e-ISSN: 0975-1556, p-ISSN:2820-2643

Available online on www.ijpcr.com

International Journal of Pharmaceutical and Clinical Research 2023; 15(5); 2054-2058

Original Research Article

Cold Pressor Test in Medical Students as a Predictor of Hypertension

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Received: 16-02-2023 / Revised: 30-03-2023 / Accepted: 30-04-2023
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Conflict of interest: Nil

Abstract

Introduction: Early detection of hypertension risk is crucial to its prevention since hypertension is a significant risk factor for cerebrovascular morbidity and mortality. The cold pressor test, which measures how blood pressure reacts to an external cold stimulus, has been used to pinpoint hyperreactive people who are at risk of developing hypertension. Our study's objective was to determine how the cold pressor test (CPT) affected medical students with and without a history of hypertension in terms of heart rate and blood pressure.

Materials and Methods: This study was conducted on sixty normotensive children of normotensive parents and sixty normotensive children of hypertensive parents between the ages of 18 and 22 at Surabhi Medical College in Siddipet, Telangana, between February and August 2022. The cold pressor test has been performed. The obtained values were expressed as Mean± SD and compared using the student 't' test.

Result: The cold pressor test caused an increase in blood pressure and heart rate in all of the young, normotensive students. Blood pressure and heart rate returned to baseline five minutes after the removal of the stressor in students with no history of hypertension in the family. In contrast, the students whose parents were reported to be hypertensive exhibited elevated diastolic blood pressure five minutes after the stressor was removed.

Conclusion: The present study revealed that the normotensive students who presented prolonged elevated diastolic pressure in response to sympathetic stimulation through the cold pressor test were prone to develop hypertension in the future.

Keywords: Hypertension, Cold Pressor Test, Sympathetic Nervous System.

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Introduction

Hypertension, a major health issue in the modern world, poses a threat to all humanity. Essential hypertension is the most frequent type of hypertension.[1] Early detection of hypertension risk may enable an individual to live a healthy life by changing their lifestyle habits such as avoiding alcoholic beverages, smoking, eating too much fat, and adopting

the practise of yogic exercise,[2] moderate aerobic exercise,[3] mental relaxation,[4] and so on. Therefore, it will certainly be advantageous if a person can be made aware that he or she may have hypertension well before the condition manifests itself.

Cardiovascular response to stress may play a detrimental role in neurogenic hypertension. According to reports, people at high risk of hypertension may have an exacerbated stress-induced cardiovascular response at a younger age.[5] The sympathetic nervous system is crucial in the development of essential hypertension. Subjects with a positive history of familial hypertension, a high resting heart rate, or a transitory increase in arterial hypertension have been found to exhibit hyperresponsive blood pressure to stress stimuli mediated by sympathetic nervous system overactivity.[6]

When activated by a stressor, the sympathetic nervous system increases heart rate and blood pressure; however, heart rate and blood pressure normally recover to normal values within a short amount of time when the stressor is removed.[7] Overactivity of the sympathetic nervous system also plays a role in the pathophysiology of neurogenic hypertension in young people [8]. The patient is at high risk of developing hypertension in the future if his or her cardiovascular system is particularly sensitive to a stressor and recovers slowly after its absence.[9]

The current study was carried out to assess cardiovascular responses such as blood pressure and heart rate changes during a cold presser test as a possible future risk for hypertension in young healthy normotensive students.

Materials and Methods

This cross-sectional comparative study was carried out in the Department of Physiology at Surabhi Medical College in Siddhipet, Telangana. The study lasted from February 2022 to August 2022. After receiving approval from the relevant ethical review board and obtaining informed written consent, 60 healthy first-year MBBS students of both genders (30 males and 30 females were included. Students were divided into two groups: Group N had 30 students (15 males and 15 females) without a family history of hypertension and Group H had 30 students (15 males and 15 females) with a family history of hypertension. The students in the study were all normotensive. belonged to the age group of 18-22 years. Subjects with a history of any chronic illness or drug intake known to influence blood pressure were excluded from the study

Blood pressure of all the students was measured in a sitting position using an auscultatory method using a standard mercury sphygmomanometer. To reduce anxiety, the students were asked to rest for ten minutes before their blood pressure was taken. The first and fifth Korotkoff sounds indicated systolic and diastolic blood pressure, respectively. First, heart rate and blood pressure were monitored from the right hand, The sphygmomanometer cuff was left in place for the next blood pressure reading. The students left hand was immersed in a water kettle having water at 4 degrees Celsius. After one minute, the subject's blood pressure and pulse rate were monitored and was requested to remove the hand from the cold water. The students hand was then wrapped in a warm towel for 3 minutes before being permitted to rest. Heart rate and blood pressure were measured again five minutes after the cold pressor test (recovery).

Statistical Analysis

The data was analyzed using SPSS version 22. The changes in blood pressure and heart rate amongst the children of the hypertensive and the children of normotensive parents were compared using Student’s t-test.

Results

The age of the Group N(Children of normotensive parents) subjects was 20±0.824 and that for the Group H (Children of Hypertensive parents) was 20± 0.643. There were 15 males and 15 females in both groups. The Body mass index was 22.12± 2.72 and 22.62±2.93in 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 have been given in Table 1.

Table 1: Comparison of participants' characteristics in children of normotensive and hypertensive parents

Parameter	Group N (Children of Normotensive parents) N=30	Group H (Children of Hypertensive parents) N=30	P value
Age (years)	20±0.824	20± 0.643	0.213
Gender			
Male	15	15	
Female	15	15	0.143
BMI (kg/ m2)	22.12± 2.72	22.62±2.93	0.08

After the end of the test, systolic and diastolic pressures increased in children of both normotensive and hypertensive parents. both systolic and diastolic pressure, approached the baseline in the children of normotensive parents 5 minutes after the withdrawal of the stimulus. On the other hand, in the case of children from hypertensive families (n=25), diastolic blood pressure remained elevated and did not return to the baseline 5 minutes after the withdrawal of the stimulus

Table 2: Comparison of HR & BP in children of normotensive and hypertensive family

Parameter	reading	Group N (Children of Normotensive parents) N=30	Group H (Children of Hypertensive parents) N=30	P value
Heart rate (beats/min)	1st	76.14±9.54	74.12±13.43	0,621
	2nd	77.83±10.42	76.62±11.24	0,213
	3rd	75.84±10.32	75.93±11.24	0,031
Systolic Blood pressure (mmHg)	1st	114.32±9.43	116.43±10.12	0,002*
	2nd	119.84±9.86	122.64±10.97	0,032*
	3rd	114.64±9.61	116.95±9.80	0.012*
Diastolic Blood pressure (mmHg)	1st	72.32±9.86	73.42±8.24	0.003*
	2nd	76.36±10.23	84.12±8.96	0.012*
	3rd	72.42±9.86	79.24±9.45	0.032*

*significant at $p<0.05$

Discussion

The current study was carried out to examine the effect of cold stimulation on blood pressure in 60 healthy medical students from Surabhi Medical College in Siddipet, Telangana. The objective of this study was to identify those who might develop hypertension as they get older. Participants underwent a cold pressor test, and blood pressure was taken before and after one minute of immersion in cold water, as well as at 1 and 5 minutes afterward.

The cold pressor test (CPT), which evaluates blood pressure response to an external cold stimulus, has long been a standard test for the characterisation of sympathetic function and has been shown to predict the risk of hypertension in normotensive people. [10]. The CPT is known to elicit widespread sympathetic activation and considerable arteriolar vasoconstriction, resulting in an elevation in blood pressure. [11] The CPT has been proven in studies to raise plasma nor-epinephrine and muscular sympathetic nerve activity. Increases in both mean arterial blood pressure and peripheral venous norepinephrine concentration are strongly correlated with increases in muscle sympathetic nerve activity. [12]

There was a statistically significant difference in cold pressor response between the offspring of hypertensive and normotensive parents in the current investigation. This finding is similar with the findings of research conducted among 100 children of hypertension and normotensive parents between the ages of 16 and 20, which revealed a highly significant cold pressor response in blood pressure among offspring of hypertensive parents.[13]

Immersion of the right hand in 4˚c cold water up to the wrist stressed the subjects through cold sensation and pain.[14] The cold pressor test stimulated the sympathetic nervous system, resulting in an acceleration of the heart rate and a rise in blood pressure, both systolic and diastolic, in comparison to those recorded before the test in all normotensive subjects. In the case of hypertensive adults' offspring, the increase in diastolic pressure was so substantial that the mean blood pressure increased significantly when compared to the baseline mean pressure. This study backs up the prior observation that offspring of hypertension parents have higher blood pressure responses to stress.[15]

Conclusion

Individuals who exhibit increased and especially extended response to diastolic blood pressure due to sympathetic stimulation via the cold pressor test may be at a high risk of developing hypertension early in life. Early detection of hypertension risk may assist an individual in leading a healthy life by implementing certain lifestyle changes such as diet restriction, exercise, and yoga.

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