Evaluation of Sympathetic Reactivity by Hand Grip Exercise Test in Children of Hypertensive Parents

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ABSTRACT

Background: Genetic factors likely play some role in causing a high blood pressure. About 40% of patients with primary hypertension have genetic predisposition. It is a well documented fact that sympathetic dominance increases heart rate and blood pressure and the same has been observed in young normotensive off springs of hypertensive parents.

Aim: Our present study was focused to evaluate blood pressure responses to isometric hand grip exercise test in children of hypertensive and non- hypertensive parents.

Methods: The present study was conducted in 50 healthy subjects doing MBBS, 25 of whom had a positive family history and 25 had no family history of hypertension. Isometric hand grip test for sympathetic evaluation was carried out in both the groups following measurement of resting blood pressure. Rise in diastolic blood pressure measured during isometric hand grip taken as a test response.

Result: Results were tabulated and analysed using paired t test, p value <0.001 was considered as significant. Higher values were obtained in diastolic and systolic blood pressure in children of hypertensive parents at rest when compared to age matched controls while during isometric hand grip increase in diastolic blood pressure in offspring of hypertensives was statistically significant. Findings are suggestive of an increased sympathetic dominance in children of hypertensive.

Conclusion: The present study suggests that healthy children of hypertensive parents have a higher sympathetic dominance when compared to healthy children of non hypertensive parents.

Keywords: Isometric Hand Grip, Blood Pressure, Normotensive Offspring.

Introduction

Hypertension is one of the most important causes of premature deaths occurring worldwide and thus is claimed to be a silent killer by the World Health Organization. In India, hypertension is the third most important risk factor burdening both cardiovascular health and health care systems in the country. It is one of the major risk factor for cardiovascular mortality which accounts 20-50% of all deaths. There is also a duet relation between cardiovascular risk factors and blood pressure, the higher the blood pressure, the higher the risk of both stroke and coronary events. As per the studies conducted by Raghupati Anchala, thirty three percent of urban and twenty five percent of rural Indians are hypertensive¹. Fortunately early diagnosis can prevent about 3 lakh deaths in India.² increasing prevalence of the condition is blamed on life style factors, such as stress, physical inactivity, a salt rich diet created by processed, fatty food and alcohol and tobacco use.³ Genetic factors also play important role in causing a high blood pressure. About 40% of patients with primary hypertension have genetic predisposition.⁴ Several genes are implicated that encode for the onset of hypertension. Few of them are genes that encode for components of renin angiotensin and

aldosterone synthesis, Angiotensin converting enzyme, angiotensin receptor, atrial natriuretic peptide etc. Moreover there is a twofold increase in occurrence of cardio-vascular disease which include coronary heart disease, congestive heart failure, stroke and renal failure in patients suffering with hypertension.⁵ Occurrence of high blood pressure before a person reaches 55 years of age occurs 3.8 times more frequently among persons with a family history of hypertension.⁵ Children with one hypertensive parent have a 25% probability of developing high blood pressure and in children with both the parents being hypertensive the probability of developing hypertension increases to 50%.⁶ It is likely that people with a family history of high blood pressure share common environments and other potential factors which might increase their risk of developing hypertension. Heredity combined with unhealthy life style choices, such as smoking cigarettes and eating junk food makes a person more susceptible to hypertension.

It is a well documented fact that sympathetic reactivity increases heart rate and blood pressure and the same has been observed in young normotensive off springs of hypertensive parents.^{7,8} They also manifest an elevated level

of blood pressure during and after five minutes of exposure to physical stress.⁹ Certain other researchers found no sympathetic dominance in children born to hypertensive parents.¹⁰ Hence evaluating cardiac autonomic function may prove to be useful as a predictive tool in diagnosis of impending high blood pressure.

Isometric hand grip dynamometer is a simple tool which can be used with ease. Hence, using a dynamometer to demonstrate autonomic modulation is a simple, non-invasive and inexpensive method. While performing exercise using a dynamometer there is an increase in heart rate and blood pressure due to stimulation of efferent sympathetic pathway.¹¹ Also an increased tension produced in muscles due to isometric contraction increases the arterial pressure with a small increase in heart rate and cardiac output. In addition there is also a rise in peripheral vascular resistance which accounts for increase in diastolic blood pressure.¹²

The present study was undertaken to evaluate increase in sympathetic reactivity in children of hypertensive parents and compare them with children of non hypertensive parents.

Materials and Methods:

The present study was undertaken in LLRM Medical College, Meerut after an ethical clearance from the institution and completed within a period of 12 months. The study group comprised of 50 volunteers both males and females in the age group of 18 to 24 years. Height and weight of the subjects were matched. Out of them 25(males & females) subjects had a positive family history of hypertension (FH+) and other 25(males & females) subjects belong to non-hypertensive parents (FH-).

Selection criteria: The present study was conducted on healthy medical students doing MBBS in the same college. The medical students were considered as study group who's one or both the parents are hypertensive of varying duration and being treated with anti hypertensive drugs and other medical students of normotensive parents were considered as controls. All subjects included in the study were normotensive. All healthy subjects in age group of 18-24 years, non-smokers and having normal range of BMI (18.5-24.9 kg/m²) included in the study, while subjects not giving consent, suffering from any acute illness, Diabetes Mellitus, smokers and any direct metabolic disorder were excluded from the study.

Blood pressure was recorded using auscultatory method with a mercury type sphygmomanometer of Diamond make. Basal blood pressure in sitting posture was recorded

on three separate occasions to confirm that volunteers were normotensive. Only those subjects whose basal blood pressure in sitting posture was normal were included in the study. After the subjects rested for a period of five minutes blood pressure was recorded in them using auscultatory method and documented.

Isometric hand grip dynamometer of the spring type was used in the study. Subjects were briefed on how to use the instrument before conducting the procedure. The paddles of the dynamometer were compressed with maximum effort with the dominant hand. The dynamometer has two needles, one remains at zero while the other needle portrays maximal voluntary contraction. The subjects were made to perform the same maneuver thrice with a brief interval of 30 seconds to prevent fatigue. The readings were documented respectively. Mean of the three readings was calculated and documented (Tmax). Thirty percent of the Tmax was calculated and subjects were asked to maintain the same for a period of two minutes. Blood pressure was recorded simultaneously in the non dominant arm during the procedure and after a rest of five minutes. Blood pressure in resting state and during the procedure was compared between groups.

Result

Results were tabulated and analysed using paired t test. p value <0.001 was considered as significant. **Table 1** gives an idea of distribution of body mass index of both control and study group. Average body mass index control was 21.52 kg/m² and that of study group was 21.06 Kg/m². There was not much significant difference in average body mass index in both the groups. The body mass index was found in normal range (normal range 20-25 kg/m²). **Table 2, 3** shows that there was a significant increase in systolic blood pressure and diastolic blood pressure in children of hypertensives before performing isometric hand grip between control and study group. **Table 4** shows the mean increase in Diastolic and Systolic blood pressure during hand grip test which was more in study group as compared to the age matched controls and statistically significant.

Discussion

The present study shows blood pressure and mean arterial pressure were significantly higher in off springs of hypertensive parents when compared to children of normotensive parents. While performing isometric hand grip manoeuvre there was a significant increase in systolic blood pressure and diastolic blood pressure in the study group which was taken as a test response. Five minutes after performing isometric hand grip maneuver, parameters returned to normal in both the groups. Isometric exercise

TABLE 1: Distribution of Body Mass Index (Bmi) In Offspring of Normotensive (Controls) and Hypertensive (Study Group) Parents.

BMI (kg/m ²)	Controls			Study group		
	n	Mean	SD	n	Mean	SD
≤ 22	7	18.37	1.00	8	18.46	0.99
22-24	11	21.50	0.96	12	21.66	1.02
≥ 24	7	24.69	1.24	5	24.19	0.50
Total	25	21.52	2.61	25	21.06	2.25

Table 2: Mean ± Sd of Systolic Blood Pressure (Mm of Hg) in Controls and Study Group Before Hand Grip Test.

Age (yrs)	controls				study group			
	n	Mean systolic BP	SD	95% confidence	n	Mean systolic BP	SD	95% confidence
19-20	11	114.36	4.17	111.9-116.82	11	119.63	7.78	115.03-124.23
21-22	9	116.66	5.00	113.39-119.93	8	119.00	4.78	115.69-122.31
23-24	5	121.60	2.60	119.32-123.88	6	120.00	6.06	115.15-124.85
Total	25	116.64	4.92	114.71-118.57	25	119.52	6.30	117.05-121.99

Table 3: Mean ± Sd of Diastolic Blood Pressure (Mm of Hg) in Controls and Study Group Before Hand Grip Test.

Age (yrs)	Controls				study group			
	n	Mean Diastolic BP	SD	95% confidence	n	Mean Diastolic BP	SD	95% confidence
19-20	11	77.09	5.95	73.57-80.61	11	79.09	5.46	75.86-82.32
21-22	9	79.77	4.84	76.61-82.93	8	82.50	2.07	81.07-83.93
23-24	5	80.00	2.00	78.25-81.75	6	81.73	5.36	75.71-84.29
Total	25	78.64	5.02	76.67-80.61	25	80.40	4.69	78.56-82.24

Table 4: Mean ± Sd of Rise in Diastolic and Systolic Blood Pressure During Hand Grip Test.

	Control group (25)	Study group (25)	P value
Diastolic blood pressure	19.36 ± 2.05	26.72 ± 2.93	0.001
Systolic blood pressure	14.67 ± 12.88	17.07 ± 12.32	0.001

when performed causes an increase in intramuscular pressure which in turn compresses blood vessels within muscles. Compression of the vessels results in decreased muscle blood flow which in turn causes an accumulation of metabolites within the muscle that stimulate muscle chemo receptors resulting in an increase in sympathetic nerve activity.¹³ This in turn causes an increase in blood pressure during isometric exercise. Although systolic blood pressure increased in both groups, but it was more significant in cases as compared to age matched controls. Similar findings were reported by Schneider GM et al and Lopes et al.^{7, 14} The results obtained in this study are suggestive of a sympathovagal imbalance in off springs of hypertensive parents. This could be explained by findings obtained by Sherwood et al. They suggested that in the early stages there is increase in cardiac output following which peripheral resistance increases in children of hypertensive owing to rise in blood pressures.¹⁵ Nor- epinephrine when

infused in children of hypertensive have a greater pressor response was seen due to reduced threshold levels to nor epinephrine in them.¹⁶

Conclusion

The present study suggests that healthy children of hypertensive parents do have a sympathetic dominance when compared to healthy children of non hypertensive parents. The exaggerated sympathetic response seen in stress may be used as a marker to detect people who may develop hypertension in future. Simple and non- invasive tests are more useful for early detection of altered autonomic functions. The regular autonomic function testing might be beneficial to find hyper reactors who have positive family history. Such periodical analysis of autonomic function tests might help in early detection of future hypertension and may prove beneficial in reducing the global burden of hypertension on health care system.

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