ID: JCDR/2012/3912:2140

Original Article

Physiology Section

Modulation of Cardiaovascular Response after Ujjayi Pranayama and Shavasana Training in Normal Human Volunteers

G.V.LATHADEVI , T.UMA MAHESWARI, R.NAGASHREE

ABSTRACT

Background and objectives: Pranayama (breathing exercise) can produce different physiological responses in healthy individuals. The effect of the non-conventional yogic intervention, ujjayi pranayama and shavasana in modulating the cardiovascular functions, were assessed in 60 healthy male adults.

Methods : 60 subjects were divided into two groups of 30 each (Group I and GroupII). Group I was given training in ujjayi pranayama and shavasana. Ujjayi pranayama is a slow deep inspiration followed by slow deep expiration, with breathholding in between. Shavasana- the patients lie supine, with all the muscles being totally relaxed. The following cardiovascular parameters like the heart rate (HR), systolic blood pressure (SP) and diastolic blood pressure (DP) were recorded. The PP (pulse pressure) mean arterial pressure (MAP) and the rate pressure product (RPP) were calculated. All the above parameters were measured before and after 6 weeks of ujjayi pranayama and shavasana. Group II served the control group and the results which were obtained was analyzed statistically.

Results: Ujjayi pranayama and shavasana produced a significant decrease in the HR, SP, DP, PP, MAP and RPP after 6 weeks of yoga training, with a p value of < 0.0001. No significant changes were observed in the Group II subjects.

Interpretation and conclusion: A short term pranayama practice for six weeks improved the para-sympathetic (vagal) functions which suppressed the sympathetic activity, thus denoting the para-sympathetic dominance on the cardiovascular system. This breathing exercise can also relieve stress, and it can also be practiced by hypertensive patients as a complimentary therapy with drug therapy.

Key Words: Ujjayi pranayama, Shavasana, Cardiovascular Parameters, Rate pressure product

INTRODUCTION

Pranayama is a part of the ancient Indian art of yoga, which is the fourth step of ashtanga yoga. Pranayama is a controlled and conscious breathing exercise which involves mental concentration. Man is subjected to stress during the day to day activities and stress related problems like essential hypertension, angina, psychoneurosis, gastric ulcer, asthma and insomnia very commonly occur. The cardiac functions are controlled primarily by the vagal and the sympathetic tones. Abnormalities of the sympathovagal balance, added to the stress, lead to major cardiovascular dysfunctions like ischaemic heart diseases and hypertension.

In the ancient Indian vedic literature, it has been indicated that breathing with consciousness improves the mental and physical health. There are different types of pranayamas that are specially advised for the treatment of various disorders.There are evidences that pranayama training produces a deep psychosomatic relaxation [1,2] and an increase in the cardiorespiratory efficiency [3], and the autonomic functions [4]. Raghuraj et al., have studied the acute effect of fast and slow pranayamas on the heart rate variability [5], while Tells and Desiraju have demonstrated the heart rate changes during the performance of different pranayamas [6]. Patel and North also reported a decrease in the blood pressure in hypertensive patients who were trained in the yoga relaxation methods [7]. Pramnik T et al., found a decrease in the heart rate and the blood pressure after the bhramari and the bhastrika pranayamas [8,9].

The rate pressure product (RPP) is a reliable index of the myocardial oxygen consumption and the cardiac work and it correlates well with the myocardial oxygen consumption of normal subjects as well as of patients with angina pectoris [10]. Pranayamas may influence the RPP by altering the preload and/or the afterload. However, there is paucity of literature on the effect of ujjayi pranayama and shavasana on the heart rate, blood pressure and the RPP in normal human volunteers. In view of this, the present work was planned, to study the effect of pranayama training on cardiovascular responses like the heart rate, blood pressure, pulse pressure, mean arterial pressure and the rate pressure product.

MATERIALS AND METHODS

The present study was conducted in the Department of Physiology, PSG Institute of Medical Sciences and Research (PSGIMS R), Coimbatore, India. Prior to the commencement of the study, permission from the institute research council and the institute ethics committee were obtained.

SUBJECTS

This study was carried out on 60 healthy male subjects who were 20-50 years of age. Subjects who had a history of active sports training or yoga practice and medical illnesses such as diabetes, hypertension, bronchial asthma and ischaemic heart diseases were excluded from the study. The nature of the study

was explained to all the subjects and a written informed consent was obtained from all of them. The subjects were divided into 2 groups of 30 each.

Group I consisted of men (n=30) who practised ujjayi pranayama and shavasana for 6 weeks. Group II who served as the controls (n=30) did not practice pranayama and shavasana .

The control group was incorporated to exclude factors other than those of the experimental intervention.

RECORDINGS

A few days before the actual recording, the subjects were familiarized with the laboratory environment and the experimental procedure. On the day of the test, the subjects reported to our laboratory in the morning, two hours after a light breakfast. The laboratory temperature was maintained at 25+1^{0}C. After 15 minutes of supine rest, the ECG were recorded in lead II by using BIOPAC systems, Inc, MANB5L3S, student version. The heart rate was calculated from the mean RR interval.

The blood pressure was recorded from the right brachial artery by using a sphygmomanometer. Three BP recordings were taken at 5-minute intervals and the lowest of these values was included for the calculation. The pulse pressure (PP = SP – DP), the mean arterial pressure (MAP=DP+PP/3).

The rate pressure product (RPP = HR x SP)/100, were calculated for each reading. All the above parameters were measured before and after six weeks of the ujjayi pranayama and shavasana training in the Group I subjects. All the parameters were recorded initially and after six weeks in the Group II control subjects also.

BREATHING EXERCISES

Ujjayi Pranayama – The subjects were asked to sit in a comfortable posture, keeping the back erect and rigid, with their eyes closed. They were instructed to do slow deep inspiration, followed by slow deep expiration, with breathholding in between, by observing the mula bandha. This cycle was repeated for 5 to 10 minutes. The shavasana-patients lay supine, with all the muscles being totally relaxed, for 10 minutes. The patients were asked to concentrate on the process of inspiration and expiration. During the training period, the practice sessions were held for 20 minutes daily in the early morning on an empty stomach, under the supervision of an experienced yoga teacher. The subjects were instructed to do the same before dinner for a period of six weeks. The subjects of the control group were not trained in pranayama and shavasana. However, their basal recordings of the HR, BP, PP, MAP and the RPP were also compared before and after six weeks.

The data which was collected from the 60 subjects were subjected to statistical analysis by using the Student's paired 't'- test. A 'p' value of less than 0.05 was considered as significant.

RESULTS

In males, the ujjayi pranayamic breathing exercise, followed by the shavasana, caused a significant decrease (P<0.0001) in the heart rate, systolic pressure, diastolic pressure, pulse pressure, mean arterial pressure and the rate pressure product, after six weeks of the training period in the Group I subjects, as shown in [Table/Fig-1]. No significant changes was observed in any of the parameters in the Group II controls who did not practice pranayama and shavasana.

DISCUSSION

The purpose of this study was to determine whether the pranayama and shavasana training modulated the cardiovascular responses. The ujjayi pranayama and the shavasana training for six weeks, resulted in a significant decrease in the basal heart rate and the blood pressure in the Group I subjects. In contrast, there was no change in the basal heart rate in the control subjects [Table/Fig-1]. The basal heart rate is the function of the para-sympathetic system. The calculated RPP also decreased significantly, as RPP was an index of the myocardial oxygen consumption and the load on the heart [10]. A significant decrease in the RPP following the pranayama training in the Group I subjects, indicated a reduction in the work which was done by the heart. Madanmohan and Rai et al also reported that the pranayama training resulted in a decrease in the oxygen consumption [1,2]. These studies showed that the pranayama training produced an overall reduction in the oxygen consumption, the metabolic rate and the load on the heart. Hence, our study showed that a pranayama training of six weeks duration produced a decrease in the basal sympathetic tone and an increase in the basal parasympathetic activity.

The Sanskrit word 'ujjayi pranayama' means victorious breath. The prefix, "ud" means upwards or expanding and "jayi" means conquest or success. Pramanik et al., reported that slow breathing exercises influenced the heart rate and the blood pressure through the para-sympathetic dominance [8,9]. As ujjayi pranayama, followed by shavasana, is a type of slow breathing exercise, it stimulates the para-sympathetic system.

Pranayama makes the person concentrate on the process of breathing, and it destresses him. This may decrease the release

Parameter	Group I Pranayama group		Group II Controls	
	Before	After	Before	After
HR (bpm)	73.60 ± 2.54	66.80 ± 2.44 *	73.77±1.74	74.03±1.56
SP (mm Hg)	112.20 ± 4.50	104.53 ± 4.50*	112 ± 9.53	113.47± 9.07
DP (mm Hg)	72.00 ±2.88	67.40 ± 2.88*	72.00 ± 10.25	73.20 ±7.13
PP (mm Hg)	40.20±2.12	36.80 ± 1.86*	39.20 ± 5.03	37.73±6.58
MP (mm Hg)	85.75±8.69	79.66 ± 3.39*	85.03±10.69	85.75±8.69
RRP (units)	77.04± 4.53	68.04 ± 2.61*	83.28±7.79	83.49± 7.10

[Table/Fig-1]:]: Effect of six weeks of ujjayi pranayama and shavasana training on various cardiovasular parameters in normal human volunteers. GroupI (n=30) and GroupII controls(n=30).
Data is expressed as Mean±SD.*P<0.0001.Group I Before: parameters recorded before pranayama. After: parameters recorded after pranayama. In Group II Before: before 6 weeks, After: after 6 weeks. HR: heart rate; SP: systolic blood pressure; DP: diastolic blood pressure;PP: pulse pressure; MAP: mean arterial pressure; RPP: rate pressure product.

of adrenaline i.e., decrease the sympathetic activity and hence, it may decrease the heart rate and the blood pressure [10]. In the present study, ujjayi pranayama showed a significant decrease in the heart rate and the blood pressure, which was supported by the findings of a study which was conducted by Pramanik et al., [8,9]. Pranayama increases the frequency and the duration of the inhibitory neural impulses by activating the stretch receptors of the lungs during the tidal volume inhalation as in the Hering-Breuer reflex. This brings about a withdrawal of the sympathetic tone in the skeletal muscle blood vessels, leading to widespread vasodilatation, thus causing a decrease in the peripheral resistance and thus decreasing the diastolic pressure in our study. In shavasana, the person relaxes with slow rhythmic movements of the respiratory muscles and other parts of the body. This influences the hypothalamus through a continuous feedback of the slow rhythmic proprioceptive and exteroceptive impulses to reset it at a lower level, thus reducing the blood pressure [11].

During voluntary expiration, the intra-thoracic pressure increases and blood from the lungs is squeezed into the heart, leading to an increase in the stroke volume; the baro-receptors in the carotid sinus experience more pressure and they discharge more. The increased baro-receptor discharge inhibits the tonic discharge of the vasoconstrictor nerves and it excites the vagus innervations of the heart, thus producing vasodilatation, a drop in blood pressure and bradycardia [12].

The decrease in the diastolic pressure was so significant, that as a result, the pulse pressure and the mean arterial blood pressure also decreased significantly. Most of the volunteers felt a calmness of mind and a sense of well-being, thus supporting the parasympathetic stimulation.

CONCLUSION

Ujjayi pranayama and shavasana thus showed a strong tendency of improving or balancing the autonomic nervous system through an enhanced activation of the para-sympathetic system and thus, they can be practiced for mental relaxation and for the reduction of stress in daily life. Therefore, this simple exercise can be prescribed to hypertensive patients with proper monitoring, along with medical therapy.

REFERENCES

[1] Madanmohan, Rai UC, Balavittal V, Thombre DP, Swami Gitananda. Cardiorespiratory changes during savitri pranayam and shavasan. The *Yoga Review* 1983; 3: 25-34.
[2] Rai UC, Madanmohan, Subramanian N, Swami Gitananda. Oxygen consumption and ventilatory changes during savitri pranayam and shavasan. *J Res Edit Indian Med* 1982; 1: 23-26.
[3] Gopal KS, Anantharaman V, Balachander S, Nishith SD. The cardiorespiratory adjustments in pranayama with and without bandhas in vajrasana. *Indian J Med Sci* 1973; 27: 686-692.
[4] Pal GK,Velkumary S, Madanmohan. Effect of short term breathing exercises on the autonomic functions in normal human volunteers. *Indian J Med Res* 2004;120:115-21.
[5] Raghuraj P, Ramakrishnan AG, Nagendra HR, Telles S. Effect of two selected yogic breathing techniques of the heart rate variability. Indian *J Physiol Pharmacol* 1998; 42 : 467-72.
[6] Telles S, Desiraju T. Oxygen consumption during a pranayamic type of very slow-rate breathing. *Indian J Med Res* 1991; 94 :357-63.
[7] Patel C, North WRS. A randomised controlled trial of yoga and biofeedback in the management of hypertension.*The Lancet* 1965; 2:93-95.
[8] Pramanik T, Sharma HO, Mishra S, Prajapati R, Singh S.Immediate effect of slow pace Bhastrika pranayama on the blood pressure and the heart rate. *J Alter Complement Med* 2009; 15: 293-5.
[9] Pramanik T, Pudasaini B, Prajapati R. Immediate effect of the slow pace breathing exercise, Bhramari pranayama on the blood pressure and the heart rate. *Nepal Med Coll J* 2010 sep ;12(3) 154-7.
[10] Gobel FL, Nordstrom LA, Nelson RR, Jorgensen CR, Wang Y. The rate-pressure-product as an index of myocardial oxygen consumption during exercise in patients with angina pectoris.*Circulation* 1978;57:549-56.
[11] Datey KK, Deshmukh SN, et al. Shavasana : a yogic exercise in the management of hypertension.*Angiology* 1969;20:325 -33.
[12] Ganong WF. Review of Medical Physiology. 22nd ed. Boston,Mc Graw Hill 2005; 605.

AUTHOR(S):

1. Dr. G.V. Lathadevi
2. Dr. T. Uma Maheswari
3. Dr. R. Nagashree

PARTICULARS OF CONTRIBUTORS:

1. Corresponding Author,
2. Professor, Department of Physiology,
3. Professor, Department of Physiology,

PSG Institute of Medical Sciences and Research (PSGIMS & R), Coimbatore – 641 004, India.

NAME, ADDRESS, TELEPHONE, E-MAIL ID OF THE CORRESPONDING AUTHOR:

Dr. G.V. Lathadevi,
Associate professor, Department of Physiology,
PSG Institute of Medical Sciences and Research (PSGIMS & R),
Coimbatore – 641 004, India.
Phone: 9344851415, Fax: 0422 2594400
Office phone: 0422 2570170 [ext.5809]
E-mail: lathadeviphysio@yahoo.co.in

DECLARATION ON COMPETING INTERESTS:

No competing Interests.

Date of Submission: **Jan 05, 2012**
Date of Peer Review: **Jan 10, 2012**
Date of Acceptance: **Jan 17, 2012**
Date of Publishing: **May 31, 2011**