Effect of Sudarshankriya Yoga on Cardiorespiratory Parameters

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Research Article

Abstract: **Objective**: The present study is done to determine the effect of Sudarshankriya Yoga on heart rate, systolic blood pressure (SBP), diastolic blood pressure (DBP) and respiratory rate. **Material and Methods**: About 30 subjects (cases) underwent the practice of Sudarsharkriya Yoga for 12 weeks. Above cardio respiratory parameters were measured before and after the practice of Sudarshankriya Yoga. Comparative analysis is done for the effect of 12 weeks of yoga practice on these parameters. **Results**: Sudarshankriya yoga showed statistically significant decrease in the values of heart rate, systolic blood pressure, diastolic blood pressure as well as respiratory rate after 12 weeks of practice. **Conclusion:** The mechanism involved is by creating balance in autonomic nervous system functions by parasympathetic dominance and decreased sympathetic drive.

Keywords: Sudarshankriya Yoga, Ujjayi, Bhastrika, Heart rate, Systolic blood pressure, Diastolic blood pressure, Respiratory rate.

Introduction

The term "yoga" and the English word "yoke" are derived from Sanskrit root "yuj" which means union. Yoga is a psycho-somatic-spiritual discipline for achieving union & harmony between our mind, body and soul and the ultimate union of our individual consciousness with the Universal consciousness[1]. Sudarshan Kriya Yoga (SKY) is a rhythmic breathing process where three rhythms are followed by a cyclical fashion. According to Sri Sri Ravi Shankar ji, an intimate link exists between our thoughts, emotions & pattern of breath. He states "Breath is one of the mystery of existence and the deeper mystery of our consciousness". SKY takes you to the deepest meditation where body, mind & breath come in the rhythm connecting to the source of life deep within. One of few mechanisms contributing to a state of calm alertness includes increased parasympathetic drive[2]. By voluntarily controlling breathing patterns, it is possible to influence autonomic nervous system functions, including heart rate variability and cardiac vagal tone[3,4,5], chemoreflex sensitivity [6]. SKY practice of ujjayi shifts parasympathetic dominance via vagal stimulation from somatosensory afferents in the glottis, pharynx, lungs and abdominal viscera[2]. A practioner of Pranayama tries to keep his attention on the act of breathing, leading to concentration. This act of concentration removes his attention from worldly worries and "de-stress" him. This may decrease release adrenaline i.e. decrease sympathetic activity and hence decrease in heart rate, respiratory rate, blood pressure etc [7]. Same effect can be observed during SKY breathing. Various central and autonomic mechanisms as well as mechanical (heart) and hemodynamic adjustments are triggered in response to variation of breathing patterns, thereby causing both tonic and phasic changes in cardiovascular functioning [8]. Slow, rhythmical and deep breathing cycles cause significant decrease in oxygen consumption, heart rate and diastolic blood pressure [9]. It has been reported earlier that yoga and pranayama are beneficial for the treatment of cardiopulmonary diseases, autonomic nervous system imbalances, and psychological or stress-related disorder[10,2].

Subjects and Methods

Thirty male volunteers took part in the present study. Their age, height, weight was recorded. All the subjects were healthy and did not have any cardio- respiratory diseases. All were nonsmokers, nonalcoholic, without any drug addiction & were not under any medications. Subjects selected were either medical students or staff of MIMSR Medical College, Latur, Maharastra. On first day, the subjects performed 30 min resting period during which they were seated comfortably to complete general physical examination & to fill subject history forms. The aim and objective of the study were explained to each of them and verbal consent was taken. A baseline record (which served as control) of Heart rate (Beats/min), Systolic blood pressure (mmHg), Diastolic blood pressure (mmHg), respiratory rate (RR/min) were measured on the day before starting SKY session. Heart rate was measured with the help of ECG in lead II. Blood pressure (SBP and DBP in mmHg) was measured in supine position by using a mercury sphygmomanometer by the auscultatory

method [11,12]. RR/min was recorded by observing abdominal wall movement in supine position.

Method of Sudarshankriya Yoga [2,13]- The Sudarshankriya Yoga (SKY) is a rhythmical cyclical breathing done in vajrasana posture with eyes closed & breathing through nostrils. It is taught by a trained & certified instructor as a 20 -22 hours program & is typically five to six sessions of two and half or three hours. Following the course, homemade practice consists of-

1. *Ujjayi* or "Victorious Breath" is sometimes called "Ocean Breath" because the sound created by the gentle contraction of the laryngeal muscles and partial closure of the glottis is reminiscent of the sound of the sea. This slow three stage breath technique (2 to 4 breaths per minute) increases airway resistance during inspiration and expiration and controls airflow so that each phase of the breath cycle can be prolonged to an exact count. Each breath cycle consists of four phases (Inspiration; End inspiration breath hold; Expiration; End expiration breath hold) with a time ratio of 4:4:6:4. In the first stage hands are held at the waist, in the second hands are held at chest level while in the third elbows point upward with palms placed on upper back.
2. During *Bhastrika* or "Bellows Breath" air is rapidly inhaled and forcefully exhaled at a rate of 30 breaths per minute. It again is a three stage technique with 15 to 20 cycles each. During inspiration arms go straight up, hands open with fingers extended while during expiration elbows come down with hands closed.
3. "Om" is chanted three times with very prolonged expiration.
4. *Sudarshan Kriya* or "Proper Vision by Purifying Action" is an advanced form of cyclical breathing at varying rates—slow (8 to 10 cycles per minute), medium (30 cycles per minute) and fast (150 to 180 cycles per minute) . This is done with no pause between inspiration & expiration without any airway resistance. The breath work is followed by meditation & rest.

By the end of twelve weeks, all parameters were recorded again (following SKY session). Mean & standard deviation of all parameters were calculated and compared with values of all parameters (mean ± SD) measured before starting of SKY session.

Statistical analysis

The data was analyzed by using figure pad software. Analysis of physical characteristics & cardio respiratory parameters were carried out by using descriptive statistics. Physical characteristics & differences in the mean values of heart rate, SBP, DBP & respiratory rate were subjected to paired't' test. A 'P' value of <0.05 was considered significant.

Result

Sudarshankriya Yoga showed statistically significant (p value <0.0001) decrease in all the above cardio respiratory parameters after 12 weeks of practice. Heart rate decreased from mean value of 81.07 ± 4.8 before starting the practice to mean value of 73.93 ± 4.77. SBP decreased from mean value of 127.07 ± 6.76 before starting the practice to mean value of 120.13 ± 6.8. DBP decreased from mean value of 81.07 ± 4.25 before starting the practice to mean value of 75 ± 4.25. Respiratory rate decreased from mean value of 13.93 ± 1.7 before starting the practice to mean value of 11.87 ± 1.47.

Discussion

It has been found that there is significant reduction in resting pulse rate, systolic blood pressure and diastolic blood pressure indicating increase in baroreflex sensitivity after yoga training for more than 5 years[14]. In one study it has been demonstrated that two months of yoga training decreases basal heart rate, blood pressure, myocardial oxygen consumption and load on the heart[15]. Another study assessed the effect of yoga based guided relaxation on autonomic variables and found that power of the low frequency component of heart-rate variability spectrum reduced, whereas the power of high frequency component increased, suggesting a reduced sympathetic activity[16]. One study reported a decrease in pulse and respiratory rates after yoga practice[17]. Another study found out that there was significant reduction in cardiovascular risk factors after 3 months of residential yoga and meditation training program that blood pressure were significantly reduced especially in the subjects with elevated levels[18]. It also have been demonstrated that regular yoga practice of 1 hour/day done for a period of 11 weeks was as effective as medical therapy in controlling high blood pressure in hypertensive subjects[19]. Decrease in heart rate and systolic & diastolic blood pressure has been found in school children after 3 months of meditation practice[20]. Baroreceptor sensitivity can be enhanced significantly by slow breathing. This seems to occur through a relative increase in vagal activity, as could be argued by the small reduction in the heart rate observed during slow breathing and by reduction in both systolic and diastolic pressure[21]. Inhibitory current synchronizes rhythmic cellular activity between the cardiopulmonary center[22]. Inhibitory current regulates excitability of nervous tissue[23] and is known to elicit synchronization of neural elements, which typically is indicative of a state of relaxation[24]. Synchronization within the hypothalamus and the brainstem[25] is likely to be responsible for inducing the parasympathetic response[26] during breathing exercises. Slow ujjayi

breathing enhances parasympathetic activity & increases indicators of vagal tone such as respiratory sinus arrhythmia (RSA) & heart rate variability (HRV). It also decreases chemoreflex sensitivity & improves baroreflex sensitivity[2,27,28], oxygenation & exercise tolerance[29]. Adaptation of peripheral/central chemoreceptors to chronic CO2 retention and/or adaptation of pulmonary stretch receptors to a habit of deep slow respiration may increase vagal afferent discharge to nucleus of Tractus Solitarius (NTS) that sends projections to the thalamus & limbic system[29,30]. Contraction of laryngeal muscles with partial closure of glottis during slow ujjayi breathing also stimulates somatosensory vagal afferents[2]. Resistive loading created during ujjayi breathing send afferent input via vagal & spinal sources arising from lung & chest wall structures to parabrachial nucleus (PBN) & locus coeruleus[31] which also receives projections from NTS, feeding back through dorsomedial nucleus to vagal efferents which in turn slows heart rate by increasing parasympathetic & decreasing sympathetic input to SA node [3,2], thus decreasing the heart rate. During prolonged voluntary expiration intra-thoracic pressure increases and blood from the lungs is squeezed into the heart leading to an increase in stroke volume; baro-receptors in carotid sinus experiences more pressure and discharge more. The increased baroreceptor discharge inhibit the tonic discharge of the vasoconstrictor nerves and excites the vagus innervations of the heart producing vasodilatation, a drop in systolic blood pressure and bradycardia[32]. Bradycardia itself results in fall in systolic blood pressure. Diastolic blood pressure depends upon peripheral vascular resistance & lung inflation has been known to decrease systemic vascular resistance[33]. This response is initiated by pulmonary stretch receptors, which bring about withdrawal of sympathetic tone in the skeletal muscle blood vessels, leading to widespread vasodilatations, thus causing a decrease in peripheral resistance[34] and decreasing the diastolic blood pressure. Yoga on long duration affects hypothalamus and brings about decrease in systolic blood pressure through its influence on vasomotor centre which leads to decrease in sympathetic tone and peripheral resistance[35], thus reducing diastolic blood pressure. Inspiration & expiration against airway resistance (resistive loading) during slow ujjayi breathing increases intrathoracic pressure & arterial baroreceptor stimulation with increase in HRV & RSA. Resistive loading itself & increase in HRV plus RSA prolong respiratory period[36], thus reducing the rate of respiration. One study showed that pranayama practice for 20 minutes twice a day on week days and once on Saturday for 6 weeks showed significant decrease in respiratory rate[37]. Another study suggested that ten weeks of yoga practice significantly reduced respiratory rate[38] while six weeks[37] and ten weeks[38] of pranayam breathing course resulted in improved ventilatory functions in the form of lowered respiratory rate.

Conclusion

About 30 subjects (cases) underwent the practice of Sudarsharkriya Yoga for 12 weeks. Cardio respiratory parameters such as heart rate, systolic blood pressure, diastolic blood pressure and respiratory rate were measured before & after the practice of Sudarshankriya Yoga. Comparative analysis is done for the effect of 12 weeks yoga practice on these parameters. Sudarshankriya yoga showed statistically significant decrease in the values of all the above parameters after 12 weeks of practice. The mechanism involved is by creating balance in autonomic nervous system functions by parasympathetic dominance and decreased sympathetic drive. Our study may prove to be helpful in finding out some solution in hypertensive cases & in those patients who either die of cardiac diseases or live a morbid life with such diseases. To what much extent effect of Sudarshankriya Yoga benefits in either saving lives of patients dying of cardiac problems or even preventing such problems to take place is a matter of further research.

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Table 1: Descriptive Statistics for Age, Height and Weight

	Age in years	Height in cms	Weight in Kgs
Mean	22.30	173.63	70.20
SD	2.76	4.61	6.48

Table 2: Statistical Significance for Heart rate, SBP, DBP and Respiratory rate

Groups	Heart rate before & after SKY sessions		SBP before & after SKY sessions		DBP before & after SKY sessions		Respiratory rate before & after SKY sessions	
	Before	After	Before	After	Before	After	Before	After
MEAN	81.07	73.93	127.07	120.13	81.07	75	13.93	11.87
SD	4.806	4.77	6.762	6.806	4.258	4.259	1.701	1.479
t test	14.973		16.705		13.649		9.204	
p value	<0.0001		<0.0001		<0.0001		<0.0001	
Significance	Significant		Significant		Significant		Significant