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"Study of Status of Sympathovagal Balance in Offsprings with Family History of Hypertension and in Those without It"

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Abstract **Original Research Article**

Background: Autonomic functions, sympathetic and vagal/ parasympathetic, are found to be deranged in hypertensive subjects. The derangement of autonomic functions in terms of sympatho-vagal imbalance has also been found in off-springs of hypertensive people. ***Method:*** Spectral analysis of heart rate variability (HRV) was recorded in 30 subjects of control group & 30 subjects of case /study group(offsprings of hypertensive parents) before and after Hand Grip Test(HGT). Body mass index (BMI), basal heart rate (BHR), blood pressure (BP) was recorded at the outset. Spectral indices of HRV included Standard deviation of NN intervals (SDNN), total power (TP), normalized low frequency power (LFnu), normalized high frequency power (HFnu), ratio of low frequency power to high frequency power (LF-HF ratio), mean heart rate (mean RR), square root of the mean squared differences of successive normal to normal intervals (RMSSD) and the number of interval differences of successive NN intervals greater than 50 ms (NN50). ***Result****:* In study group SDNN & LF/HF finding was significant which means there is a sympathetic dominant effect. Pre and Posttest HGT and HRV values were found to be significant when study and control groups were compared. This means changes occur in sympathetic variables before actual onset of hypertension. No correlation was seen as regards to HRV & BMI. ***Conclusion***: It can be concluded that offsprings of Hypertensive parents tend to have some degree of autonomic imbalance before the actual onset of essential hypertension.

Keywords: Sympathovagal balance, family history of hypertension, Normotensives.

INTRODUCTION

Hypertension is a major cause of cardiovascular morbidity and mortality worldwide. It largely precipitates as a result of complex interaction of genetic and environmental factors, with heredity accounting for as much as about 30-60% of its expression [1]. Autonomic functions, sympathetic and vagal/ parasympathetic, are found to be deranged in hypertensive subjects [2-4]. The derangement of autonomic functions in terms of sympatho-vagal imbalance has also been found in off-springs of hypertensive people. And over time, with interplay of other environmental and acquired factors, it precipitates as hypertension in them [1, 5]. Most of the studies have been done in pre-hypertensive off-springs of hypertensive parents and at a later age where environmental modulation of genetic predisposition has already started taking place [5, 6]. Also, most studies have used either heart rate variability test (HRV) alone or the isometric handgrip test alone to explore sympatho-vagal balance; may involve giving different drugs to study the difference in the two arms of autonomic control [7]. "Heart rate variability" has become the conventionally accepted term to describe variations of both instantaneous heart rate and RR intervals. It is the oscillation in the interval between consecutive heartbeats as well as the oscillations between consecutive instantaneous heart rates [8]. Although cardiac automaticity is intrinsic to various pacemaker tissues, heart rate and rhythm are largely under the control of the autonomic nervous system [9]. The RR interval variations present during resting conditions represent a fine tuning of the beat-to-beat control mechanisms.

Efferent sympathetic and vagal activities directed to the sinus node are characterized by discharge largely synchronous with each cardiac cycle that can be modulated by central (vasomotor and respiratory centers) and peripheral (oscillation in arterial pressure and respiratory movements) oscillators.

These oscillators generate rhythmic fluctuations in efferent neural discharge that manifest as short- and long-term oscillation in the heart period [10].

Very few studies have been done exploring the hereditary manifestations in the off-springs when their blood pressure is still optimal i.e<120/80 mmHg i.e at a young age when effect of environmental factors is still less. Different studies have found different components of frequency domain analysis of HRV to be associated with cardiovagal function [8, 14]. By incorporating non-invasive tests in one study and comparing the results, how autonomic response is altered with genetic/ hereditary predisposition, at a young age when the individuals are still normotensive with BP < 120/80 mm of Hg, can be studied in a simpler manner. It is against this background the study was taken up.

Aim -To find out if autonomic responses are altered in those individuals who have atleast one parent having hypertension when their blood pressure is still optimal i.e<12/80 mm Hg.

MATERIAL AND METHODS

The study was conducted among First MBBS students of Jawaharlal Nehru Medical college, Sawangi (meghe) using Heart Rate Variability(HRV) during Deep breathing and Blood Pressure Response to Sustained Hand Grip Exercise test(HGT) for evaluating the sympatho-vagal responses in those subjects who have at least one parent having hypertension and in those whose parents do not have hypertension and comparing the two.

This was a case -control study involving a cross sectional examination of students/subjects / participants aged 17 – 19 years, both males and females. After obtaining an informal consent of subjects, their brief medical history and family history was taken. For the case group, history of hypertension in one or both parents was taken and its being secondary to any renal or endocrine cause was ruled out from history as well as checking of their medical records brought by the subjects. Participants having any condition which might affect their status of autonomic function like autonomic function disease, respiratory illness, cardiovascular illness, endocrine disease, renal disease, musculoskeletal disorder, tobacco and alcohol intake was excluded from the study. That who exercise regularly or perform yoga was also excluded from the study as these modulate the autonomic balance towards a favorable one. From a selection of those fulfilling the criteria of case group, having at least one hypertensive parent and control group whose no parent has hypertension, 30 subjects was selected by simple random sampling for each group. Those selected were asked to come to Autonomic Function Laboratory in the department of physiology on a specific day and time, having slept adequately on the night before and having taken a light meal, avoiding tea, coffee, alcohol, tobacco on that day. A complete history of the study participant was taken followed by their general clinical examination. Details regarding current medical illness, major past illness, current medication, personal history and medical history of his/her family was noted. Pulse rate, blood pressure and anthropometric values namely weight, height, waist circumference was noted.

The tests and measurements was performed as per following details-

Weight: using a digital weighing scale correct to nearest 100g with light clothing.

Height: using a stadiometer correct to nearest 1 cm.

Body mass index: was calculated using the formula weight divided by height(in meters) square.

Thereafter, they were instructed and given a demonstration of the autonomic function tests. After giving a rest of 5 minutes, the tests were carried out as per details given below-

1. Heart Rate Variability(HRV) at rest:

Normal 3 bipolar/ limb lead ECG recording for 5 minutes at rest using an automatic/ digital 12 channel ECG recording device was done. The HRV in frequency domain (LF, HF and LF/HF) was automatically calculated by the device from the resting ECG recording of 3 minutes and the result was recorded on thermal paper. Recording of HRV, was done based on the recommendation of the Task Force on HRV (11). ECG electrodes were connected and Lead II ECG was acquired at a rate of 1000 samples/second during supine rest using Polyrite. Frequency domain such as total power (TP), normalized LF power (LFnu), normalized HF power (HFnu), LF-HF ratio, and time-domain indices such as mean heart rate (mean RR), square root of the mean squared differences of successive normal to normal intervals (RMSSD), the number of interval differences of successive NN intervals greater than 50 ms (NN50), Standard deviation of NN intervals (SDNN) were calculated.

2. Heart Rate Variability (HRV) after Hand Grip Test (HGT)

The baseline BP was recorded. The subject was asked to press handgrip dynamometer at 30% of maximum voluntary contraction for 2 minutes. The BP was recorded at 1st minute and 2nd minute of contraction. ΔDBP_{IHG} (maximum rise in diastolic BP above baseline) was noted. Immediately after this, the HRV of the subject was done and noted.

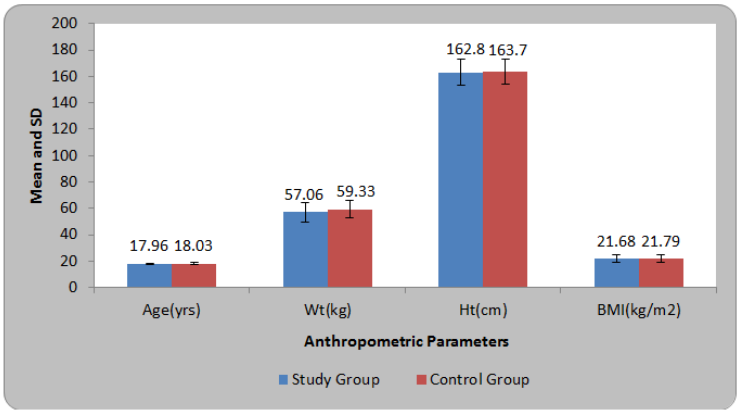
Statistical analysis was done by using descriptive and inferential statistics using Student's paired, unpaired t test and Pearson's Correlation Coefficient and software used in the analysis was SPSS

27.0 version and $p<0.05$ was considered as level of significance.

OBSERVATION

Table-1: Distribution of patients according to anthropometric characteristics in two groups Student's unpaired t test

Parameters	Study Group	Control Group	t-value	p-value
Age(yrs)	17.96±0.66	18.03±0.88	0.32	0.74,NS
Wt(kg)	57.06±7.45	59.33±6.64	1.24	0.21,NS
Ht(cm)	162.80±9.90	163.70±9.52	0.35	0.72,NS
BMI(kg/m2)	21.68±3.04	21.79±3.01	0.14	0.88,NS



Graph-1: Distribution of patients according to anthropometric characteristics in two groups

Table-2: Comparison of HRV values -Pre and Post test HGT in study group Student's paired t test

HRV values	Pre Test	Post Test	t-value	p-value
SDNN(ms)	71.64±10.27	73.08±9.52	3.15	0.004,S
RMSSD(ms)	60.33±12.36	59.23±12.91	1.10	0.26,NS
NN50	120.42±28.09	120.42±28.09	-	-
LF/HF	1.33±0.43	1.51±0.47	2.85	0.008,S
TP(ms2)	3762.64±1310.33	3762.64±1310.33	-	-

Table-3: Comparison of HRV values -Pre and Post test HGT in control group

HRV values	Pre Test	Post Test	t-value	p-value
SDNN(ms)	70.79±10.93	70.66±10.81	0.46	0.64,NS
RMSSD(ms)	59.80±12.30	59.52±12.31	2.09	0.045,S
NN50	119.40±27.29	119.40±27.29	-	-
LF/HF	1.38±0.38	1.40±0.43	1.10	0.28,NS
TP(ms2)	3769.29±1309.12	3769.29±1309.12	-	-

Table-4: Comparison of HRV values - Pre and Post test HGT in Study and Control group

HRV values	Study Group	Control Group	t-value	p-value
SDNN(ms)	73.08±9.52	70.66±10.81	0.92	0.36,**S**
RMSSD(ms)	59.22±13.51	59.52±12.31	0.08	0.93,**S**
NN50	120.42±28.09	119.40±27.29	0.14	0.88,**S**
LF/HF	1.51±0.47	1.40±0.43	0.90	0.37,**S**
TP(ms2)	3762.64±1310.33	3769.29±1309.12	0.02	0.98,**S**

Table-5: Correlation of HRV values between Posttest HGT in Study group with BMI.

HRV values	Mean	SD	r-value	p-value
SDNN(ms)	73.08	9.52	0.26	0.15,**NS**
RMSSD(ms)	59.22	13.51	0.22	0.24,**NS**
NN50	120.42	28.09	-0.04	0.83,**NS**
LF/HF	1.51	0.47	0.11	0.53,**NS**
TP(ms2)	3762.64	1310.33	0.14	0.43,**NS**

RESULT

Table 1- Finding not significant which means both groups are matcheable.
Table 2- In study group SDNN & LF/HF finding is significant which means there is sympathetic dominant effect.
Table3- In control group significant finding in RMSSD variable.
Table 4- Finding is significant when HRV values of Pre and Posttest HGT in Study and Control group were compared. This means changes occur in sympathetic variables before actual onset of hypertension.
Table5- No correlation as regards to HRV & BMI.

DISCUSSION

The effects of modulation of neural mechanisms on the sinus node is understood by spectral analysis of HRV. The efferent vagal activity is a major contributor to the HF component and the sympathetic modulation to LF component.

As remarkable decrease in total power of HRV may not be associated with proportionate alterations in LF and HF power, decreased HRV representing poor vagal modulation of cardiac activities could possibly manifest with decreased LF-HF ratio [11]. Therefore, changes in LF-HF ratio should preferably be corroborated with the results of classical autonomic functions tests such as heart rate and blood pressure responses to orthostatic challenges, deep breathing and isometric handgrip [12]. G. K. Pal *et al*. 2011 in their study on Sympathovagal Imbalance in Prehypertensive Offspring of Two Parents versus One Parent Hypertensive found that the LF-HF ratio of prehypertensive subjects (Groups III and IV) was significantly higher than that of normotensive subjects (Groups I and II) indicating a considerable sympathovagal imbalance (SVI) in prehypertensives as LF-HF ratio is a marker of sympathovagal balance [11, 13]. In our study too, a significant finding was obtained in SDNN & LF/HF variable of study group.

Mario Estévez-Báez *et al*. in their study on Influence of Heart Rate, Age, and Gender on Heart Rate Variability in Adolescents and Young Adults found that heart rate produced more significant effects on HRV indices than age or gender [14].

In line with our study,Amrendra Jha *et al*. 2018 in their research on Time and Frequency Domain Analysis of Heart Rate Variability (HRV) In Response to Cold Stress in Subjects with Family History of Hypertension, found RMSSD was decreased (p value= 0.042) and SDNN was increased (p value= 0.048: borderline) post-CPT in subjects with family history of hypertension, suggesting that some amount autonomic dysfunction is manifested at early age [15].

Unlike our study Chen *et al*., 2016 found reduction in the ratio of low-frequency power to high-frequency power (the LF/HF ratio) and increment in the normalized high-frequency power (HFnu) during the stress tests [16].

On similar lines with our study Camm *et al*., 2004; Muralikrishnan *et al*., 2011 found that basal LFnu (normalized unit) and LF/HF ratio were significantly higher while the basal HFnu was significantly lower in the study group compared to control group, LF power was significantly increased in the study group. HF power was decreased in the study group [17, 18].

RMSSD value post-HGT was lower in the study group in our study which points to decreased parasympathetic tone in subjects with family history of hypertension. This is in line with existing views that decreased parasympathetic tone is one of the factors leading to hypertension in adults. This also shows that autonomic imbalance start at an early age, which results in increased risk of hypertension in future.

CONCLUSION

Our study showed a decreased RMSSD and increased SDNN post HGT. It can be concluded that offsprings of Hypertensive parents tend to have some degree of autonomic imbalance before the actual onset of essential hypertension. This fact should be taken into consideration and appropriate lifestyle modification measures should be incorporated in daily life for such subjects.

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