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Original Research Article

The Prevalence of Cardiac Autonomic Neuropathy in Type 2 Diabetes Mellitus

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Abstract

Introduction: *CAN (Cardiovascular Autonomic Neuropathy) causes resting tachycardia, orthostatic hypotension, exercise intolerance and is associated with higher cardiovascular mortality. It is often under diagnosed, very little data is available regarding cardiac autonomic neuropathy in literature so this study was planned to know the prevalence of CAN in T2 DM.*

Aim: *To study prevalence of cardiac autonomic neuropathy in type 2 diabetic patients.*

Methods: *Hundred cases of diabetes mellitus (type 2) with no clinical evidence of cardiac disease were subjected to cardiac autonomic function tests according to Ewing's criteria which were heart rate variability during deep breathing, Valsalva maneuver ratio, heart rate response on standing and BP response to standing and BP response to sustained handgrip to find the prevalence of CAN. Patients were categorized as with no CAN, early, definite and severe type of CAN depending upon abnormality of one or more tests.*

Results: *In this study prevalence of CAN was 54% out of which early, definite and severe involvement was found in 16%,14% and 24% respectively. Cardiac autonomic function tests of heart rate variability during deep breathing, Valsalva maneuver ratio, heart rate response on standing and BP response to standing and BP response to sustained handgrip found abnormal response in 38%,22%,34%,14% and 20% respectively.*

Conclusion: *Prevalence of CAN among diabetics was 54% and parasympathetic cardiac autonomic function tests are more sensitive for the detection of CAN than sympathetic cardiac autonomic function tests. Development of CAN in diabetic patients lead to poor prognosis, increased silent myocardial infarction and sudden cardiac death hence all diabetic patients should be routinely evaluated for CAN using these feasible bedside tests.*

Keywords: *Cardiovascular Autonomic Neuropathy (CAN); Cardiac Autonomic function tests; Ewing's criteria ;T2 Diabetes Mellitus.*

Introduction

Cardiac Autonomic Neuropathy (CAN) is a common type of diabetic autonomic neuropathy which causes abnormalities in heart rate control, central and peripheral vascular dynamics, the clinical manifestations of which include exercise

intolerance, intra operative cardiovascular lability, orthostatic hypotension and painless (silent) myocardial ischemia. As cardiac autonomic neuropathy is often over looked both in diagnosis and treatment of diabetes, it becomes imperative to study the prevalence of this life threatening complication. So the present study aims to assess the prevalence of cardiac dysautonomia.

Materials and Methods

The study was conducted at M.M Institute of Medical Sciences and Research Mullana, Ambala, Haryana. Hundred Type 2 Diabetic patients were enrolled from OPD and indoor wards of the Department of Medicine. American Diabetes Association Guidelines were followed to diagnose diabetes. All patients were subjected to detailed history and systemic examination. Patients were selected irrespective of the duration of disease and therapeutic status. Patients were excluded from the study who gave history of chronic alcoholism, asthma, chronic obstructive pulmonary disease, recent use of sympatholytic or Para sympatholytic drugs and those patients who were unable to perform Valsalva man euver. Each subject was given rest for at least 20 minutes before carrying out the actual tests. Standard 12- lead electrocardiogram was taken and heart rate was measured by continuous electrocardiographic recording using lead –II. Before every test, the heart rate was allowed to come down to normal. All patients underwent following tests for CAN[1] (cardiac autonomic neuropathy):

A. Tests reflecting cardiac parasympathetic action: I. By the patient blowing into a mouth piece connected to a sphygmomanometer and holding it at a pressure of 40 mmHg for 15seconds while a continuous ECG was recorded. The man oeuvre was performed 3times with an interval of one minute in between. The result was expressed as the Valsalva ratio. The mean of three Valsalvaratios was taken as the final value (normal Valsalva ratio 1.21; borderline between 1.11and 1.20; abnormal < 1.10). II. Heart rate variation during deep breathing: The patient sat quietly and breathed deeply at 6 breaths a minute (5 seconds in, and 5seconds out) for one minute. An ECG was recorded throughout the period of deep breathing with a mark used to indicate the onset of each inspiration and expiration. The maximum and minimum R-R intervals during each breathing cycle were measured and converted to beats/minute. The result was then expressed as the mean of the difference between maximum and minimum heart rates for the 6 measured cycles in beats/minute; (normal response >15 beats/minute, borderline 11 - 14 beats/minute; abnormal response < 10 beats/minute). III. Immediate heart rate response to standing: The test was performed with the patient lying quietly on a couch while heart rate was recorded continuously on the ECG machine. The patient was asked to stand up unaided and the point at starting to stand was marked on the ECG. The shortest R-R interval at or around the 15th beat and largest R-R interval at or around the 30th beat after starting to stand was measured with a ruler. The characteristic heart rate response was expressed by 30 - 15 ratio (which is normal if > 1.04; borderline between 1.01 and 1.03; and abnormal if < 1.00).

B. Tests reflecting cardiac sympathetic action: I. BP response to standing: The test was performed by measuring the patient's BP while he was lying down quietly and again when he stood up. The postural fall after 2minutes in BP was taken as the difference between systolic BP lying and the systolic BP standing (normal response < 10 mmHg; borderline 11 - 29 mmHg; abnormal response> 30 mmHg). II. BP response to sustained handgrip: After instructions in using hand grip of an inflated BP cuff, the subject gripped maximally with is dominant arm for a few seconds; this was repeated thrice. Highest of the 3 readings is called maximum voluntary contraction (MVC). Now the subject was instructed to maintain hand grip. The result was expressed as the difference between the highest DBP during hand grip exercise and mean of 3 DBP readings beforehand grip began(normal response > 16

mmHg; borderline 11- 15 mmHg; abnormal < 10 mmHg).

Results obtained from above said tests were interpreted according to Ewing's criteria for CAN.

Test	Normal	Borderline	Abnormal
Heart rate variations during deep breathing (in beats per minute)	>15	11-14	<10
Valsalva ratio (R-R interval ratio)	>1.21	1.11-1.20	<1.10
Tachycardia response to standing 30:15 ratio	> 1.04	1.01-1.03	< 1.00
blood pressure response to standing: fall in systolic BP (in mmHg)	<10	10-20	>20
blood pressure response to sustained handgrip: rise in diastolic BP (in mmHg)	>16	11- 15	<10

Normal = all tests normal or 1 test borderline.

Early = one of the three heart rate tests abnormal or two borderline.

Definite = two heart tests abnormal.

Severe = two heart tests abnormal + one or both BP tests abnormal. Statistical analysis was done using appropriate statistical tests with help of SPSS version 20.0. Statistical significance was considered when p value was <0.05. Data was presented as simple mean and standard deviation for quantitative data and as proportions for qualitative data.

Results

A total of 100 cases were included in the study group,52% were male 48% were females.36% in the age group 41 - 50 years, 24% in 51 – 60years,4% in 71 – 80years. 54% of the patients had positive CAN whereas 46% had no CAN. Early and definite type of CAN was 16% and 14% respectively whereas severe CAN was present in 24% of subjects. Subjects with no CAN and severe CAN had mean duration of 6.78±1.73 and 11.87±3.90 years respectively whereas early and definite CAN had mean duration of diabetes as 8.25±3.61 and 10.07±4.41 years respectively (Table 1).

Table 1: Type of CAN among patients and mean duration of years.

Type of Cardiac autonomic neuropathy	No of patients (percentage)	Mean Duration DM in years
No	38 (38%)	6.78±1.73
Early	18 (18%)	8.25±3.61
Definite	16 (16%)	10.07±4.41
Severe	28 (28%)	11.87±3.90

Giddiness was the most common neuropathic symptom constituting 38% of studied subjects. Other common symptoms were bladder symptoms (36%), sweating (22%) and bowel symptoms (20%).

Table 2: Ewing's criteria variables for CAN among patients.

Ewing's Variable	Normal	Borderline	Abnormal
Heart rate variability	50 (50%)	12 (12%)	38 (38%)
Valsalva ratio	48 (48%)	30 (30%)	22 (22%)
Tachycardia response to standing 30:15 ratio	58 (58%)	8 (8%)	34 (34%)
Postural hypotension	62 (62%)	24(24%)	14 (14%)
BP response to sustained handgrip	44 (44%)	36 (36%)	20 (20%)

Heart rate variability and Tachycardia response to standing were abnormal in 38% and 34% of patients respectively whereas Blood Pressure response to sustained handgrip and Valsalva ratio were termed as abnormal in 20% and 22% patient respectively (Table 2).

Discussion

Diabetic cardiac autonomic neuropathy (CAN) is a common, chronic and serious complication found type 2 diabetic patients. In our study CAN was present in 54 patients (54%) out of 100 patients. Barthwal et al[2] reported prevalence of cardiac dysautonomia as 36.2% in Indian diabetic patients whereas Mathur et al[3] reported prevalence of definite CAN as 58%. Kumar et al[4] and Veglio et al[5] reported prevalence of cardiac dysautonomia as 60% and 63.7% respectively. Most of the studies done among diabetic patients had a CAN prevalence of 50-60% which corresponds to the results of our study. This shows that more than

half of the diabetic subjects had one or more signs of CAN as per Ewing's criteria. In present study out of 54 (54%) patients having CAN, 16 (16%) had early CAN, 14 (14%) had definite CAN and 24 (24%) had severe CAN. Mathur et al[3] (2006) reported 58% CAN among diabetics including 20% having early CAN, 30% having definite CAN and 8% having severe CAN . Another study by Ahireet al[6] reported severe CAN as 20%. Early and definite cardiac dysautonomia was present in 33.3% and 23.3% respectively. Prevalence of severe CAN was comparatively higher in current study which may be due to late reporting of diabetic subjects where the CAN had already set in.

In the present study, duration of diabetes correlated with the severity of CAN. The mean duration of diabetes was found to be 8.25±3.61, 10.07±4.41 and 11.87±3.90 in patients with early CAN, definite CAN and severe CAN respectively while patients with no cardiac autonomic involvement had 6.78±1.73 mean duration of diabetes, our result showed that severity of CAN is directly correlated with duration of diabetes mellitus. Kumar et al[4] reported that mean duration of diabetes with CAN was 8.52 ± 6.26 years whereas among patients without CAN it was 3.19 ± 2.81 years. In a similar study by Barthwalet al[2], duration of diabetes among patients with CAN was 7.11 ± 3.49 years and in patients without CAN was 3.51 ± 2.81 years.

Postural dizziness was observed in 38 (38%) out of 100 patients. It was however less than as reported by other studies, but it was the most common presenting complaint of the studied patients. Basu et al[7]. also reported postural dizziness as most common symptom. Sweating abnormalities were noted in 22% of our patients. Basu et al[7] reported that 16% of patients had hyperhidrosis whereas Lakhotia et al[8] reported that 26% of patients had sweating abnormalities. The findings of our study are similar to results reported by Basu et al[7] and Lakhotia et al[8]. Similarly impotence was observed in 23% of males in the current study whereas 54% and 30% impotency was found by Lakhotia et al[8] and Shetty et al[9]. In the current study impotence was reported by male subjects only which may account for low proportion of impotence among our study population. Heart rate variability on deep breathing, valsalva ratio, tachycardia response to standing (30:15 ratio), BP response to sustained handgrip and postural hypotension found abnormal results in 38(38%), 22(22%), 34(34%), 20(20%) and 14(14%) respectively. The results of the present study support the findings of Mathur et al[3] and Basu et al[7]as deep breath test was the most sensitive test, found abnormal in 38% patients in this study. Also, Mathur et al[3] and Basu et al[7] had also reported deep breath test as the most sensitive test with sensitivity as 48% and 32% respectively. Postural hypotension was the least sensitive test for cardiac autonomic dysfunction in the present study (14%), similar findings were shared by Basuet al[7].

Conclusion

We concluded that prevalence of CAN was 54% in T2DM and severity of CAN was increasing with duration of diabetes mellitus so Cardiac autonomic reflex tests (CARTs) as described by Ewing's criteria involving five bedside simple tests are important feasible and reproducible diagnostic tool for evaluation cardiac autonomic neuropathy in diabetic patients. All diabetic patients whether symptomatic or asymptomatic should be routinely evaluated for presence of CAN using CARTs at the time of diagnosis and every five years thereafter.

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