ISSN: 0975-8585

Research Journal of Pharmaceutical, Biological and Chemical Sciences

The Assessment of Autonomic Status in Young Healthy Normotensive Subjects with and Without Parental History of Essential Hypertension.

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ABSTRACT

Normotensive subjects with a family history of hypertension are characterized by altered cardiovascular autonomic activity. To assess autonomic status in normotensive subjects with and without parental history of essential hypertension. Sixty young healthy normotensive subjects with (n = 30) and without (n = 30) parental history of essential hypertension were examined. Autonomic functions were assessed by heart rate variability analysis. The data were expressed as mean ± SD. The results were compared between the groups using SPSS software. Low frequency power in normalized units and Low frequency/High frequency ratio were significantly higher ($P<0.05$) and High frequency power in normalized units was significantly lower ($P<0.05$) in subjects with parental history of essential hypertension. Autonomic activity is impaired in hypertensive offspring. Thus, cardiovascular autonomic status in younger age group may help to identify those prone to develop hypertension in future life.

Keywords: Autonomic activity, Essential hypertension, Heart rate variability analysis

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INTRODUCTION

The autonomic drive to the heart with a normal sinoatrial (SA) node gives valuable insight the sympathovagal interplay [1]. The heart rate variability evaluates the SA node modulation by two interactive limbs of autonomic nervous system, namely sympathetic and parasympathetic nervous system [2-4].

The children of two normotensive parents had 3% possibility of developing hypertension whereas this possibility is 45% in children of both hypertensive parents [5]. Thus, the present study was planned to assess the autonomic activity in normotensive subjects of hypertensive parents.

MATERIAL AND METHOD

The present study was carried out in the upgraded Department of Physiology, SMS Medical College, Jaipur. Sixty non alcoholic, non smoking, young healthy normotensive medical students of either gender aged 18-25 years were recruited for the study after obtaining written informed consent to a protocol that was approved by the institutional ethics review board. A detailed history of subjects was taken with main emphasis on the parental history of essential hypertension.

Subjects were divided into two groups:

- Subjects with parental history of Essential Hypertension (FH^+, n=30)
- Subjects without parental history of Essential Hypertension (FH^-, n=30).

All subjects had normal medical history and physical examination. Autonomic evaluation was carried out in the morning from 10.00 to 12.00 noon, 2 hours after a light breakfast and after familiarizing the subjects with the test procedures. For the calculation of body mass index, body weight was measured in kilogram and height was measured in inch by using Stadiometer on scale (Feca 100 Jahre, Waagenbau). After 5 minutes of supine rest, blood pressure was taken by using mercury sphygmomanometer.

Heart rate variability (HRV)

Heart rate variability was recorded by the medical analyzer module based on principle of impedance plethysmography (NIVOMON, L & T) and analysis of signal was done in frequency domain measures. For short term analysis of HRV, impedance peripheral pulse in the right forearm was recorded in the supine position for 5 minutes after 10 minutes of supine rest. Room ambient temperature was maintained at $24\text{-}25^0$ C. The impedance peripheral pulse wave signals were continuously amplified, digitized and stored in the computer for offline analysis in frequency domains. The detection of impedance peripheral wave was digitally done by medical analyzer, Non-invasive Vascular Monitor (NIVOMON, L & T). Abnormal beats and areas of artifacts were automatically and manually identified and excluded from the study.

In the present study, the power spectrum is subsequently divided into three frequency bands: Very low frequency (VLF) (<0.04 Hz), Low frequency (LF) (0.04-0.15 Hz) and High frequency (HF) (0.15-0.4Hz). Powers of spectral bands are calculated in absolute units (ms^2) and normalized units (nu) [4]. The normalized units were calculated as:

- High frequency power in normalized units (HF nu) = (HF ms^2) / (LF ms^2 + HF ms^2) × 100)
- Low frequency power in normalized units (LF nu) = (LF ms^2) / (LF ms^2 + HF ms^2) × 100)[6].

Statistical analysis

Data are presented as mean ± standard deviation (SD). Statistical analysis was performed by using Student Unpaired‘t’ test for comparison between various measures of HRV in subjects with and without parental history of essential hypertension. The data were analyzed with the use of SPSS version 10 software packages. All P values were two tailed. Differences were considered statistically significant for P values < 0.05.

RESULTS

Table 1 depicts the demographic characteristics of studied subjects and no significant difference was observed between systolic blood pressure (SBP) and diastolic blood pressure (DBP) in both groups.

Comparison of Heart Rate Variability components between the study groups were demonstrated in Table 2. Total power, amplitude of LF power, amplitude of HF power, LF power in absolute units (LF ms^2) and HF power in absolute units (HF ms^2) in subjects with FH^+ and FH^- showed no significant differences. In contrast, the LF nu (49.81 ± 21.98) was significantly higher ($P<0.05$) and the HF nu (50.19 ± 21.98) was significantly lower ($P<0.05$) in subjects with FH^+ as opposed to the subjects with FH^- (LFnu=38.39 ± 16.49; HFnu=61.61 ± 16.49). The LF/HF ratio was significantly higher ($P<0.01$) in subjects with FH^+ (1.55 ± 1.46) as compared to the subjects with FH^- (0.75 ± 0.52).

Table 1: Demographic characteristics

Basal parameters	Subjects with FH^+ (n=30)	Subjects with FH^- (n=30)
Age (yr)	20.03 ± 1.52	19.93 ± 1.66
Height (cm)	161.57 ± 7.04	164.23 ± 10.21
Weight (kg)	56.9 ± 8.11	55.97 ± 8.93
BMI (kg/m^2)	21.73 ± 2.20	20.67 ± 2.07
SBP (mmHg)	117.57 ± 10.73	114.57 ± 7.18
DBP (mmHg)	73.67 ± 7.68	75.20 ± 6.76

Values are mean ± SD
BMI: Body mass index, SBP: Systolic blood pressure, DBP: Diastolic blood pressure, FH^+: Subjects with parental history of essential hypertension, FH^-: Subjects without parental history of essential hypertension.

Table 2: Comparison of heart rate variability components between the study groups

HRV Components	Subjects with FH^+ (n=30)	Subjects with FH^- (n=30)	P value
Total power (ms^2) (0.0 – 0.4 Hz)	1877.57 ± 2369.69	1123.42 ± 841.14	0.1059
Amplitude of LF power (ms)	4.48 ± 2.35	3.19 ± 1.58	0.0156
Amplitude of HF power (ms)	3.50 ± 2.98	4.80 ± 2.98	0.0988
LF power in absolute units (LF ms^2) (0.04 – 0.15 Hz)	478.65 ± 486.99	278.38 ± 314.40	0.0634
HF power in absolute units (HF ms^2) (0.15 – 0.4 Hz)	754.15 ± 1251.20	489.02 ± 451.59	0.2795
LF power in normalized units (LF nu)	49.81 ± 21.98	38.39 ± 16.49	0.0265*
HF power in normalized units (HF nu)	50.19 ± 21.98	61.61 ± 16.49	0.0265*
LF/HF ratio	1.55 ± 1.46	0.75 ± 0.52	0.0065**

Values are mean ± SD, *P<0.05, **P<0.01
HRV: Heart rate variability, LF: Low frequency, HF: High frequency
FH^+: Subjects with parental history of essential hypertension
FH^-: Subjects without parental history of essential hypertension

DISCUSSION

Autonomic functions were assessed by measurement of the variation in resting heart rate using frequency spectrum analysis of HRV. High frequency spectral power reflects parasympathetic modulation of RR intervals at respiratory frequency [7]. LF power in absolute units of power quantifies baroreflex mediated modulation of RR intervals in the 0.04-0.15 Hz range changes in sympathetic as well as vagal nerve traffic to heart are thought to contribute to LF power [8]. Total power calculated as the sum of LF and HF powers is also an index of overall HRV. The representation of LF and HF in normalized units emphasizes the controlled and balanced behavior of the two branches of autonomic nervous system [4]. The amplitude of LF or HF power is a measure of autonomic nervous system modulation of sinus node firing, and not a measure of global sympathetic and parasympathetic nervous system tone. However, the LF/HF ratio is used as an index of sympathetic-parasympathetic balance [9].

Present study examined the autonomic responsiveness in subjects with and without parental history of essential hypertension by using frequency spectrum analysis of HRV. We observed a significant higher LF nu ($P<0.05$), reduced HF nu ($P<0.05$) and higher LF/HF ratio ($P<0.01$) in subjects with FH^+ as opposed to subjects with FH^- [Table 2], consistent with the study of Sowmya *et al*, [10].

Consistent with present reports, Piccirillo *et al*, and Maver *et al*, also reported that higher spectral densities of low frequency in normalized units had a greater ratio of low-frequency to high-frequency powers (LF/HF) of R-R interval variability in normotensive persons with a positive family history of arterial hypertension compared to the persons with a negative history[11,12]. Moreover, Maver et al in 2004 observed a decreased high frequency power of the heart rate variability spectrum. They concluded that normotensives with a family history of hypertension exhibit altered sympathovagal balance with decreased parasympathetic activity at the cardiac level [12].

Contrary to the above studies, Shang Wu *et al*, found that FH^+ subjects had lower HF power than that of FH^- subjects but there was no difference in the square roots of LF/HF ratios between FH^+ and FH^-[13].

The above studies had shown that normotensive subjects with parental history of essential hypertension exhibit exaggerated sympathetic activity and reduced parasympathetic activity indicating altered sympathovagal balance as evidenced by increased LF (nu), LF/HF ratio and decreased HF (nu). Thus, the altered sympathovagal balance may be an early marker of cardiovascular changes in subjects with a genetic predisposition to hypertension. Autonomic imbalance may be because of the direct consequence of genetic defects or a result of the cardiac structural and functional abnormalities found in the offspring of hypertensive families [14].

CONCLUSION

Thus, we concluded that normotensives with a family history of hypertension exhibit altered sympathovagal balance with decreased parasympathetic activity at the cardiac level, suggesting that early diagnosis and treatment does have significant effect on cardiovascular autonomic activity. The ability to detect cardiovascular autonomic status in younger age group may help to identify those persons who are prone to develop hypertension later in their future life.

REFERENCES

[1] Davrath LR, Goren Y, Pinhas I, Toledo E, Akselrod S. Am J Physiol Heart Circ Physiol 2003; 285:H1697-H1704.
[2] Akselrod S, Gordon D, Ubel FA, Shannon DC, Barger AC, Cohon RJ. Science 1981; 213:220-222.
[3] Malliani A, Pagani M, Lombardi F, Cerutti S. Circulation 1991; 84:1482-1492.
[4] Task Force. Circulation 1996; 93(5):1043-1061.
[5] Bianchi G, Gatti M, Ferrari P, Picatti GB, Colombo G, Velis O. Lencet 1979; 1:172-177.
[6] Pichon A, Bisschop C, Diaz V, Denjean A. Chest 2005; 127:23-29.
[7] Madanmohan, Prakash ES, Bhavanani AB. Indian J Physiol Pharmacol 2005; 49(2):132-138.
[8] Berniston GG, Bigger JT, Eckberg DL, Grossman P, Kauffman PG, Malik M, et al. Psychophysiol 1997; 34:623-648.

[9] http:// patentscope.wipo.int/WO2007136851
[10] Sowmya R, Maruthy KN, Gupta R. Indian J Physiol Pharmacol 2009; 54(1):37–44.
[11] Piccirillo G, Viola E, Nocco M, Durente M, Tarantini S, Marigliano V. J Lad Clin Med 2000; 135(2):145-152.
[12] Maver J, Strucl M, Accetto R. Blood Press 2004; 13(2):95-100.
[13] Shang Wu J, Hwa Lu F, Yang YC, Sheng Lin T, Chen JJ, Hsing Wu C, et al. J Am Coll Cardiol 2008; 51:1896-1901.
[14] Pitzalis MV, Iacoviello M, Massari F, Guida P, Romito R, Forleo C, et al. J Hypertens 2001; 19:143-148.