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Effect of Short Term Pranayama on Cardiovascular Autonomic Function in Hypothyroidism

Kiran Kumar Chintala[1], Vedadhruthy Samudrala[2], Bandi Hari Krishna[3]

[1]Associate Professor, Department of Physiology, [2]MBBS student, Narayana Medical College, Nellore, Andhra Pradesh, India, [3]Assistant Professor, Department of Physiology, Sri Venkateswara Medical College, Tirupati, Andhra Pradesh, India

Abstract

Introduction: 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. Since Pranayama have proven to have beneficial and therapeutic effects, in normal and diseased states alike, we plan to study the effects of short term (1 month) practice of pranayama on cardiovascular autonomic function in hypothyroid patients.

Materials and Method: The present study was conducted on 50 volunteers' in between 18-30yrs of age. After obtaining ethical clearance from the institutional Human Ethics Committee. 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 was the criteria to exclude the patients.

Results: 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 were 31.13%, 16.39% and valsalva ratio in PG, CG were 8.11% and 4.23 respectively. The reduction diastolic blood pressure change in hand grip test was 19.52% in PG and 6.21% in CG. In cold pressor test, diastolic blood pressure was reduced by 12.34% in PG and 7.75% in CG.

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

Key words: *Pranayama, hypothyroidism, cardiac autonomic function.*

Introduction

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 [(1)]. Hypothyroidism is among the common endocrine diseases accounting for 2-15% of diseases in the general population [(2)] In India, hypothyroidism is the second most metabolic disorder, next to diabetes mellitus [(3)]. 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 [(4,5)]. Studies have shown that SVI was associated with cardiovascular risk in hypothyroidism [(6)].

Yoga, an ancient Indian science, aims to bring about functional harmony between body and mind through three main practices: Asanas, pranayama and meditation.

Corresponding author:
Dr. Bandi Hari Krishna,
Assistant Professor, Department of Physiology,
Sri Venkateswara Medical College, Tirupati, Andhra Pradesh, India. Email: hariphysiologist@gmail.com
Mobile: +91 9052792108.

Pranayama means control of 'prana'. "Prana" in Indian philosophy, refers to all forms of energy in the universe. Life force in an individual is symbolized by breathing. Breath is a dynamic bridge between the body and mind [7]. Growing evidences have claimed that yoga practices has therapeutic effect [8]. The beneficial effects of six weeks practice of different type of pranayama are well reported and have sound scientific basis [9] Breathing exercises for three weeks are reported to influence cardio respiratory and autonomic functions [10]. Since Pranayama have proven to have beneficial and therapeutic effects, in normal and diseased states alike, we plan to study the effects of short term (1 month) practice of pranayama on cardiovascular autonomic function in hypothyroid patients.

Materials and Method

The present study was conducted on 50 volunteers' in between 18-30yrs of age. After obtaining ethical clearance from the institutional Human Ethics Committee. 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 was 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 25 patients in each group.

Pranayama group (PG) (n=25) patients were diagnosed with hypothyroidism and given one month pranayama training in addition to standard medical treatment. The *Control group (CG) (n=25)* 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, Narayana Medical College (NMC), Nellore. 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^{o} C - 28^{o} 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 was done as per standard protocols published in the literature [11].

Deep breathing test: This is a test of parasympathetic reactivity [12]. The recording of heart rate was done from the ECG recordings on the ECG machine (Cardiowin 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 [12]. 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 [12]. 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 [12]. 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 pranayamaa 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

The baseline characteristics of the patients assigned to PG (n=22), CG (n=25) are given in Table 1.

Autonomic function tests: Within group differences of autonomic function tests were depicted in table 2. 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 were 31.13%, 16.39% and valsalva ratio in PG, CG were 8.11% and 4.23 respectively. The reduction diastolic blood pressure change in hand grip test was 19.52% in PG and 6.21% in CG. In cold pressor test, diastolic blood pressure was reduced by 12.34% in PG and 7.75% in CG (Table 3).

Table 1. Patient's demographics and baseline characteristics.

Sl. no	Parameter	PG (n=22)	CG (n=25)
1	Age (years)	25.48 ± 5.61	28.65 ± 7.45
2	BMI (kg/m^2)	25.56 ± 3.25	26.45 ± 4.25
3	HR (bpm)	71.45 ± 7.81	73.37 ± 8.67
4	SBP (mmHg)	107.56 ± 35.98	112.34 ± 29.94
5	DBP (mmHg)	73.45 ± 25.56	75.56 ± 24.56
6	Free - T3 (pg/ml)	1.50 ± 0.48	1.62 ± 0.59
7	Free - T4 (ng/dl)	0.68 ± 0.18	0.72 ± 0.21
8	TSH (uIU/mL))	96.37 ± 21.34	112.63 ± 42.56

Data presented are mean ± SD; BMI=Body mass index; HR=Heart rate; SBP=systolic blood pressure; DBP=Diastolic blood pressure; TSH=Thyroid stimulating hormone.

Table 2. Within group differences of autonomic function tests.

Sl. No	Test	Parameter	PG (n=22)		CG (n=25)	
			Time = 0 month	Time = 1 month	Time = 0 month	Time = 1 month
1	DBT	Delta heart rate (bpm)	11.34 ± 2.43	14.87 ± 3.23***	12.87 ± 3.91	14.98 ± 5.45*
2	VM	Valsalva ratio	1.11 ± 0.35	1.20 ± 0.32**	1.18 ± 0.19	1.23 ± 0.22*
3	HT	Change in DBP (mmHg)	18.34 ± 5.39	14.76 ± 3.42***	17.54 ± 4.45	16.45 ± 4.98
4	CPT	Change in DBP (mmHg)	18.23 ± 2.90	15.98 ± 4.35***	17.28 ± 3.24	15.94 ± 6.34*

*p<0.05, **p<0.01, ***p<0.001.

Data presented are mean ± SD; p <0.05 were considered statistically significant. DBP=Diastolic blood pressure; DBT: Deep breathing test; VM=Valsalva maneuver; HT=Hand grip test; CPT=Cold pressor test.

Table 3. Between group differences of autonomic function tests.

Sl. No	Test	Parameter	Mean % change from baseline	
			PG (n=22)	CG (n=25)
1	DBT	Delta heart rate (bpm)	31.13 *** ⇧	16.39 ⇧
2	VM	Valsalva ratio	8.11* ⇧	4.23 ⇧
3	HT	Change in DBP (mmHg)	19.52 *** ⇩	6.21 ⇩
4	CPT	Change in DBP (mmHg)	12.34 ** ⇩	7.75 ⇩

*p<0.05, **p<0.01, ***p<0.001

*p<0.05, **p<0.01, ***p<0.001

Data presented are mean ± SD; p <0.05 were considered statistically significant. DBP=Diastolic blood pressure; DBT: Deep breathing test; VM=Valsalva maneuver; HT=Hand grip test; CPT=Cold pressor test.

Discussion

Yoga, an ancient culture of Indian heritage, when adopted as a way of life is claimed to bestow the practitioner with ideal physical, mental, intellectual, and spiritual health. As a result, yoga is fast emerging as a new discipline for integrating mind and body into harmony [13]. Asana (postures) and pranayama (breathing exercises) in the form of yoga may be beneficial in the rehabilitation of cardiovascular diseases [14]. Studies have demonstrated the effect of yoga on improvement of lipid profiles [15], blood pressure [16], psychological well-being, and even regression of atherosclerosis when combined with dietary and other lifestyle modifications [6,7], left ventricle ejection fraction in coronary heart patients [19], improves quality of life, functional capacity [20] cardiac function [21] heart rate, blood pressure, rate pressure product, cardiac autonomic function [22] oxidative stress and inflammation in heart failure [23]. Despite of the widespread appeal of yoga, data on effect pranayama practice on cardiovascular autonomic functions were limited.

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 O_2 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 [21]. 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[25].

Limitations of the study is Being a part of short term research project, time was the biggest limiting factor. Due to the shortage of time we were unable to study in more num ber of patients. Further, the autonomic activity measured in this may not be very accurate. Therefore, future studies should include more accurate methods of assessment of sympathetic activity such as estimation of plasma catecholamine or metabolites of catecholamine in urine like Vanillylmandelic acid (VMA), Metanephrine, and Normetanephrine.

Conclusion

The results of this study demonstrate that regular practice of pranayama in addition to standard medical

therapy is more beneficial to improve cardiovascular autonomic function in hypothyroid patients.

Conflicts of Interest: None.

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