

A COMPARATIVE STUDY OF CARDIOVASCULAR RESPONSE TO ISOMETRIC HAND GRIP EXERCISE IN OFFSPRING OF HYPERTENSIVE AND NORMOTENSIVE PARENTS

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ABSTRACT

Blood pressure and heart rate response to isometric hand grip exercise were studied in young (age 17-25 years) normotensive men with parental history of hypertension (n=27) and in young normotensive men with normotensive parents (n=27) with an aim to find whether subjects with positive family history established a different pattern of blood pressure and heart rate responses during isometric hand grip exercise. Blood pressure and heart rate were recorded at rest (baseline), at 4 minutes after initiation of isometric hand grip (IHG) and after 5 minutes of completion of isometric hand grip. Baseline heart rate ($p < 0.05$) was significantly higher in test group. Baseline blood pressure did not differ between the two groups. Heart rate increased during the IHG in both groups with greater increase ($p < 0.01$) in test group. Heart rate showed delayed recovery ($p < 0.001$) i.e. time taken to return to baseline, in test group. Systolic blood pressure showed greater increase during IHG ($p < 0.05$) and delayed recovery ($p < 0.001$) in test group. We conclude that normotensive subjects with positive family history of hypertension were characterized by increased heart rate and blood pressure responses during IHG and delayed recovery after 5 minutes of completion of IHG as compared with subjects with negative family history. Such increased responsiveness to IHG could be related to subsequent development of high blood pressure in subjects predisposed to essential hypertension.

Keywords: *Isometric Hand Grip (IHG), Heart Rate, Systolic Blood Pressure (SBP), Diastolic Blood Pressure (DBP), Normotensive Essential Hypertension*

INTRODUCTION

Essential hypertension is multifaceted progressive disease process spanning over several decades of life. Twenty five percent of children with one hypertensive parent and 50% of children with two hypertensive parents will eventually become hypertensive demonstrating that heredity plays a major role in development of hypertension (Olson and Kroon, 1987).

There is still a controversy whether normotensive offspring of hypertensive parent have an inherent increased sympathetic response to stress i.e. IHG and such increased sympathetic response may lead to development to hypertension with time.

Present study was conducted to determine if there is difference in cardiovascular reactivity (initial stress response), and/or recovery (time required to returned to baseline levels) between the normotensive, young offspring of hypertensive parents (test group) and normotensive offspring of normotensive parents (control group).

Previous studies have shown that repeated pressor stress may lead to sustained hypertension (Jenkins CD *et al.*, 1984) and hypertensive subjects recover more slowly than normotensive after laboratory induced behavioral stress (Davath *et al.*, 2003; Fredrikson and Engel, 1985). Normotensive offspring of hypertensive parents also show persistent elevation of systolic blood pressure during recovery from exercise suggestive of enhanced cardiovascular response to physical stress (Biagini *et al.*, 1996; Sowmya *et al.*, 2009). Several studies have also shown delayed blood pressure recovery (de Visser *et al.*, 1995; Gerin and Pickering, 1995) as well as increased reactivity to laboratory stress in normotensive offspring of hypertensive parents (Hastrup *et al.*, 1982; Sausen *et al.*, 1991).

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MATERIAL AND METHODS

Present study was conducted in S.M.S. Medical College after selecting fifty four male students of age group 17-25years by simple random technique and after taking approval from Research Review Board of S.M.S. Medical College, Jaipur. Subjects included were healthy normotensive males whose either or both parents have history of hypertension and subjects excluded who were taking any type of medication especially those affecting cardiovascular parameters and having cardiovascular disease, thyroid disease, diabetes mellitus. Smoker and alcoholics did not form the part of study cohort. The study protocol was explained to the subjects after obtaining informed written consent to participate in study. Parental history of essential hypertension was ascertained from the medical prescription of hypertensive parents. The study was conducted between 9:00am-12:00pm after emptying bladder, consuming light breakfast 1-2hrs before arrival. Subjects were asked to abstain from the use of caffeine and other stimulants 12hrs before the study and strenuous exercise 24hrs before the study. Heart rate was recorded manually after counting radial pulse for 1minute. Blood pressure was recorded by mercury sphygmomanometer in supine posture in left arm. After resting in supine posture for 15 minutes baseline HR and BP was taken. Subjects were asked to do IHG. BP and HR were recorded 4 minutes after initiation of IHG and 5 minutes after completion of IHG.

Isometric Hand Grip (IHG) (Misra and Kalita)

The subjects were asked to hold the hand dyanometer in right hand to have a full grip of it. Then the subject was instructed to compress the dyanometer with maximum effort and developed tension was measured. This was maximal isometric tension (T_{max}). After 1 minute of rest the subject was asked to maintain the pressure of 30% of T_{max} for 5 minutes.

Statistical Analysis of Data

Data are presented as Mean \pm standard deviation. Mean and standard deviation of the observations for all the parameters were calculated and comparison was done by applying student 't' test (paired and unpaired).

RESULTS AND DISCUSSION

Subject Matching

There was no significant difference between two parental history groups hence the study group can be considered as homogenous group.

Two groups did not show significant differences in baseline SBP and DBP. Heart rate was significantly higher ($p < 0.05$) in test group than control group at rest.

Table 1: Baseline characteristics of test group and control group

Variables	Control group	Test group	P values
BMI(kg/m ²)	20.53 \pm 3.22	21.39 \pm 2.19	NS
HR(bpm)	73.29 \pm 9.99	80.26 \pm 9.68	P<0.05
SBP(mmHg)	114.04 \pm 8.47	115.7 \pm 7.76	NS
DBP(mmHg)	74.51 \pm 11.7	74.18 \pm 8.99	NS

NS-not significant ($p > 0.05$)

Table 2: Effect of IHG on HR, SBP and DBP

Parameters	Control group (n=27)			Test group (n=27)		
	At rest	During IHG	At 5 minutes IHG	At rest	During IHG	At 5 minutes IHG
HR(bpm)	73.29 \pm 9.99	77.4 \pm 10.58®	72.62 \pm 8.86	80.26 \pm 9.68≠	86.63 \pm 10.95®	84.81 \pm 10.39®≠
SBP(mmHg)	114.07 \pm 8.47	124.81 \pm 10.78®	115.11 \pm 7.87	115.7 \pm 7.76	133.07 \pm 12.54®≠	128.81 \pm 9.87®≠
DBP(mmHg)	74.51 \pm 11.17	85.03 \pm 12.76®	74.44 \pm 12.2	74.18 \pm 8.99	89.0 \pm 12.44®	82.4 \pm 9.86®≠

®depicts comparison with parameters at rest (paired 't' test) ® $p < 0.05$

≠ depicts comparison with control group (unpaired 't' test) ≠ $p < 0.05$

Data presented are mean \pm SD, $p < 0.05$

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Two groups did not show significant differences in baseline SBP and DBP whereas heart rate at rest was significantly higher ($p < 0.05$) in test group than control group.

Both heart rate and BP increased significantly with IHG. Change in heart rate during IHG was significantly ($p < 0.05$) greater in test group (80.26 ± 9.68 bpm in test group and 73.29 ± 9.99 bpm in control group increased to 86.63 ± 10.95 bpm and 77.4 ± 10.58 bpm respectively). HR returned to baseline only in control group after 5 minutes of IHG i.e. delayed recovery was shown in test group.

SBP increased significantly in both groups during IHG but this increase was significantly greater ($p < 0.05$) in test group than control group (115.7 ± 7.76 mm Hg in test group and 114.07 ± 8.47 mm Hg in control group increased to 133.07 ± 12.54 mm Hg and 124.81 ± 10.78 mm Hg respectively) Increase in SBP during IHG did not returned to baseline in test group (ie. delayed recovery). This finding was further strengthened by significant difference ($p < 0.001$) between mean values of SBP at 5 minutes post IHG in test group and control group.

DBP increased during IHG in both test and control group. But this increase was not significantly different between test group and control group. In test group DBP showed significant ($p < 0.05$) delayed recovery ie. DBP did not returned 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 test and control group.

Discussion

Increased blood pressure and heart rate responsiveness (both absolute levels and relative changes from baseline) were observed during IHG exercise in subjects with positive family history of hypertension. This support the hypothesis of increased central and peripheral cardiovascular responsiveness to different stressors in normotensive subjects predisposed to development of primary hypertension.

Increased HR responses to IHG and delayed recovery of HR at 5 minutes post IHG are in accordance with those observed by Julius *et al.*, (1978), Ditto *et al.*, (1989), Pickering G¹⁹ (1995), Schneider GM *et al.*, (2003), Lopes *et al.*, (2008).

There was an evidence that the early HR increase during IHG was due to vagal withdrawal whereas the tachycardia that followed was a result of sympathetic activation. Thus the greater increase in HR in test group during IHG indicates hyperactive sympathetic nervous system and reduced vagal tone.

Significantly greater increase in SBP during IHG in test group and significant delayed recovery of SBP and DBP in test group at 5 minutes post IHG was observed. This was in accordance of Ditto *et al.*, (1989), Widgren *et al.*, (1992), Walia *et al.*, (1994), Kasagi *et al.*, (1995), Schneider GM *et al.*, (2003), Lopes *et al.*, (2008).

This can be explained by hypothesis of Julius *et al.*, (1978); Obrist (1981) and Sherwood *et al.*, (1986) that there is an initial state of myocardial activation (high cardiac output) progressing to a later state of increased peripheral resistance in offspring of hypertensive parents. The enhanced cardiovascular response to IHG in test group suggests that the two groups differed in sympathovagal balance. The possible mechanism of enhanced sympathetic nervous system include greater receptor sensitivity and enhanced medullary activity Greater peripheral adrenergic receptor sensitivity in test group can be explained by previous studies (Bianchetti *et al.*, 1984; Doyle and Fraser, 1961) that showed that offspring of hypertensive parents exhibit exaggerated pressor responses to infused nor epinephrine. In regard to second hypothesis, Falker *et al.*, (1979) found that offspring of hypertensive parents exhibited greater plasma catecholamine response to stress. Pal G K also suggests that there is sympathovagal imbalance in offspring of hypertensive parents (Pal *et al.*, 2011).

In summary the results of the present study suggest that healthy young offspring of hypertensive and normotensive parents exhibit different pattern of cardiovascular responses to stress. A maladaptive response to repeated stress in genetically predisposed individuals might be an early physiological marker in determining which person will eventually develop hypertension. Prescreening such individuals might allow for pre-emptive treatment in the early prehypertensive phase of the disease in the form of lifestyle modifications, such as weight reduction and implementation of a moderate intensity aerobic exercise program which may delay or prevent the onset of full blown hypertension.

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