



THE HEART RATE VARIABILITY IN NORMOTENSIVE AND HYPERTENSIVE INDIAN ADULTS IN MADHUBANI DISTRICT OF BIHAR- A COMPARATIVE STUDY

Physiology

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ABSTRACT

Background: Autonomic imbalance is seen in hypertensive. Hypertension is a critical health condition that damages vascular system and organ systems like heart, brain, kidneys, eyes and genital organs. **Aims & Objective:** To compare the heart rate variability in normotensive and hypertensive Indian adults in Madhubani district of Bihar. **Methods And Materials:** The study was conducted in the Department of Physiology, Madhubani Medical College, Madhubani, Bihar. The test group consisted of 75 healthy normotensive subjects studying in 1st year of MBBS with hypertensive parents and the control group consisted of 75 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. Study comprised of 60 test subjects and 60 controls. There were no significant differences in the age, height and BMI between the two groups. There were no significant differences in the basal systolic and diastolic blood pressure as well as pulse rate in between the two groups. **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.

KEYWORDS

Hypertension, Heart rate variability and Sympathovagal imbalance

INTRODUCTION:

Hypertension is a critical health condition that damages vascular system and organ systems like heart, brain, kidneys, eyes and genital organs [1]. Hypertension and prehypertension are responsible for 8.5 million deaths globally and 1.47 million deaths in India. Approximately, 46% of adults are unaware about their hypertensive state. Approximately, 42% adults get treatment of high blood pressure but only 21% hypertensive adults have proper control, so rest of hypertensive have poor control of high blood pressure [2]. Extended community health assessment program using digital technology is a need of time for proper control of high blood pressure [3]. World health organization recommended usage of computer and mobile based digital technology for control of cardiovascular diseases and for reduction of healthcare cost. WHO and Digital India Corporation recommend usage of HRV technology for various community health programs. Hypertension represents a multifactorial disease of blood pressure (BP) regulation with persistently elevated systolic and/or diastolic BP over 140/90mmHg. 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 cerebrovascular (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 offspring's 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 analyzing 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 analyzed the indices of heart rate variability in the offspring's of hypertensive parents and offspring's of normotensive parents to understand if there is any autonomic imbalance between the two groups.

Aims And Objective:

To compare the heart rate variability in normotensive and hypertensive Indian adults

MATERIAL AND METHODS:

The study was conducted in the Department of Physiology, Madhubani Medical College, Madhubani, Bihar. The test group consisted of 75 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 power lab, 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 analyzed 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 \pm SD

Study Duration:- From January 2022 to December 2023

Inclusion Criteria:

1. Patients within age group of 18 to 25 years.
2. Known case of Hypertension
3. All proven cases of Hypertensive individual.
4. All patients whose symptoms and signs of hypertension persisted for more than 6 months.

Exclusion Criteria:

1. Age <25 years
2. H/O alcohol intake
3. Non-alcoholic liver disease, Diabetes mellitus.
4. Patients who were known case of primary hepatocellular carcinoma or any other malignancy.
5. Patients who were on treatment for anaemia or had blood transfusion in last 3 months.
6. Patients on drugs causing bone marrow suppression.
7. Patients suffering from end stage medical diseases like heart failure, chronic kidney disease (CKD) and those who were chronic smokers were excluded.

Methodology

The study was conducted from January 2022 to December 2023 in the department of physiology in Madhubani Medical College, Madhubani, Bihar after obtaining the institutional and ethical committee clearance. A written informed consent was taken from each patient before the commencement of the study. 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.

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Statistical Analysis:

Collected data were entered in the Microsoft excel spreadsheet, coded appropriately and later cleaned for any possible errors. Analysis was carried out using Statistical Package for the Social Sciences (SPSS) for windows version 20.0. Normally distributed data were presented as means and standard deviation and categorical data were expressed as frequency.

RESULT:

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. Our study comprised of 75 test subjects and 75 as 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) Data of anthropometric measurements and base line characters

	Cases (n=75) (Mean \pm SD)	Control (n=75) (Mean \pm SD)	P value (<0.05 significant)
Height (m)	1.66 \pm 0.11	1.63 \pm 0.07	0.24
Weight (kg)	60.52 \pm 9.84	60.72 \pm 8.16	0.95
BMI (kg/m ²)	21.97 \pm 2.40	22.65 \pm 3.02	0.28
SBP (mm Hg)	107.86 \pm 4.97	106.7 \pm 8.02	0.51
DBP (mm hg)	70.46 \pm 6.88	70.3 \pm 4.86	0.86
Pulse rate (bpm)	72.81 \pm 3.83	71.1 \pm 4.46	0.10

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. LFnu was found to be higher in cases and the difference between the groups was statistically significant. The Hfnu 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 LFnu 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. 13HFnu 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 deregulation 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..

REFERENCES:

1. Covic A, Goldsmith DJA, Covic M. Reduced blood pressure diurnal variability as a risk factor for progressive left ventricular dilatation in hemodialysis patients. *Am J Kidney Dis* 2000;35:617–23.
2. Kikuya M. Prognostic significance of blood pressure and heart rate variabilities: The Ohasama study. *Hypertension* 2000; 36:901–6.3. WHO Cardiovascular Diseases (CVDs). WHO. Available at: <http://www.who.int/mediacentre/factsheets/fs317/en/>. Accessed on 20 July 2020.
3. Steel N. Global, regional, and national age-sex specific mortality for 264 causes of death, 1980-2016: a systematic analysis for the Global Burden of Disease Study 2016. *Lancet*. 2017;390(10100):1151-210.
4. Wu J, Lu F, Yang Y, Lin T, Chen J, Wu C, Huang Y, Chang C. Epidemiological Study on the Effect of Pre hypertension and Family History of Hypertension on Cardiac Autonomic Function. *J Am Coll Cardiol*. 2008;51:1896-901.
5. Julius S. Autonomic nervous system dysregulation in human hypertension. *Am J Cardiol*. 1991;67:3B–7.
6. Wang NY, Young JH, Meoni LA, Ford DE, Erlinger TP, Klag MJ. Blood pressure change and risk of hypertension associated with parental hypertension: the john's Hopkins precursor study. *Arch Intern Med*. 2008;168(6):643-8.
7. Pal GK, Pal P, Nanda N, Lalita V, Datta TK, Adithan C. Sympathovagal Imbalance in Prehypertensive. Offsprings of Two Parents versus One Parent Hypertensive. *Int J Hypertens*. 2011.
8. Task Force Report: Task Force of the European Society of Cardiology and The North American Society of Pacing and Electrophysiology. Heart Rate Variability: Standards of Measurement, physiological interpretation and clinical use. *Circulation*. 1990;93:1043-65.
9. Bailey JJ, Berson AS, Garson A Jr, Horan LG, Macfarlane PW, Mortara DW et al. Recommendations for standardization and specifications in automated electrocardiography. *Circulation*. 1990;81:730-9.
10. Krishnan M, Kabali B, Badanidiyur VR. Heart Rate Variability in Normotensive Subjects with Family History of Hypertension *Indian J Physiol Pharmacol*. 2011;55(3):253-61
11. Surekharani C, Anita H, Shailaja P, Shashikala G V, Roopa A. Comparative study of Heart Rate Variability in normotensive offsprings of hypertensive parents. *Biomedical Research* 2013;24(1):123-6
12. Prakash ES, Madanmohan, Sethuraman KR, Narayanan SK. Cardiovascular Autonomic Regulation in Subjects with Normal Blood Pressure, High-Normal blood pressure and Recent Onset Hypertension. *Clin Exper Pharmacol Physiol*. 2005;32(5-6):488-94.
13. Patel P, Diwan J, Shah C, Mehta H. Study of Heart Rate Variability in Hypertensive Subjects. *Natl J Integr Res Med*. 2015;6(1):1-6
14. Karthk S, Pal GK, Nivedita. Sympathovagal balance in thyroid dysfunction in females; correlation with thyroid profile, heart rate and blood pressure. *Indian J Physiol Pharmacol*. 2009;53:243–52.
15. Schroeder E, Liao D, Chambless L, Prineas R, Evans G and Heiss G. Hypertension, Blood Pressure, and Heart Rate Variability. The Atherosclerosis Risk in Communities (ARIC) Study. *Hypertension*. 2003;42:1106-1111.
16. Singh J, Larson M, Tsuji H, Evans J, O'Donnell C and Levy D. Reduced heart rate variability and new-onset hypertension: insights into pathogenesis of hypertension: The Framingham Heart Study. *Hypertension*. 1998;32:293–7.