

Original Research Article

## **Study of Autonomic Functions- Hert Rate and Blood Pressure in Normotensive, Young Healthy Offspring of Hypertensive Parents and Normotensive Parents**

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**Abstract:** Essential hypertension is a 'silent killer' and a major health challenge in all countries of the World. The purpose of study was undertaken to identify early autonomic dysfunction in individuals with parental history of essential hypertension. Present study was conducted to determine differences in cardiovascular reactivity and recovery. Comparison was done between normotensive, young healthy offspring of hypertensive parents (40 cases) and normotensive parents (40 controls). Autonomic functions were assessed by RMS Digitized Polygraph Polyrite D Version 2.4 and analysis of signal was done in time and frequency domain measures. After recording baseline HRV (heart rate variability), HR (heart rate) and BP (blood pressure) subjects were asked to do isometric hand grip (IHG) test. HRV, BP and HR were recorded during the test and 5 minutes after completion of IHG. Comparison was done by paired and unpaired t test. Baseline HR was significantly more in male test group than control group. HR increased significantly during IHG in both control and test group but test group showed delayed recovery after 5 minutes of IHG. Increase in SBP was significantly more in male test group than male control group ( $p < 0.05$ ). SBP and DBP showed delayed recovery after 5 minutes of IHG in test groups. The study indicates the early existence of malfunctions in autonomic nervous system associated with increased risk of hypertension.

**Keywords:** IHG, HR, BP, RMS Digitized Polygraph Polyrite D

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### **INTRODUCTION**

Essential hypertension [1] affecting 95% of hypertensive patients has no identifiable cause [2-4]. According to Joint National Committee report (JNC 8), blood pressure  $\geq 140/90$  mmHg is hypertension [5]. Various risk factors associated with hypertension are obesity [6], salt sensitivity [7], genetics [8], obstructive sleep apnea [9], insulin resistance [10], sympathetic over activity [11, 12] etc. Despite awareness of multiple risk factors, pathophysiology of hypertension remains ambiguous.

### **MATERIAL AND METHOD**

The prospective study was carried out in the Department of Physiology, J. L. N. Medical College, Ajmer, from 2015 to 2016 study A total of 80 subjects (age 17 to 25 years) were included (40 cases and control each). The subjects were classified into four groups: group A (n=20) Male subjects without family history of hypertension. Group B (n=20) Female subjects without

family history of hypertension. Group C (n=20) Male subjects with family history of hypertension. Group D (n=20) Female subjects with family history of hypertension. The subjects were of similar nutritional status assessed by body mass index. Subjects taking any type of medications especially those affecting autonomic activity, Cardio respiratory disease, and Thyroid disease, Diabetes Mellitus, Smokers and Alcoholic were excluded from. The study protocol was explained to subjects after obtaining informed written consent to participate in the study. A detailed history and clinical examination was done. The study was carried out between 9:30 am-12:00 pm after emptying bladder, consuming a light standard breakfast 1½ to 2 hrs before arrival. Subjects were asked to abstain from the use of caffeine and other stimulants 12 hrs before the study and strenuous exercise 24 hrs before the study. Room ambient temperature was maintained between 24-25°C. Subject was instructed to breathe quietly during the entire recording period with closed eyes

Basal Heart Rate, Blood Pressure and Autonomic function of subjects by HRV analysis was recorded after making them comfortable by resting in supine posture for 15 minutes. Blood Pressure and Heart Rate Variability was recorded by RMS Digitized Polygraph Polyrite D; Version 2.4 and analysis of signal was done in time and frequency domain measures. After baseline HRV, subjects were asked to do Isometric Hand Grip test. HRV was recorded during the test and 5 minutes after completion of Isometric Hand Grip test. BP and Heart Rate was recorded at rest (Baseline), 4 minutes after initiation of IHG and 5 minutes after completion of IHG. The subject was instructed to compress the hand dynamometer (right hand) 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% of  $T_{max}$ . The

Impedance Peripheral Pulse wave signals were continuously amplified, digitized, and stored in the computer for offline analysis in Frequency domain and Time domain.

**Analysis of data**

Collected data were entered in computer based Microsoft Excel sheet. Comparisons were done by applying Student’s ‘t’ test (paired and unpaired), using PRIMER software.

**OBSERVATIONS**

In present study Systolic Blood Pressure (SBP), Diastolic Blood Pressure (DBP), and Heart Rate (HR) were measured at rest (Basal), during (i.e. with the initiation of IHG for 5 minutes) and after 5 minutes of IHG.

**Table1: Heart rate, systolic blood pressure and diastolic blood pressure**

|     | A       |            |             | B       |            |             | C       |            |             | D       |            |             |
|-----|---------|------------|-------------|---------|------------|-------------|---------|------------|-------------|---------|------------|-------------|
|     | Resting | During IHG | After 5 min | Resting | During IHG | After 5 min | Resting | During IHG | After 5 min | Resting | During IHG | After 5 min |
| HR  | 81±11   | 92±20      | 83±12       | 81±11   | 97±15      | 86±5.6      | 83±14   | 92±14      | 85±9.1      | 89±17   | 96±17      | 86±11       |
| SBP | 116±6.1 | 124±8.4    | 114±7.3     | 114±6.3 | 119±6.5    | 113±6.6     | 119±8.5 | 124±10     | 116±7.9     | 114±8.3 | 123±8.4    | 117±7.1     |
| DPB | 73±8.8  | 79±7.2     | 71±6.5      | 70±7.9  | 75±8       | 65±9.6      | 75±8.2  | 80±9.7     | 74±14       | 75±9.6  | 79±9.2     | 73±8.3      |

**Table1- A: p value paired t test**

| Group           |                        | A     | B     | C     | D     |
|-----------------|------------------------|-------|-------|-------|-------|
| Study Parameter |                        |       |       |       |       |
| HR              | At rest and during IHG | 0.008 | 0.000 | 0.002 | 0.090 |
|                 | At rest and post IHG   | 0.162 | 0.016 | 0.554 | 0.452 |
| SBP             | At rest and during IHG | 0.001 | 0.000 | 0.002 | 0.000 |
|                 | At rest and post IHG   | 0.106 | 0.190 | 0.100 | 0.113 |
| DBP             | At rest and during IHG | 0.000 | 0.002 | 0.003 | 0.226 |
|                 | At rest and post IHG   | 0.009 | 0.064 | 0.513 | 0.439 |

**Table1-B: p value unpaired t test**

| Group           |               | At rest | During IHG | Post IHG |
|-----------------|---------------|---------|------------|----------|
| Study Parameter |               |         |            |          |
| HR              | Group A and C | 0.618   | 1.000      | 0.556    |
|                 | Group B and D | 0.085   | 0.845      | 1.000    |
| SBP             | Group A and C | 0.207   | 1.000      | 0.411    |
|                 | Group B and D | 1.000   | 1.000      | 0.073    |
| DBP             | Group A and C | 0.462   | 0.713      | 0.390    |
|                 | Group B and D | 0.730   | 0.151      | 0.008    |

The changes in HR were significant when comparisons were done between resting HR and HR during IHG in group A, B & C But not significant in group D. However, changes in HR were significant in test group (Group B) at rest and at 5 minutes post IHG. Heart rate at different phases of IHG in group A and C

were not significantly different at all phases of IHG. Observed mean values of HR were higher in group D than group B at all phases of IHG (table No. 1). HR during at rest, IHG and at 5 minutes post IHG between group B and D showed statistically no significant difference.

SBP were not significant in all groups when comparisons were done between SBP at rest and at 5 minutes post IHG. No statistical significant difference were observed in SBP at rest, at 5 minutes post IHG and during IHG between group A and C. SBP at different phases of IHG in group B and D. Observed mean values of SBP were higher in group D than group B during IHG and at 5 minutes post IHG which were statistically not significant (table No. 1).

The changes in DBP were significant when comparisons were done between resting DBP and DBP during IHG in groups A, B and C but not significant in group D. However, changes in DBP were not significant in all groups at rest and at 5 minutes post IHG. Observed mean value of DBP was higher in group C at all stages as Compared to group A. No significant difference observed when comparisons were done of mean values at rest and during IHG and at 5 minutes of post IHG in between group A and C (table 1 and Fig. 5). Observed mean values of DBP were higher in group D than group B at all phases of IHG. No significant differences were observed between mean values of DBP of group B and D at rest and during IHG but there was statistical difference observed between group B and D at 5 min post IHG (table No. 1).

## **DISCUSSION**

There is a controversy about whether normotensive children of hypertensive parents have an increased sympathetic response to stress. Such a response could produce a hyperactive sympathetic response which in turn may lead to the development of hypertension. Present study was conducted to determine if there were differences in cardiovascular reactivity (initial stress response) or recovery (time required to return to baseline) between normotensive, young offspring of hypertensive parents and normotensive offspring of normotensive parents.

### **Effect of IHG on Heart rate**

Baseline HR was significantly different ( $p < 0.05$ ) between group A and group C. Mean values of baseline HR was significantly greater in group C. HR increased significantly during IHG in both control and test group but returned to baseline only in control group i.e. delayed recovery was shown in test group. The increase in HR during IHG was significantly ( $p < 0.05$ ) greater in the group.

There was evidence that the early Heart Rate increase during Sustained Hand Grip was due to vagal withdrawal whereas the tachycardia that followed was a

result of sympathetic activation. Thus the greater increase in heart rate in test group during IHG indicates hyperactive sympathetic nervous system and reduced vagal tone in test group [13-18].

### **Effect of IHG on SBP**

There was significant increase in SBP during IHG in all four groups but this increase was significantly greater ( $P < 0.05$ ) in C group when comparison was done between group A and C. Increase in SBP during IHG did not return to baseline in study group i.e. delayed recovery was shown in test group. This finding was further strengthened by significant difference ( $P < 0.001$ ) between mean values of SBP at 5 minutes post IHG in group-A and C. In present study both groups had an increase in SBP during IHG however the test group had a significantly greater response as compared with control group [14, 19-21]. In present study increase in SBP showed delayed recovery in study group.

### **Effect of IHG on DBP**

All four groups did not exhibit significant difference in baseline diastolic pressure. DBP increased during IHG in both test and control group but this increase was not significantly different between test and control group. In test group, DBP showed delayed recovery i.e. DBP did not return to baseline at 5 minutes post IHG. This was further strengthened by significant difference ( $P < 0.01$ ) between mean values at 5 minutes post IHG in group A and C [13, 14, 16, 21]. Diastolic blood pressure response could be predictor of future development of hypertension. Thus both SBP and DBP increased during IHG but showed delayed recovery after 5 minutes of IHG in the test group. This can be explained by hypothesis of Julius *et al.*; [15], Brist [22] and Sherwood *et al.*; [23] that there is initial state of myocardial activation (high cardiac output) [24] progressing to a later state of increased peripheral resistance in offspring of hypertensive parents.

### **Potential Implications of the Study**

Identification of individuals prone to hypertension may be possible with the use of these noninvasive techniques, by establishing a set of threshold values for autonomic responses to challenges, such as change in posture and IHG. Evidence of elevated sympathetic activation [24] can be targeted as primary goal in the prevention and treatment of HT.

## **CONCLUSION**

It can be deduced from present study that there is enhanced sympathetic activity during IHG in test

group and on recovery from IHG; vagal reactivation is more sluggish in test group. Current study indicates that early existence of malfunctions [24] in both branches of autonomic nervous system in individuals at increased risk of hypertension.

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