International Journal of Research in Health and Allied Sciences
Journal home page: www.ijrhas.com

Official Publication of "Society for Scientific Research and Studies" [Regd.]

ISSN: 2455-7803 Index Copernicus value [ICV] = 68.10;

Original Research

Assessment of relationship between QTc dispersion, QT dispersion and cardiac autonomic neuropathy in type-2 diabetic patients

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ABSTRACT:
Background: The present study was conducted to assess relationship between QTc dispersion, QT dispersion and cardiac autonomic neuropathy in type-2 diabetic patients. **Materials & Methods:** The present study was conducted on 50 patients of type 2 diabetes mellitus of either sex. A detailed history and clinical examination was recorded in proforma of all cases. Patients were screened for cardiac autonomic neuropathy. The data so collected was compared with 25 diabetic patients without cardiac autonomic neuropathy (CAN) and 25 age and sex matched healthy individuals who will form the control group. **Results:** Male female ratio I group A was 1.5:1.0, in group B was 1.08:1 and in group C was 1.0:1.08, mean age in group A 52.4 years, in group B was 51.9 years and group C was 41.4, duration of diabetes was 7 years in group A, 3.76 years in group B, FBS was 171.3 mg% in group A, 151.9 mg% in group B and 97.4 mg% in group C. Abnormal Valsalva ratio was found in 16 out of 25 patients with cardiac autonomic neuropathy 64%. **Conclusion:** The QTcd was the parameter which had the highest accuracy in predicting patients of type 2 diabetes with cardiac autonomic neuropathy. The QTc dispersion is hence a specific marker in the diagnosis of cardiac autonomic neuropathy, which can be easily evaluated.
Key words: Cardiac autonomic neuropathy, Diabetes, Valsalva ratio

Received: 12 November, 2019 Revised: 19 December, 2019 Accepted: 26 December, 2019

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This article may be cited as: Singh H, Singh G, Singh G, Khubber M, Sharma S. Assessment of relationship between QTc dispersion, QT dispersion and cardiac autonomic neuropathy in type-2 diabetic patients. Int J Res Health Allied Sci 2020; 6(1): 115-119.

INTRODUCTION

Prevalence of diabetes is steadily increasing world wide, particularly in developing countries. In 2000, India (31.7 million) topped the world with the highest number of people with diabetes mellitus followed by China (20.8 million) with the United States (17.7 million) in second and third place respectively.[1] The prevalence of diabetes is predicted to double globally from 171 million in 2000 to 366 million in 2030 with a maximum increase in India.[2] It is predicted that by 2030 diabetes mellitus may afflict up to 79.4 million individuals in India, while China (42.3 million) and the United States (30.3 million) will also see significant increases in those affected by the disease.[3] One of the long term complications of diabetes is autonomic neuropathy, symptoms include postural hypotension, gustatory sweating, Diarrhoea, unawareness of hypoglycemia, bladder dysfunction, impaired temperature regulation and altered sweating.[4]

Diabetes duration is a major risk factor for the development of CAN in patients with T1DM and T2DM. The incidence of CAN has been reported to be 6% and 2% annually in patients with T1DM and T2DM, respectively. The prevalence of CAN increased from 9% at the close of the DCCT study to 31% 1 year later.[5] Possible factors associated with high mortality and sudden death due to autonomic neuropathy are cardiorespiratory arrest/increased perioperative and peri-intubation risk; silent myocardial ischemia (SMI)/ infarction etc. Hyperglycemia plays an important role in

the pathogenesis of diabetes-related microvascular complications and hence it is not surprising that hyperglycemia has an unfavorable impact on the development and progression of CAN.[6] The present study was conducted to assess relationship between QTc dispersion, QT dispersion and cardiac autonomic neuropathy in type-2 diabetic patients.

MATERIALS & METHODS

The present study was conducted on 50 patients of type 2 diabetes mellitus of either sex, admitted in the various medical wards and OPDs and diabetes clinics of Guru Nanak Dev Hospital attached to Govt. Medical College, Amritsar.

The patient was explained in their vernacular language about the procedure to be adopted in the study and their written informed consent was taken. The study was conducted after approval from the institutional thesis and ethical committee.

The diagnosis of cardiac autonomic neuropathy were based on findings such as heart rate response to Valsalva Maneuver, immediate heart rate response to standing (30: 15 ratio of 1.00 or less), BP response to standing (Fall in systolic B.P of 30 mmHg or more) and BP response to sustained handgrip (increase in diastolic B.P of 10 mmHg or less).

A detailed history and clinical examination was recorded in proforma of all cases. Patients were screened for cardiac autonomic neuropathy. The data so collected was compared with 25 diabetic patients without cardiac autonomic neuropathy (CAN) and 25 age and sex matched healthy individuals who will form the control group.

The QT, QTc, QT dispersion and QTc dispersion were calculated for both the cases and controls. They were compared and statistically analyzed. P value less than 0.05 was consideredsignificant.

RESULTS

Table I Comparing gender ratio, mean age, duration of diabetes of patients

Parameters	Group A	Group B	Group C
Male: Female	1.5:1.0	1.08:1.0	1.0:1.08
Age (years)	52.44±8.66	51.92±8.44	41.48±10.80
Duration of diabetes (Years)	7.00±3.68	3.76±1.92	-
FBS (mg%)	171.36±51.07	151.92±65.97	97.44±10.44

Table I shows that male female ratio I group A was 1.5:1.0, in group B was 1.08:1 and in group C was 1.0:1.08, mean age in group A 52.4 years, in group B was 51.9 years and group C was 41.4, duration of diabetes was 7 years in group A, 3.76 years in group B, FBS was 171.3 mg% in group A, 151.9 mg% in group B and 97.4 mg% in group C.

Table II Comparing mean age and mean duration of diabetes according to CAN staging

Parameters	CAN 1	CAN 2	CAN 3
Mean age (years)	52.60±5.78	49.50±10.74	55.57±9.64
Mean duration of diabetes	5.70±2.90	7.00±3.58	8.85±4.45

Table II shows mean age and mean duration of diabetes according to CAN staging.

Table III Comparing patients with abnormal valsalva ratio

	Group A			Group B	Group C
	CAN 1	CAN 2	CAN 3		
No. of patients	10	8	7	25	25
No. of patients with abnormal Valsalva ratio	4	5	7	-	-
Percentage	40%	62%	100%	-	-

Table III shows that abnormal Valsalva ratio was found in 16 out of 25 patients with cardiac autonomic neuropathy 64%. There were 10 patients of early cardiac autonomic neuropathy (CAN 1 stage). 4 out of these 10 had abnormal

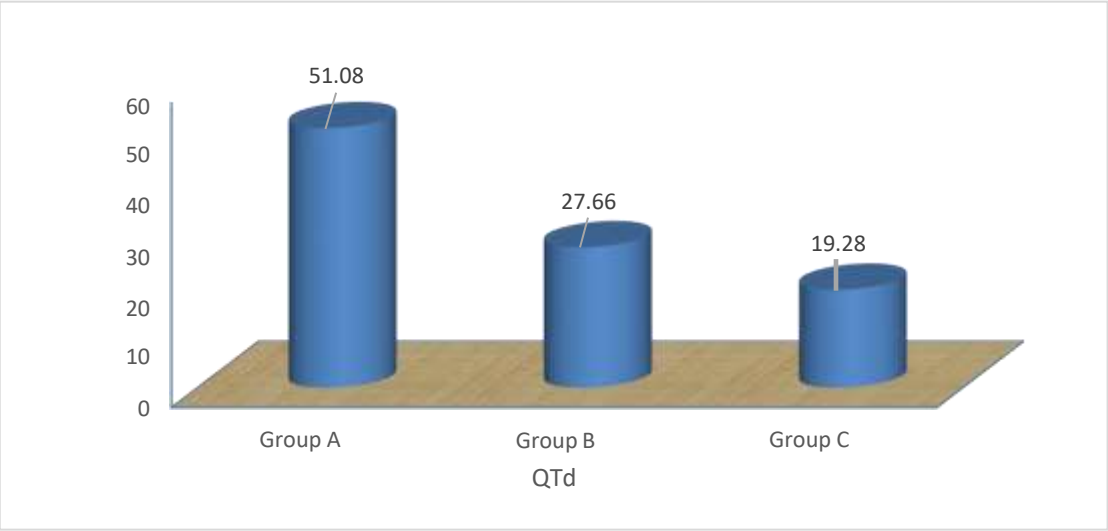
Valsalva ratio (40%). There were 8 patients with definitive cardiac autonomic neuropathy (CAN 2 stage). 5 out of these 8 patients had abnormal Valsalva ratios (62%). In group B, none of the 25 patients of group B had abnormal Valsalva ratios and in group C, none of the 25 patients of group C had abnormal Valsalva ratios.

Table IV Comparing patients with mean QT interval

	Group A			Group B	Group C
	CAN 1	CAN 2	CAN 3		
No. of patients	10	8	7	25	25
Mean QT (ms)	365.60±32.4	383.12±48.14	367.85±23.14	315.24±19.6	309.72±18.8
Total Mean QT (ms)	371±35.62				

Table IV shows that in group A, mean QT in this group was 371±35.62 with the range of 303 to 460 ms. There were 10 patient with early cardiac autonomic neuropathy (CAN 1 stage). The mean QT was 365±32.49 with the range of 312 to 402 ms. There were 8 patients with early cardiac autonomic neuropathy (CAN 2 stage). The mean QT was 383.12±48.14 with the range of 303 to 460 ms. There were 7 patients with early cardiac neuropathy (CAN 3 stage). The mean QT was 367.85±23.14 with the range of 340 to 400 ms. In group B, mean QT in this group was 315.24±19.61 ms with the range of 281 to 349 ms and in group C, mMean QT in this group was 309.72±18.82 ms with the range of 281 to 351 ms.

Graph I Mean QTd in patients



Graph I shows that mean QTd in group A was 51.08±10.81 ms. There were 10 patients with early cardiac autonomic neuropathy (CAN 1 stage). The mean QTd was 44.50±6.85 ms with the range of 40 to 60. There were 8 patients with definite cardiac autonomic neuropathy (CAN 2 stage). The mean QTd was 52.50±11.26 ms with the range of 40 to 68 ms. There were 7 patients with severe cardiac autonomic neuropathy (CAN 3 stage). The mean QTd was 58.85±10.20 with the range of 40-70 ms. In group B, mean QTd was 27.36±4.5 ms with the range of 18 to 36 ms. In group C, mean QTd was 19.28±3.82 ms with the range of 13 to 28 ms.

DISCUSSION

Complication of diabetes mellitus pose major health problems for the patients. The prevalence of DM in India ranges from 5–17%, with higher levels found in the southern part of the country and in urban areas.[7] The importance of this diabetic complication is best illustrated by the fact that the mortality rate in patients with CAN is 5-6 times higher in the period of 5-6 years than the mortality in patients with diabetes but without CAN in the same period.[8,9]

The prolonged QTc interval are prone to ventricular arrhythmias, especially unique torsades de pointes and sudden cardiac death. The present study was hence

undertaken to evaluate and to compare and find out the difference if any in QT, QTc, QTd and QTcd between healthy subjects and patients of type-2 diabetes mellitus.[10,11] The studies aim was also to study the relationship, if any, between QTc dispersion and QT dispersion and cardiac autonomic neuropathy in type-2 diabetic mellitus. In our study we found that mean duration of diabetes was higher in diabetic patients with cardiac autonomic neuropathy (Group A) as compared to the diabetic patients without cardiac autonomic neuropathy (Group B). The male to female ratio was 1.5:1.0 the mean age was 52.44±8.66 years. The mean FBS was 171.36±51.07mg%. The mean duration of diabetes in Group A was 7.00±3.58 years. Dimova et al[12] found that mean duration diabetes was in 11.56±6.15 in CAN positive and 3.12±1.52 in CAN negative patients.

Group A was further subdivided into three groups according to the severity of cardiac autonomic neuropathy as assessed by the grading system in material and methods. Early cardiac autonomic neuropathy (CAN 1 stage): there were 10 patients 8 males, 2 females with mild cardiac autonomic neuropathy. The average duration of diabetes in these patients was 5.70±2.90 years. The average age was 52.60±5.78. Definitive cardiac autonomic neuropathy (CAN-2 stage): there were 8 patients with moderate cardiac autonomic neuropathy (3 males, 5 females). The average duration of diabetes in this group was 7.0±3.58 years. The average age was 49.50±10.74 years. Severe cardiac autonomic neuropathy (CAN-3 stage): there were 7 patients with severe cardiac autonomic neuropathy (4 males, 3 females). Average duration of disease was 8.85±4.40 years and average age was 55.57±9.64 years.

In group B, there were 25 patients, in group B (13 males, 12 females). Average duration of diabetes in this group was 3.76±1.92 years. The mean age was 51.92±8.44 and the mean FBS was 151.92±65.97mg%. In group C, There were 25 subjected, in this group, none of them were diabetic and none of them had cardiac autonomic neuropathy. The mean age in this group was 41.48±10.80 years. The mean FBS was 97.44±10.44.

We found that In type 2 diabetic patients with cardiac autonomic neuropathy had abnormal Valsalva ratio (64%), hear rate variation during deep breathing (52%), immediate heart rate response from lying to standing position (64%) blood pressure response to sustain handgrip (32%) and severe postural hypotension (28%).

We found that mean duration of diabetes in patients with cardiac autonomic neuropathy was 7.00±3.58 years which was higher than group B, in whom this was 3.72±1.8 years. The mean QT, mean QTc, mean QTd, mean QTcd in diabetic patients with cardiac autonomic neuropathy (Group

A) were significantly elevated than that in control group (Group C). 10 patients, (40%) of diabetic patients with cardiac autonomic neuropathy (Group A) had a prolonged QTc of more than 440 ms. No diabetic patients without cardiac autonomic neuropathy (Group B) and in control group (Group C) had a QTc of more than 440 ms. Our results are in agreement with Maser et al.[14]

In present study, all patients in diabetic patients with cardiac autonomic neuropathy (Group A) had a QTcd of more than 40ms, while 11 (44%) patients had a QTcd of more than 56 ms. No cases in diabetic patients without cardiac autonomic neuropathy (Group B) had a QTcd of more than 39 ms. All four parameter were severely deranged in patients of group A with longer duration of diabetes. Our results are in agreement with Vinik et al.[15]

CONCLUSION

The QTcd was the parameter which had the highest accuracy in predicting patients of type 2 diabetes with cardiac autonomic neuropathy. The QTc dispersion is hence a specific marker in the diagnosis of cardiac autonomic neuropathy, which can be easily evaluated. So it is suggested that an electrocardiogram must be done in every cases of diabetes mellitus and QTc dispersion must be calculated to judge the presence of cardiac autonomic neuropathy.

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