Available online at: www.ijmrhs.com **DOI:** 10.5958/2319-5886.2015.00154.X

Research article **Open Access**

MODULATION OF SYMPATHOVAGAL BALANCE AFTER CHANDRANADI PRANAYAMA IN HEALTHY VOLUNTEERS

Chintala Kiran Kumar CH[1], Bandi Hari Krishna[2], Mallikarjuna Reddy N[1]

ARTICLE INFO

Received: 10th June 2015
Revised: 14th Aug 2015
Accepted: 9th Sep 2015

Authors details: [1]Department of Physiology, Narayana Medical College, Nellore, Andhra Pradesh, India, [2]Department of Physiology, Sri Venkateswara Medical College, Tirupati, Andhra Pradesh, India

Corresponding author: Chintala Kiran Kumar CH
Narayana Medical College, Nellore,
Andhra Pradesh, India,
Email: dr.chkirank@gmail.com

Keywords: *Heart rate variability, Autonomic function, Pranayama, Blood pressure.*

ABSTRACT

Background and objectives: Regardless of prevailing advances in yoga research, the immediate benefit of chandranadi pranayama (CNP) on heart rate variability was not explored. Therefore, in this study, we planned to study the immediate effect of CNP on heart rate, blood pressure and HRV. **Methods:** One hundred and ten medical students were randomly divided into two groups; control group (n=55) and CNP group (n=55). CNP group participants were individually trained to perform CNP by an experienced yoga instructor with a regularity of 6 breaths/min for five minutes. CG volunteers didn't undergo CNP, Pre and post intervention HR, BP measurements and spectral analysis of HRV was done in both the groups. The paired student's t test was used to determine significant differences. **Results:** There was a significant decrease in HR ($p<0.01$), BP ($p<0.05$), LFnu ($p<0.05$), LF/HF ($p<0.001$) and increase in HFnu ($p<0.01$) followed by five minutes of CNP in CNP group. Further, HR, SBP, DBP was reduced by 9.10%, 4.80%, 7.75 % respectively. HRV results showed 7.59% reduction in LFnu, 17.8% reduction in LF/HF and HF was increased by 12.37%. There were no significant changes in CG. **Conclusion:** It is concluded that CNP is beneficial in reducing HR, BP and to improve Sympathovagal balance. We advise that this effective method be included with the management protocol of hypertension and utilized when immediate reduction of blood pressure is required in day-to-day as well as clinical situations.

INTRODUCTION

Yoga is mind-body practice which consists of relaxation, meditation together with a group of physical exercises carried out in sync with breathing. Being holistic, it will be ideal means for achieving physical, mental, social and spiritual well being of the practitioners. This may be attained by methodical and well organized practice of ashtanga (eight-limbed) yoga described by sage Patanjali. The first two limbs of ashtanga yoga are yama and niyama which are ethical code and personal discipline for the development of our moral, spiritual and social aspects. 3rd and 4th limbs are asana and pranayama which help in our physical development and improvement of physiological functions. 5th and 6th limbs are pratyahar and dharna for controlling our senses and making our mind one-pointed, calm and alert [1].

Prana means ''breath, wind, life, energy, and vitality.'' Ayama means ''length, stretching, restraint or expansion'' It is the science of breath. There are many techniques of pranayama. In humans, the left and right nostril will not work at the same time. One of the nostrils is usually more congested as compared to the other no matter if the nasal passages are clean and unobstructed by mucus. This congestion alternates between the right and left nostril through the day and night[2].The influence of CNP on cardio respiratory as well as autonomic function parameters were investigated only these days[3,4,5]. with exceptionally conflicting outcomes; the authors describing increase, decline and no alterations in Respiratory rate (RR), Heart rate (HR), and Galvanic skin response (GSR). Furthermore, to the best of our understanding, the immediate effect of chandranadi pranayama **(CNP)** Sympathovagal modulation measured by spectral analysis of heart rate variability (HRV) was not explored. Therefore, the present study was planned to investigate the immediate effects CNP on HR, SBP, DBP and HRV.

MATERIALS AND METHODS

Study design: This was Experimental randomized controlled trial.

Ethical approval: The procedure was explained to the volunteers and informed written consent obtained. The study was approved by the institute ethics committee

Inclusion criteria: The present study was conducted on 110 apparently healthy medical students, aged from 19–22 yrs. The participants were of the same socio - economic and nutritional status.

Exclusion criteria: The participants suffering free from any cardio - respiratory diseases and were using any drugs which affect autonomic nervous system.

Sample size: 110

Grouping: Divided into two groups Group 1: control group (CG) (n=55), Group 2: CNP group (n=55) and Their age, height, weight and food habits were recorded. The Control group participants didn't receive any intervention; chandranadi pranayama group participants underwent the following procedure.

Pranayama procedure: The CNP was done with subjects in lying down posture and it was ensured that there was no nasal obstruction. The participants were individually taught to perform CNP by a qualified and experienced yoga therapist. An overview of the practice was given to the subjects. They were asked to keep their eyes closed. The subjects were instructed to perform nasika mudra with their right hand, by touching the tip of their index finger to the base of their thumb. The right thumb was then used to close their right nostril with gentle pressure. The CNP was then performed through the left nostril in a calm and regular manner with a conscious effort to use low, mid and upper parts of the lungs in a sequential manner for both inspiration and expiration. Subjects were instructed to breathe in and out for an equal count of 5 that was given by the yoga therapist throughout the period. A regularity of counts at the rate of 6 breaths/min (BPM) was maintained by the yoga therapist for the entire duration of nearly 5min taken to complete 27 rounds of CNP. HRV was recorded before, during, and immediately after CNP.

Methodology:

Laboratory conditions and assessment of Sympathovagal balance: All experiments were carried out in the cardiac autonomic function research laboratory. Sympathovagal balance was assessed by using spectral analysis of heart rate variability (HRV). Recording of Short-term HRV was carried out at 8.00 AM following ten minutes of supine relaxation. The volunteers were instructed to stay away from extreme physical exercise for one day and from drinking of alcohol and caffeinated beverages for twelve hours before to the recording. The laboratory temperature was maintained as 25^{o}C - 28^{o}C and lights subdued. The volunteers were instructed to void urine before the recording and asked to sit in the lab to adjust to the lab environment. First, HR and ascultatory BP were recorded after the volunteer had been sitting calmly for ten minutes. The mean of 3 successive recordings with an optimum difference of 4 mm Hg of both SBP and DBP was taken[6]. Then with eyes closed at supine rest and relaxed posture, lead II ECG was recorded at 200 samples/second for ten minutes with 12-18 breaths/minute using an ECG machine (Cardiowin system, PC based 12 channel simultaneous digital ECG, Genesis Media System Pvt. Ltd, India). The task force recommendations on HRV were followed[7] ; an RR interval collection was acquired from ECG with optimum amplitude and sharpness of the peaks for R wave identification. After exclusion of artifacts and ectopics, a stationary 256s RR interval collection was selected and analyzed with Kubios HRV Version 2.0 software for HRV (Bio-signal analysis Group, Finland). "The RR series was resampled at 4Hz, its mean and trend removed, a Hann window applied and the 1024 data-point series was transformed by Fast Fourier Transformation (FFT). Frequency domain indices such as total power (TP), normalized LF power (LFnu), normalized HF power (HFnu) and LF-HF ratio were calculated" [8].

Statistical analysis: Statistical analysis was performed by using SPSS 16. All data passed normality testing by Kolmogorov-Smirnov test and hence was analyzed using Students *t* test for paired data. *P* values less than 0.05 were accepted as indicating significant differences between pre and post intervention data.

RESULTS

The baseline characteristics of the subjects were given in Table 1. There were no significant differences in baseline parameters. Results of the pre and post CNP comparisons are given in Table 2 and Fig 2-7. All values are given as mean ± SD. No significant differences were found in CG Table 2. Five minutes of CNP produced an immediate decrease in all the measured cardiovascular parameters with the decrease in HR ($p<0.01$), SBP ($p<0.05$), DBP ($p<0.05$). Spectral analysis of HRV showed significant reduction in LFnu ($p<0.05$), LF/HF ($p<0.001$) and significant increase in HFnu ($p<0.01$). HR, SBP, DBP was reduced by 9.10%, 4.80%, 7.75 % respectively. HRV results showed 7.59% reduction in LFnu, 17.8% reduction in LF/HF and HF was increased by 12.37%.

Table 1: Baseline physiological characteristics of participants.

Parameter	CNP group (n=55)	Control group (n=55)
Age (year)	20.23 ± 2.45	19.48 ± 3.21
Gender (male/female)	42/13	39/16
Height (cms)	172.56 ± 34.45	171.67 ± 31.23
Weight (kg)	67.51 ± 12.45	65.44 ± 11.19
BMI (kg/m^2)	22.7 ± 6.24	22.21 ± 5.92
BSA (m^2)	1.83 ± 0.34	1.77 ± 0.29

Data expressed as mean ± SD

Table 2: Values of HR, SBP, DBP and HRV parameters in Control group (Baseline and after 5mins), Immediate effect of chandranadi pranayama.

Parameter	Group1 Control group		Group II (Interventional group CNP)		
	Parameter	Baseline	Before CNP	After CNP	% change
HR (bpm)	78.7± 7.36	77.45 ± 7.12	79.45 ± 8.46	72.22±8.1**	9.10
SBP (mmhg)	119.4± 12.6	118.43±11.2	118.24±13.5	112.6±12.3*	4.80
DBP (mmhg)	76.45±11.12	78.34± 12.8	78.44±10.25	72.4± 11.5*	7.75
LFnu	61.0± 13.18	63.0 ± 7.42	62.0 ± 12.08	57.3± 8.45*	7.59
HFnu	39.0± 13.18	37.0 ± 7.42	38.0 ± 12.08	42.7± 8.45**	-12.37
TP (ms^2)	190± 79.56	191± 55.46	185 ± 88.34	177 ± 65.45	4.3
LF-HF	1.61± 0.29	1.7 ± 0.55	1.63 ± 0.34	1.3± 0.25***	17.8

∗ $P<0.05$; ∗∗ $P<0.01$; ∗∗∗ $P<0.001$.

HR: Heart rate; SBP: Systolic blood pressure; DBP: Diastolic blood pressure; LFnu: Normalized units of low frequency component of HRV; HFnu: Normalized units of high frequency component of HRV; TP: Total power; LF-HF: Low frequency to high frequency ratio.

DISCUSSION

In the present study, following five minutes of CNP, there was a decrease in HR, SBP, DBP, LFnu, LF/HF and increase in the HFnu (Table 2). The low frequency band (0.05-0.15Hz) of the heart rate variability spectrum is thought to correspond to sympathetic modulation, especially when expressed as normalized as opposed to absolute units[7]. The representation of low frequency and high frequency energy values in normalized units expresses the degree of control exerted and the relative balance of the two branches of the autonomic nervous system. The efferent vagal activity is a major contributor to the high frequency band (0.15-0.50Hz). The low frequency/high frequency ratio is correlated with the sympathovagal balance[9].

The immediate reduction in HR, SBP, DBP, LFnu and LF/HF followed by five minutes CNP in our participants can be explained by changes in the autonomic balance as it has been previously reported that sympathetic activity is lower during left nostril breathing[5] . It has also been reported that exclusive left nostril breathing, repeated 4 times a day for a month reduced sympathetic activity[3] . Our findings are in agreement with those of a previous report that left UFNB at the rate of 6 BPM lowers HR[10]. Another study done on normal volunteers reported a significant decrease in blood pressure[11].

In this study, the reduced LFnu and increased HFnu indicates the decreased sympathetic activity and increased parasympathetic activity of heart, further the reduce LF/HF indicates the shift towards parasympathetic dominance. **Limitations:** The HRV tool used to assess sympathetic activity is not adequate. Therefore, potential investigations should include precise approaches to assess the sympathetic activity by using of plasma catecholamines or metabolites of catecholamines in urine like vanillylmandelic acid (VMA), metanephrine, and normetanephrine.

CONCLUSION

It is concluded that CNP is effective in reducing HR, SBP and DBP. This may be due to a normalization of autonomic cardiovascular rhythms with increased vagal modulation and/or decreased sympathetic activity along with improvement in baroreflex sensitivity. Further studies are required to enable a deeper understanding of the mechanisms involved as well as determine how long such a BP lowering effect persists. We suggest that this simple and cost effective method be added to the regular management protocol of hypertension and utilized when immediate reduction of blood pressure is required in day-to-day as well as clinical situations.

Conflicts of Interest: Nil.

REFERENCES

1. Effect Of Yogic Practices On Different Systems OF HUMAN BODY.doc - yogresearchMMT.pdf [Internet]. [cited 2014 Nov 2]. Available from: http://icyer.com/documents/yogresearchMMT.pdf
2. Jain N, Srivastava RD, Singhal A. The effects of right and left nostril breathing on cardiorespiratory and autonomic parameters. Indian J Physiol Pharmacol. 2005 ;49(4):469–74.
3. Telles S, Nagarathna R, Nagendra HR. Breathing through a particular nostril can alter metabolism and autonomic activities. Indian J Physiol Pharmacol. 1994 ;38(2):133–7.
4. Khanam AA, Sachdeva U, Guleria R, Deepak KK. Study of pulmonary and autonomic functions of asthma patients after yoga training. Indian J Physiol Pharmacol. 1996;40(4):318–24.
5. Mohan SM. Svara (nostril dominance) and bilateral volar GSR. Indian J Physiol Pharmacol. 1996 ;40(1):58–64.
6. Chobanian AV, Bakris GL, Black HR, Cushman WC, Green LA, Izzo JL, et al. Seventh report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure. Hypertension. 2003;42(6):1206–52.
7. Heart rate variability: standards of measurement, physiological interpretation and clinical use. Task Force of the European Society of Cardiology and the North American Society of Pacing and Electrophysiology. Circulation. 1996;93(5):1043–65.
8. Krishna BH, Pal P, Pal G K, Balachander J, Jayasettiaseelon E, Sreekanth Y, et al. Effect of yoga therapy on heart rate, blood pressure and cardiac autonomic function in heart failure. J Clin Diagn Res. 2014;8(1):14–6.
9. Malliani A, Pagani M, Lombardi F, Cerutti S. Cardiovascular neural regulation explored in the frequency domain. Circulation. 1991;84(2):482–92.
10. Shannahoff-Khalsa DS, Kennedy B. The effects of unilateral forced nostril breathing on the heart. Int J Neurosci. 1993;73(1-2):47–60.
11. Raghuraj P, Telles S. Immediate effect of specific nostril manipulating yoga breathing practices on autonomic and respiratory variables. Appl Psychophysiol Biofeedback. 2008;33(2):65–75.