



IJCRR

Vol 04 issue 18

Section: Physiology

Category: Research

Received on:12/06/12

Revised on:05/07/12

Accepted on:27/07/12

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

Rinku Garg, Yogesh Tripathi, Varun Malhotra

Department of Physiology, Santosh Medical College, Ghaziabad

Email for corresponding: rgrinkigarg6@gmail.com

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 2-4⁰ 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 $\geq 140/90$ 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⁽²⁾. Genetic 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 pressure¹⁴. Cardiovascular reactivity to stress has pathophysiological role in hypertension¹².

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 + 1/3rd 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 2-4⁰ 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

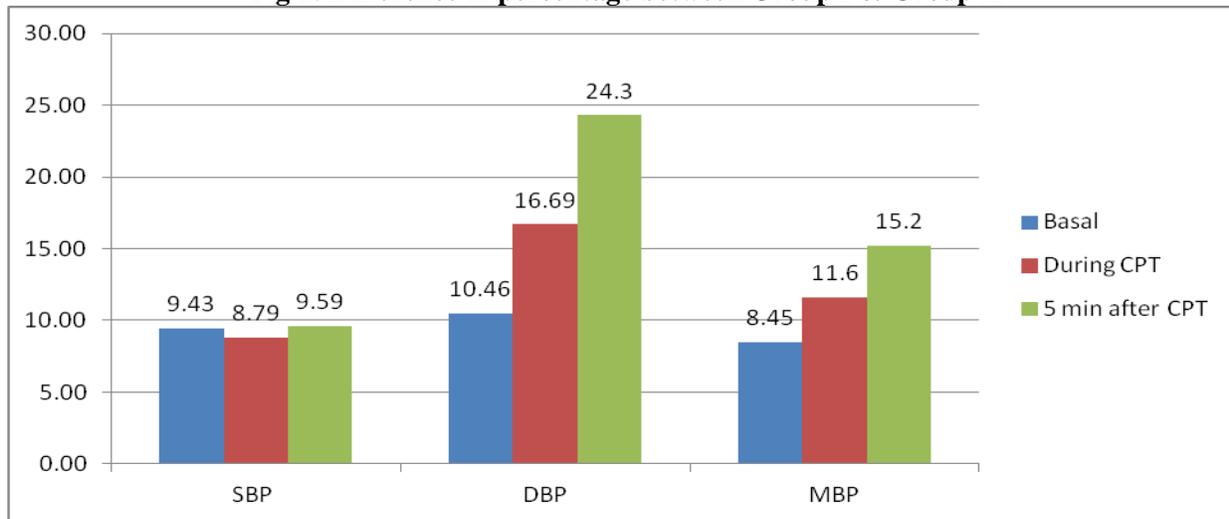
RESULTS

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 1: Statistical analysis of SBP, DBP & MBP of basal blood pressure, during CPT and 5 minutes after CPT in group I and group II

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

* $p < 0.001$ versus group I

Fig 1: Difference in percentage between Group I & Group II

*Percent value was calculated by taking group I as 100%

Percentage change in SBP, DBP & MBP (mmHg) between Group I & Group II has been presented in Fig. 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 parents¹⁶.

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 II²³.

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 pronounced¹¹. Other similar studies suggest a significant increase in systolic and diastolic blood pressure ($p < 0.001$)¹⁶.

Results of the present study were partially similar to that of Khaliq et al¹⁰ 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*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 study¹⁸.

Gupta *et al*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 hypertension²⁰. 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 parents¹⁵.

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 pressure²¹. Results of the present study were similar to that of Rajashekhar RK *et al*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

1. World Health Organisation Expert Committee: Hypertension Control Technical Report Series 862 Geneva, WHO 1996.
2. Ganong WF. Cardiovascular homeostasis in health and disease. In: Ganong WF, ed. Review of medical physiology. 22nd ed. New York: McGraw Hill; 2005, p, 631-646.
3. McIlhenny ML, Shaffer JW, Hines EA Jr: The heritability of blood pressure: an investigation of 200 pairs of twins using the cold pressor test. *John Hopkins Med J* 1975; 136(2): 57-64.
4. Thacker EA: A comparative study of normal and abnormal blood pressure among university students, including the cold-pressor test. *American Heart Journal* 1940; 20(1): 89-97.
5. Busjahn A, Faulhaber HD, Viken RJ, Rose RJ, Luft FC: Genetic influences on blood pressure with the cold-pressor test: a twin study. *J Hypertens* 1996; 14(10): 1195-9.
6. Williams RR, Hunt SC, Hasstedt SJ, Hopkins PN, Wu LL, Berry TD, Stults BM, Barlow GK, Schumacher MC, Lifton RP: Are there any interactions and relations between genetic and environmental factors predisposing to high blood pressure. *Hypertension* 1991; 18(3): 129-37.
7. Mancia G, Di Rienzo M, Giannattasio C, Parati G, Grassi G: Early and late sympathetic

- activation in hypertension. *Scand Cardiovasc J Suppl* 1998;47:9-14
8. Grassi, Guido: Role of sympathetic nervous system in human hypertension. *Journal of Hypertension* 1998;16(12):1979-1987.
 9. Quattro VD, Feng M. The sympathetic nervous system: the muse of primary hypertension. *Journal of Human Hypertension* 2002;16(1):s64-s69.
 10. Khaliq F, Gupta K, Singh P. Autonomic reactivity to cold pressor test in prehypertensive and hypertensive medical students. *Indian J Physiol Pharmacol* 2011;55(3):246-252.
 11. Parmanik T, Regmi P, Adhikari P, Roychowdhury P. Cold pressor test as a predictor of hypertension. *J The Univ Heart Ctr* 2009; 3:177-180
 12. Mathews KA, Woodall KL, Allen MT. Cardiovascular reactivity to stress predicts future blood pressure status. *Hypertension* 1993;22:479-485.
 13. Menkes MS, Matthews KA, Krantz DS, Lundberg U, Mead LA, Qaqish B, Liang KY, Thomas CB, Pearson TA. Cardiovascular reactivity to the cold pressor test as a predictor of hypertension. *Hypertension* 1989;14(5):524-30.
 14. Edgar A, Hines Jr: The significance of vascular hypertension as measured by the cold-pressor test. *American Heart Journal* 1940;19:408-416.
 15. Hooft IMV, Grobbee DE, Waal-Manning HJ, Hofman A. Hemodynamic characteristics of the early phase of primary hypertension. The Dutch Hypertension and offspring study. *Circulation* 1993;87:1100-1106.
 16. Walia V, Ahuja J, Kaur P. Cardiovascular reactivity to cold pressor test in offspring of normotensive and hypertensive parents. *The Indian Journal of Medical Research* 1994;99:38-41.
 17. Douglas C, George DS, Gonneke W, David S, Peter M S, John EJG, Peter CE. Blood pressure reactions to the cold pressor test and the prediction of ischaemic heart disease: data from the carephilly study. *J Epidemiol Community Health* 1998;52:528-529.
 18. Verma V, Singh SK, Ghosh S: Identification of susceptibility to hypertension by the cold pressor test. *Indian J Physiol Pharmacol* 2005;49(1):119-120.)
 19. Gupta AK. Influence of family history of morbid cardiovascular events on blood pressure of school children. *Indian Paediatr* 1991;28(2):131-9.
 20. Thomas J. Meharry Cohort study. *J Natl Medl Assoc.* 82(6):409-412.
 21. Nageswari KS, Sharma R, Kohli DR. Assessment of respiratory and sympathetic cardiovascular parameters in obese school children. *Indian J Physiol Pharmacol* 2007;51(3):235-243.
 22. Rajashekhar RK, Niveditha Y, Ghosh S. Blood pressure response to cold pressor test in siblings of hypertensives. *Indian J Physiol Pharmacol* 2003;47(4):453-458.
 23. Velasco M, Gomez J, Blanco M, Rodriguez I. The cold pressor test: pharmacological and therapeutic aspects. *American Journal of Therapeutics* 1997;4(1):34-38.