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Original Research Article

To Investigate the Impact of a Brief Period of Pranayama Practice on the Cardiovascular Autonomic Function in Patients Diagnosed with Hypothyroidism

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Abstract

Aim: The aim of the present study was to assess the effects of short term (1 month) practice of pranayama on cardiovascular autonomic function in hypothyroid patients.

Methods: The present study was conducted on 80 volunteers at Department of Physiology for 6 months in between 18-30yrs of age. All consenting subjects meeting inclusion and exclusion criteria of the study was selected and informed written consent was obtained after thoroughly explaining the procedure. They were randomly divided into two groups with 40 patients in each group.

Results: The mean age was 26.44 $\pm$ 5.65 and 29.69 $\pm$ 7.43 in both groups respectively. The mean BMI was 24.58 $\pm$ 3.27 and 25.45 $\pm$ 4.26 in both groups respectively. The mean HR was 72.48 $\pm$ 7.87 and 74.36 $\pm$ 8.64 in both groups respectively. Parasympathetic tests, the delta heart rate in deep breathing test and Valsalva ratio were increased in both groups however the increase in delta heart rate in deep breathing test in PG, CG. The increase in delta heart rate in deep breathing test in PG, CG were 32%, 16% and valsalva ratio in PG, CG were 8% and 4 respectively. The reduction diastolic blood pressure change in hand grip test was 18% in PG and 6% in CG. In cold pressor test, diastolic blood pressure was reduced by 12% in PG and 8% in CG.

Conclusion: The results of this study demonstrated that regular practice of pranayama in addition to standard medical therapy is more beneficial to improve cardiovascular autonomic function in hypothyroid patients.

Keywords: Pranayama, Hypothyroidism, Cardiac Autonomic Function.

Introduction

Thyroid dysfunctions are common global health problems, hypothyroidism accounting for 5–15% and hyperthyroidism 0.3 to 0.6% in general population. Recently, the incidence of thyroid dysfunctions has increased considerably and presently, the burden of thyroid disorders in India is about 42 millions. [1] It is not clearly known; whether the increased occurrence of thyroid dysfunctions is directly linked to the change in life style in the society. However, it is well documented that diabetes, hypertension and coronary artery diseases are directly associated with the degree of stress and physical inactivity [2] and the common pathophysiological basis of these disorders has recently been attributed mainly to the autonomic imbalance. [3] Thyroid hormones are the major regulators of metabolism, and the degree of metabolism has a direct impact on sympathovagal balance. Affection of cardiovascular system is one of the most frequent and most serious clinical manifestations of thyroid dysfunctions. [4]

Nevertheless, the type and the degree of autonomic imbalance and its contribution to cardiovascular abnormalities in thyroid dysfunctions have not yet been fully investigated. The utilization of yoga as a therapeutic tool, which started out early in the 20th century, takes benefit of a variety of psycho physiological benefits of the component practices. The asanas may improves the patient's flexibility, co-ordination as well as strength, while the pranayama and also meditation techniques may calm and focus the mind to improve better awareness as well as reduce anxiety [5], thus results in higher QoL. Further useful outcomes may include a reduction of distress, blood pressure, improves mood and also metabolic regulation.[6] Khalsa reported that a majority of the research conducted on therapeutic potential of yoga was

performed in India and a considerable portion of these were documented in Indian journals, many of which are usually tough to obtain for Western clinicians and scientists. [6]

Association (AHA) guidelines emphasized on the importance of lifestyle interventions such as regular exercise and yoga, as an alternative approach for the management of HTN. [7] Yoga, one of the commonest component in complementary and alternative medicine (CAM) for managing high blood pressure is becoming increasingly popular [8-10] and worthy to be included in the clinical guidelines. [11] The major mechanism through which pranayama influences blood pressure is through improved baroreceptor sensitivity, that changes the autonomic balance between parasympathetic and sympathetic nervous system. [12,13]

The aim of the present study was to assess the effects of short term (1 month) practice of pranayama on cardiovascular autonomic function in hypothyroid patients.

Materials and Methods

The present study was conducted on 80 volunteers' at department of Physiology, Patna Medical College, Patna, Bihar, India for 6 months in between 18-30yrs of age . Inclusion criteria consisting of 18-30 years of aged women, newly diagnosed hypothyroidism. Pregnant or breast-feeding, addicted to alcohol or drugs, those who are already practicing pranayama were the criteria to exclude the patients.

All consenting subjects meeting inclusion and exclusion criteria of the study was selected and informed written consent was obtained after thoroughly explaining the procedure. They were randomly divided into two groups with 40 patients in each group.

Pranayama group (PG) (n=40) patients were diagnosed with hypothyroidism and given one month pranayama training in addition to standard medical treatment. The Control group (CG) (n=40) participants were also hypothyroid patients on standard medical treatment only.

All experiments were performed at the cardiac autonomic function research laboratory in Dept of Physiology, Patna Medical College, Patna, Bihar, India. The patients were asked to refrain from heavy physical activity for 24 hours and from consumption of alcohol and caffeinated beverages for 12 hours prior to the measurements. The temperature of the laboratory was kept between 25° C - 28° C and lights subdued. The patients were asked to void urine before testing and made to sit in the lab comfortably to accustom to the new environment. Baseline and anthropometric parameters were recorded before undergoing assessment of cardiovascular autonomic function.

Tests for assessment of cardiovascular autonomic status: The tests for the assessment of cardiovascular autonomic status were done as per standard protocols published in the literature. [14]

Deep breathing test: This is a test of parasympathetic reactivity. [15] The recording of heart rate was done from the ECG recordings on the ECG machine (Cardio win system, PC based 12 channel simultaneous digital ECG, Genesis Media System Pvt. Ltd, India). A baseline recording of ECG was taken for 30 seconds. The subject was asked to take slow and deep inspiration followed by slow and deep expiration such that each breathing cycle lasted for 10 seconds. The calculation was done from the tracing of ECG. The changes in the heart rate between inspiration and expiration were averaged over 6 cycles.

Valsalva maneuver: This is a test of parasympathetic reactivity. [15] It was done in sitting position. The patient was instructed to blow into a mouthpiece attached to sphygmomanometer. The expiratory pressure was kept at 40 mmHg for 15 seconds. At the end of 15 seconds the subject was asked to release the pressure. Valsalva Ratio was calculated from the longest RR interval during phase IV and the shortest RR interval during phase II.

Handgrip test: This is a test of sympathetic reactivity. The baseline blood pressure was recorded. The subject was asked to press a handgrip dynamometer at 30% of maximum voluntary contraction for 4 minutes. The blood pressure was recorded in 1st, 2nd and 4th minute of contraction. The rise in the diastolic pressure above the baseline was noted.

Cold pressor test: This is a test of sympathetic reactivity. The baseline blood pressure was recorded. The subject was instructed to immerse the right hand in the cold water (8 degree Celsius) for 1 minute up - to the wrist. The blood pressure was measured at the end of one minute. The rise in the diastolic pressure over baseline was noted.

Intervention: After the pre-test, instructions were given to pranayama group about the practices. After the initial instructions they will be taught following practices

Loosening procedures	: 5 min
Chandranadi pranayama	: 2 min
Bhramari pranayama	: 2 min
Nadishuddi pranayama	: 2 min
Pranava pranayama	: 2 min
havasana	: 15 min

The pranayama group practiced the above schedule for 3 days a week under our direct supervision and

remaining days at home practice. At the end of one month, all the parameters were recorded and the obtained data will be analyzed statistically.

Statistical analysis: Statistical analyses were conducted utilizing the R for windows. Descriptive statistics were expressed as means and standard deviations for continuous variables. After examining for normality, 2 tailed paired t - test for normally distributed data of within group difference, independent t test to test the % change in between group difference and Mann- Whitney U - test for skewed data for within group and between group was used. The null hypothesis was rejected at $p<0.05$.

Results

Table 1: Patient's demographics and baseline characteristics

Parameter	PG (n=40)	CG(n=40)
Age(years)	26.44± 5.65	29.69± 7.43
BMI (kg/m^2)	24.58± 3.27	25.45 ± 4.26
HR (bpm)	72.48± 7.87	74.36± 8.64
SBP (mmHg)	108.52± 36.94	112.36±28.92
DBP (mmHg)	74.46± 26.54	76.54± 23.57
Free-T3(pg/ml)	1.52± 0.48	1.65± 0.55
Free-T4(ng/dl)	0.69± 0.19	0.75± 0.25
TSH (uIU/mL))	98.32± 22.38	110.62±42.58

The mean age was 26.44 ± 5.65 and 29.69 ± 7.43 in both groups respectively. The mean BMI was 24.58 ± 3.27 and 25.45 ± 4.26 in both groups respectively. The mean HR was 72.48 ± 7.87 and 74.36 ± 8.64 in both groups respectively.

Table 2: Within group differences of autonomic function tests

Test	Parameter	PG (n=40)		CG(n=40)	
		Time=0month	Time=1month	Time=0month	Time=1month
DBT	Delta heartrate(bpm)	12.36±2.48	14.84± 3.28	12.82± 3.97	15.95± 5.40
VM	Valsalva ratio	1.11±0.36	1.22± 0.38	1.20± 0.22	1.24± 0.24
HT	Change in DBP(mmHg)	18.32± 5.40	14.78± 3.48	17.58± 4.46	16.48± 4.96
CPT	Change in DBP(mmHg)	18.22± 2.88	15.95± 4.38	17.23± 3.27	15.98± 6.39

Parasympathetic tests, the delta heart rate in deep breathing test and Valsalva ratio were increased in both groups however the increase in delta heart rate in deep breathing test in PG, CG.

Table 3: Between group differences of autonomic function tests

Test	Parameter	Mean% change from baseline	
		PG(n=40)	CG(n=40)
DBT	Delta heartrate(bpm)	32	16
VM	Valsalva ratio	8	4
HT	Change in DBP (mmHg)	18	6
CPT	Change in DBP (mmHg)	12	8

The increase in delta heart rate in deep breathing test in PG, CG were 32%, 16% and valsalva ratio in PG, CG were 8% and 4 respectively. The reduction diastolic blood pressure change in hand grip test was 18% in PG and 6% in CG. In cold pressor test, diastolic blood pressure was reduced by 12% in PG and 8% in CG.

Discussion

Hypothyroidism is defined as a clinical state resulting from insufficient secretion of thyroid hormone from thyroid gland due to some structural or functional impairment of thyroid hormone production. [16] Hypothyroidism is among the common endocrine diseases accounting for 2-15% of diseases in the general population. [17] In India, hypothyroidism is the second most metabolic disorder, next to diabetes mellitus. [18] Hypothyroidism in general is a prominent hypo metabolic state and sympathetic activities are anticipated to be less in this condition as sympathetic activation is a common manifestation of hyper metabolic state such as hyperthyroidism. However, Sympathovagal imbalance (SVI) due to increased sympathetic activity has been reported in hypothyroidism. [19,20] Studies have shown that SVI was associated with cardiovascular risk in hypothyroidism. [21] Cardiovascular functions are controlled by neural factors as well as others such as temperature, hormones, etc., Of these, neural

factors primarily concern the autonomic nervous system (ANS), which plays a major role in maintaining and regulating cardiac functions, e.g., systolic blood pressure (SBP), diastolic blood pressure (DBP) and heart rate (HR). Imbalances in these lead to cardiovascular disorders such as hypertension, ischemia, infarction, etc. Numerous studies indicate a strong association between compromised ANS (e.g., decreased vagal activity or increased sympathetic activity) and sudden and non-sudden cardiac death.[22]Cardiovascular disease is the leading cause of death for both men and women. [23] Lifestyle modifications are important factors in the treatment, prevention, and rehabilitation of cardiovascular disorders. [22]

The mean age was 26.44 ± 5.65 and 29.69 ± 7.43 in both groups respectively. The mean BMI was 24.58 ± 3.27 and 25.45 ± 4.26 in both groups respectively. The mean HR was 72.48 ± 7.87 and 74.36 ± 8.64 in both groups respectively. Parasympathetic tests, the delta heart rate in deep breathing test and Valsalva ratio were increased in both groups however the increase in delta heart rate in deep breathing test in PG, CG. The increase in delta heart rate in deep breathing test in PG, CG were 32%, 16% and valsalva ratio in PG, CG were 8% and 4 respectively. The reduction diastolic blood pressure change in hand grip test was 18% in PG and 6% in CG. In cold pressor test, diastolic blood pressure was reduced by 12% in PG and 8% in CG.Mechanisms by which yoga may have improved the parasympathetic dominance in PG in this study are speculative at this time. In addition to the proposed mechanism of yoga's ability to attenuate the derangement of autonomic nervous system, its effect on BP may be a benefit as well, yoga may also promote effective extraction of oxygen by peripheral tissues. When a muscle is stretched, the O2 consumption increases. Studies that examined the health-related aspects of yoga found that 8 week yoga training increased muscular strength by 31%, increased muscular endurance by 57%, increased flexibility by 88%, increased oxygen uptake by 7% and reduced cardiovascular risk in healthy adults. [24] This reduces the stress of myocardium. [25] Further, Slow pranayama breathing generates inhibitory signals and hyperpolarizing current within neural and non-neural tissue by mechanically stretching tissues during breath inhalation and retention. It is likely that inhibitory impulses in cooperation with hyper polarization current initiates the synchronization of neural elements in the central nervous system, peripheral nervous system, and surrounding tissues ultimately causing shifts in the autonomic balance towards parasympathetic dominance. [26]

As a technique, pranayama can assume rather complex forms of breathing. But the essence of the practice is slow and deep breathing. Slow breathing induces a generalized decrease in the excitatory pathways regulating respiratory and cardiovascular systems. As respiratory and cardiovascular systems have similar control mechanisms, alteration in one system will modify the functioning of the other. [27] During slow and deep breathing lung inflates to the maximum. This stimulates pulmonary stretch receptors which bring about withdrawal of sympathetic tone in skeletal muscle blood vessels leading to widespread vasodilatation and decrease in peripheral resistance and thus decrease diastolic blood pressure. [28] While practicing pranayama one concentrates on the act of breathing which removes attention from worries and "de-stresses" him. This stress-free state of mind evokes relaxed responses in which parasympathetic nerve activity overrides sympathetic activity. [29] Meditation by modifying the state of anxiety reduces stress-induced sympathetic over activity thereby decreasing arterial tone and peripheral resistance resulting in lowering of diastolic blood pressure and heart rate. [30] Regular practice of yoga has showed improvement in baroreflex sensitivity and decrease in the sympathetic tone thereby restoring blood pressure to normal level in patients of essential hypertension. [31,32]

Conclusion

The results of this study demonstrated that regular practice of pranayama in addition to standard medical therapy is more beneficial to improve cardiovascular autonomic function in hypothyroid patients. There is lack of consistency in the results of specific nostril yogic breathing and the mechanisms behind the effects of various pranayama. Hence, future studies are required in the field of pranayama to explore its precise effect with the underlying mechanisms.

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