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Effect of Unilateral Nostril Breathing on Autonomic Functions Assessed by Power Spectral Analysis of Heart Rate Variability (HRV)

Kapil Gupta[1], Bhoopendra Patel[2*]
[1]Associate Professor, Department of Physiology, S.M.S. Medical College, Jaipur, Rajasthan, India
[2]Senior Resident, Department of Physiology, S.M.S. Medical College, Jaipur, Rajasthan, India

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***Corresponding author**
Bhoopendra Patel

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Abstract: The effect of unilateral nostril breathing on autonomic functions was investigated in healthy male medical students aged 17-20 years in the Department of Physiology, S.M.S. Medical College, and Jaipur. The subjects were randomly divided into three groups, viz. RNB (right nostril breathing), LNB (left nostril breathing) and BNB (both nostril breathing) with 15 students in each group. Autonomic functions were assessed by power spectral analysis of heart rate variability using High Frequency (HF=0.15-0.4 Hz), and Low Frequency (LF=0.04-0.15 Hz), which represent vagal and sympathetic efferent activity to heart, respectively. These components were analyzed as LF n.u. (LF in Normalized Units), HF n.u. (HF in Normalized Units) and LF/HF ratio. HRV assessment was done before and after 15 minutes of breathing intervention initially at day 1, as per their breathing group and again at 4 week of study period. Analysis of breathing interventions on HRV by unpaired student's't' test showed no significant changes in any of the parameters, although a decreasing trend was observed in LF n.u. and LF/HF ratio along with increasing trend of HF n.u. values at 4 week of study period, which might suggest generalized parasympathetic activation due to unilateral as well as both nostril breathing. The probable explanation for this finding could be the entrainment of the brain achieved by the daily regular breathing maneuver at a slow rate (8 breaths per minute) along with calm and relaxed status of subjects, which might have led to increased parasympathetic activation in the subjects. A larger duration of study period could help establish the effect of unilateral breathing on autonomic function status. Thus it can be concluded that unilateral nostril breathing has no influence on the autonomic function status of an individual.
Keywords: Right nostril breathing, Left nostril breathing, both nostril breathing and Heart Rate Variability.

INTRODUCTION

The nasal cycle has a periodicity of 2-3 hours with alternating patency and functional efficiency of right and left nares during awake state [1]. Indian Yogic system of breathing describes right nostril dominance corresponding to activation of 'Pingla' (sympathetic activation) whereas left nostril dominance to 'Ida' svara (parasympathetic activation) [2].

Activation of contralateral cerebral cortex and change in Intraocular pressure (IOP) has also been demonstrated with unilateral breathing. IOP increases with left nostril breathing, whereas decreases with right nostril breathing [3, 4]. The effect of unilateral breathing on sympathetic (Pingla) and parasympathetic (Ida) system can be best assessed using Heart Rate Variability (HRV) [5]. HRV is beat to beat variation in heart rate (R-R intervals) under resting conditions. These beat to beat variations occur due to continuous interplay of sympathetic and parasympathetic outflow on the heart [6]. HRV is more sensitive method to detect changes in autonomic functions as compared to conventional tests of autonomic functions viz., Deep Breathing, Hand-grip Dynamometer, Heart response to posture, etc. [7]. Power spectral analysis of HRV reveals 3 spectral components - VLF (Very Low Frequency, 0.001 - 0.04 Hz), LF (Low Frequency, 0.04 - 0.15 Hz) and HF (High Frequency, 0.15 - 0.4 Hz) [6]. HF power is largely a function of parasympathetic activity whereas LF Power is related to both sympathetic activity and parasympathetic activity [6].

Pranayama is voluntary regulation of breathing intended to calm the mind. Nadisuddhi Pranayama includes inhalation and exhalation through alternate nostrils for successive respiratory cycles. Unilateral nostril breathing is a component of Nadisuddhi Pranayama [8]. The present study was therefore planned to investigate the effect of unilateral nostril breathing on autonomic functions assessed by power spectral analysis of heart rate variability.

MATERIALS AND METHODS

This prospective study was conducted on forty five male medical student volunteers in the age group of 17-22 years in the Department of Physiology, S.M.S. Medical College, and Jaipur. All the subjects were healthy and had not performed any form of breathing exercises previously. They were free from any cardio-respiratory, neurological and endocrine disorders and were not on any medications. Subjects with local nasal pathology and smokers were excluded.

The subjects were randomly divided into three groups of fifteen subjects each viz., Right Nostril Breathing (RNB), Left Nostril Breathing (LNB) and Both Nostril Breathing (BNB) groups [9]. BNB group was studied, so as to neutralize the effect of rate of breathing which could have acted as a confounding factor. The subjects performed RNB (closure of left nostril and breathing through right nostril), LNB (closure of right nostril and breathing through left nostril) and BNB (breathing through both nostrils) for fifteen minutes every day in the morning for next 4 weeks according to the group they were randomized.

The Experimental Protocol was explained to them after obtaining informed written consent to participate in the study. The study protocol was approved by Research Review Board of S.M.S. Medical College, Jaipur. A thorough history and clinical examination was done to satisfy inclusion and exclusion criteria. The subjects were instructed to avoid coffee, alcohol and nicotine for at least 24 hours and had taken meals at least 2 hours prior to the recording of HRV [10].

Method for Unilateral Nostril Breathing (RNB/LNB) [2]

In a calm and quiet surrounding, the subjects sat with a relaxed stable posture with head, neck and trunk erect and in a straight line. The left/right nostril was closed with the fingers of the right hand and then the subjects breathed through the corresponding nostril only. During this unilateral breathing the exhalation and inhalation were of equal duration and without any pause. The breathing so desired was diaphragmatic, slow and controlled with no sensation of exertion. Subjects were instructed to perform controlled breathing at 8 breaths per minute. Subjects of BNB group performed similar breathing maneuver with both nostrils open.

Measurements and Recording Devices

Autonomic functions as evaluated through power spectral analysis of HRV were assessed by Medical Analyzer, Noninvasive Vascular Monitor (Nivomon; L & T). Detection of Impedance Peripheral pulse wave was digitally done. Abnormal beats and areas of artifacts were automatically and manually identified and excluded.

For short term analysis of HRV, Impedance Peripheral Pulse in the right forearm was recorded in the supine position for 5 minutes as per the International Protocol [10]. The schedule of data collection so adopted was:

- The recordings of subjects were taken on a daily basis with 3-4 students evaluated per day.
- At day one basal recording was taken first and then subjects were instructed to perform nasal breathing intervention for fifteen minutes. A repeat recording was taken on the same day immediately after the intervention. The subjects were then instructed to maintain the schedule on a daily basis in the morning and repeat recordings were taken at 4 week interval after the start of the intervention. At 4 weeks, no breathing intervention was done immediately before the recording.

The frequency components of HRV were analyzed by Fast Fourier Transform (FFT). The power spectrum is subsequently divided into three frequency bands; VLF (0.001-0.04 Hz), LF (0.04-0.15 Hz) and HF (0.15-0.4 Hz)[6]. Power of the spectral bands was calculated in normalized units (n.u.) as [6]:

$$HF\ (n.u.) = HF\ (ms^2) / [Total\ Power\ (ms^2) - VLF\ (ms^2)] \times 100$$

$$LF\ (n.u.) = LF\ (ms^2) / [Total\ Power\ (ms^2) - VLF\ (ms^2)] \times 100$$

The LF/ HF ratios were calculated to assess sympathetic/parasympathetic modulation.

Analysis of Data

Mean and standard deviation of the observation for all the parameters were calculated and comparisons were done by applying Student's't' test (unpaired), using Windows Microsoft Excel. Statistical significance was assigned at $p < 0.05$.

RESULTS

The results of different breathing interventions on autonomic functions as assessed by spectral analysis of HRV are summarized in Tables 1and 2.

Analysis of breathing interventions on HRV by unpaired student's't' test revealed no significant change in LF n.u., HF n.u. and LF/HF ratio either between BNB group and RNB group or BNB Group and LNB group.

DISCUSSION AND CONCLUSION

As evident from the Tables 1and 2, breathing interventions did not have any significant effect on LF n.u., HF n.u. and LF/HF ratio, although LF n.u. and LF/HF ratio values were found to be decreased and HF n.u. was increased at 4 week. Decreased LF n. u., increased HF n. u. and decreased LF/HF ratio is a measure of increased parasympathetic drive to the heart [6].

Table-1: Effect of Breathing Intervention on LF n.u., HF n.u. and LF/HF Ratio

HRV Parameters		BNB Group (n=15)	RNB Group (n=15)	LNB Group (n=15)
LF n.u. (Mean ± S.D.)	Basal	49.6 ± 11	42 ± 15	39 ± 19
	After 15 Minute	43 ± 12	44 ± 17	40 ± 18
	4 Week	41 ± 16	37 ± 17	36 ± 11
HF n.u. (Mean ± S.D.)	Basal	49 ± 11	57 ± 15	59 ± 18
	After 15 Minute	55 ± 13	55 ± 17	58 ± 18
	4 Week	57 ± 16	62 ± 18	63 ± 11
LF/HF Ratio (Mean ± S.D.)	Basal	1.1 ± 0.56	0.86 ± 0.56	0.90 ± 0.89
	After 15 Minute	0.88 ± 0.58	0.98 ± 0.65	0.88 ± 0.66
	4 Week	0.87 ± 0.71	0.75 ± 0.59	0.62 ± 0.32

Table-2: Comparison of mean difference of LF n.u., HF n.u. and LF/HF Ratio between BNB, RNB and LNB Group (Unpaired Student's't' test)

HRV Parameters		Level of Significance (p-value)	
		Between BNB & RNB Group	Between BNB & LNB Group
LF n.u.	Basal	0.156	0.124
	After 15 Minute	0.854	0.595
	4 Week	0.512	0.327
HF n.u.	Basal	0.156	0.110
	After 15 Minute	0.858	0.730
	4 Week	0.525	0.327
LF/HF Ratio	Basal	0.884	0.467
	After 15 Minute	0.679	0.99
	4 Week	0.619	0.224

Telles *et al*. reported significant increase in GSR (reduced sympathetic activity) in subjects performing LNB and no significant change in subjects performing Alternate Nasal Breathing (ANB) and RNB [11]. Jain *et al*. reported a significant decrease in HR after 8 wks training in RNB, HR which marks the dominance of parasympathetic activity [12]. They concluded that both RNB and LNB lead to general parasympathetic activation, which partly favors findings of this study. Moreover alternate nasal breathing has also been shown to increase overall parasympathetic dominance, which may explain our finding [13]. In the present study no change in autonomic activity in either group was observed immediately after breathing intervention. These findings are consistent with findings of a study in which autonomic functions were assessed by HRV [12, 14].

Unilateral Nostril breathing is a component of various yogic breathing techniques and the parasympathetic activity helps in maintaining homeostasis of body [15]. The present study showed an increasing trend in parasympathetic activity with unilateral as well as both nostril breathing, as indicated by non significant increase in HF n.u., and decrease in LF n.u. and LF/HF ratio at 4 week among groups, which might suggest yogic breathing procedures are helpful in maintaining homeostasis of body by causing generalized parasympathetic activation due to unilateral as well as both nostril breathing. The probable explanation for this finding could be the entrainment of the brain achieved by the daily regular breathing maneuver at a slow rate (8 breaths per minute) along with calm and relaxed status of subjects, which might have led to increased parasympathetic activation in the subjects. Thus it can be concluded that unilateral nostril breathing has no influence on the autonomic function status of an individual. A larger duration of study period could help establish the effect of unilateral breathing on autonomic function status.

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