



Study of Autonomic Functions in Normotensive Young Adults of Hypertensive Parents

KEYWORDS

Essential Hypertension (HTN), Autonomic functions, Valsalva manuevere

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ABSTRACT Essential hypertension is a major health hazard in developed and developing countries. Essential hypertension, if left undetected and untreated can lead to cardiovascular abnormalities with increased risk of morbidity and mortality. This study was undertaken to evaluate the autonomic functions in normotensive children of hypertensive parents with the following objectives. To assess the possible alteration of autonomic functions. The earliest age at which these alterations are detected. This study was carried out on 33 normotensive children of normotensive parents and 33 normotensive children of hypertensive parents in the age group of 17 to 25 years. Autonomic functions were evaluated by standardized methods. Heart rate response to standing, deep breathing and Valsalva maneuver were done to measure the parasympathetic function. Sympathetic function was assessed by blood pressure response to standing, isometric exercise and cold pressor test. The values obtained were expressed as Mean \pm SEM and was compared by using student t test. The heart rate response to standing for cases and controls were 1.14 ± 0.21 and 1.3 ± 0.21 , to deep breathing were 18.02 ± 9.5 and 39.14 ± 4.85 , and to Valsalva maneuver were 1.29 ± 0.27 and 1.41 ± 0.19 respectively. The difference between cases and controls was statistically significant ($P < 0.05$). The blood pressure response to isometric exercise was significantly higher in cases compared to controls. There was a demonstrable alteration in the autonomic function. There was reduced parasympathetic response coupled with enhanced sympathetic response resulting in sympathetic predominance.

INTRODUCTION

Hypertension is one of the major cardiovascular causes of morbidity and mortality. It can lead to a variety of complications such as cardiac failure, stroke and renal damage. Early identification of risk factors can be used to prevent the complications of hypertension by suitable lifestyle modifications. According to JNCVII report, blood pressure recording of 120/80 mm Hg is considered normal, 140/90 mm Hg as pre hypertensive state, systolic blood pressure greater than 140 but lesser than 160 mm Hg and diastolic blood pressure greater than 90 but lesser than 100 mm Hg as grade I hypertension and systolic blood pressure greater than 160 mmHg and diastolic blood pressure greater than 100 mm Hg is considered as grade II hypertension. There is an established relationship between HTN and cardiovascular risk factors. Studies in young normotensive subjects with a positive family history of HTN help in detecting early modifications and possible biological markers of arterial HTN. Studies on genetic factors associated with HTN are increasing because selective preventive measures have been developed for those with genetic predisposition. The application of preventive measures especially in children is essential as development of HTN usually begins at an early age. Offsprings of hypertensives manifest with exaggerated cardiovascular responses to stress in the form of autonomic challenges like deep breathing, cold pressor test, isometric exercise. The present study was undertaken to see differences in the reactivity to autonomic challenges between offspring of hypertensives and normotensives, for clear understanding of the heritability of HTN. If autonomic dysfunction can be detected before a sustained increase in BP, elucidation of the dysfunction may lead to a design of a scheme for early detection of HTN. Early identification of prehypertensive profile in an individual will provide an opportunity for implementation of lifestyle modifications, such as weight reduction, moderate intensity aerobic exercise program, which may prevent or postpone the occurrence of HTN. To detect the earliest age at which the alterations in autonomic functions take place. It has been reported

that hypertension is inherited through a gene on the Y chromosome and also on the gene present on the autosomes. The gene present on the Y chromosome is likely to have a stronger influence where as the gene present on the autosomes has a weaker impact on inheritance of hypertension. Considering the accepted evidence about the inheritance, it is reasonable to postulate that major contribution for the inheritance comes from the father and the manifestation is more common in the male offspring of hypertensive parents.

MATERIALS AND METHODS

The present study was conducted in the Department of Physiology, Kurnool Medical College, Kurnool. Medical students who volunteered for the study were recruited as subjects. Family history of hypertension was taken and children of hypertensive parents were taken as cases, children of normotensive parents were considered as controls. Autonomic function tests were performed on 33 cases and 33 controls in this case-control study. **METHODS AND DIAGNOSTIC CRITERIA** Autonomic function tests: Sympathetic tests: Blood pressure response to cold pressor test, Blood pressure response to sustained handgrip, parasympathetic tests: Heart rate response to deep breathing, Heart rate response to Valsalva

RESULTS

The present study was conducted with 33 cases and 33 control subjects. The age of the control subjects was 18.97 ± 1.36 and that for the cases was 19.27 ± 1.31 . The height in cm was 171.06 ± 10.09 and 169.21 ± 6.01 in controls and cases respectively. The weight in Kg was 64.76 ± 10.43 and 63.79 ± 11.28 in controls and cases respectively. The Body mass index was 22.2 ± 3.8 and 22.22 ± 3.39 in controls and cases respectively. There was no statistically significant difference between controls and cases in the anthropometric parameters. The anthropometric parameters of controls and cases has been given in Table 1. The resting pulse rate of controls and cases were 78.33 ± 8.35 and

78.42 ± 8.97 respectively. The resting systolic blood pressure in controls and cases were 113.45 ± 8.71 and 118.42 ± 8.26 respectively. The resting diastolic blood pressure in controls and cases were 71.52 ± 6.21 and 74.48 ± 6.21.

Heart rate response to deep breathing

The mean of difference between maximum and minimum heart rate during deep breathing was 39.14 ± 4.85 and 18.02 ± 9.5 for controls and cases. The mean values were lower in cases compared to controls. The difference was statistically significant ($p < 0.001$).

Heart rate response to valsalva maneuver

The shortest R-R intervals during Valsalva maneuver were 0.6 ± 0.06 and 0.63 ± 0.09 for controls and cases respectively. The longest R-R intervals after the maneuver were 0.84 ± 0.12 and 0.8 ± 0.13 for controls and cases respectively. The Valsalva ratio for controls and cases were 1.41 ± 0.19 and 1.29 ± 0.27 respectively. The ratio was less in cases compared to controls. The difference was statistically significant. ($p < 0.05$)

Blood pressure response to sustained handgrip

a. changes within the group

i. Systolic blood pressure

The resting systolic blood pressures for controls were 114.48 ± 7.53. The blood pressure recordings at the end of 1st, 2nd, 3rd, 4th & 5th minute during the handgrip test were 118.48 ± 7.35, 121.58 ± 7.63, 124.30 ± 7.09, 126.79 ± 7.18 and 128.73 ± 7.4 respectively. The resting systolic blood pressures for cases were 118.18 ± 7.32. The blood pressure recordings at the end of 1st, 2nd, 3rd, 4th & 5th minute during the handgrip test were 120.42 ± 7.45, 123.57 ± 8.69, 125.82 ± 7.69, 126.30 ± 7.48, and 125.76 ± 7.28 respectively. There was significant increase in blood pressure from resting state during hand grip test in controls. There was a steady increase in systolic blood pressure throughout the duration of test. In cases, there was a significant increase in systolic blood pressure during handgrip test with resting pressure. There was a gradual increase in the systolic pressure during first 3 minutes of the test but did not show a significant alteration during last 2 minutes.

ii. Diastolic blood pressure

The resting diastolic blood pressures for controls were 73.45 ± 5.15. The blood pressure recordings at the end of 1st, 2nd, 3rd, 4th & 5th minute during the handgrip test were 76.36 ± 6.37, 78.79 ± 6.28, 81.7 ± 6.6, 82.91 ± 5.98, 84.73 ± 5.67 respectively. The resting diastolic blood pressures for cases were 75.82 ± 5.46. The blood pressure recordings at the end of 1st, 2nd, 3rd, 4th & 5th minute during the handgrip test were, 78.914 ± 6.1, 81.94 ± 5.01, 84.24 ± 5.47, 84.3 ± 5.66, 81.881 ± 4.27 respectively. There was significant increase in blood pressure from resting state during hand grip test in controls. There was a steady increase in diastolic blood pressure throughout the duration of test. In cases, there was a significant increase in diastolic blood pressure during handgrip test.

b. changes between the groups

i. Systolic blood pressure

The resting systolic blood pressures for controls and cases were 114.48 ± 7.53 and 118.18 ± 7.32 respectively. The resting systolic blood pressure was significantly higher in cases compared to controls. The systolic blood pressure recordings at the end of 1st, 2nd, 3rd, 4th & 5th minute during the handgrip test were 118.48 ± 7.35, 121.58 ± 7.63, 124.30 ± 7.09, 126.79 ± 7.18 and 128.73 ± 7.4

controls and 120.42 ± 7.45, 123.57 ± 8.69, 125.82 ± 7.69, 126.30 ± 7.48 and 125.76 ± 7.28. During the hand grip test, there was no significant difference between cases and controls on a minute to minute basis.

ii. Diastolic blood pressure

The resting diastolic blood pressure for controls and cases were 73.45 ± 5.15 and 75.82 ± 5.46 respectively. There was no significant difference in resting diastolic blood pressure between controls and cases. The diastolic blood pressure recordings at the end of 1st, 2nd, 3rd, 4th & 5th minute during the handgrip test were 76.36 ± 6.37, 78.79 ± 6.28, 81.7 ± 6.6, 82.91 ± 5.98, 84.73 ± 5.67 for controls and 78.914 ± 6.1, 81.94 ± 5.01, 84.24 ± 5.47, 84.3 ± 5.66, 81.88 ± 4.27 for cases. The diastolic blood pressure response to sustained hand grip at the end of 2nd minute was significantly higher in cases compared to controls. The diastolic blood pressure response at end of 1st and 3rd minute was higher in cases.

Blood pressure response to cold pressor test

a. changes within the group

i. Systolic blood pressure

The systolic blood pressure for controls was 115.21 ± 7.26 before cold pressor test and 126.06 ± 9.25 at the end of test. The systolic blood pressure for cases was 117.27 ± 8.21 and 126.24 ± 7.96 at end of test. There was significant increase in systolic blood pressure after the test in controls and cases ($p < 0.001$).

ii. Diastolic blood pressure

The diastolic blood pressure for controls was 74.97 ± 5.32, before cold pressor test and 82.61 ± 6.35 at the end of the test. The diastolic blood pressure for cases was 74.91 ± 5.55, before the test and 83.76 ± 5.63 at the end of the test. There was a significant increase in diastolic blood pressure after the test in controls and cases ($p < 0.001$).

b. changes between the groups

i. Systolic blood pressure

The systolic blood pressure was 115.21 ± 7.26 and 117.27 ± 8.21 for controls and cases before cold pressor test. The systolic blood pressure was 126.06 ± 9.25 and 126.24 ± 7.96 for controls and cases after the test. The difference in systolic blood pressure between the groups was not significant.

ii. Diastolic blood pressure

The diastolic blood pressure was 74.97 ± 5.32 and 74.91 ± 5.55 for controls and cases before cold pressor test respectively. The diastolic blood pressures were 82.61 ± 6.35 and 83.76 ± 5.63 for controls and cases after the test. The difference between the groups was not significant.

DISCUSSION

In the present study, autonomic function tests are done in the age group of 17 to 25 years. Majority of the subjects are above 17 years. The sympathetic functions were assessed by blood pressure response to standing, sustained handgrip and cold pressor test. The parasympathetic functions were assessed by heart rate response to standing, deep breathing and Valsalva maneuver. The diastolic blood pressure showed a time dependant significant difference between controls and cases in response to sustained handgrip. There was no significant difference in the blood pressure responses to the other sympathetic function tests. The observations suggest the

onset of mild sympathetic hyper responsiveness even in adulthood. As compared to the sympathetic activity which showed minimal alterations, there was a significant decrease in the parasympathetic activity. The resultant effect is indicative of sympathetic predominance in normotensive children of hypertensive parents. It is clear from the observation that the autonomic dysfunction sets in as early as adulthood. Thus autonomic function tests hold the promise to be used as a reliable screening test to detect potential hypertensives.

SUMMARY

Hypertension is a major risk for cardiovascular diseases. Stress during modern day life, unhealthy eating habits and sedentary life style influence the expression of genetically inherited traits of HTN. There is a demonstrable autonomic dysfunction in subjects with potential to develop HTN later in life. Alteration in autonomic function sets in as early as childhood and progresses throughout life. An early detection of autonomic dysfunction will facilitate the modification of factors which influence the expression of HTN. In the present study autonomic functions were performed in age and anthropometrically matched normotensive children of normotensive and hypertensive parents. The mean age of study population was 17 to 25 years. The observation in our study suggests that there is decreased parasympathetic response and enhanced sympathetic response. It was also evident that alteration in autonomic functions has set in during adulthood in asymptomatic children of hypertensive parents. The autonomic function tests can be used as a screening tool in the later part of childhood or atleast during the adulthood to detect the possibility of developing essential hypertension

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