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Study of Autonomic Nervous Functions in People Practicing Yoga

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Abstract: ***Introduction: The stressful present day life leads to increased likelihood of lethal cardiovascular diseases and signs of either increased sympathetic or reduced vagal activity. Autonomic control of the heart plays an important role in cardiac mortality. Yoga exercises strengthen and increase tone of weak muscles and help with conscious control over autonomic functions of the body. Aims & objectives: To study and compare the effect of regular yoga (pranayamas & meditation).on the activity of autonomic nervous system. Material and Methods – Fifty cases(volunteers) and 50 controls were studied with respect to their autonomic functions. The findings were tabulated and subjected to statistical analysis. Results: Amongst the sympathetic nervous system parameters, statistically significant difference existed between cases and controls for the RHR, RDBP, ODBP, CSBP and CDBP (decrease); whereas out of the parasympathetic nervous system parameters tested, statistically significant difference existed between the two groups for RHR and 30:15 ratio. Discussion: – Yoga asanas reduce sympathetic tone and increase parasympathetic tone. Decreased sympathetic tone caused by yogasanas leads to decreased peripheral resistance in blood vessels and leads to fall in blood pressure***

Keywords: ans, sympathetic, parasympathetic dominance, yoga, resting heart rate, stress response

1. Introduction

During the last few decades, researchers have recognized the significance of the relationship between autonomic nervous system and cardiovascular mortality. Studies have shown that there is an association between an increased likelihood of lethal arrhythmias and signs of either increased sympathetic or reduced vagal activity. This has encouraged the development of quantitative markers of functions of ANS. (1)

Autonomic control of the heart plays an important role in cardiac mortality. One of the main characteristics of the autonomic control to heart is constant modification of heart rate on beat to beat basis. The periodic fluctuations of heart rate are indicative of the relative contributions of sympathetic and parasympathetic components of ANS to the heart. (2)

The modern day diseases which are directly related to our way of life which is full of stress, more and more people turn towards yoga and relaxation techniques(3)

Yoga is a state which is defined as a high level of consciousness achieved through a fully rested and relaxed body and a fully awake and relaxed mind.(4) The effect of yoga on body functions may be related to decreased arousal and a decreased sympathetic nervous system activity. (5) Yoga includes meditation, relaxation, control of breathing, and various Physical postures (asanas). Regular practice of yoga establishes natural harmony and functional balance between various organ systems, leading to better health and a feeling of well-being. Yoga exercises strengthen and increase tone of weak muscles and help with conscious control over autonomic functions of the body.(6)

Although few studies have been done in the past to study autonomic nervous function in people involved with specific breathing exercises [7,8] and few asanas [9] but were performed for a very short duration. And hence this elaborate work was taken up to see how yoga affects people who are practicing it for more than 5 years together.

2. Aims and Objectives

The objective of the present work was to study and compare the effect of regular yoga (pranayamas & meditation).on the activity of autonomic nervous system.

3. Materials and Methods

The present study was conducted on 50 volunteers in age group 30 to 60 years who were performing regular yoga asanas and relaxation techniques for at least 5(five) years. The subjects included both males (42) and females (8). A control group of similar age group was studied who were not performing yoga asanas and relaxation techniques or were not engaged with any other type of physical exercises. The control group comprised of both genders – males (38) and females (12). A brief history was taken and general and systemic examinations were performed and healthy subjects were recruited based on inclusion and exclusion criteria.

Inclusion Criteria –

- Males and females in age group of 30 to 60 years,
- Non smokers and non alcoholics,
- Practicing yogic exercises and meditation (for test group),
- Not engaged in any sort of physical exercise and yogic techniques (for control group).

Exclusion Criteria

- Any acute illness,
- Diabetes mellitus,
- Antihypertensive medication or any medication interfering with ANS,
- History of breathlessness, chest pain, orthoponea,
- Any physical disability like arthritis.

Before the commencement of the study, ethical committee approval was obtained from the institutional ethical committee. The study was performed in the very same environment where the subjects were performing yogic kriyas [Yogadas Satsang Center, Rajahmundry]. The subjects were interviewed the previous day and the detailed description of the protocol was explained to them. An informed consent was obtained from subjects as well as controls.

Experiments were conducted on Sundays between 10:00 am and 12:00 noon. The following non invasive tests were carried out – Blood pressure was measured using OMRON automatic blood pressure monitor HEM-7111, Omron Healthcare Ltd, Singapore. For orthostasis test, normal Sphygmomanometer was used to measure blood pressure readings.

Heart rate and ECG were recorded by CARDIART 108T/MK-VI ECG machine, BPL Ltd. Recordings were carried out with lead II. Both the study groups underwent the following tests For Sympathetic activity

1) RESTING HEART RATE: this was calculated from the ECG using Standard Limb lead II, minimum heart rate during supine position was taken to be as resting heart rate.
2) BLOOD PRESSURE: reading during supine position was taken to be as resting blood pressure.
3) ORTHOSTASIS: blood pressure was recorded when the subjects were supine and upon immediate standing the fall in B.P was recorded. Orthostasis was determined by finding the difference between supine B.P and immediate standing B.P
4) COLD PRESSOR TEST: Resting B.P was recorded with the subject sitting comfortably. Subject was then asked to immerse his/her hand in cold water (temperature at 4-6^{0}C) throughout the procedure B.P measurements were made from the other arm at 30 second intervals for a period of 2 minutes after which the subject was asked to remove his/her hand. Maximum increases in systolic and diastolic pressures were determined.
5) Corrected QT interval (QTc): QT interval will be measured from ECG and then standardized by converting it to QTc. For this Bazett's formula was used.
6) QTc = QT INTERVEL/$\sqrt{R-Rinterval.}$ QT interval and RR interval will be expressed in seconds.
7) HAND GRIP TEST: B.P was recorded with the help of automated blood pressure monitor. The subjects were instructed to remain seated throughout. Resting B.P was recorded 3 times in each subject. The B.P response to static exercise was studied by asking the subjects to apply pressure on standardized handgrip dynamometer at 30% of the maximum voluntary contraction for 3 minutes. B.P. was recorded simultaneously on the non-exercising arm. This was repeated 3 times with an interval of rest between the episode. The change was taken to be as the difference between mean of B.P during dynamometry and that during rest for both systolic (SBP) and diastolic B.P(DBP)

For assessing parasympathetic system activity:

1) RESTING HEART RATE: this was calculated from the ECG using Standard Limb lead II, minimum heart rate during supine position was taken to be as resting heart rate.
2) STANDING TO LYING RATIO: It was calculated as the ratio of longest R-R interval during 5 beats before lying down to shortest R-R interval after lying down.
3) 30:15 RATIO:: It is the ratio between the R-R interval at beats 30 and 15 of ECG recorded immediately upon standing
4) Valsalva Ratio: Subjects were asked to exhale into the mouth piece connected to a mercury manometer and to maintain the expiratory pressure at 40 mm of hg for 15 sec. During this maneuver and 45sec afterwards, ECG was recorded. The valsalva ratio was calculated between the maximum R-R interval (after release of strain) and minimum R-R interval (During strain)

Student's unpaired t test was applied for statistical analysis. The analysis was performed using SPSS (Software Package for Social Studies) Version 13

4. Observation and Results

Table 1: Anthropometric Profile in Cases And Controls

Parameter	*Group*	*Mean*	*St Dev*	*P value*	*Significance*
Age	Cases	40.9104	11.82295	0.699	Not Significant
	Controls	40.95745	9.064881		
Height	Cases	1.585303	0.16528	0.694	Not Significant
	Controls	1.618936	0.097852		
Weight	Cases	65.02331	15.90634	0.118	Not Significant
	Controls	62.91489	12.03406		
BMI	Cases	25.5217	4.558855	0.483	Not Significant
	Controls	23.7114	3.73187		
WC	Cases	76.31722	17.5108	0.726	Not Significant
	Controls	77.65957	9.794134		
HC	Cases	95.44269	21.99413	0.248	Not Significant
	Controls	94.80851	9.02566		
WHR	Cases	0.805786	0.096716	0.483	Not Significant
	Controls	0.817867	0.073367		

BMI – Body Mass Index, WC – Waist Circumference, HC – Hip Circumference, WHR – Waist to Hip ratio
Table 1 depicts the anthropometric profile of study (Cases) and control population where none of the parameters showed statistically significant difference.

RHR – Resting heart rate, RSBP - Resting systolic blood pressure, RDBP - Resting diastolic blood pressure, OSBP – orthostatic systolic blood pressure, ODBP – Orthostatic diastolic blood pressure, CSBP – Cold pressure systolic blood pressure, CDBP – Co;d pressure diastolic blood pressure, CQT – Corrected 'QT' interval, HGSBP – Hand grip systolic blood pressure, HGDBP – Hand grip diastolic blood pressure, YP – Yoga Performers (Cases), NYP – Non Yoga Performers (Controls).

Table 2: Comparison of Sympathetic System Activity in Cases and Controls

Parameter	*Group*	*Mean*	*St Dev*	*P Value*	*Significance*
RHR	YP	72.04	10.94	0.010	Significant
	NYP	77.45	9.79		
RSBP	YP	116.10	12.44	0.480	Not Significant
	NYP	117.98	14.05		
RDBP	YP	66.74	11.20	0.013	Significant
	NYP	71.84	11.03		
OSBP	YP	10.46	5.34	0.799	Not Significant
	NYP	10.76	6.37		
ODBP	YP	3.54	5.40	0.009	Significant
	NYP	6.34	5.13		
CSBP	YP	19.98	11.60	0.050	Significant
	NYP	24.81	12.73		
CDBP	YP	14.60	9.20	0.035	Significant
	NYP	18.82	10.55		
CQT	YP	0.39	0.02	0.381	Not Significant
	NYP	0.40	0.02		
HGSBP	YP	14.65	9.77	0.245	Not Significant
	NYP	12.53	8.29		
HGDBP	YP	8.49	6.45	0.125	Not Significant
	NYP	10.36	5.59		

Table 2 shows the comparison of sympathetic nervous system activity in cases and controls. Statistically significant difference existed between cases and controls for the following parameters - RHR, RDBP, ODBP, CSBP and CDBP. For other parameters the difference failed to gain any statistical significance.

Table 3: Comparison of Parasympathetic System Activity of Yoga and Non Yoga Practitioners

Parameter	*Group*	*Mean*	*St Dev*	*P Value*	*Significance*
RHR	YP	72.04	10.94	0.010	Significant
	NYP	77.45	9.79		
SLR	YP	0.97	0.12	0.065	Not Significant
	NYP	1.01	0.11		
30:15 R	YP	0.99	0.08	0.036	Significant
	NYP	0.96	0.07		
V R	YP	1.47	0.37	0.303	Not Significant
	NYP	1.54	0.30		

RHR – Resting Heart Rate, SLR – Standing to Lying down Ratio, 30:15 R – Thirty to Fifteen Ratio. VR – Valsalva Ratio, YP – Yoga Practitioners (Cases), NYP – Non Yoga Practitioners (Controls).

Table 3 demonstrates the comparison of parasympathetic system activity between cases and controls. As can be seen from the table, statistically significant difference existed between the two groups for RHR and 30:15 ratio; whereas the difference failed to reach the statistically significant levels in the other three parameters.

5. Discussion

The most significant outcome of the present study can be mentioned as –

Amongst the sympathetic nervous system parameters, statistically significant difference existed between cases and controls for the RHR, RDBP, ODBP, CSBP and CDBP (decrease); whereas out of the parasympathetic nervous system parameters tested, statistically significant difference existed between the two groups for RHR and 30:15 ratio. Although difference was also observed between the cases and controls for other parameters studied, but failed to gain statistical significance.

In general, the observed facts suggest that in people practicing yoga the balance between the two parts of the autonomic nervous system improves. It appears that the sympathetic tone is reduced and the parasympathetic tone is increased producing achievable outcome.

The results found in our study are in conformity with some findings of the previous workers like Bharashankar et al(3). The results of present study show a significant lowering of resting heart rate (RHR) by yoga and relaxation techniques. Similar results have been noticed by Murugesan R et al(13), Sundar S et al and Sangita Jain et al(14).

Yoga and relaxation techniques gradually reduce sympathetic dominance resulting in a decrease of pulse rate. Further yoga and relaxation practices lead to reduction of stress induced sympathetic over activity by overcoming stress itself, leading to lowering of RHR.(11)

In the present study, both the systolic and diastolic blood pressures are less in yoga practitioners. The difference in diastolic blood pressure value is statistically significant whereas the systolic blood pressure difference doesn't gain the same. The values are characteristically lower in people practicing yoga and relaxation techniques than those who do not practice them. This is in conformity with the observations by Sangita Jain et al(14), Sundar S et al(11), Telles S et al (10)and Murugesan et a(13)l.

As mentioned earlier, the sympathetic dominance gradually diminishes with yoga and relaxation practices resulting in better balance between sympathetic and parasympathetic nervous activities. Moreover, decreased sympathetic tone caused by yogasanas leads to decreased peripheral resistance in blood vessels and leads to fall in blood pressure as is also observed in the this study.

Environmental conditions and variety of behavioral factors such as stress, anxiety, affective and attitudinal dispositions of the individual influence the cardiovascular responses. Yogic exercise involves physical, mental and spiritual task in a comprehensive manner. It brings about the behavioral changes. Yoga in long duration affects hypothalamus and brings about decrease in the systolic and diastolic BP through its influence on vasomotor centre, which leads to reduction in sympathetic tone and peripheral resistance (3).

6. Limitations

Although the present study could achieve a few significant findings but small sample size, limited time span and less number of female cases and controls were a few limitations which need further detailed study for better analysis so also to see the gender differences affecting the ANS in yoga nad non yoga practitioners.

7. Conclusion

In today's highly competitive world, we are 24×7 exposed to persistent stress. Although stress response is extremely useful for improving performance and survival mechanism, it is equally detrimental if invoked when not needed or chronically invoked and is associated with cardiovascular mortatlity and morbidity. For a healthier cardiovascular system and improved longevity, through repeated practice of yoga and relaxation techniques as well as life style modifications such as diet and behaviour, a balance can be achieved between sympathetic and parasympathetic division of ANS.

8. Summary

Fifty yoga practictioners between the age group of 30 to 60 years were investigated for autonomic functions(sympathetic as well as parasympathetic activity) using standard tests. In previous studies done to evaluate ANS activity only few tests were used either sympathetic or parasympathetic. In the present study 6 tests for the evaluation of sympathetic nervous system were done – RHR,RSBP, RDBP, Orthostasis, QTC, Sustained hand grip test and Cold pressure test ; four tests for parasympathetic evaluation namely RGR, SL Ratio< 30:15 ratio and Valsalva maneouver. A control group of 50 healthy subjects was also tested for the same who were not engaged in any physical exercise or yoga. The comparative study between cases and controls showed a significant decrease in sympathetic tone as suggested by less values of RHR, RSBP, RDBP and Cold pressor response in cases with simultaneous increase in parasympathetic activity as seen with significant decrease in RHR and 30:15 ratio.

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