

Original Research Article

Comparative study of heart rate variability in normotensive young adults with family history of hypertension

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ABSTRACT

Background: Hypertension is a risk factor for the development of cardiovascular and cerebro-vascular diseases. Autonomic nervous system plays a crucial role in the development of hypertension. The integrity of autonomic modulation of heart rate is evaluated by analysing heart rate variability (HRV), which refers to oscillations in the intervals between consecutive heartbeats or R-R intervals. The present study was designed to analyse the indices of heart rate variability in the offsprings of hypertensive parents and off springs of normotensive parents to understand if there is any autonomic imbalance between the two groups.

Methods: The study was conducted in the Department of Physiology, Government Medical College, Srinagar. The test group consisted of 30 healthy normotensive subjects studying in 1st year of MBBS with hypertensive parents and the control group consisted of healthy normotensive of 1st year of MBBS with both parents normotensive. In time domain analysis the standard deviation of all normal-to-normal intervals {SDNN(ms)} was taken as index of overall HRV. Frequency domain analysis was done with respect to low frequency (LF) analysis and high frequency (HF) analysis. Low and high frequency power were expressed in normalized units.

Results: The SDNN was reduced in cases but was not statistically significant. RMSSD was also reduced in cases though not statistically significant. LFnu was found to be significantly higher in cases. The HFnu was significantly reduced in cases. LF/HF ratio was found to be higher in cases and the difference was statistically significant.

Conclusions: Our study reveals that incidence of prehypertension and the risk of cardiovascular dysfunction in relation to sympathovagal imbalance is more in the off springs of hypertensive parents than in the off springs of normotensive parents. Sympathovagal imbalance in the form of increased sympathetic drive and decreased parasympathetic drive can lead to prehypertension in these genetically predisposed individuals.

Keywords: Hypertension, Heart rate variability, Sympathovagal imbalance

INTRODUCTION

Hypertension represents a multifactorial disease of blood pressure (BP) regulation with persistently elevated systolic and/or diastolic BP over 140/90 mmHg. It is a multifaceted progressive disease process spanning several decades of life. Hypertension is a risk factor for the development of cardiovascular (myocardial infarction, heart failure) and cerebro-vascular (stroke) diseases.^{1,2}

Cardiovascular diseases remain the top cause of global mortality, with an estimated 17.9 million attributed deaths in 2016 (31% of global deaths).³

According to the global burden of diseases estimate 2015, hypertension is the most important cause of mortality as well as the loss of disability-adjusted life years.⁴ Results from various studies suggested that autonomic nervous system plays a crucial role in the development of

hypertension.⁵ The arterial baroreflex mechanism regulates blood pressure through reflex effects on the heart, resistance vessels and renal excretion of sodium and water.⁶ Hypertension runs in families, and parental history of hypertension increases the risk of developing hypertension.⁷ Autonomic abnormalities in the form of increased sympathetic tone has been demonstrated in young normotensive offsprings of hypertensive parents. Though hypertension is more common in middle aged and elderly population, prehypertension is relatively more common in young adults especially in those who have family history of hypertension.⁸

The integrity of autonomic modulation of heart rate is evaluated by analysing heart rate variability (HRV), which refers to oscillations in the intervals between consecutive heartbeats or R-R intervals. It is non-invasive, an accurate, reliable, reproducible, yet simple to measure and to process for assessment of the cardiac autonomic nerve function. At present HRV investigation has superseded classic test for autonomic function because it quantifies sympathetic and parasympathetic activity.^{9,10} HRV can be measured by two methods: the time domain method and the frequency domain method.⁹

In the time domain method, mean heart rate (MHR), mean heart beat interval (MNN), the square root of variance of RR intervals (SDNN) and square root of the mean squared differences of successive RR intervals (RMSSD) are included. SDNN reflects all cyclic components of the variability in recorded series of RR intervals. RMSSD is an estimate of high-frequency variations in short-term RR recordings and therefore reflects parasympathetic regulation of the heart. On the other hand, frequency domain parameters include total power (TP), very low frequency (VLF), low frequency (LF), high frequency (HF), normalized low frequency (LF norm), normalized high frequency (HF Norm) and LF/HF ratio. HF and LF norm reflect parasympathetic modulation. LF/HF Ratio signifies the overall balance between sympathetic and parasympathetic systems.⁹

Therefore, in the present study, we have analysed the indices of heart rate variability in the off springs of hypertensive parents and off springs of normotensive parents to understand if there is any autonomic imbalance between the two groups.

METHODS

The study was conducted in the Department of Physiology, Government Medical College, Srinagar. The test group consisted of 30 healthy normotensive subjects studying in 1st year of MBBS, whose parents are hypertensive, either father, mother or both. The control group consisted of healthy normotensive subjects who are studying in 1st year of MBBS of same college with both parents normotensive. Participation in the test was voluntary and informed written consent was taken from every participant. Detailed history and physical examination of each subject was done. Subjects known to have any cardiovascular or cardio respiratory disorders or any disease known to alter the cardiovascular hemodynamics were excluded from the study. The subjects were briefed in detail about the experimental procedure. Height in meters and weight in kgs were measured and BMI calculated using Quetelet index. Baseline blood pressure was measured with sphygmomanometer. ECG was recorded for 5 minutes in lead II using powerlab, AD instrument which is data acquisition system and the Heart Rate Variability analysed with respect to time and frequency domain.

In Time domain analysis the Standard deviation of all normal-to-normal intervals {SDNN(ms)} was taken as index of overall HRV. Root mean square successive difference {RMSSD(ms)} was also studied. Frequency domain analysis done with respect to low frequency (LF) analysis and high frequency (HF) analysis. Low frequency and high frequency spectral powers were determined by integrating the power spectrum between 0.04 and 0.15 Hz and between 0.15 and 0.4 Hz respectively. Low and high frequency power were expressed in normalized units. The results were analysed statistically using unpaired t test. EPI-info software and microsoft excel were used. P value<0.05 was considered significant. The values of all the parameters are expressed in mean±SD.

RESULTS

Our study comprised of 30 test subjects and 30 controls. There were no significant differences in the age, height and BMI between the two groups (Table 1). There were no significant differences in the basal systolic and diastolic blood pressure as well as pulse rate in between the two groups (Table 1).

Table 1: Data of anthropometric measurements and base line characters.

	Cases (n=30) (Mean±SD)	Controls (n=30) (Mean±SD)	P value (< 0.05 significant)
Height (m)	1.66±0.12	1.63±0.08	0.25
Weight (kg)	60.73±9.94	60.83±8.17	0.96
BMI (kg/m²)	21.99±2.50	22.74±3.01	0.29
SBP (mm Hg)	107.86±4.97	106.7±8.01	0.50
DBP (mm Hg)	70.46±6.99	70.2±4.8	0.87
Pulse rate (bpm)	72.83±3.84	71.1±4.46	0.11

Table 2: HRV parameters in cases and controls.

	Cases	Controls	P value (< 0.05 significant)
SDNN (msec)	52.66±10.96	56.5±19.55	0.3519
RMSSD (msec)	32.96±10.34	37.83±10.75	0.0789
Lfnu	59.93±7.69	52.43±14.78	0.0167
Hfnu	22.56±5.05	26±6.59	0.0270
LF/HF	2.72±0.73	2.13±0.82	0.0047

Table 2 shows the comparison of various HRV parameters between two groups. The SDNN was reduced in cases but was not statistically significant. RMSSD was also reduced in cases though not statistically significant. LF nu was found to be higher in cases and the difference between the groups was statistically significant. The HF nu was reduced in cases and the difference was statistically significant. LF/HF ratio was found to be higher in cases and the difference was statistically significant.

DISCUSSION

In our study we found that basal systolic and diastolic blood pressure was not significantly different in two groups. The difference in pulse rate was also not significant. This shows that both groups are normotensive at rest. On comparing the various HRV parameters there is increased LFn and decreased HFnu and increased LF/HF ratio along with decreased SDNN in the study group. These findings indicate that there is increased sympathetic activity and decreased parasympathetic activity in the study group when compared with the control group. Our findings are in accordance with findings of Pal et al, Krishnan et al and Chinagudi et al.^{8,11,12}

LF reflects the sympathetic activity when represented in the normalized units. LF component of HRV is a strong predictor of future hypertension. Prakash et al observed increase in LF power in recent onset hypertension.¹³ HFnu is the direct representation of vagal tone.¹² Vagal tone is an important determinant of cardiovascular health. Vagal tone has influence on the heart rate, cardiac output and blood pressure. Any reduction in the HF power and/or HFnu indicate decreased vagal activity.¹³ In our study HFnu was found to be significantly less in the study group when compared to control group. So our study shows early cardiovascular vagal changes in the study group. Similar findings have also been reported in other studies.^{8,11,12,14}

The LF/HF ratio was significantly increased in the study group when compared with controls. LF/HF ratio also is an indicator of sympathovagal imbalance.¹¹⁻¹³ The reciprocal relationship between LF and HF is a better measurement of sympathovagal balance.¹⁵ SDNN represents the long term vagal modulation of cardiac functions. A lower SDNN indicates diminished

baroreflex modulation of RR intervals. In our study test group had decreased SDNN, though not statistically significant. Decreased SDNN along with decreased HF would indicate poor vagal control in the study group.¹⁶ RMSSD was also decreased in the study group when compared with the control group. RMSSD reflects vagal modulation of heart rate, and therefore RMSSD is considered as an important short term indicator of parasympathetic drive.⁹

Our study reveals that incidence of prehypertension and the risk of cardiovascular dysfunction in relation to sympathovagal imbalance is more in the offsprings of hypertensive parents than in the offsprings of normotensive parents. Sympathovagal imbalance in the form of increased sympathetic drive and decreased parasympathetic drive can lead to prehypertension in these genetically predisposed individuals.^{11,17}

CONCLUSION

In conclusion, our findings show that HRV is reduced in normotensive young adults with history of parental hypertension. This lower HRV is associated with greater risk for developing latent hypertension. These findings support the hypothesis that autonomic dysregulation is present at early stage in offsprings of hypertensive parents. So recording of HRV in the predisposed group becomes mandatory to prevent them from progressing to prehypertension and hypertension subsequently.

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