A STUDY OF QT DISPERSION AMONG TYPE 2 DIABETICS ATTENDING A TERTIARY CARE HOSPITAL IN PUDUCHERRY

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ABSTRACT

BACKGROUND

Increased QT interval dispersion (QTD) has been commonly found among type 2 diabetes mellitus.

Aims and Objectives- The aim of the study is to find out the prevalence of QT dispersion in type 2 diabetes mellitus in a tertiary care hospital.

MATERIALS AND METHODS

QTc is measured through Bazett's formula and QT dispersion is calculated in a total of 80 outpatients and in patients with type 2 diabetes mellitus at a tertiary care hospital between October 2017 and December 2017 and to compare with controls.

RESULTS

Case subjects has 40% of QT dispersion (32 out of 80 subjects) compared to the control has 22.5% of QT dispersion (18 out of 80 subjects, that is 17.5% higher than control group).

CONCLUSION

Hence, subject with diabetes mellitus has more chance of cardiovascular disease than non-diabetes subjects. QT dispersion helps in identifying the cardiovascular disease as early as possible.

KEY WORDS

Type 2 Diabetes Mellitus, QT Dispersion, Poor-Man's Treadmill Test.

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BACKGROUND

Cardiovascular disease (CVD) is now the most common cause of death worldwide. Before 1900, infectious diseases and malnutrition were the most common causes and CVD was responsible for less than 10% of all deaths. In 2010, CVD accounted for approximately 16 million deaths worldwide (30%) including nearly 40% of deaths in high-income countries and about 28% in low- and middle-income countries.¹

There are multiple risk factors for cardiovascular disease; of the most important one is diabetes mellitus.² An estimated 346 million people worldwide have diabetes. The International Diabetes Foundation predicts that this number will reach 522 million by 2030, a yearly rate of growth that is higher than that of the world's adult population.³ QT dispersion in ECG is considered as poor-man's treadmill test, which is used to find out any cardiovascular abnormalities in those patients with abnormal ECG that can be considered for coronary angiogram.⁴

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Even in healthy individuals, diabetes mellitus can prolong the QTc interval and decrease T-wave area and amplitude in electrocardiography (ECG).⁵ QT dispersion measurements (QTd and QTcd) as the most important independent predictors of global and cardiovascular mortality, QT interval dispersion could represent a summation of several adverse conditions present in the diabetic myocardium such as fibrosis, ischaemia, hypertrophy and dilatation, and autonomic dysfunction.⁶

MATERIALS AND METHODS

Study Design

A hospital-based case-control study.

Study Area

Sri Manakula Vinayagar Medical College and Hospital, Kalitheerthalkuppam.

Duration of Study- 3 months.

Study Population

The patients who attended the outpatient and admitted as an inpatient in Department of General Medicine.

Sample

Sample size is taken as per our convenience.

Case

Patients in age between 30 - 65 years who are coming to the General Medicine Department as a known case of type 2

diabetics or newly diagnosed type 2 diabetics with any one of the following criteria-

- Symptoms of diabetes plus random blood glucose concentration ≥ 200 mg/dL (≥ 11.1 mmol/L), or
- Fasting plasma glucose ≥ 126 mg/dL (≥ 7.0 mmol/L), or
- 2-h plasma glucose ≥ 200 mg/dL (≥ 11.1 mmol/L) or
- Haemoglobin A1c $\geq 6.5\%$.

Electrocardiography (ECG) will be taken from the diabetic patients and other blood investigations such as fasting lipid profile and HbA1c were taken.

Control

Patients in age between 30 - 65 years coming to the General Medicine Department from other complaints are not a known diabetic, hypertensive or with coronary artery disease. Electrocardiography (ECG) will be taken from the non-diabetic patients.

Sampling

Electrocardiography (ECG) will be taken from the diabetic/non-diabetic patients during the given span of time, after getting the informed consent from the patient (or patient's attender) and clearance from the Research and Ethical Committee. Patients were studied on both general and systematic examination. Blood tests such as fasting lipid profile and HbA1c were taken.

Instrumentation

Standard resting 12-lead ECGs were recorded with the same commercial equipment (BPL Cardiant 9108) operated by one ECG technician at 25 mm/ s paper speed and 10 mm/ mV amplitude.

All the ECGs were analysed by One Person with no Knowledge of the Clinical Data-

1. QT intervals were measured manually from the onset of QRS complex to the end of the T-wave, defined as the return to the T-P baseline, independent of the polarity of the T-wave. When U-waves were present, the QT was measured to the nadir of the curve between the T- and U-waves. Whenever possible, three consecutive cycles in each of the 12 leads were measured with the mean QT interval calculated.
2. The RR interval to the measured QT was used to calculate the heart rate-corrected (QTc) interval using Bazett's formula ($QTc = QT/RR^{1/2}$).
3. The QT dispersion (QTd) defined was calculated as the difference between the maximum and the minimum QT interval obtained in any of the 12 electrocardiographic leads.
4. The QTc dispersion (QTcd), the difference between QTc maximum and QTc minimum.

Ethical Consideration

The Ethical approval will be obtained from the Institute Ethics Committee of SMVMC and H, Puducherry. All the ethical principles will be adhered in the study.

Statistical Analysis

Statistical analysis was performed in SPSS 16.0. The qualitative data were expressed as number (%), while the continuous quantitative data as mean $\pm$ standard deviation

(SD). Comparison between cases and controls is done by chi-square test and Fisher's exact test. QTc is measured through Bazett's formula and QT dispersion is calculated. P-value of <0.05 was considered significant, while > 0.05 was considered not significant.

RESULTS

	Cases (N=80)	Controls (N=80)
Age (Mean $\pm$ SD)	52.7 $\pm$ 11.9	47.1 $\pm$ 13.6
Duration of diabetes in years (Mean $\pm$ SD)	8.2 $\pm$ 6.2	-
Gender		
Male	53 (66.3%)	43 (53.7%)
Female	27 (33.7%)	37 (46.3%)

Table 1. Characteristics of Cases and Controls

In this study mean age ≥ 50 years of age, mean duration of diabetes mellitus ≥ 8 years, more than $\geq 50\%$ are male.

	Cases (N=80)		Controls (N=80)		P value*
	No.	%	No.	%	
Smoking	22	{27.5}	13	{16.3}	0.08
Alcohol use	22	{27.5}	24	{30.0}	0.72
Family history	20	{25.0}	31	{38.8}	0.06
Orthostatic hypotension	37	{46.3}	0	{0.0}	<0.001
HbA1c ≥ 6.5	55	{68.8}	0	{0.0}	<0.001
Hypercholesterolaemia	11	{13.8}	6	{7.5}	0.19
Hypertriglyceridaemia	21	{26.3}	8	{10.0}	0.007
Raised LDL	3	{3.8}	0	{0.0}	0.24
QT dispersion	32	{40.0}	18	{22.5}	0.016

Table 2. Comparison between Cases and Controls

*P value from chi-square test except for raised LDL (Fisher's exact test).

P-value is more than 0.05. This means it is not statistically significant. Wherever it is less than 0.05, it is significant.

In this study variables such as orthostatic hypotension, hbA1c ≥ 6.5 , hypertriglyceridaemia has significant QT dispersion.

	QT Dispersion (N=50)		Non-QT Dispersion (N=110)		P value*
	No.	%	No.	%	
Smoking	15	{30.0}	20	{18.2}	0.09
Alcohol use	16	{32.0}	30	{27.3}	0.54
Family history	17	{34.0}	34	{30.9}	0.69
Orthostatic hypotension	28	{56.0}	9	{8.2}	<0.001
HbA1c ≥ 6.5	24	{48.0}	31	{28.2}	0.014
Hypercholesterolaemia	9	{18.0}	8	{7.3}	0.04
Hypertriglyceridaemia	14	{28.0}	15	{13.6}	0.02
Raised LDL	2	{4.0}	1	{0.9}	0.23
Diabetes mellitus	32	{64.0}	48	{43.6}	0.016

Table 3. Comparison between QT Dispersion and Non-QT Dispersion

*P value from chi-square test except for raised LDL (Fisher's exact test).

In this study if p-value is less than 0.05, it is significant. Orthostatic hypotension, HbA1c ≥ 6.5 , hypercholesterolaemia and hypertriglyceridaemia are all significant.

DISCUSSION

As per result from the study, QT dispersion in type 2 diabetes mellitus is significant.⁷ Even in healthy individuals, hyperinsulinaemia-induced hypoglycaemia can prolong the QTc interval and decrease T-wave area and amplitude.⁸ Okin et al² also found that both QTc prolongation and ST depression predicted all-cause mortality in patients with type 2 diabetes. It is associated with the increased mortality attributed to prolonged QT interval predisposing to ventricular arrhythmias, silent ischaemia and cardiac arrest.⁹ Prolonged QTc interval and duration of the disease over 10 years were the factors associated with higher risk.

The specificity of QTc prolongation in type 1 diabetes was found to be lower in a cohort (62.5%) when compared to the specificity of 86% reported by Veglio et al¹⁰ among 3250 patients.

The pathophysiology of cardiovascular disease in diabetes mellitus, chronic hyperglycaemia and insulin resistance determine a significant alteration in the coagulation factors as well as increased platelet aggregation, leading to a prothrombotic state. Diabetes-induced increase of tissue factor levels activates thrombin converting fibrinogen into fibrin. Fibrin organisation is further enhanced due to high plasminogen activator inhibitor-1 (PAI-1) and reduced t-PA (Tissue plasminogen activator) levels. Increased Ca²⁺ content, thrombin stimulation as well as interaction with VWF (Von-Willebrand factor) via GPIIb/IIIa receptor lead to platelet shape change, granule release and aggregation. Release of MPs (Micro particles) from injured endothelium and circulating platelets contribute to accelerate thrombus development. Endothelial dysfunction precipitates rupture of the endothelial layer leading to exposure of collagen and VWF, thereby activating platelets and favouring vascular thrombosis.¹¹

Exact mechanism of QTc prolongation is not defined clearly, but it has been suggested that some non-quantifiable sympathetic imbalance is responsible for QTc prolongation, as parasympathetics have little influence on QTc modulations.⁹

Recently ADA and American Academy of Neurology, considered the QTc interval to be specific, reproducible and standardised early test for autonomic function.¹²

This analysis suggested that cardiac dysautonomia can be picked up at the earliest by calculating QTc dispersion.¹³ Sawicki et al¹⁴ found QT dispersion to be the most important independent predictor of total mortality and also an independent predictor of cardiac and cerebrovascular mortality.

Christensen et al found high prevalence of QTc 440 ms^{1/2} (67%) and of QT dispersion 50 ms (51%) in a cohort study of 324 patients with type 2 diabetes and that prolonged QTc.

In diabetes patients, chest pain from silent ischaemia, unstable angina cannot be classical than compared to the other non-diabetes because of sympathetic overactivity of peripheral nervous system.¹⁵

The QT dispersion in type 2 diabetes mellitus is considered as poor-man's treadmill test. This can be taken as clinically significant. This can be used to identify the cardiovascular manifestation as early as possible.

From the study subjects with orthostatic hypotension, HbA1c ≥ 6.5 , hypertriglyceridaemia has more higher chance of cardiovascular disease compared than other variables.

CONCLUSION

Diabetes is an established risk factor for cardiovascular disease and is associated with the mortality.¹⁶ The increasing prevalence of type 2 diabetes, earlier onset of diabetes and aging of the population will result in an increasing prevalence of diabetes induced CV disease, suggesting that accurate non-invasive identification of diabetic individuals at high risk may play a role in the development of more effective preventive strategies for decreasing diabetes-related cardiovascular diseases. Although, increased QT interval and QT dispersion have been implicated as possible ECG predictors of cardiovascular diseases in type 2 diabetic patient.

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