SYMPATHETIC REACTIVITY TO COLD PRESSOR TEST IN MEDICAL STUDENTS OF HYPERTENSIVE AND NORMOTENSIVE PARENTS

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ABSTRACT
Background: Essential hypertension shows familial predisposition. It is detectable at an early age in descendants of hypertensive parents following sympathetic stimulation. Aims and objectives: The present study was designed to examine the response in the blood pressure to the cold pressor test in medical students of hypertensive parents and to compare it with age-matched controls of medical students of normotensive parents. Material and Methods: Cold pressor test was performed in the study and control groups. First basal blood pressure was recorded and afterwards subjects were asked to dip left arm in the cold water (temperature at 2-4°C) for 2 minutes and blood pressure was recorded from the right arm in sitting position. Blood pressure was again recorded 5 minutes after hand was taken out of the cold water. Results and conclusions: Results showed that basal systolic and diastolic blood pressure were higher (p <0.001) in students of hypertensive parents as compared to students of normotensive parents. During cold pressor test, rise in both systolic and diastolic blood pressure was significantly higher (p<0.001) in the study group of hypertensive parents. Children of hypertensive parents require regular monitoring of blood pressure for an early detection of hypertension as it is well known that lifestyle and dietary modifications can be helpful in prevention of, future hypertension related issues.
Keywords: hypertension, cold pressor test, baseline blood pressure

INTRODUCTION
Blood pressure is defined as the lateral pressure exerted by the column of flowing blood on the blood vessel wall. Hypertension is the increase in blood pressure ≥140/90 mm Hg measured on three separate occasions1. In about 88% of the patients with hypertension, cause of hypertension is unknown and they are said to have essential hypertension. Essential hypertension is polygenic in nature, Genes factors as well as environmental factors play an important role in the development of primary hypertension3-6. High blood pressure before the age of 55 years occurs 3.8 times more in individuals with a family history of hypertension6. Sympathetic system has been implicated to be overactive in these individuals7-11. Individuals developing hypertension at a later age might have an altered physiology at a very young age12. Blood pressure regulating mechanisms have been shown to be hyperactive in these individuals13. There are different sets of genes that regulate blood pressure during rest and during cold pressor test and are independent of each other5. Main circulatory alteration in essential hypertension might be due to increased vascular peripheral resistance or a raised cardiac output15. People at high risk for high blood pressure may have an exaggerated stress-induced cardiovascular response at a younger age13. Cold
pressor test is a satisfactory method in studying the reactivity of blood pressure\textsuperscript{14}. Cardiovascular reactivity to stress has pathophysiological role in hypertension\textsuperscript{12}.

The aim of the present study was to examine the blood pressure response following sympathetic stimulation in the form of cold pressor test in the medical students of hypertensive parents and compare it with the age-matched controls of normotensive parents.

**MATERIAL AND METHODS**

The present study was a cross-sectional study, conducted in Santosh Medical College, Ghaziabad. Ethical approval was taken from the research committee of the Institution. Fifty medical students in the age group of 17-24 years with family history of hypertension (either single parent or both parents) were recruited for the study and the results were compared with fifty age-matched medical students with no familial history of hypertension. Informed consent was taken from all the medical students. Medical students with H/o any chronic illness, on any medication, smokers were excluded from the study.

Subjects were divided into 2 groups

- **Group I**- control group with no family h/o hypertension
- **Group II**- study group with family h/o hypertension

Procedure of the cold pressor test (CPT) was explained to all the students participating in the study. Before the test, subjects were allowed to rest for 10 minutes in a quiet room to reduce the anxiety.

Basal blood pressure of all the subjects was measured by auscultatory method with the help of mercury sphygmomanometer (DIAMOND). First Kortkoff sound indicated systolic blood pressure (SBP) and fifth Kortkoff sound indicated diastolic blood pressure (DBP). Mean blood pressure (MBP) was calculated as diastolic blood pressure + 1/3\textsuperscript{rd} of Pulse Pressure. Cold pressor test was done in both the study group and control groups. After recording basal blood pressure, subjects were asked to dip left arm in the cold water (temp at 2-4° C) for 2 minutes and blood pressure was recorded from the right arm. Blood pressure was again recorded 5 minutes after hand was taken out from the cold water. Results were analysed by ANOVA with SPSS version 17.0 using unpaired ‘t’ test

**RESULTS**

Data presented in Table 1 shows that there was significant increase in the basal SBP, DBP & MBP in the individuals as compared to group I and values were statistically significant (p<0.001). In group II, SBP, DBP & MBP increase was much more pronounced in comparison to group I during the cold pressor test (p<0.001). Five minutes after cold pressor test, systolic, diastolic and mean blood pressure was higher in group II (p<0.001) in comparison to group I.

<table>
<thead>
<tr>
<th>Subjects</th>
<th>Conditions</th>
<th>SBP(mmHg) Mean±SD</th>
<th>DBP(mmHg) Mean±SD</th>
<th>MBP(mmHg) Mean±SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group I (control group with no family h/o hypertension)(n=50)</td>
<td>Basal</td>
<td>109.24±3.70</td>
<td>73.00±1.86</td>
<td>85.23±1.48</td>
</tr>
<tr>
<td></td>
<td>During CPT</td>
<td>120.64±2.87</td>
<td>83.16±1.98</td>
<td>95.68±1.49</td>
</tr>
<tr>
<td></td>
<td>5 min after CPT</td>
<td>109.52±3.63</td>
<td>73.24±1.93</td>
<td>85.42±1.62</td>
</tr>
<tr>
<td>Group II (study group with family h/o hypertension) (n=50)</td>
<td>Basal</td>
<td>119.48±3.33*</td>
<td>80.64±3.91*</td>
<td>93.10±2.13*</td>
</tr>
<tr>
<td></td>
<td>During CPT</td>
<td>131.20±4.12*</td>
<td>97.04±3.48*</td>
<td>108.68±3.88*</td>
</tr>
<tr>
<td></td>
<td>5 min after CPT</td>
<td>119.96±3.37*</td>
<td>91.04±3.21*</td>
<td>100.6±2.79*</td>
</tr>
</tbody>
</table>

* p<0.001 versus group I
It is evident from Fig 1 that there was significant increase in basal systolic (9.43%), diastolic (10.46%) and mean blood pressure (8.45%) in group II individuals in comparison to group I. With the application of cold stress, percent increase in diastolic (16.69%) and mean blood pressure (11.6%) was much more higher in comparison to that of systolic blood pressure (8.79%) in group II individuals. Five minutes after removal of the cold pressor stimulus, percent increase in diastolic (24.3%) and mean blood pressure (15.2%) was significantly higher as compared to that of percent increase in systolic blood pressure (9.59%) in group II individuals.

**DISCUSSION**

Results of the present study showed a significant increase in the basal SBP, DBP & MBP in the study group of hypertensive parents. In the study group, CPT increased blood pressure significantly after 5 minutes as compared to control group of normotensive parents. It has been reported that systolic and diastolic blood pressure increases significantly in the offsprings of hypertensive parents which might be due to increased cardiovascular reactivity occurring as result of higher sympathetic activity in offsprings of hypertensive parents. Increased sympathetic activity induced by cold water stress causes norepinephrine release and elevation of blood pressure. Increase in blood pressure might also be contributed by release of endothelins, prostaglandins and angiotensin II. It has been showed that subjects from the hypertensive families had greater and prolonged responsiveness to sympathetic stimulation in the form of cold pressor test in comparison to the subjects from the non-hypertensive families with increase in systolic as well as diastolic blood pressure, however increase in diastolic blood pressure was much more pronounced. Other similar studies suggest a significant increase in systolic and diastolic blood pressure (p<0.001).

Results of the present study were partially similar to that of Khaliq et al who reported that increase in the diastolic and mean blood pressure in the subjects was significantly higher with family history of hypertension which was similar to our study. However, findings contradictory to the present study showed that baseline blood pressure significantly did not differ in study and control groups with and without family history of...
hypertension in their study and returned to baseline values within 5 minutes after CPT in all groups.

Results of the present study were contradictory to that of Verma et al\textsuperscript{18} as in their study, basal systolic, diastolic and mean blood pressure were not significantly higher in study group with family history of hypertension as compared to control group with no family history of hypertension. Although, cold pressor test significantly increased the blood pressure in the study group as compared to control group and recovery of systolic and diastolic blood pressure were significantly higher than resting values of systolic, diastolic and mean blood pressure which were in confirmation to the present study\textsuperscript{18}.

Gupta et al\textsuperscript{19} have showed that children of subjects with hypertension increased incidence of persistently elevated blood pressures than that of children from families with no history of hypertension\textsuperscript{20}. Another study showed that mean 24-hour blood pressure was higher in the offsprings of two hypertensive parents as compared to the offspring of two normotensive parents\textsuperscript{15}.

Raise in blood pressure of children of hypertensive parents may be due to hereditary factor of hypertensive parents (single or both). Stimulation of sympathetic nervous system in the form of cold pressor test results in increase in arterial pressure either due to increase in heart rate and force of contraction, causing an increase in cardiac output and systolic blood pressure or due to vasoconstriction and resultant increase in total peripheral resistance and diastolic blood pressure\textsuperscript{21}. Results of the present study were similar to that of Rajashekhar RK et al\textsuperscript{22} who studied that siblings of hypertensives had a higher basal systolic and diastolic blood pressures, however mean arterial blood pressure was not included in their study.

CONCLUSIONS
Early detection of hypertension in the children of hypertensive parents is of prime importance as lifestyle modification can be started at an early age and cardiovascular risk can be avoided. Routine screening must be performed to detect asymptomatic hypertension amongst adolescents with the family history of hypertension.

ACKNOWLEDGMENT
The authors are thankful to Dr. R.K. Arya, Professor & HOD, Department of Community Medicine, for his help in statistics.

Conflict of Interest: Nil

REFERENCES