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Research Article

EFFECT OF SUDARSHAN KRIYA YOGA ON PARA-SYMPATHETIC FUNCTION TEST IN HYPERTENSIVE PATIENT

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ABSTRACT

The Sudarshan Kriya is a unique cyclical controlled yogic breathing process developed from ancient Indian science of Yoga. It has potential to integrate body and mind. It is known to eliminate stress, fatigue and negative emotions such as anger, frustration and depression, leaving you calm yet energized, focused yet relaxed. This study evaluated the effects of sudarshan Kriya on autonomic para-sympathetic variable in hypertensive subjects. In present study two groups each having 35 subjects one is hypertensive and one is normotensive were selected between age 25-75 years of either sex were studied in the morning hours. The patients of hypertension were randomly selected reporting to department of Medicine / Cardiology PBM Hospital, Bikaner. Study group were asked to do Sudarshan Kriya Yoga for three months after proper training under the supervision of expert at The Art of Living Centre Rani Bazar, Bikaner. This study was conducted in the department of physiology Sardar Patel Medical College, Bikaner. Para-sympathetic non invasive autonomic function test were performed that is lying to standing test, deep breathing test, valsalva manoeuvre including resting blood pressure. The results were statistically analysed by applying paired "t" test. After the twelve weeks of sudarshan kriya para-sympathetic function test like lying to standing test, deep breathing test, valsalva manoeuvre were statistically insignificant lower ($p > 0.05$). Reduction was more profound in study group than in control group.

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INTRODUCTION

Hypertension is one of the leading causes of the global burden of disease. Approximately 7.6 million deaths (13-15% of the total) and 92 million disability adjusted life years worldwide were attributable to the high blood pressure in 2001. Hypertension doubles the risk of cardiovascular disease, including coronary heart disease, congestive heart failure, ischemic and hemorrhagic stroke, renal failure and peripheral arterial diseases.¹

Nowadays stress is an absolutely inevitable part of life. Stress is "a physical or psychological stimulus that affects both physical and mental health. Stress causes hormonal changes; biochemical changes various illnesses and psychosomatic diseases. Exposure to chronic stress leads to certain physiological changes in our body resulting in diseased states like hypertension, diabetes, heart attacks etc."²

Hypertension is one of the most important public health problems worldwide. Hypertension is a common disease in industrialized countries, it accounts for 6% of deaths worldwide. It is associated with increased cardiovascular risk which is doubled with 20 and 10 mmHg rise of systolic and diastolic blood pressure respectively. Global epidemic of high blood pressure is expected to shift the burden of disease so that heart disease will become the most common cause of death worldwide by the year 2025.³

Due to certain physiological disorders the lumen of the arteries constricts, their volume also reduces. This creates increased pressure inside the arteries which is then referred to as "Hypertension". High B.P. may have an hormonal cause among other causes leading to disruption of renin-angiotensin-aldosterone actions, high B.P. may also be as a result of renal disorders. The so called essential hypertension does not show definite correlation to any factor.⁴

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Classification of hypertension

The following table is showing the classification of blood pressure levels in adults above age 18 years.⁵

Blood Pressure Classification	Systolic mmHg	Diastolic mmHg
Normal	<120	<80
Pre-hypertension	120-139	80-89
Stage 1 hypertension	140-159	90-99
Stage 2 hypertension	>160	>100
Isolated systolic hypertension	>140	<90

Sudarshan Kriya Yoga

Sudarshan Kriya Yoga (su = proper, darshan = vision, kriya = purifying action) is a unique rhythmical breathing technique, based on ancient vedic tradition.⁶ It is a special package of yoga, meditation and pranayam with “Sudarshan Kriya” introduced by H. H. Sri Sri Ravishankarji.⁷

Sudarshan Kriya

The Sudarshan Kriya is a rhythmical cyclical controlled breathing process with roots in traditional yoga. It has four distinct components.⁸ It consists of slow, medium, and fast cycles of breathing practiced for a total duration of 35 minutes without any relaxation in between. At the end a person is asked to remain in yoga nidra (tranquil state) for about 10 minutes. The four main SKY breathing techniques are as follows⁹:

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 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. The subjective experience is physical and mental calmness with alertness.
2. During Bhastrika or “Bellows Breath” air is rapidly inhaled and forcefully exhaled at a rate of 30 breaths per minute. It engenders excitation followed by calmness.
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, medium, and fast.

Sudarshan Kriya technique oxygenates the cells and rapidly flushes out impurities. Physically, the cells are vitalized; emotionally, one feels a sense of balance and contentment.

MATERIAL AND METHOD

Sample size: In present study two groups each having 35 subjects one is hypertensive and one is control group were selected between age 25-75 years of either sex were studied in the morning hours. The patients of hypertension were randomly selected reporting to department of Medicine / Cardiology PBM Hospital, Bikaner.

Subjects who are hypertensive according to WHO guidelines were examined for the cardiovascular autonomic. Study group and control group were asked to do Sudarshan Kriya Yoga for three months after proper training under the supervision of

expert at The Art of Living Centre Rani Bazar, Bikaner. This study was conducted in the department of physiology Sardar Patel Medical College, Bikaner.

Controls: Age-matched normotensive (N=35) were examined for the control values of the cardiovascular autonomic functions.

Exclusion criteria

1. Patients suffering for diabetes mellitus, pulmonary tuberculosis, asthma, chronic bronchitis and no other allergic condition.
2. Absence of any major psychiatric illness. They should not be on any medication of mental illness

Evaluations: The following tests were performed for assessment of sympathetic activity

Resting blood pressure

Blood pressure was recorded with standard sphygmomanometer by auscultatory method. Before recording the blood pressure, subjects were allowed to rest for 5 minutes in a quiet room to reduce the anxiety. The onset of sounds (korkoff's phase 1) was taken as indicative of systolic blood pressure and disappearance of sound (korkoff's phase 5) as indicative of diastolic blood pressure.

Parasympathetic reactivity tests

Heart rate response to standing - Postural Tachycardia Index (PTI) or 30:15 ratio

The subjects were asked to lie on the examination table quietly while heart rate is being recorded on ECG. They were then asked to stand-up unaided and ECG was recorded for 1 minute. The shortest R-R interval at or around 15th beat and longest R-R interval at or around 30th beat was measured. The result was expressed as ratio of 30/15.

PTI= Longest R-R interval at 30th beat / shortest R-R at 15th beat. A ratio of 1.00 or less was defined as an abnormal response, 1.01-1.03 as borderline and 1.04 as normal response.¹⁰

Deep breathing test (DBT) or heart rate response to deep breathing or Expiration: Inspiration ratio

In the sitting position subject was asked to breathe quietly and deeply at the rate of 6 breaths per minute. A continuous ECG was recorded for six cycles with marker to indicate the onset of each inspiration and expiration. Variation in heart rate was calculated as rate of longest R-R interval during expiration to shortest R-R interval during inspiration.¹¹ A value of 1.20 or higher was taken as normal.¹²

Heart-Rate variation to Valsalva Manoeuvre (VM)

The subject was seated comfortably and was asked to blow into a mouthpiece connected to a mercury sphygmomanometer and holding it at a pressure of 40 mm of mercury for 15 seconds, while a continuous ECG was being recorded. The ECG was continued to be recorded after release of pressure at the end of 15 seconds for 30 seconds. The heart rate changes induced by the valsalva manoeuvre was expressed as the ratio of the maximal tachycardia during the manoeuvre to the maximal bradycardia after the manoeuvre. This ratio was defined as the

Valsalva ratio and was calculated as the ratio of maximum R-R interval after the manoeuver to minimum R-R interval during the manoeuver¹³.

Valsalva ratio (VR) = maximal tachycardia/maximum bradycardia = maximum R-R interval/minimum R-R interval. A value of 1.10 or less is defined as an abnormal response, 1.11-1.20 as borderline, and 1.21 or more as a normal response.¹⁴

Analysis of Observations

Analysis was done by statistical analysis. Students ‘t’ test (two tailed) has been used to find the significance. P=0.05 was considered as statistically significant.

RESULTS

Table 1 Mean age of subjects under study

	Female		Male		Total	
	control	study	control	study	control	Study
Mean	67.51	60.54	63.71	66.07	63.15	66.12
S.D	5.43	7.26	6.65	5.67	7.55	5.63

Table 2 Anthropometric and Para-sympathetic reactivity test in Control Group in Male

Parameters		Pre-Intervention	Post Intervention	P
		Mean±SD	Mean±SD	
BMI (kg/m ²)		26.21±3.76	26.10±0.143	0.867
Blood Pressure (mmHg)	Systolic	118.24±7.97	115.72±8.84	0.391
	Diastolic	79.12±7.56	77.92±6.11	0.114
Parasympathetic Reactivity Test	30/15Ratio	1.39±0.17	1.39±0.15	0.76
	DBT (E/I) VM	1.48±0.15	1.48±0.21	0.54
		1.61±0.29	1.64±0.35	0.66

Table 3 Anthropometric and Para-sympathetic reactivity test in Control Group in Female

Parameters		Pre-Intervention	Post Intervention	P
		Mean±SD	Mean±SD	
BMI (kg/m ²)		24.21±3.12	22.11±0.113	0.865
Blood Pressure (mmHg)	Systolic	110.42±11.65	108.72±8.84	0.391
	Diastolic	73.04±5.99	70.92±6.11	0.134
Parasympathetic Reactivity Test	30/15 Ratio	1.36±0.23	1.34±0.11	0.18
	DBT (E/I) VM	1.49±0.18	1.48±0.21	0.54
		1.63±0.26	1.62±0.45	0.66

Table 4 Anthropometric and Para-sympathetic reactivity test in study group in Male

Parameters		Pre-Intervention	Post Intervention	P
		Mean±SD	Mean±SD	
BMI (kg/m ²)		34.05±5.23	26.13±1.133	0.543
Blood Pressure (mmHg)	Systolic	145.45±10.14	131.73±10.44	0.643
	Diastolic	94.04±6.71	82.92±5.17	0.342
Parasympathetic Reactivity Test	30/15 Ratio	0.73±0.30	1.33±0.10	0.12
	DBT (E/I) VM	1.12±0.18	1.28±0.32	0.52
		1.07±0.29	1.01±0.45	0.55

Parameters		Pre-Intervention	Post Intervention	P
		Mean±SD	Mean±SD	
BMI (kg/m ²)		31.65±5.39	25.11±1.23	0.623
Blood Pressure (mmHg)	Systolic	138.47±10.14	130.75±10.11	0.50
	Diastolic	91.04±6.51	82.67±5.31	0.42
Parasympathetic Reactivity Test	30/15 Ratio	0.73±0.03	1.23±0.10	0.13
	DBT (E/I) VM	1.10±0.17	1.28±0.32	0.52
		1.07±0.29	1.01±0.45	0.55

The mean age of participants was 63.15±7.55 in control group and in study group it was 61.53±8.88 years (mean ± standard deviation) (Table-1)

Data presented in above table 2,3,4,5 shows that resting blood pressure and parasympathetic reactivity test were statistically insignificantly lower (p>0.05), in both the male and female group of study group as compared to the male and female group of controls.

DISCUSSION

Sudarshan Kriya incorporates specific natural rhythms of the breath which harmonize the body, mind and emotions. This unique breathing technique eliminates stress, fatigue and negative emotions such as anger, frustration and depression, leaving you calm yet energized, focused yet relaxed.⁹

Tests assessing autonomic function are based on evaluation of the cardiovascular reflexes triggered by performing specific provocative manoeuvres. Stimuli that raise blood pressure responses to orthostatic testing are in a large part a reflection of sympathetic activity.

Our findings are consistent to Somwanshi *et al* in 2013 who found highly significant improvement in cardio respiratory parameters in healthy subjects after 3 months of Sudarshan Kriya Yoga practices.¹⁵

Effect of SKY in Reducing blood pressure and heart rate

Sustained stimulation of sympathetic nervous (fight and flight response) system increases blood pressure. It is hypothesized that the different cyclical rhythms of Sudarshan Kriya create a variety of vagal, thalamic and cortical effects. During SKY, a sequence of breathing techniques of different frequencies, intensities, lengths, and with end-inspiratory and end-expiratory holds creates varied stimuli from multiple visceral afferents, sensory receptors, and baroreceptors.¹⁶

These influence stimulates vagus nerves which in turn induces physiologic changes in organs, glands, and ascending fibers to thalamic generators, the limbic system and cortical areas.¹⁷

Resistive loading created during ujjayi breathing send afferent input via vagal & spinal sources arising from lung & chest wall structures to parabrachial nucleus (PBN) & locus coeruleus¹⁸ 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 node¹⁵ 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.¹⁹

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.²⁰ 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 resistance²¹ 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 center which leads to decrease in sympathetic tone and peripheral resistance, thus reducing diastolic blood pressure.²²

SKY practice of 'ujjayi' shifts parasympathetic dominance via vagal stimulation from somatosensory afferents in the glottis, pharynx, lungs and abdominal viscera. Thus SKY strengthens, balance, stabilize autonomic nervous system functions and establishes parasympathetic dominance with decreased sympathetic drive.¹⁶

SKY showed statistically significant decrease after 12 weeks of practice in the values of heart rate, systolic blood pressure and diastolic blood pressure in healthy subjects. The mechanism involved is by creating balance in autonomic nervous system functions by parasympathetic dominance and decreased sympathetic drive.^{15,23}

By voluntarily controlling breathing patterns, it is possible to influence autonomic nervous system functions, including heart rate variability and cardiac vagal tone.^{24,25}

Thus by establishing parasympathetic dominance SKY is beneficial to decrease blood pressure and heart rate in patients of hypertension.

Our study showed that the systolic and diastolic blood pressure response to hand grip test was significantly lower in both the male and female group of control and study groups. ($p < 0.05$)

Our findings are in consistent with Akhter *et al.*,²⁶ who conducted a cross sectional study which showed that mean values of resting heart rate, resting systolic and diastolic blood pressure were significantly ($p < 0.05$) higher and both the sympathetic nerve function parameters (blood pressure response to hand grip and blood pressure response to standing) were significantly ($p > 0.05$) lower in hypertensive compared to those of normotensive control subjects. So it can be revealed that sympathetic nerve function may be reduced in hypertension.

Piccirillo *et al.*²⁷ Peterson *et al.*²⁸ also stated the same that sympathetic nerve function are reduced in hypertension.

CONCLUSION

In our study the Para-sympathetic function tests showed insignificant ($p > 0.05$) decrease in both the prehypertensive and normotensive individual. So we can say Sudarshan Kriya Yoga can be used as an adjunct with diet and medicines in management of hypertension and anxiety.

SKY practices are cost-effective, well-tolerated tools that can be easily integrated into diverse community care models. SKY relieves stress and develops an individual's mind-body-spirit so that they can be happier, healthier, and possibly even longer lived.

In the competitive modern world, in which stress and anxiety are part of everyday life, adding a time-honored, evidence-based breathing program like SKY may facilitate a healthy life. So everyone should incorporate SKY into their life.

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