



COMPARISON OF SYMPATHETIC FUNCTION TESTS IN CHILDREN OF PARENTS WITH DIABETES MELLITUS WITH THAT OF CHILDREN OF PARENTS WITHOUT DIABETES MELLITUS

Physiology

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ABSTRACT

Background: Diabetes Mellitus is one of the most common lifestyle disorders with a genetic background requiring lifelong blood glucose monitoring and therapy. Many studies have documented Autonomic dysfunction in patients with diabetes mellitus. But there are very few studies on cardiac autonomic activity in children of parents with diabetes mellitus. This study was designed to compare cardiac sympathetic activity in children of parents with diabetes mellitus with that of children of parents without diabetes mellitus. **Materials & Methods:** Present study was a cross-sectional type of study and consisted of 50 normal children of parents without diabetes mellitus (control group) and 50 normal children having at least one parent with type 2 diabetes mellitus (study group) in the age group of 15 to 25 years involving both males and females. Two sympathetic function tests i.e. Cold Pressor Test (CPT) and Sustained Handgrip Test (SHG) were included in the study. After the recording of data, statistical analysis of observations was done using unpaired T test. **Results:** There was a reduced response to cold pressor and sustained hand grip test in study group as compared to control group. **Conclusion:** Decreased cold pressor and sustained hand grip response in study group shows impaired sympathetic activity. Thus, impaired sympathetic function tests suggest sympathetic dysfunction in the study group.

KEYWORDS

Sympathetic Function Test, Children Of Type 2 Diabetes Mellitus, Cold Pressor Test, Sustained Hand Grip Test

INTRODUCTION

Diabetes mellitus is a disease characterized by a complex interplay of genetic, epigenetic, and environmental variables¹. Diabetic autonomic neuropathy is a serious and common complication of diabetes². Many studies have documented autonomic dysfunction in patients with diabetes mellitus^{3,4}. But there are very few studies on cardiac sympathetic activity in children of parents with diabetes mellitus⁵.

The cold pressor test devised by Hines and Brown⁶ involves exposure of the individual to cold as a stressful stimulus. The reaction of the individual to stress is measured by the change in systolic and diastolic blood pressures after the exposure to cold stress. The isometric hand grip exercise activates the mechanoreceptors immediately due to the increased muscle tension. The recruitment of new motor units to maintain the muscle tension, increases the excitatory state of the central nervous system and results in a possible increase in the sympathetic outflow and a decrease in parasympathetic outflow, which explain the increase in the blood pressure response⁷.

The aims and objectives of present study were to compare blood pressure changes during various stressor stimuli as a measure of sympathetic activity between study group and control group.

MATERIALS AND METHODS

The present study was conducted in the Department of Physiology, K J Somaiya Medical College, Mumbai. Institutional ethical committee approval was taken before commencement of the research.

Present study involved 50 normal children of parents without diabetes mellitus (control group) and 50 normal children with at least one parent with type 2 diabetes mellitus (study group) in the age group of 18 to 25 years involving both males and females. Subjects with the history of smoking, cardiovascular, respiratory, any endocrine disorder or on long term medications for any other chronic disease were excluded from the study. Written informed consent was taken before recording the data on the subject.

The subjects were asked to report between 10 a.m-12 p.m. in the lab after an adequate night's sleep followed by a light breakfast. After reporting the subjects were given 15 minutes of rest. Following two sympathetic function tests were conducted on both the study groups.

1. Blood Pressure Response to Cold Pressor Test:

The subject was asked to immerse the hand in cold water maintained at 4-6°C for 2 minutes or until it becomes painful whichever was earlier; blood pressure was recorded from the other arm at the end of 2 minutes. Then maximum increase in systolic and diastolic blood pressure was determined.

2. Blood Pressure Response to Sustained Hand Grip:

The subject was asked to exert maximal hand grip strength on hand grip dynamometer, with dominant hand. First the maximum voluntary contraction (MVC) (Maximal isometric tension i.e. T max) is determined and then the subject was asked to exert 30 % of MVC for 3

minutes with dominant hand. The Blood pressure was measured in the non-exercising hand at rest and just before the release of hand grip pressure.

Statistical analysis of the observations was carried out using unpaired T test.

RESULTS

There were reduced changes in SBP after cold pressor test in study group as compared to control group and the difference was found to be statistically significant. Also, there were reduced changes in DBP after cold pressor test in study group as compared to control group but the difference was statistically not significant. (Table 1 and 2)

Also, the rise in SBP after sustained hand grip test was less in the study group as compared to control group even though the difference was statistically not significant. Similarly, there was no statistically significant difference in DBP after sustained hand grip test in study group as compared to control group. (Table 1 and 2)

Table 1 - Comparison of SBP and DBP After CPT and SHG in Study Group and Control Group

Sr. No.	Autonomic Function Test	Study Group (Mean±SD)	Control Group (Mean±SD)
1	Changes in SBP & DBP after Cold pressor test		
	ΔSBP (mmHg)	-1.22±10.24	10.55±9.32
	ΔDBP (mmHg)	2.66±8.47	8±13.67
2	Changes in SBP & DBP after Sustained handgrip test		
	ΔSBP (mmHg)	14±15.87	17.55±14.18
	ΔDBP (mmHg)	13.11±14.97	12±19.42

Table 2 - Statistical Analysis of SBP and DBP After CPT and SHG in Study Group and Control Group Using Unpaired T test

Sr. No.	Autonomic Function Test	P Value	Significance
1	Changes in SBP & DBP after Cold pressor test		
	ΔSBP	0.02	Statistically significant
	ΔDBP	0.33	Statistically Not significant
2	Changes in SBP & DBP after Sustained handgrip test		
	ΔSBP	0.62	Statistically Not significant
	ΔDBP	0.89	Statistically Not significant

DISCUSSION

The subjects included in the study were similar in terms of age and BMI (Body mass index).

CPT is known to trigger a vascular sympathetic activation and an increase in blood pressure in healthy subjects.

In present study changes in SBP (systolic blood pressure) after CPT in

study group was -1.22 ± 10.24 and in control group was 10.55 ± 9.32 mmHg respectively. Similarly changes in DBP (diastolic blood pressure) in study group was 2.66 ± 8.47 and in control group was 8 ± 13.67 mmHg respectively. (Table no. 1) There was less rise in SBP and DBP after cold pressor test in study group as compared to control group and difference was statistically significant only for SBP. (Table No. 2) Thus there was a reduced response to cold stress in study group.

This is in accordance with the study done by Nishanta et al which shows that heart rate and blood pressure after CPT were significantly lower in study group patients (group B - non-diabetic patients with at least of one parent with history of type 2 diabetes mellitus) in comparison to control group subjects (Group A - non-diabetic patients without parental history of type 2 diabetes mellitus)⁸.

It has been postulated that the pressure response to the isometric exercise is reflex in origin and any damage to the neurological pathways involved could lead to a diminished or absent cardiovascular response to sustained handgrip⁹.

In the present study changes in SBP after SHG in study group was 14 ± 15.87 and in control group was 17.55 ± 14.18 mmHg respectively. Similarly changes in DBP in study group was 13.11 ± 14.97 and in control group was 12 ± 19.42 mmHg respectively. (Table no. 1) So there was less rise in SBP after sustained handgrip test in study group as compared to control group and the difference was statistically insignificant. (Table No. 2) Similarly changes in DBP after SHG was not statistically significant. (Table No. 2)

This is in accordance with study done by Kumbhar A et al who found out that during handgrip exercise test the rise in blood pressure was significantly reduced in study group (children with parental history of diabetes mellitus) as compared to control group (children without parental history of diabetes mellitus)¹⁰. According to Foss CH et al, presence of autonomic neuropathy in subjects with parental type 2 diabetes was associated with higher UAER (Urinary Albumin Excretion Rate), fasting insulin level, and 24-h AMBP (Ambulatory Blood Pressure Monitoring) and a reduced diurnal blood pressure variation¹¹.

Whereas according to Bagudai S et al, parental history of diabetes does not have any impact on the cardiovascular autonomic activity before the disease manifestation^{12,13}.

Thus, it can be concluded that there may be presence of subclinical sympathetic dysfunction in children of parents with diabetes mellitus. The possible mechanism could be genetic association¹⁴, presence of inherited genes for sympathetic autonomic neuropathy which could be expressed before or even without development of diabetes mellitus¹⁰. It may also be due to existing insulin resistance in these children¹⁵ which predisposes them for developing cardiovascular complications.

CONCLUSION

Decreased cold pressor and sustained hand grip response in study group shows impaired sympathetic activity suggesting Subclinical Autonomic dysfunction in children of parents with type 2 diabetes mellitus. It may be due to inherited susceptibility genes for the sympathetic autonomic neuropathy or insulin resistance in these children.

REFERENCES

- Goyal S, Rani J, Bhat MA, Vanita V. Genetics of diabetes. *World J Diabetes*. 2023;14(6):656-679.
- Vinik AI, Maser RE, Mitchell BD, Freeman R. Diabetic autonomic neuropathy. *Diabetes Care*. 2003;26(5):1553-79.
- Ducher M, Cerutti C, Gustin MP, Abou-Amara S, Thivolet C, Laville M, Paultre CZ, Fauvel JP. Noninvasive exploration of cardiac autonomic neuropathy. Four reliable methods for diabetes? *Diabetes Care*. 1999;22(3):388-93.
- Ziegler D, Dannehl K, Mühlen H, Spüler M, Gries FA. Prevalence of cardiovascular autonomic dysfunction assessed by spectral analysis, vector analysis, and standard tests of heart rate variation and blood pressure responses at various stages of diabetic neuropathy. *Diabet Med*. 1992;9(9):806-14.
- B Derkenne; M Tallsund et al. Cardiac autonomic dysfunction in diabetic children. *Diabetes Care* 1999;22(11):1845-1850.
- Hines EA, Brown GE. The cold pressor test for measuring the reactivity of the blood pressure: data concerning 571 normal and hypertensive subjects. *Am Heart J*. 1936;11(1):1-9.
- Hietanen E. Cardiovascular responses to static exercise. *Scand J Work Environ Health*. 1984;10:379-402.
- Nishanta & Pushpa Gora. Impact of Cold Stress on HR & BP in Offspring with & without Parental H/O Type 2 DM. *Int J Med Res Prof*. 2020 Jan; 6(1); 64-67.
- Freyschuss, U. Cardiovascular adjustment to somatomotor activation. *Acta Physiologica Scandinavica*. 1970;Supplement 342.
- A. Kumbhar, Lalit H. Nikam. Sympathetic cardiovascular function integrity in children with parental history of diabetes mellitus. *International Journal of Recent Trends in*

Science And Technology. 2015;16(1):01-06.

- Foss CH, Vestbo E, Frøland A, Gjessing HJ, Mogensen CE, Damsgaard EM. Autonomic neuropathy in nondiabetic offspring of type 2 diabetic subjects is associated with urinary albumin excretion rate and 24-h ambulatory blood pressure: the Fredericia Study. *Diabetes*. 2001 Mar;50(3):630-6.
- Satyajit Bagudai, Hari Prasad Upadhyay. Association of Autonomic imbalance with Parental history of Type 2 Diabetes Mellitus. *Asian Journal of Medical Sciences*. 2020;11(3):67-70.
- Khadka R. Cardiovascular autonomic function in healthy young adults with parental history of type 2 diabetes. 2014; doi:10.1016/J.JNS.2013.07.2052.
- Vassy JL, Shrader P, Jonsson A, Fox CS, Lyssenko V, Isomaa B, Groop L, Meigs JB, Franks PW. Association between parental history of diabetes and type 2 diabetes genetic risk scores in the PPP-Botnia and Framingham Offspring Studies. *Diabetes Res Clin Pract*. 2011;93(2):e76-e79.
- Altinli S, Elevli M, Ozkul AA, Kara PG, Karsidag K, Dogru M. Insulin resistance and metabolic syndrome in children of parents with diabetes mellitus. *J Pediatr Endocrinol Metab*. 2007 Mar;20(3):431-6.