

Comparative study of cold pressor response in children of hypertensives and normotensives

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Abstract: *Background:* Hypertension develops early in life as a result of encounters between stressful environmental factors and genetic predisposition. *Objective:* Cold pressor response in children of hypertensives is compared with those of normotensive parents. *Method:* The blood pressure response to cold pressor test was studied in two groups of 100 each, as children of normotensives (Group I) and children of hypertensives (Group II) in the age group of 17-22 years. After noting resting blood pressure, the subjects were asked to immerse their left hand in cold water (3-5°C) for 1 minute and then the systolic (SBP) and diastolic (DBP) blood pressures are measured. *Result:* It was observed that there was no difference in resting SBP and DBP in these two groups. After cold pressor test, significant higher values of SBP and DBP after immersion and change in SBP and DBP were observed in Group II as compared to Group I ($p=0.0001$). Also a significant number of hyperreactors (rise of $>22\text{mmHg}$ SBP and $>18\text{mmHg}$ DBP) are seen in Group II. This suggests sympathetic overactivity. *Conclusion:* The latent period of vascular hyperreactivity can be detected earlier by applying cold pressor test in high risk individuals so as to implement early preventive measures to halt the progression to sustained hypertension developing at a future date.

Keywords: Blood pressure, children, cold pressor test, hypertension.

Introduction

Hypertension is one of the leading causes of the global burden of disease. Hypertension doubles the risk of cardiovascular diseases, including coronary heart disease, congestive heart failure, ischemic and hemorrhagic stroke, renal failure, and peripheral arterial disease. Though various antihypertensive drugs are available, large segments of the hypertensive population are either untreated or inadequately treated [1].

Hypertension develops early in life as a result of encounters between stressful environmental factors and genetic predisposition [2]. Adoption, twin, and family studies document a significant heritable component to blood pressure levels and hypertension. Family studies controlling for a common environment indicate that blood pressure heritability is in the range 15-35%.

In twin studies, heritability estimates of blood pressure are ~60% for males and 30-40% for females. High blood pressure before age 55 occurs 3.8 times more frequently among persons with a positive family history of hypertension [1].

Thus, early identification of the risk of hypertension is important to its prevention [3]. It was proposed that a period of vascular hyperreactivity preceded the development of sustained hypertension, by Hines and Brown.

They further suggested that vascular hyperreactivity may occur as an inherited characteristic of persons who do not have hypertension. Thus, vascular hyperreactivity manifested by an excessive pressor response to an external cold stimulus is a potential predictor of hypertension [4-5].

The cold pressor test measures the response of blood pressure to the stimulus of external cold. It helps to detect the latent stages of hypertension so that early preventive measures can be implemented to reduce morbidity and mortality caused by hypertension and its complications. The present study was undertaken with the aim of comparing cold pressor response in the children of hypertensives in age group of 17-22 years with that of age-matched children of normotensive parents.

Material and Methods

The present study was carried out on a cross section of subjects from the reputed college. 200 subjects in the age group of 17- 22 years participated in this study. They are divided into two groups consisting of 100 each; group I included the children whose parents were normotensive and group II included the children whose parents were hypertensive. All the volunteers are vegetarian, non-smokers, non-alcoholic, having normal body mass indices, not suffering from any organic disease or any other illness known to affect the functioning of autonomic nervous system [6].

A standard proforma was prepared for every subject screened. Personal information including details of family history of hypertension and anthropometric measurements were recorded. The general and relevant systemic examinations were carried out. The blood pressure was measured using auscultatory technique. The cold pressor test [5, 7] was employed. The subjects were asked to immerse their left hand to just above the wrist

in cold water (3°C to 5°C) for 1 minute. Immediately thereafter, systolic and diastolic blood pressure measurements were recorded in right arm sitting position.

Subjects of both groups were categorized, depending on their reactivity to cold pressor test as hyperreactors and normoreactors. Subjects who had registered a rise of > 22 mmHg of SBP and 18 mmHg of DBP were referred as hyperreactors. Following cold pressor test, Subjects whose both SBP and DBP were not raised > 22 mmHg and 18 mmHg respectively were referred as normoreactors [8]. The data was analysed on statistical software STATA version 10.0 by applying unpaired t-test. p < 0.05 was considered as significant.

Results

Table I shows that there is no statistical difference between the age and BMI of the two groups (p>0.05) and hence they are comparable for the study.

Table-I: Showing anthropometric profile of subjects of Group I and Group II

Parameter	Group I	Group II	t value	p value	Significance
AGE (years)	18.23 ± 0.81	18.43 ± 0.91	1.63	0.1037	NS
BMI (kg/m ²)	20.38 ± 2.64	20.25 ± 2.53	0.3282	0.7431	NS

Table-II: Comparison of various parameters (mean± S.D.) using unpaired t test in subjects of Group I and Group II

Parameter	Group I (n=100)	Group II (n = 100)	t value	p value	Significance
RESTING SBP (mmHg)	106.9 ± 8.63	108.12±7.26	1.08	0.2810	NS
RESTING DBP (mmHg)	68.72 ± 5.9	69.16 ± 6.58	0.497	0.6195	NS
AFTER CPT, SBP (mmHg)	114.4 ± 9.05	125.14±11.96	7.16	0.0001	HS
AFTER CPT, DBP (mmHg)	73.66 ± 6.9	82.16 ± 8.64	7.68	0.0001	HS
CHANGE IN SBP (mmHg)	7.5 ± 5.6	17.02 ± 9.13	8.88	0.0001	HS
CHANGE IN DBP (mmHg)	4.94 ± 4.48	13 ± 7.91	8.86	0.0001	HS

Table II shows the mean values of systolic and diastolic blood pressure before and after the cold pressor test in both the groups. The resting SBP and DBP when compared between subjects of Group I and Group II by using unpaired t test are found to be statistically non-significant (p value for resting SBP and DBP are 0.2810 and 0.6195

respectively). Also, SBP and DBP that taken after performing the cold pressor test and the change obtained in these two pressures after the test are compared between the two groups by using unpaired t test. The results found are statistically significant (p value < 0.001).

Table-III: Percentage of normoreactors and hyperreactors in both the groups					
Type of study groups	Total	Normoreactors		Hyperreactors	
		Number	Percentage (%)	Number	Percentage (%)
Group I	100	95	95	05	05
Group II	100	49	49	51	51
Chi ² = 52.48 p = 0.0001, HS					

Table III shows that in Group I, 95 % of study subjects are normoreactors and remaining 5 % are hyperreactors. Whereas in Group II, 49 % are normoreactors and remaining 51 % are hyperreactors. Thus, the occurrence of hyperreactors is significantly more in Group II than in Group I (p= 0.0001).

Discussion

The present study was conducted to compare the blood pressure response to cold pressor test by the children of hypertensives in age group of 17-22 years with that of age matched children of normotensives. In this study, two groups of 100 subjects each, i.e., children of hypertensives and children of normotensives were subjected to cold pressor test and the results were recorded and compared between these two groups.

1. Resting systolic and diastolic blood pressure

The resting SBP and DBP of both the groups were statistically non-significant (p value for resting SBP and DBP are 0.2810 and 0.6195 respectively). Similar findings are reported by Rajashekhar et al. (2003) [9], Verma et al. (2005)[10] and Garg et al. (2010) [8].

2. Systolic and diastolic blood pressure after cold pressor test

After performing cold pressor test, mean values for SBP and DBP obtained were found to be statistically significant (p value = 0.0001). Our findings match with the findings of Rajashekhar et al. (2003) [9], Verma et al. (2005) [10] Pramanik T (2008) [11] and Garg S et al. (2010) [8].

3. Change in systolic and diastolic blood pressure

Similarly, when the change in both SBP and DBP in response to cold pressor test was compared between the two study groups, they were found to be statistically significant (p value = 0.0001). Similar results have been reported by Menkes MS et al. (1989),[12] and Garg, S et al. (2010)[8].

The cold pressor test measures the change in blood pressure in response to cold and painful stimulus, elicited by placing the hands in cold water. On exposure to cold, there occurs activation of the sympathetic nervous system. This causes increase in blood pressure secondary to vasoconstriction. The rise in BP in response to localized cold exposure is reflexogenic; mediated through hypothalamus with augmented sympathetic activity, releasing non-epinephrine at vascular smooth muscle cells [13].

The children of hypertensive parents showed increased pressor response to cold stress. This indicates increased sympathetic activity and vascular hyperreactivity. Increase in sympathetic activity may be a result of inheritance or a consequence of interaction between genetic and environmental factors. This may be suggestive of the presence of latent phase of hypertension since increased sympathetic activity is the fundamental mechanism in the development of hypertension.

However, Robert H. Feldt et al. (1942) [14] contradicted the above findings and concluded that BP responses to cold are probably influenced by different factors related to participants' emotional state and coping style.

4. Percentage of normoreactors and hyperreactors among subjects of both the groups

In the present study, the occurrence of hyperreactors is significantly more in Group II than in Group I ($p= 0.0001$). Our findings are consistent with the findings of Edgar A. Hines Jr. (1940)[5] and Kasagi F et al. (1995)[15]. However, the cut-off points for distinguishing hyperreactors from normoreactors are not consistent among the investigators, because there is no cut-off point that divides naturally a hyperreactor from normoreactors [15]

In the present study, a large proportion of hyperreactors is found in Group II, indicating that subjects with the familial predisposition of hypertension possess a significant vascular hyperreactivity. This property of vascular hyperreactivity may predispose them to develop hypertension in future.

Conclusion

In conclusion, elevated SBP and DBP in response to cold pressor test and significantly higher number of hyperreactors are observed in the children of hypertensive parents. Thus, the latent period of vascular hyperreactivity can be detected earlier by applying cold pressor test so as to implement early preventive measures to halt the progression to sustained hypertension developing at a future date. The regular use of this test is recommended in high risk individuals for screening of hypertension. Follow up studies are needed to establish cold pressor test as a predictor of hypertension.

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