

“COMPARATIVE STUDY OF AUTONOMIC FUNCTIONS BETWEEN OFF SPRINGS OF NORMOTENSIVE PARENTS AND HYPERTENSIVE PARENTS”

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Introduction

Autonomic control of heart plays an important role in cardiac mortality.^{1, 2} Hypertension runs in families, and parental history of hypertension increases the risk of developing hypertension especially if both the parents of hypertensive.³ Autonomic abnormality in the form of increased sympathetic tone have been demonstrated in young normotensive offspring of hypertensive parents.⁴ Also it was observed that youngsters with a parental history of hypertension showed an enhanced reactivity of total peripheral resistance during static exercise without higher BP response as the physiological increase in stroke volume was blunted in the subject.⁵ However, till date, no work has been conducted to understand the nature of autonomic imbalance that facilitates the normotensive offspring of hypertensive parents to enter into the stage of pre-hypertension or hypertension. A recent report from one laboratory suggests that an increased sympathetic and decreased parasympathetic activity in young adults alters sympathovagal balance, which could be major mechanism in the causation of pre-hypertension.⁶ Pre-hypertension has been documented to be associated with increased rate of adverse cardiovascular events.⁷⁻⁹

Though several studies have assessed sympathovagal imbalance in hypertensive patients,¹⁰⁻¹³ and sustained sympathetic over activity has been reported among the primary mechanisms for genesis of essential hypertension,¹⁴⁻¹⁹ there is paucity of data on the nature of change in autonomic balance that slowly changes the normotensive state to develop into the state of pre-hypertension. Though hypertension is common in middle aged and elderly population,²⁰ pre-hypertension is relatively more common in young

adults especially in those who have family history of hypertension.²¹ There is a clear evidence that autonomic dysregulation underlies the initiation and maintenance of hypertension.²² Circulatory adjustments are effected by altering the output of the

pump (the heart), changing the diameter resistance vessels (primarily the arterioles), or altering the amount of blood pooled in the capacitance vessels (the veins).²³

Normotensive subjects with family history of hypertension show greater sympathetic nervous system activity and also early parasympathetic attenuation.

In the last few decades, investigations have recognized the importance of the relationship between autonomic nervous system and cardiovascular mortality. Among the primary hypertension nearly 30% has genetic pre-deposition. There are many numbers of genes responsible for the development of primary HT. In the recent years few candidate genes have been identified for primary hypertension.²⁴

In the present study, we tested the hypothesis that normotensive young male and female adults, with parental history of hypertension without the history of diabetes show a difference in the cardiovascular autonomic function. Autonomic functions are tested at rest, on standing, timed deep breathing, Valsalva maneuver and during isometric exercise by using Biopac device MP30, sphygmomanometer and isometric handgrip dynamometer.

Materials and Methods

METHODOLOGY:

Cardiovascular responses were evaluated in both off spring age between 18-22 years of normotensive and hypertensive parents. History of primary hypertension was determined from the family history narrated by the subjects. The subjects for the study were classified into the following two groups.

Control group: Normotensive subjects whose parents are neither hypertensive nor diabetic (30 subjects).

Study group: Normotensive subjects whose parents are hypertensive but not diabetic (30 subjects).

Inclusion criteria: (Common to both study and control group) Healthy subjects in the age group of

Variables	Control group (n=30) Mean $\pm$ S.D	Study group (n=30) Mean $\pm$ S.D
Age (in yrs)	19 $\pm$ 1.08	18.43 $\pm$ 0.56
Weight (in kg)	57 $\pm$ 10.54	62.5 $\pm$ 9.9
Height (in cms)	157.5 $\pm$ 8.2	160.4 $\pm$ 10.3
BMI	24.31 $\pm$ 3.64	22.9 $\pm$ 3.96
Pulse Rate (bpm)	71.9 $\pm$ 3.34	84.83 $\pm$ 5.07
RR (cycles/min)	17.3 $\pm$ 1.66	19.7 $\pm$ 1.95

18-22years, non-smokers, non-alcoholic and normal range of BMI.

Exclusion criteria: Systemic disorders including overt hypertension and diabetes mellitus or any clinical signs and symptoms related to renal or endocrinal diseases, any acute illness, any recent illness, during the past three weeks or so.

Method of collection of data: A detailed health status appraisal was done for all the subjects included in the study. It included personal details through history taking. The clinical examination procedure was explained to the individual subjects. And a written consent to the individual subjects was obtained.

A brief history was noted along with the general physical examination. Height was measured in centimeters and weight measured in kilograms. BMI was calculated for each subject who was followed by ECG recording in Lead II at rest then the autonomic function tests were performed. Parasympathetic activity was assessed by means of heart rate changes to immediate standing from lying down position, during deep breathing and during Valsalva maneuver (Valsalva ratio) using Biopac student lab device MP30. Sympathetic activity was assessed by recording BP changes in sitting position before isometric exercise, during isometric exercise and after isometric exercise. Isometric exercise was done by

using isometric handgrip dynamometer. Blood pressure was determined by using mercury sphygmomanometer.

Results

Subjects were grouped as control group and study group. Heart rate and blood pressure were measured in both control and study groups to find out any change in the cardiovascular autonomic functions in healthy adults of normotensive parents and hypertensive parents.

The data profile of subjects which include age, height, weight, BMI, and values of blood pressure and heart rate are entered in table and in graph format. P value <0.05 was considered as significant. P value <0.01 was considered as highly significant.

The values of each parameter are entered as mean and standard deviation.

Variables	Control group (no=30) Mean $\pm$ S.D	Study group (no=30) Mean $\pm$ S.D	p-value
Pre ex SBP(mmHg)	116.4 $\pm$ 4.79	126.2 $\pm$ 4.2	0.000**
Dur ex SBP(mmHg)	120.6 $\pm$ 4.76	129.5 $\pm$ 4.02	0.000**
Post ex SBP(mmHg)	130.9 $\pm$ 5	134.7 $\pm$ 10.3	0.78
Pre ex DBP (mmHg)	75.86 $\pm$ 4.26	84.1 $\pm$ 5.03	0.000**
Dur ex DBP(mmHg)	79 $\pm$ 4.63	86.5 $\pm$ 5	0.000**
Post ex DBP(mmHg)	89.7 $\pm$ 4.16	93.3 $\pm$ 4.73	0.003*

Table -1COMPARISON OF AGE, HEIGHT, WEIGHT, BMI, PR AND RR BETWEEN CONTROL GROUP AND STUDY GROUP: Table 1: shows mean $\pm$ SD values between control group and study group, their mean age, their mean height, their mean weight and BMI) which are not statistically significant but the Pulse rate and RR were computed which are statistically significant.

Table -2COMPARISON OF BLOOD PRESSURE BETWEEN CONTROL GROUP AND STUDY GROUP: Table 2: Shows the mean values of SBP, DBP, MAP and PP between study group and control group.

These values are more in study group ($P < 0.001^{**}$) than control group, except pulse pressure ($P > 0.05$). Thus, there is statistical significant increase in the cardiovascular response in basal blood pressure.

* Moderately significant ($P \text{ value} \leq 0.05$)

** Strongly significant ($P \text{ value: } P \leq 0.01$)

Table -3 COMPARISON OF BLOOD PRESSURE CHANGES IN ISOMETRIC EXERCISE BETWEEN CONTROL GROUP AND STUDY GROUP: Table 3: Shows the mean and SD values of pre-exercise SBP & DBP, during exercise SBP & DBP and post exercise SBP & DBP. There is statistically highly significant increase in the pre-exercise SBP & DBP, during exercise SBP & DBP ($P < 0.05$), post exercise DBP shows significant increase ($P \leq 0.003^{*}$) but post ex SBP is not significant ($P = 0.78$)

Table-4 COMPARISON OF HEART RATE BETWEEN CONTROL GROUP AND STUDY GROUP:

Table 4: Shows the mean and S.D values of HR in lying position, on standing position, during deep breathing and during Valsalva maneuver in control & study group. All the parameters show statistically significance increase in the study group. Increase in the HR, in lying position, on standing and during Valsalva maneuver ($P < 0.001^{**}$) was computed.

Variables	Control group(no=30) Mean $\pm$ S.D	Study group (no=30) Mean $\pm$ S.D	p-value
HR in lying position	72.89 $\pm$ 4.39	87.32 $\pm$ 3.63	0.000***
HR in standing position	1.32 $\pm$.08	1.14 $\pm$ 0.03	0.000***
HR during deep breathing	35.05 $\pm$ 2.42	45.55 $\pm$ 3.2	0.000***
HR during valsalva maneuver	1.5 $\pm$.05	1.15 $\pm$ 0.04	0.000***

Discussion

The present study was designed to evaluate the AFTs in adults of parental history of hypertension and without hypertension. Cross sectional study was done on 60 young normal individuals.

There was no statistical significant difference of age, height, weight and BMI in two groups. The data was analyzed for sympathetic activity among these two groups of subjects. The study group showed

increase in basal blood pressure and increase during isometric exercise. The data was analyzed for parasympathetic activity among these two groups of subjects. The study group showed increase in basal

Variables	Control group(no=30) Mean $\pm$ S.D	Study group (no=30) Mean $\pm$ S.D	p-value
SBP (mmHg)	116.4 $\pm$ 4.79	126.2 $\pm$ 4.24	0.000***
DBP (mmHg)	75.86 $\pm$ 4.26	84.13 $\pm$ 5.03	0.000***
Pulse Pressure	40.53 $\pm$ 5.19	42.13 $\pm$ 5.16	0.237
MAP	88.02 $\pm$ 3.73	96.7 $\pm$ 4.17	0.000***

heart rate, HR on standing, during deep breathing and during Valsalva maneuver.

The blood pressure in the offspring of parental history of hypertension showed the change in higher resting diastolic pressure probably due to hyperactive sympathetic nervous system (SNS). As a result of increased SNS activity there an increase in the heart rate, peripheral vasoconstriction resulting in the increased peripheral vascular resistance with rise in the systemic blood pressure.

G. K. Pal had shown corroboration with their recent report that exaggeration of increased sympathetic activity facilitates the onset of hypertension in prehypertensives.⁵⁷

In the present study, we found during isometric exercise the systolic and diastolic pressure were significantly higher than in the study group when compared to control group. This shows the increased sympathetic activity on the blood pressure.

The fluctuations in heart rate exhibit a marked synchrony with deep breathing due to cardiac autonomic regulation in both the groups but more significant in the study group than control group. There is a progressive attenuation of Respiratory Sinus Arrhythmia with increasing levels of physical exertion probably largely represents the direct consequence of cardiac vagal withdrawal.

Julis studies had shown that those with parental history of hypertension their offspring show higher resting diastolic pressure probably due to hyperactive sympathetic nervous system (SNS). As a result increased SNS activity cause an increase in the heart rate, peripheral vasoconstriction resulting in the increased peripheral vascular resistance with rise in the systemic blood pressure.⁵⁶

Muralikrishnan K, studies had shown the 24hsystolic and diastolic blood pressure were higher

in offspring of hypertensive subjects than in controls ($p < .001$ and ($p < .0001$, respectively), as was the coefficient variation of 24h systolic blood pressure. The offspring of hypertensive subjects exhibited higher body mass index ($p < .01$).⁴⁸

Pagani M studies had explained the combination of sympathetic predominance and reduced vagal activity and primary hypertension associated with increased cardiovascular morbidity.⁵⁴

Kobusiak-Prokopowicz M, studies had shown the neurohormonal disturbances might play a special role in view of the demonstration that an elevated sympathetic drive seems essential in hypertensive patients.⁵³

Muldoon MF studies had explained the rapid increase in blood pressure observed. This study indicates that increases in dietary sodium, weight gain and sympathetic tone are important determinants of the early blood pressure rise.⁵¹

Galderisi M studies had shown heart rate and cardiac output declined significantly more in offspring of hypertensive parents during static exercise. Youngsters with a parental history of hypertension show an enhanced reactivity of total peripheral resistance during state exercise.⁴⁹

Conclusion

Autonomic functions were evaluated in both control and study group. The physical parameters, age, height, weight and BMI were obtained which showed no statistical significant difference.

Blood pressure measurements were obtained in both groups. Basal blood pressure & BP before, during and after exercise in sitting posture were recorded by using sphygmomanometer. Heart rate measurements were obtained. Basal HR in lying position, on standing, during deep breathing and during Valsalva maneuver was recorded. Systolic, diastolic and mean arterial pressure significantly increased after exercise in the study group compared to control group. Compared to offspring of hypertensive parents the systolic, diastolic, pulse pressure, mean arterial pressure and heart rate values were significantly higher in study group than the control group.

This study shows increased sympathetic activity and decreased parasympathetic drive among study group compared to control group.

Essential hypertension remains a major modifiable risk factor for cardiovascular disease. As the increase in arterial blood pressure secondary to static effort could cause a pressure overload of the

heart, which can be dangerous for persons with cardiovascular diseases. It is advised that off springs with history of parental hypertension are required to reduce the need for antihypertensive drug therapy. Life style changes are recommended to lower BP, before starting drug therapy. The primary preventive measures of hypertension are maintenance of normal body weight for adults, reduction in dietary sodium intake (to $<100\text{mmol/day}$), reduction in saturated & total fat intake, engagement in regular aerobic physical activity, limit alcohol consumption, consumption of dietary rich in fruit & vegetables.

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