapidly eliminated they are capable of producing cellular and vascular damage. Free radicals have been implicated in pathogenesis in atherosclerosis, diabetes and micro vascular complications. Generally protective enzymes act as scavengers, the best known of which is superoxide dismutase, reduced glutathione, vitamin A, vitamin C and vitamin E all of which act as antioxidants and prevent free radical activity. Another group of antioxidant that provide important lipid protection are carotenoids specially beta carotenoids and antioxidant minerals like Se, Mn, Cu, Zn etc. A regular practice of pranayama and transcendental meditation (TCM) may restore pro oxidant - Anti-oxidant balance, however the studies on the effect of pranayama on oxidative stress need to be more extensive and elaborative. Therefore the current study was undertaken with an objective to study the effect of pranayama on cardiopulmonary parameters and oxidative stress. In 74 normal healthy subjects 2 months pranayama training camp was conducted and effects on blood pressure, pulse, respiratory rate and serum MDA levels were studied. In this technique breathing exercises and mental concentration helped the individual to attain control over the autonomic nervous system, resulting in

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optimization of homeostatic function of body and improving mental health.

MATERIAL AND METHODS

The present study was designed as a self controlled trial. A two months pranayama camp was arranged in GMC, Aurangabad. A total 74 subjects in the age group of 25-55 years of either sex were selected for the study. The subjects included were healthy adults who were neither receiving any antioxidant drugs nor performing any other type of exercise. They were not addicted to any drugs or suffering from any major illness. The active intervention period for pranayama was one hour per day for 2 months. In the beginning, information of the participants was collected by self administered questionnaire. The information was ascertained by interviewing the study subjects. Blood pressure, pulse, respiratory rate and MDA levels were determined before and after the training programme.

Pranayama training programme consisted of:

1. 1st Day: Introduction, Pranayama intervention programme and dietary counselling.
2. 2nd Day: Health Check Up and Investigations.
3. 3rd Day Onwards: Pranayama Breathing Exercises.

Lecture on - Coronary heart diseases and its risk factors

- Diabetes
- Obesity
- Hypertension
- Diet and diseases.

1. Group discussion: daily for 10 minutes before and after pranayama.
2. Dietary counselling: average intake of calories and protein of each subject was calculated and accordingly modified diet was prescribed for each subject.

It consisted

1. 20-30% total energy from fat.
2. Less than 10% total energy from saturated fat.
3. Increased carbohydrate consumption like vegetables, fruits, sprouted cereals.
4. Salt intake to 5 grams or less daily.
5. Exclude all animal products except milk.

General instructions:

1. To wear loose and comfortable cloths.
2. Bowel and bladder emptied.
3. Body parts not involved in pranayama to be kept relaxed.
4. As a thumb rule, during pranayama inhale while lifting any part of the body from ground level and exhale while nearing the ground.
5. Take meals one hour after completion of pranayama.
6. Stop and relax if experience symptoms like physical strain, sprain, breathlessness, fatigue, chest pain etc.

Types of pranayama practiced during intervention period:

Following pranayamas were taught step by step.

1. Kanishtha pranayama (3 mins.)
2. Madhya pranayama (3 mins.)
3. Dhyoti pranayama (3 mins.)
4. Chin mudra pranayama (3 mins.)
5. Chinmay mudra pranayama (3 mins.)
6. Aadi mudra pranayama (3 mins.)
7. Meru danda pranayama (3 mins.)
8. Mahat (bhastrika) pranayama (3 mins.)
9. Shitali pranayama (3 mins.)
10. kapalbharatipranayama (5 mins.)
11. shitkari pranayama (3 mins.)
12. ujjai pranayama (5 mins.)
13. bhramaripranayama (5 mins.)

All these pranayamas were practiced for 40-60 minutes with a relaxation of 30 seconds between two pranayamas. Subjects were also told to practice pranayama for minimum 30 minutes at their home. Time for each pranayama was increased slowly according to their ability. Asanas which were taught on previous day were again practiced and repeated on next day before teaching new asanas.

Parameters studied:

In all the study subjects resting pulse rate,respiratory rate,blood pressure were recorded before and after the training programme. Serum MDA levels were measured in nmol/ml. before and after the training. All the values were compared by using paired‘t’ test by using SPSS software version 11.0

OBSERVATION AND RESULTS

Table 1: Comparison of pulse rate before and after pranayama

Parameter	Before pranayama Mean ± SD	After pranayama Mean ± SD	“t” value	“p” value	Significance
Pulse rate in females (beats/min) (n = 41)	80 ± 5.67	72.73 ± 5.01	18.17	< 0.001	Highly significant
Pulse rate in males (beats/min) (n = 33)	79.76 ± 4.43	72.42 ± 4.14	20.95	< 0.001	Highly significant
Pulse rate combined (beats/min) (n = 74)	79.89 ± 5.24	72.59 ± 4.61	26.61	< 0.001	Highly significant

Table 2: Comparison of average systolic blood pressure before and after pranayama

Parameter	Before pranayama Mean ± SD	After pranayama Mean ± SD	"t" value	"p" value	Significance
Systolic blood pressure in females (mm of Hg) (n = 41)	122.39 ± 4.27	117.46 ± 4.21	10.08	< 0.001	Highly significant
Syatolic blood pressure in males (mm of Hg) (n = 33)	122.06 ± 4.37	117.57 ± 4.57	8.73	< 0.001	Highly significant
Syatolic blood pressure combined (mm of Hg) (n = 74)	122.49 ± 4.29	117.51 ± 4.35	13.33	< 0.001	Highly significant

Table 3: Comparison of average diastolic blood pressure before and after pranayama

Parameter	Before pranayama Mean ± SD	After pranayama Mean ± SD	"t" value	"p" value	Significance
diastolic blood pressure in females (mm of Hg) (n = 41)	81.41 ± 2.94	76.44 ± 3.53	5.56	< 0.001	Highly significant
diastolic blood pressure in males (mm of Hg) (n = 33)	81.15 ± 2.83	76.18 ± 3.67	4.85	< 0.001	Highly significant
diastolic blood pressure combined (mm of Hg) (n = 74)	81.30 ± 2.87	76.32 ± 3.57	7.38	< 0.001	Highly significant

Table 4: Comparison of respiratory rate before and after pranayama

Parameter	Before pranayama Mean ± SD	After pranayama Mean ± SD	"t" value	"p" value	Significance
Respiratory rate in females (beats/min) (n = 41)	19.61 ± 1.5	17.27 ± 1.47	12.91	< 0.001	Highly significant
Respiratory rate in males (beats/min) (n = 33)	19.45 ± 1.34	17.21 ± 1.32	10.9	< 0.001	Highly significant
Respiratory rate combined (beats/min) (n = 74)	19.54 ± 1.43	17.24 ± 1.39	16.87	< 0.001	Highly significant

Table 5: Comparison of average serum MDA levels before and after pranayama

Parameter	Before pranayama Mean ± SD	After pranayama Mean ± SD	"t" value	"p" value	Significance
Serum MDA levels in females (nmol/ml) (n = 41)	3.82 ± 0.77	1.73 ± 0.56	13.87	< 0.001	Highly significant
Serum MDA levels in males (nmol/ml) (n = 33)	3.73 ± 0.73	1.65 ± 0.54	12.35	< 0.001	Highly significant
Serum MDA levels combined (nmol/ml) (n = 74)	3.79 ± 0.75	1.69 ± 0.55	18.57	< 0.001	Highly significant

DISCUSSION

Age old Indian practices like yoga or pranayama are not religious. These are pure sciences like mathematics, physics or physiology. *Yoga says " experience" just as science says"experiment's.* Experiment and experience both are same but their directions are different. Experiment means there is something you can do outside the body while experience is something which you feel from within the body. Thus, it is a pure mathematics of inner being. Pranayama are yogic breathing techniques that increase the capacity of lungs and help to strengthen the internal organs, improve mental control and deepens one's ability to relax. Pranayama is the part of yoga and is an art of control breathing. According to yogic belief, life expectancy is linked to the frequency of respiration. If we can learn to slow down our breathing, we can add years to our lives. The present self controlled trial shows the effect of pranayama on resting pulse rate, blood pressure and respiratory rate as well as MDA levels in 74 subjects of both sexes in age group 25-65 years.

Pulse Rate

In the present study it was observed that, pulse rate in females decreased from 80± 5.6 to 72.7 ± 5.0 /min. after a 2 month pranayama technique. In males, it decreased from 79.7 ± 4.7 to 72.4 ± 4.1 / min. [table 1].Thus, average fall in pulse rate was 7.3/min. which was found to be statistically significant. These findings are in agreement with those of Baride and Sancheti (fall in pulse rate by 10/min. after 2 months of yoga)[4], Patel and Maromet (fall by 4.5 beats /min. at the end of 8 months training)[5], Wallace and Robert (decreased heart rate). Yogic posture and yogic breathing contribute for physical, emotional and mental relaxation which is responsible for decreased pulse rate.

Blood Pressure

Table 2 shows effect of pranayama on blood pressure. In females, systolic blood pressure decreased from 122.4± 4.2to 117.4 ± 4.2mm Hg. In males, systolic blood pressure decreased from 122.6± 4.3 to 117.5 ± 4.57 mm Hg and combined 122.5 ± 4.3 to 117.5 ±4.3 mm Hg. Diastolic blood pressure decreased from 81.4±2.3 to 76.4±3.5 mm Hg in females and in males it decreased from 81.1±2.8 to 76.1 ± 3.67 mm Hg, and combined effect it decreased from 81.3 ± 2.87 to 76.3 ± 3.57 mm Hg. Thus, average fall in systolic blood pressure was 4.98 and diastolic blood pressure was 4.98 after pranayama which was found to be statistically significant. These findings are in accordance with findings of Barmard *et al.*[6] who observed a 5.46 mm Hg and 7.5 mm Hg systolic and diastolic blood pressure respectively. Laxmikant *et al* observed a fall of 12.94 mm Hg and 8.4 mmHg. In systolic and diastolic blood pressure respectively after 3 wks. yoga[7]. Lance *et al*[8] demonstrated that at the end of 10 months training, systolic blood pressure fell by 7 mmHg and diastolic fell by 5 mmHg. Patel *et al*[9] observed a fall of 9.5 mmHg and 6.8 mmHg in systolic and diastolic blood pressure respectively after 8 months intervention. It has been recognised that normal cardiovascular responses can be influence by different environmental and behavioural conditions like attitudinal disposition of the individual, stress and anxiety. Thus chronic arousal of hypothalamic emergency reactions with associated increased sympathetic nervous system activity leads to elevated systemic arterial blood pressure. Asanas, pranayama may be responsible for alteration of behaviour which is associated with decreased sympathetic over activity that ultimately results in depression in blood pressure. Pranayama may be responsible for alteration of behaviour which is associated with decrease in plasma renin and aldosterone activity thereby leading to reduction in blood pressure.

Respiratory Rate

Table 3 shows the effect of pranayama on respiratory rate. Respiratory rate was reduced from 19.6 ± 1.5 to 17.27 ± 1.4 /min. in females. It was decreased from 19.45 ± 1.3 to 17.21 ± 1.3 in males. And combined effect showed a decrease from 19.54 ± 1.4 to 17.24 ±1.4/ min. The average fall in respiratory rate was 2.3/min. which was statistically significant.

Similar findings were observed by Robert, Eenson, Wilson and Bekkar[10]. Breathing is an unconscious event which is regulated by bulbopontine respiratory control mechanism which is further modified by suprapontine mechanism in conscious persons. The pnumotaxic center relays suprapontine messages which promotes voluntary inspiration and expiration. Usually, during pranayamic breathing exercise, bulbopontine complex which regulates respiration autonomically, slows down its rhythm by voluntarily prolonging the phase of inspiration and expiration by stretching to their fullest extent thus, making respiratory apparatus to work to maximum extent. Many areas in reticular substance and tractus solitarius control autonomic functions most important of these being heart rate, blood pressure and respiratory rate signals from hypothalamus and cerebrum also can affect the activities of almost all the brain stem autonomic control centers. It is also observed that pranayama causes considerable increase in alpha waves in EEG which indicates relaxation i.e. Decrease in pulse rate, respiratory rate and blood pressure. Plasma cortisol levels are decreased and plasma prolactin levels are increased. Studies indicate lesser adrenocortisol activity after yoga which is responsible for inhibitory effect on neuroendocrine axis. Thus it is hypothesizes pranayama is responsible for decreased respiratory rate by alteration in bulbopontine complex to a new pattern of breathing which is slower than a basal rhythm.

Serum MDA levels

Serum MDA which is an indicator of levels of free radicals was significantly decreased after pranayama. In females, it reduced from 3.82 ± 0.7 to 1.73 ± 0.5 nmol/ml. and combined 3.79± 0.7 to 1.69 ± 0.5 nmol./ml. The average fall in serum MDA levels was 2.1 nmol./ml. which was statistically significant. Similar results were reported by Schneider *et al* [12], Tiwari *et al*[13], Singh *et al* [14] who showed decrease in MDA levels from 6 to 3 nmol./ml. Yoga causes decreased metabolism and decreased production of free radicals in the body thus reducing serum MDA levels. When catecholamines are oxidised, they supply electrons for formation of free radicals. It is observed that catecholamines are decreased after yoga, less free radicals are formed thereby decreasing serum MDA levels[15]. It is also observed that yoga causes decreased serum cholesterol and FFA in

body. Thus, if FFA is less, lipid peroxidation is decreased thus reducing serum MDA levels[16]. Thus, pranayama shift the balance from sympathetic over activity to parasympathetic system, providing energy conservation and calming mechanisms. More over once learned, these techniques can be self trained, without any instrument, with minimum cost. So we feel that comprehensive lifestyles are ideal for protecting and promoting health, providing a total physical, emotional and mental relaxation and tranquility of mind.

CONCLUSION

In present study it was observed that pulse rate, systolic blood pressure, diastolic blood pressure, respiratory rate was decreased significantly after pranayama practice. It was also observed that serum MDA levels which are indicators of stress level also were decreased, thus proving reduction in oxidative stress. So it can be concluded that practices of regular pranayama helps to improve the quality of life.

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