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RESEARCH ARTICLE

HEART RATE VARIABILITY DUE TO ISOMETRIC HAND GRIP ON CHILDRENS OF HYPERTENSIVE PARENTS

[1]Dr. Hemlata Gupta and [2,*]Dr. Ram Krishna Gupta

[1]Assistant Professor, Department of Physiology, Lakhiram Agrawal Medical College, Raigarh, Chhattisgarh
[2]Associate Professor, Department of Plastic Surgery, Cancer Hospital and Research Institute, Gwalior, M.P

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ABSTRACT

Background- One of the primary pathologies associated with hypertension is a complex autonomic malfunction with evidence of sympathetic hyperactivity and/or vagal withdrawal. **Objectives-** To assess the possibility for early detection of hypertension in children of hypertensive parents based on analysis of effect of Isometric Hand Grip (IHG) and heart rate variability. **Material and Methods**: 100 young, normotensive male offspring of normotensive parents (control group) and 100 young, normotensive male offspring of hypertensive parents (test group) of similar body mass index participated in this study. Heart rate variability was recorded at baseline, during Isometric hand grip and after 5 minutes after isometric hand grip. **Results:** There was no significant difference seen in both groups in baseline parameters of heart rate variability. Low frequency in normalised unit (LFnu), Low frequency/ High Frequency (LF/HF) ratio were significantly increased and High frequency in normalised units (HFnu) was significantly decreased during isometric hand grip in test group. **Conclusion:** These results indicate the early existence of malfunctions in both branches of autonomic control in individuals at increased risk of hypertension.

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INTRODUCTION

Essential Hypertension is a multifaceted progressive disease process spanning several decades of life. In all, 25% of children with one hypertensive parent and 50% of children with two hypertensive parents will eventually become hypertensive (Olson, 1987; Julius *et al*., 1983) demonstrating that hereditary plays major role in development of disease. Essential Hypertension is characterized by an increase in sympathetic nervous system activity and reduced vagal modulation of sinoatrial node (Lopes *et al*., 2000). Previous studies had shown that there is increased sympathetic activity in offspring of hypertensive parents before exercise and a greater response during isometric exercise (Schneider *et al*., 2003). It is also reported that cardiovascular hemodynamic response to repeated mental stress in normotensive offspring of hypertensive parent show enhanced reactivity, blunted adaptations and delayed recovery (Steptoe, 2005). Normotensive offspring of hypertensive parents are at increased likelihood to develop hypertension but discernible differences in resting state are unlikely, so we include autonomic challenge i.e. 30% maximal voluntary contraction isometric hand grip in experimental protocol. Spectral analysis of heart rate variability has recently been used as sensitive tool for assessment of autonomic dysfunctions in various clinical disorders (Jain, 2003). The rationale of the present study was to unveil malfunctions in autonomic control in subjects genetically predisposed to hypertension.

MATERIAL AND METHODS

Study settings- The present study was carried out in Functional test Laboratory of Department of Physiology, LAMC, Raigarh, Chhattisgarh. Study Design- Prospective Case Control study.

***Corresponding author:* Dr. Ram Krishna Gupta,**
Assistant Professor, Department of Physiology, Lakhiram Agrawal Medical College, Raigarh, Chhattisgarh.

Sample Size- The study was conducted on 200 young healthymales (100 case and 100 controls) aged 18 to25 years. Inclusion Criteria- Healthy, normotensive subjects who were non-smokers and non-alcoholic were included in the study. Exclusion Criteria- Subjects regularly practicing athletic activities, history of any respiratory, cardiovascular, endocrine and neurological disorders, suffering from Diabetes Mellitus were excluded from the study. An informed consent was taken from the subjects. A detailed relevant clinical history about the subjects and their parents was obtained from them. Ethical Approval- The Institutional Review Board of LAMC, Raigarh approved this non-invasive study.

Methodology- Subjects were asked to report in laboratory between 10:00am to 12:00 noon after having a light breakfast 1hr before arrival. Subjects were instructed to abstain from the use of caffeine and other stimulants for 24hr before the study. Subjects were reported to empty their bladder before the experiment. Height was measured using a standard stadiometer. Weight was measured using calibrated weighing machine. Body mass index was calculated as the weight in kilograms divided by the square of height in meters. Autonomic function of subjects by HRV analysis was recorded after making them comfortable by resting them in supine posture for 15 minutes. This recording was considered as basal recording. After baseline HRV, subjects were asked to perform isometric hand grip test. HRV was recorded during the test and at 5 minutes after completion of isometric hand grip test. Isometric hand grip: The subjects were asked to hold the hand dynamometer in right hand to have a full grip of it. Then the subject was instructed to compress the dynamometer with maximum effort and developed tension was measured. This was maximal isometric tension (T max). After one minute the subject was asked to maintain a pressure of 30% T max for 5minutes (Hausberg *et al*., 1998). Heart rate variability: Heart rate variability was recorded by the Medical Analyzer module based on principle of Impedance

Table 1. Comparison of Power and ratio of Low frequency and High frequency of HRV among cases ad controls at rest, during and after 5 minutes of Isolated hand grip

Parameters	Cases			Controls		
	At rest	during IHG	5min post IHG	At rest	During IHG	5 min post IHG
Power	1740.78±1412.10	1830.80±1298.46	2100.30±2016.24	2060.40±2901.20	2150.60±2216.48	2780.32±3780.60
LF/HF	1.11±0.91	1.23±0.95*	1.21±1.45	0.91±1.22	0.98±1.34	0.92±0.64

*p<0.05 is significant.

Table 2. Comparison of Power and ratio of Low frequency and High frequency in normalised units of HRV among cases ad controls at rest, during and after 5 minutes of Isolated hand grip

Parameters	Cases			Controls		
	At rest	during IHG	5min post IHG	At rest	During IHG	5 min post IHG
LFNu	45.54±16.78	52.20±14.54*	48.87±17.21	41.20±16.78	42.32±15.44	40.98±14.22
HFNu	54.43±20.32	52.22±16.78*	48.98±17.68	54.98±14.20	56.04±10.12	53.22±12.34

Table 3. Comparison of Power and ratio of Low frequency and High frequency power of HRV among cases and controls at rest, during and after 5 minutes of Isolated hand grip

Parameters	Cases			Controls		
	At rest	during IHG	5min post IHG	At rest	During IHG	5 min post IHG
LF power	402±78.88	506±54.78	768.88±90.98*	370.34±68.54	478.20±112.22	420.20±46.86
HF power	644.42±12.12	546.54±34.02	624.32±24.22	770.98±22	746.34±32.20	556.78±20

Plethysmography (Nivomen, L & T) and analyses of signal was done in frequency domain measures. All recording were visually examined and manually corrected if required. Abnormal beats and area of artefacts were identified and excluded from the study. Power spectral density (PSD) analysis provides analysis of tachogram. The frequency components of HRV were analyzed by using Fast Fourier Transform (FFT). Subjects was instructed to breath quietly during the entire recording period with closed eyes and to avoid talking, moving hands, legs and body, coughing and sleeping.

Statistical Analysis: The recorded observations were fitted into Epi-info software for analysis. Data was offered as Mean ± SD. Paired't' test was applied between baseline indices of HRV and indices of HRV during IHG, and between indices of HRV at baseline and at 5 minutes post IHG. P<0.05 was considered statistically significant.

RESULTS

Table 1 shows no significant difference in total power of both the groups. However, significant difference was seen during IHG in the LF/HF ration in cases. A per table 2significant difference was seen during IHG in both normalised units in cases. No significance was seen at rest, or post IHG. Table 3 shows no significant difference in power of HRV among both cases and controls. There is significant increase in LF power at 5 minutes post IHG as compared to LF power at rest. There is no significant effect of IHG on HF power in both groups.

DISCUSSION

In present study it is found that values of HRV parameters at rest do not differ between two groups. LFnu, LF/HF ratio are significantly increased and HFnuis significantly decreased during IHG in test group in comparison to control group indicating hyper responsiveness of sympathetic nervous system to stress in test group in comparison to control group. In present study it is found that HRV parameters at rest do not differ between two groups. This is in accordance of previousstudies (Hausberg *et al*., 1998; Yamada *et al*., 1988) that no signs of difference in sympathetic nervous system activity measured by 24 hours urinary catecholamine excretion or venous plasma concentrations of nor epinephrine and epinephrine was observed in offspring of hypertensive parents. In present study there is increased sympathetic activity during IHG. Grassi G *et al*. observed that adrenergic activation in hypertension isnot a consequence of high BP state but rather plays apathogenic role in its occurrence (Grassi, 1998). It triggers the elevation in BP and favours the maintenance of hypertensive state. Noll G *et al* did not find differences in sympathetic activity before exercise in offspring of hypertensive parents but found a greater increase in sympathetic activity during mental stress (Noll *et al*., 1996).

Davrath LR found increased LF/HF ratio during IHG which is in accordance of present study (Davrath *et al*., 2003). In present study it is observed that there is decreased parasympathetict one during recovery in test group and Grossman P *et al.* suggested that parasympathetic tone decreases as hypertension progress (Grossman *et al*., 1992).

Conflict of Interest: None declared

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