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EFFECT OF NADI SHODHAN PRANAYAMA ON CARDIOVASCULAR FUNCTIONS

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ABSTRACT

BACKGROUND

Modern man is the victim of stress and stress related disorders which threaten to disrupt his life totally. Being holistic in its approach, Yoga offers the best way out of this 'whirlpool of stress.

MATERIAL AND METHODS

30 normal subjects in the age group of 18-40 years, subjected to Nadi shuddi Pranayam for 10 minutes in Department of Physiology, Santosh Medical College, Ghaziabad.

RESULTS

Pranayama reduced the sympathetic activity and increased the parasympathetic activity, leading to improvement in vagal tone as shown by significant decrease in heart rate, systolic blood pressure, Rate Pressure Product. Along with this, these acts of concentration remove his attention from worldly worries and de-stress him/her. This stress free state of mind evokes relaxed response.

KEYWORDS

Nadi Suddhi Pranayama, Hear Rate, Blood Pressure, RPP, ECG.

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INTRODUCTION

Modern man is the victim of stress and stress related disorders which threaten to disrupt his life totally. Being holistic in its approach, Yoga offers the best way out of this 'whirlpool of stress. Yogic lifestyle, Yogic diet, Yogic attitudes and various Yogic practices help man to strengthen his body and mind and develop positive health, enabling him to withstand stress by normalizing the perception of stress, optimising the reaction to it and by effectively releasing the pent-up stress through various Yogic practices.⁽¹⁾ Yoga is a great gift that has its origin in Indian civilization. On one side it is a science to convert ordinary person into a divine personality and on the other hand it provides ways for salvation. It is a process of total health. Yoga has sound scientific basis and an ideal tool for improving health of our masses. Scientific studies and laboratories have shown that the practice of Yoga has beneficial effect on our physiological functions¹. However, to put Yoga on a firm scientific pedestal and popularize it among the general public and our college students in particular, and to further evaluate the effectiveness of Yogic techniques we planned to undertake the systematic study on cardiovascular functions with help of ECG, pulse oximeter and sphygmomanometer in normal subjects.

MATERIAL AND METHODS

30 normal subjects in the age group of 18-40 years, subjected

to Nadi shuddi Pranayam for 10 minutes in Department Of Physiology, Santosh Medical College, Ghaziabad. Subjects having any medical history of malignancy, cardiovascular or respiratory illness e.g Asthma, hay fever, sinusitis, emphysema, bronchitis, High Blood pressure were excluded from the study.

The following Parameters were measured before & after Pranayama

- Weight (In Kg) & Height (In meter) measured using Digital Weighing scale & measuring tape.
- B.M.I. (Height & Weight) calculated using Quetelet's Index.

$$\text{BMI (Quetelet)} = \frac{\text{weight (kg)}}{\text{length}^2 (\text{m}^2)}$$

- HR (Heart rate) to be measured by Pulse Oximeter.
- Blood Pressure was measured by standard mercury sphygmomanometer.
- Systolic blood pressure.
- Diastolic blood pressure.
- Rate Pressure Product (RPP) was calculated as:
R.P.P. = Systolic B.P. x Heart Rate
- ECG was looked for sQRS & QTc interval.

In this study the subjects were explained in detail about the study & written consent was taken.

Nadishuddi Pranayama has been described below Technique

It was instructed to subjects to block the right nostril with the right thumb with mild pressure and left nostril with the right middle and ring fingers. The rest two fingers were free and the palm stayed above the nose. Subjects began, closing the right

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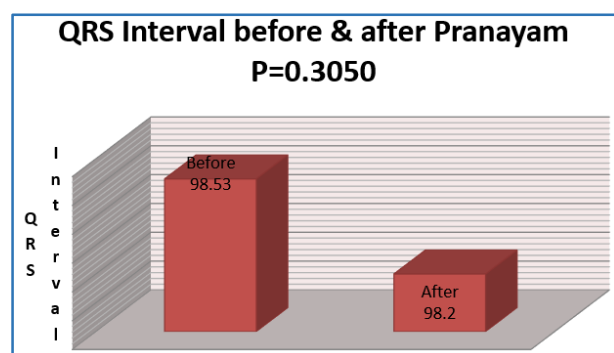
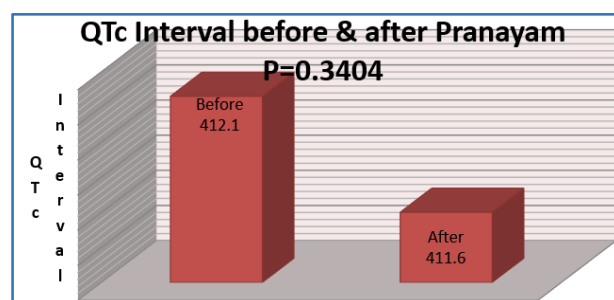
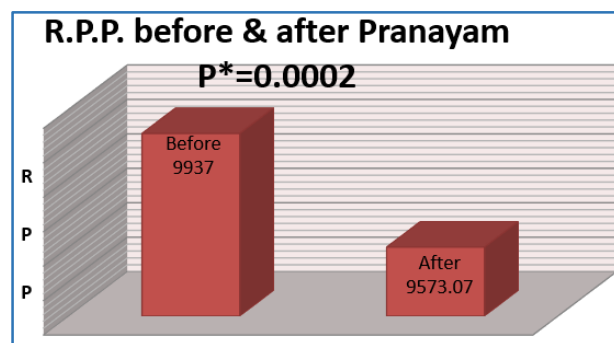
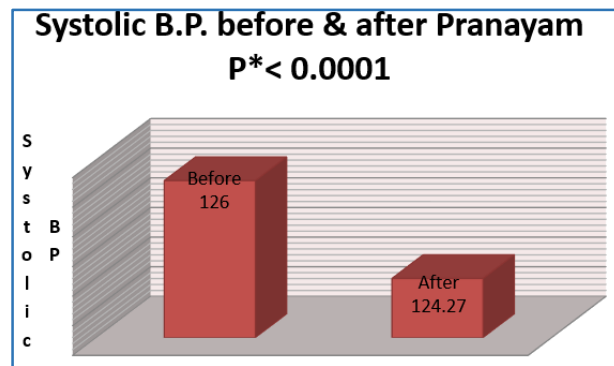
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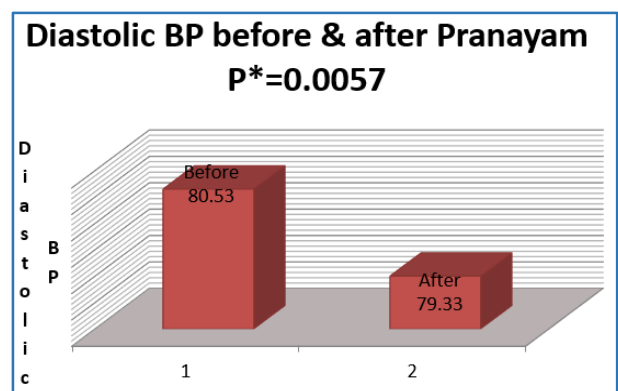
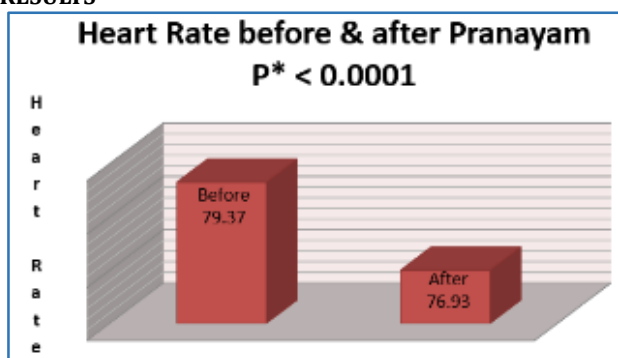
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nostril with the thumb, inhaling from the left nostril. After inhalation, closing the left nostril with the middle and the ring finger, lifting the thumb off the right nostril, and exhalation is done. Then inhaling with the right and exhaling with the left nostril. This made one round. The second round begins with the right nostril inhalation, and so on.

Parameters		Before Pranayama	After Pranayama
HR (Beats/min)	Mean	79.37	76.93
	S.D.	9.92	9.25
	P value	<0.0001	
	Significance	*Significant	
SBP (mm of Hg)	Mean	126	124.27
	S.D.	4.43	3.89
	P value	<0.0001	
	Significance	*Significant	
DBP (mm of Hg)	Mean	80.53	80.47
	S.D.	2.34	1.36
	P value	0.8012	
	Significance	Non-Significant	
RPP	Mean	9937	9573.07
	S.D.	1469.24	1312.61
	P value	0.0002	
	Significance	*Significant	
PR (msec.)	Mean	117.2	118.53
	S.D.	16.08	16.24
	P value	0.0023	
	Significance	*Significant	
QTc (msec.)	Mean	412.1	411.6
	S.D.	12.4	12.6
	P value	0.3404	
	Significance	Non-Significant	
QRS (msec.)	Mean	98.53	98.2
	S.D.	13.53	13.54
	P value	0.3050	
	Significance	Non-Significant	



RESULTS



DISCUSSION

Pranayama effects balance between Ida and Pingla nadi i.e. parasympathetic and sympathetic activity (2). In the present study the fall in HR, SBP and RPP after 10 minutes of pranayama among our study subjects were noted.

Heart Rate

Our study showed significant decrease in heart rate in Pranayama Group A (Case) after 10 minutes of Pranayama.

Pranayamic breathing has been shown to alter the autonomic activity. T Raghuraj et al(3) have reported that slow pranayama (Nadishuddhi) increases parasympathetic activity whereas fast pranayama (Kapalbhati) increases the

sympathetic activity. Subbalakshmi et al⁽⁴⁾ observed statistically significant reduction in heart rate after Nadishuddhi.

Udupa et al⁽⁵⁾ and K Upadhyay Dhungel et al⁽⁶⁾ showed significant reduction in pulse rate after short term yoga training. Bal Baljinder et al⁽⁷⁾ and Vinayak and Anil⁽⁸⁾ also showed statistically significant reduction in pulse rate after regular practice of yoga and it was attributed to increased vagal tone and decreased sympathetic activity.

Pal et al⁽⁹⁾ study results coincided with our findings. It showed slow breathing produced significant decrease in heart rate. Singh et al⁽¹⁰⁾ too showed significant decline in heart rate after Nadishuddhi pranayama for 6 weeks. Indla Devsana et al⁽¹¹⁾ showed significant reduction in the heart rate in the subjects practicing yoga.

Systolic Blood Pressure

We observed significant decrease in systolic blood pressure in our study. Significant decline in systolic blood pressure in our study is in accordance with findings of Singh et al⁽¹⁰⁾. A Singh et al⁽¹²⁾ and Dandekar Pradnya Deepak⁽¹³⁾ The former studies suggested that significant change in the results after yoga might be due to immediate effect on peripheral vascular resistance to reduce heart rate.

Dandekar Pradnya Deepak⁽¹³⁾ attributed the decrease in systolic blood pressure to balance in autonomic nervous system by Anulom vilom pranayama and also suggested that short term practice of Anulom vilom could get better parasympathetic control over heart.

Yoga practice increases vagal tone, decreases the work load on heart leading to decrease in cardiac output and hence systolic blood pressure and it also affects the hypothalamus directly and brings about decrease in blood pressure (In both systolic and diastolic blood pressure) through its influence on vasomotor centre which leads to reduction in sympathetic tone and peripheral resistance. ^(8, 11)

Diastolic Blood Pressure

Our study reported non-significant decline of diastolic blood pressure and the findings are in accordance with study of Singh et al⁽¹⁰⁾ and Dandekar Pradnya Deepak⁽¹³⁾

Diastolic blood pressure mainly varies with the degree of peripheral resistance and heart rate.⁽¹⁴⁾ Non significant change in diastolic blood pressure observed in the present study suggested that Nadi-shodhan Pranayama might have no any long term effect on peripheral vascular resistance or it has some roles, but is obscured by a slow heart rate but it may need practice for longer periods.⁽¹⁵⁾

Rate Pressure Product

Rate pressure product.⁽¹⁶⁾ also known as Cardiovascular Product or Double Product, is used in cardiology and exercise physiology to determine the myocardial workload.

Rate Pressure Product (RPP) = Heart Rate (HR) x Systolic Blood Pressure (SBP) with the units for the Heart Rate being beats per minute and for the Blood Pressure mmHg.

Rate pressure product is a measure of the stress put on the cardiac muscle based on the number of times it needs to beat per minute (HR) and the arterial blood pressure that it is pumping against (SBP). It will be a direct indication of the energy demand of the heart and thus a good measure of the energy consumption of the heart.

Our study reported significant decrease in Rate Pressure Product indicating a significant decrease in Myocardial Oxygen demand after 10 minutes of Nadishuddhi Pranayama .RPP is an indicator of myocardial O₂ consumption and load on the heart, thereby signifying a lowering of strain on the heart. RPP provides a simple measure of Heart Rate Variability in hypertensive patients and is a surrogate marker in situations where HRV analysis is not available. Hence, the reduction in RPP following NS implies better autonomic regulation of the heart in our subjects with decreased O₂ consumption and load. This can be attributed to either an overall increase of parasympathetic tone and/or a reduction in sympathetic tone.

QTc Interval

The QT interval on the surface ECG is measured from the beginning of the QRS complex to the end of the T wave. Thus, it is the electrocardiographic manifestation of ventricular depolarization and repolarization. This electrical activity of the heart is mediated through channels, complex molecular structures within the myocardial cell membrane that regulate the flow of ions in and out of cardiac cells. The rapid inflow of positively charged ions (Sodium and calcium) results in normal myocardial depolarization. When this inflow is exceeded by outflow of potassium ions, myocardial repolarization occurs. Malfunction of ion channels leads to an intracellular excess of positively charged ions by way of an inadequate outflow of potassium ions or excess inflow of sodium ions. This intracellular excess of positively charged ions extends ventricular repolarization and results in QT interval prolongation.

Automatic ECG machines have inbuilt algorithm to calculate QTc quite accurately avoiding the inter & intra-observer variation in it.

This study could not notice any significant change in QTc interval.

QRS Interval

Not any significant change in QRS

The following reasons may be possible for the significant decline in heart rate, systolic blood pressure, Rate Pressure Product & significant increase in Blood pressure and pulse rate related with cardiovascular system is controlled by autonomic nervous system. In Nadishuddhi pranayama respiration is slower, deeper and more prolonged with greater duration of expiration. By reducing inspiration and lengthening expiration, the vagal nerve traffic is more strengthened. This improves the cardiac vagal modulation and increases vagal tone. Thus, heart rate is reduced.

Pranayama increases cardiac output, decreases hepatic renal blood flow and increases peripheral vessels blood flow.⁽¹⁵⁾ Nadishuddhi brings a balance in autonomic nervous system.⁽⁶⁾Yoga practitioner not only tries to breathe, but at the same time, also tries to keep his attention on act of breathing, leading to concentration. These acts of concentration remove his attention from worldly worries and de-stress him. In this relaxed state, parasympathetic activity overrides sympathetic activity.⁽⁵⁾

Lung inflation has been known to decrease systemic vascular resistance. This response is initiated by pulmonary stretch receptors which bring about withdrawal of sympathetic tone in skeletal muscle blood vessels leading to wide spread vasodilatation thus bringing up decrease in

peripheral resistance.⁽¹⁵⁾ It has also been explained that in slow pranayamas, gradual and graded increase in lung volume and rib cage increases nerve traffic from thoracic cage proprioceptors that strengthens vagal tone through the central limbic-hypothalamic influence of the sensory projections to thalamus and cortex.⁽¹⁷⁾ It has been observed that such pranayamas augment cerebral blood flow and oxygenation that improves neuronal activities of the brain centers including those present in the limbic areas, hypothalamus, and medulla and improve sympathovagal outflow.⁽¹⁸⁾ During Pranayama senses are disconnected from brain, as in sleep, as life force or prana supplying them is cut off consciously. Distraction of smell, taste, hearing etc is prevented from reaching the brain leading to state of concentration & calmness. Venous blood is converted to oxygenated blood in Nadi Shuddi pranayama. Heart function is subserved by deep breathing. It gives extraordinary rest to heart & heart rate decreases.^(19,20,21)

SUMMARY AND CONCLUSION

The present study revealed that Pranayama reduced the sympathetic activity and increased the parasympathetic activity, leading to improvement in vagal tone as shown by decrease in heart rate.⁽⁵⁾ Along with this, these acts of concentration remove his attention from worldly worries and de-stress him/her. This stress free state of mind evokes relaxed response.⁽¹⁴⁾ In this relaxed state, parasympathetic nerve activity overrides sympathetic nerve activity.⁽³⁾ Therefore, the significant decline in basal heart rate, systolic blood pressure, Rate Pressure Product could be largely due to better parasympathetic control over the heart. Making Yoga a part and parcel of our day to day routine may condition the cardiovascular system leading to prevention and delayed onset of diseases like Hypertension, Coronary Artery Disease, Arrhythmias & other cardiovascular diseases. In light of these facts, it can be said that Yogic practices can be adopted as a potent way of maintaining cardiovascular health and fitness.

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