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Original Research Article

Effect of a Stressor on Blood Pressure in Healthy Offspring with and without Parental History of Type 2 Diabetes Mellitus

Dr. Arifuddin M K[1], Dr. Vivek P[2*], Dr. Nagalakshmi[3]

[1]Assistant Professor, Department of Physiology, Sri Siddhartha Medical College, Tumkur, Karnataka, India
[2]Assistant professor, Department of Physiology, Chamarajanagar Institute of Medical Sciences, Chamarajanagar, Karnataka, India
[3]Professor, Department of Physiology, SDM Medical College, Dharwad, Karnataka, India

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***Corresponding author:** Dr. Vivek P

Abstract

Background: The incidence of Type 2 DM (T2DM) is rapidly increasing worldwide and constitutes a major global public health problem**.** Autonomic reactivity to a challenge like that of exercise or cold offers a greater scope to evaluate and assess the capability of autonomic system to regulate and maintain homeostasis. The cold Pressor test (CPT) which is considered to be a sympatho-excitatory maneuver is a simple, noninvasive and validated test of sympathetic activation. The Blood pressure (BP) responses to CPT could be used as indicators of global sympathetic activation, and thus of cardiac status and autonomic function. ***Aims:*** To compare the autonomic reactivity by recording the Blood pressure during and after CPT between healthy offspring with and without parental history of T2DM. ***Methods:*** This study consists of 40 healthy male subjects with family history of T2DM (cases) and 40 healthy male subjects without family history of T2DM (controls) in the age group of 18-25 years. BP during and after CPT were compared between cases and controls. ***Results:*** Chi-square/ Fisher Exact test has been used to find the significance of study parameters on categorical scale between two or more groups. In the present study, the post CPT changes in Systolic Blood Pressure (SBP) and Diastolic Blood Pressure (DBP) did not demonstrate any significant differences. However, the graphical representation of SBP changes after CPT shows fluctuation among cases before it reaches the stable value, whereas, in controls the decrease was at constant level. ***Conclusion:*** The results suggest there was altered autonomic reactivity to physical stress among the offspring with parental history of T2DM when compared to their counterparts and hence this points towards the fact that they are at a risk of developing future autonomic dysfunction and cardiovascular complications.

Keywords: Cold Pressor test (CPT), Type2 Diabetes Mellitus (T2DM), Systolic Blood Pressure (SBP) and Diastolic Blood Pressure (DBP).

INTRODUCTION

The incidence of Type 2 DM (T2DM) is rapidly increasing worldwide and constitutes a major global public health problem [1**].** Great deal of evidence is available to support the fact that pathogenesis of T2DM is influenced by both genetic and environmental factors [2]. Further, clustering of cardiovascular risk factors like obesity, dyslipidemia in the offspring of diabetics is more prevalent which are the additional contributing factors towards pathogenesis of the condition [3]. Therefore, the prevalence of DM is in an increasing trend among young Indian population.

Autonomic reactivity to a challenge like that of exercise or cold offers a greater scope to evaluate and assess the capability of autonomic system to regulate and maintain homeostasis. Studies among diabetics and obese individuals have shown an exaggerated BP change to various forms of stress which includes isometric exercise, dynamic exercise, Cold Pressor Test (CPT) and psychological stress [4-6]. The CPT has been used both clinically and experimentally to evaluate non-baroreflex-mediated sympathetic neural control in humans [7, 8].

The present study intends to evaluate the autonomic status and its reactivity among healthy offsprings with parental history of diabetes and compare the same with age and gender matched offsprings without parental history of diabetes. The hypothesis is that autonomic status and its reactivity to

physical stress is heightened and sustained in offsprings with parental history of diabetes.

MATERIALS AND METHOD

This study is having total number of 80 subjects of which 40 are healthy male non diabetic subjects without parental history of T2DM (control) and 40 are healthy male non diabetic subjects with atleast one parent with T2DM (cases). Both the groups are in the age group 18-25years.

Subjects were selected among the general population, ethical clearance was obtained and the protocol was briefed to the subject and the informed written consent was obtained from all the subjects. Those with history of with Type I Diabetes Mellitus, those suffering from cardiac, respiratory, metabolic, endocrine, neurological and psychiatric diseases, those who are smokers or alcoholics or drug abusers, those on regular medications affecting cardiovascular and respiratory system, those undergoing any physical conditioning programme were excluded from the study.

Cold Pressor Test

Subject instructed to immerse the hand till the wrist in cold water (1-4^{o}C) for 2 minutes or until toleration whichever is earlier. Care was taken to ensure that the subject avoided any isometric contractions, breath holding or performance of Valsalva maneuver. SBP and DBP using BPL cardiac monitor was obtained from the other arm at 30 seconds interval till subject removed the hand or completion of two minutes. After removing the hand the BP was recorded at an interval of 30 seconds for 3 minutes.

RESULT

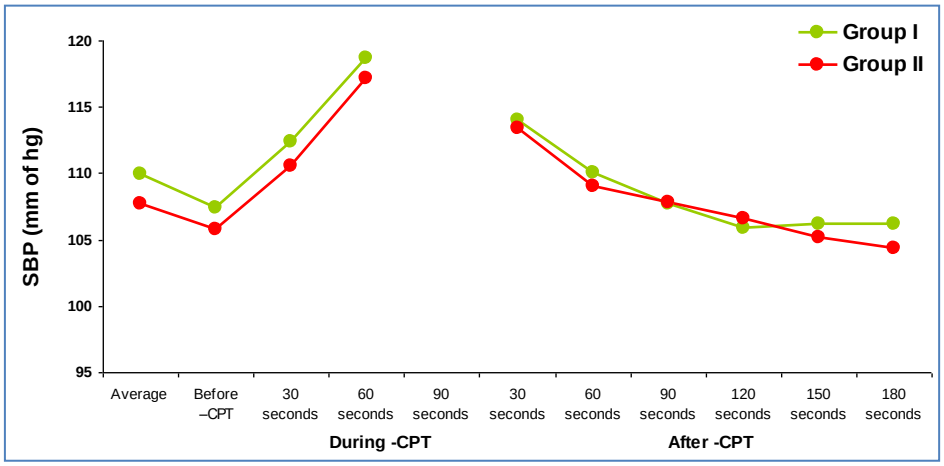
Student t test (two tailed, independent) has been used to find the significance of study parameters on continuous scale between two groups on metric parameters. Chi-square/ Fisher Exact test has been used to find the significance of study parameters on categorical scale between two or more groups. The Statistical software namely SAS 9.2, SPSS 15.0, Stata 10.1, were used for the analysis of the data. Significance is assessed at 5 % level of significance.

Table-1: Comparison of age and anthropometric measurements between cases and controls

Variables	Cases n=40	Controls n=40	P value
Age (years)	19.20±0.85	19.05±0.78	0.415
Height (cm)	1.71±0.07	1.70±0.05	0.594
Weight (kg)	61.10±8.29	61.18±7.14	0.966
BMI (kg/m^2)	20.88±2.61	21.06±2.07	0.739
Waist circumference (cm)	81.23±8.99	79.98±5.95	0.465
HIP circumference (cm)	94.58±8.89	93.20±5.44	0.407
W/H ratio	0.86±0.03	0.86±0.03	0.953
Wrist circumference (cm)	16.4±0.78	16.59±0.65	0.245

Table-2: Comparison of SBP (mm of Hg) during and after CPT between cases and controls

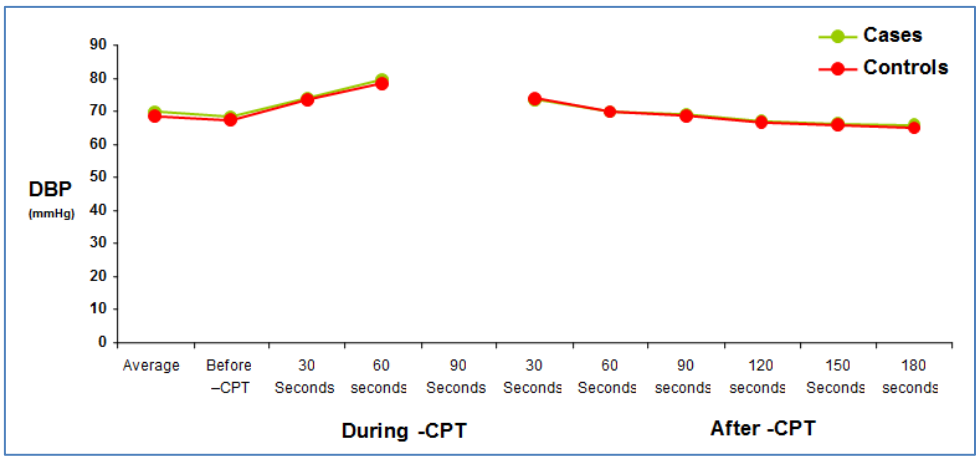
SBP (mm of Hg)	Cases (n=40)	Controls (n=40)	P value
Before –CPT	107.38±7.95	105.78±7.02	0.343
During –CPT			
30 seconds	112.35±9.12	110.55±7.64	0.342
60 seconds	118.63±8.41	117.18±7.61	0.421
90 seconds	-	-	-
After –CPT			
30 seconds	113.98±7.56	113.35±7.93	0.719
60 seconds	110.08±7.61	109±7.68	0.531
90 seconds	107.7±6.73	107.85±7.39	0.925
120 seconds	105.85±6.69	106.6±7.17	0.630
150 seconds	106.15±6.78	105.2±6.53	0.525
180 seconds	106.15±7.05	104.4±6.44	0.250



Graph-1: Representation of SBP changes after CPT between cases and controls

Table-3: Comparison of DBP (mm of Hg) during and after CPT between cases and controls

DBP (mm of Hg)	Cases (n=40)	Controls (n=40)	P value
Before –CPT	67.83±7.91	67.08±6.20	0.638
During –CPT			
30 seconds	73.78±6.76	73.20±6.34	0.696
60 seconds	79.48±9.05	78.15±8.76	0.508
90 seconds	-	-	-
After –CPT			
30 seconds	73.23±7.17	73.58±7.24	0.829
60 seconds	69.58±7.73	69.83±7.41	0.883
90 seconds	68.65±7.74	68.38±7.36	0.871
120 seconds	66.83±7.35	66.55±6.48	0.860
150 seconds	66.1±6.72	65.55±6.22	0.705
180 seconds	65.63±6.75	64.73±5.73	0.522



Graph-2: Representation of DBP changes after CPT between cases and controls

The mean and standard deviation (SD) of age, anthropometric variables and their comparison between cases and controls are depicted in Table.1. Both the groups were comparable for age and anthropometric measurements. Diabetic family history among cases showed that about 40% had paternal and 30 % had maternal. Among parental history, paternal positive history predominates than maternal.

The systolic and diastolic blood pressure response to CPT is given in Table.2 and Table.3 respectively. Normally during CPT the SBP increases by 10-20 mm of Hg and DBP increases by 8-10 mm of Hg. The SBP during CPT was comparable between the two groups. At 30 sec SBP was 112.35±9.12 mm of Hg and 110.55±7.64 mm of Hg (P = 0.342) and by 60 sec it reached 118.63±8.41 mm of Hg and 117.18±7.61 mm

of Hg (P = 0.421) in cases and controls. The DBP during CPT was comparable between the two groups. At 30 sec DBP was 73.78±6.76 mm of Hg and 73.20±6.34 mm of Hg (P = 0.696) and by 60 sec it reached 79.48±9.05 mm of Hg and 78.15±8.76 mm of Hg (P = 0.508) in cases and controls. But, the post CPT changes in either of blood pressure did not demonstrate any significant differences. However, the graphical representation of SBP changes after CPT (Graph.1) shows fluctuation among cases before it reaches the stable value, whereas, in controls the decrease was at constant level. Even though the absolute values were not much significant the dynamics of physiological response among cases give an insight to cardiovascular regulation among offspring of T2DM. The graphical representation of DBP changes after CPT is shown in Graph 2.

DISCUSSION

Dysfunction in the autonomic nervous system activity, alteration in the glucose and lipid metabolism are associated with increased risk of developing diabetes in future and therefore it may serve as an predicting factor in early detection of diabetes risk among the population [9, 10]. The reactivity hypothesis has suggested that exaggerated response and the dynamics of physiological recovery to the stressor may predict the development of cardiovascular diseases in future and any deviation from the normal recovery could be the earliest subclinical sign [11].

However there are a few studies evaluating the cardiac autonomic response and its reactivity among the healthy offsprings of diabetics. Hence in this study we have attempted to assess the changes in the cardiac autonomic activity and its reactivity to physical stress among the healthy offsprings of diabetics; which if present may act as warning bells of future diabetes, among healthy offsprings with parental history of T2DM.

The cold presser response is an indicator of sympathetic activity after cold stress [12, 13]. A number of studies have been performed to identify the mechanisms leading to elevations in blood pressure during this procedure. This may be due to an increased Cardiac Output during the initial period of the test with little increase in muscle sympathetic nerve activity. The increase in MSNA correlates linearly with increases in both mean arterial blood pressure and peripheral venous norepinephrine [14]. There are reports demonstrating that the hyper responsiveness of BP during CPT could be an indication to develop a neurogenic HTN among healthy individuals who are at risk [15].

In the present study the cardiac autonomic reactivity to physical stress among the offsprings of diabetics has provided an insight into the dynamics of the physiological response for the physical stress. Further, Elucidation of this dynamics among wider age group and/or following the same subjects may provide us a greater understanding. Because of younger age group of our subjects a distinct physiological difference in the study could not be found. This is the limitation of this study.

CONCLUSION

In the present study, the post CPT changes in SBP and DBP did not demonstrate any significant differences. However, the graphical representation of SBP changes after CPT shows fluctuation among cases before it reaches the stable value, whereas, in controls the decrease was at constant level. This as a whole signifies a altered autonomic reactivity to physical stress among the offsprings with parental history of T2DM when compared to their counterparts and hence this points towards the fact that they are at a risk of developing future autonomic dysfunction and cardiovascular complications.

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