ORIGINAL RESEARCH PAPER
Volume - 12 | Issue - 08 | August - 2023 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

"AN OBSERVATIONAL STUDY ON QT INTERVAL IN THE PATIENTS OF DIABETES MELLITUS ATTENDING AT TERTIARY CARE TEACHING INSTITUTE, RANCHI, JHARKHAND"

Physiology

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ABSTRACT

Introduction: Cardiac and autonomic dysfunctions are most important complications that cause mortality silently among long standing asymptomatic Diabetes mellitus. Electrocardiographic changes especially QTc prolongation has associated with this. Objective of this study was to determine the prevalence of prolong QT interval among Diabetic Population. **Methods:** An observational study on QT interval among 77 Diabetics was carried out from July 2021 to September 2022 after getting approval from Institutional Ethics Committee, Rajendra Institute of Medical Sciences, Ranchi. Statistical methods: Data were entered and analyzed using Excel & SPSS software. Prevalence and mean with S.D. and P-value were calculated with the help of software. **Results:** Mean corrected QT interval (QTc) interval was 421.40±27.42. Three patients (4%) out of 77 had recorded QTc input less than 350 milliseconds. QTc interval was normal in 53 (69%) cases and Prolong QTc in 21 (27%) cases. **Conclusion:** Prevalence of prolong QT interval among Diabetic Population of Jharkhand was a 27%. Prolongation of QTc was related to increased duration of DM.

KEYWORDS

QT interval, Electrocardiography, Diabetes Mellitus, Prevalence

INTRODUCTION

Diabetes mellitus (DM) is one of the most common disorders characterized by a lack of insulin in type 1 diabetes mellitus (IDDM) and peripheral tissue insulin resistance in type 2 diabetes mellitus (NIDDM). It affects approximately 9% of the adult population.[1] Worldwide prevalence of Diabetes Mellitus has increasing over the past two decades, based on the current trends more than 552 million individuals will be diabetic by the year 2030. Currently 72 million cases of diabetes mellitus are present in India and are now considered as diabetic capital of world. Cardiac and autonomic dysfunctions are most important complications that cause mortality silently among long standing asymptomatic Diabetes mellitus. Exercise ECG testing as compared to resting ECG with a normal, is the first choice for screening for silent ischemia in asymptomatic type 2 diabetes patients. Myocardial ischemia is more often painless in patients with diabetes mellitus.[2] Resting ECG abnormalities as well as cardiac autonomic dysfunction were found to be predictors of silent ischemia in asymptomatic persons with T1D.[3]

Previous study has shown the Prevalence of QTc prolongation more than 440ms occurs in 18%-44% of type I and II diabetes mellitus patients.

Electrocardiography and heart rate variability are methods to assess Cardiac Autonomic Dysfunction. Cardiac Autonomic Dysfunction results due to decreased vagal modulation of the heart rate in diabetic patients at night.[4] People with increased basal heart rate and low heart rate variability (HRV) had high risk for future diabetic.[5] Type1 and type2 diabetes has multiple cellular, hormonal, inflammatory, neuropathic and physiological processes that influence the QTc interval in diabetes. The term 'diabetic myocardium' has been used to describe the long term changes in the myocardium due to increased deposition of advanced glycated metabolites, myofibroblast activity, and simultaneously coronary heart disease and heart failure.[6] These changes appeared to be mediated by a systemic inflammatory response(SIRS), with cytokines IL-1b and TNF-alpha demonstrated in animal models to mediate QTc changes. Acutely, blood glucose plays a direct role in modulating QTc, with both hypo- and hyperglycaemia prolonging QTc in healthy volunteers as well as in patients with diabetes.[7] The QT interval is easily obtained from a standard 12 leads resting Electrocardiograph (ECG), it measures the duration of electrical activation and recovery of the ventricular myocardium. QT interval varies inversely with the cardiac rate, so it can be corrected for heart rate by using Bazett formula, Where, QTc=QT$\sqrt{RR}$ interval. Zhang et.al. examined the effect in rat models, hypothesizing that hypoglycemia-induced QTc prolongation was predominantly due to an acute lack of ATP, reducing hERG and ion channel (IKr) function, while hyperglycemia induced increased reactive oxygen species (ROS), reducing hERG function with the same result.[8] In controlled clinical studies, hyperglycemia in healthy volunteers considerably prolongs QTc.[9] In large population studies, chronic hyperglycemia and high HBA1C are linked to QTc prolongation .[10]

This study has done to determine the correlation between QT interval and Diabetes Mellitus patients of Jharkhand. Prevalence of DM among different tribal groups in India is reported to be 0.7–10% with a pooled prevalence of 5.9%. [11] There are no relevant data of QT interval on Diabetic Population of Jharkhand till date. In view of the above, the present study, a part of a larger health survey has done to estimate the prevalence of Prolonged QT interval among Diabetic Population of Jharkhand. Primary Objectives of this study were to determine the prevalence of prolong QT interval among Diabetic Population of Jharkhand and to find out relationship between duration of Diabetes Mellitus and prolong QT interval.

METHODS:

An observational, cross-sectional, analytical study was carried out in a teaching hospital after getting approval from Institutional Ethics Committee, Rajendra Institute of Medical Sciences, Ranchi. In this study, 77 diabetes mellitus patients admitted in Rajendra Institute of Medical Sciences, Ranchi from July 2021 to September 2022 were randomly selected for various tests. Patients were of different age groups with varying duration of illness. Patients of both sexes were included in this study. Written consent was taken by the patients, who full filled the inclusion criteria of this study. Detailed history of the duration of diabetes mellitus was recorded. Patients were examined clinically for diabetic cases and subjected to battery of tests to look for diagnosis of diabetes mellitus. Random blood sugar level was determined from venous blood sample using the glucose hexokinase assay and glycosylated hemoglobin (HbA_1C) level of estimation done by HPLC-high performance liquid chromatography method. Then Electrocardiographic study was done using BPL CARDIART 6208 model machine and QT interval was recorded.

QTc interval was calculated by Bazzet's formula using online Corrected QT Interval software. No Follow-up was needed in this study. While, Patients with diagnosed cases of Diabetes mellitus, both Type I and Type II Patients both male and female above 30 years of age, Patient on insulin, oral hypoglycemic agents or on both were included. Patients with known cardiovascular diseases, Patients having any chronic diseases such as Chronic Kidney Disease, Chronic Obstructive Pulmonary Disease and Thyroid disorders were excluded from this study. Outcome Variable for this study was change in QT interval and Exposure was Diabetes mellitus and Electrocardiography. Predictors of this study was Patients with hereditary long QT interval and Potential confounders and effect modifiers were the Patients on drug like digitalis, quinidine, procainamide, tricyclic- antidepressant or any other drug that can lead to QT prolongation. Patients with electrolytes disturbances like hypocalcaemia were also confounders. Diagnostic criteria for Diabetic Study subjects on the basis of A.D.A. Criteria was

either Glycosylated hemoglobin (HbA_1C) > 6.5% or Fasting blood glucose OR Fasting blood glucose > 126mg/dl (7.0mmol/L) OR Post-prandial glucose > 200 mg/dl (11.1mmol/L) OR Random blood glucose > 200mg/dl (11.1mmol/L). Expected Value for controlled diabetics was as per level of % HbA_1C level:

Healthy individuals < 6.0% HbA_1C
Good Control 6.0 - 7.0% HbA_1C
Fair Control 7.0 - 8.0% HbA_1C
Unsatisfactory Control 8.0 - 10.0% HbA_1C
Poor Control > 10.0% HbA_1C

Study design:
Investigator has not assigned any intervention that's why it is Observational study and comparison group is present so it analytical and with onset of time exposure and outcome both at same time it was cross-sectional study

Study size:
The sample size for this study was 77 calculated using Cochrane formula, $n = Z^2pq/d^2$
Z = (1. 96) - 95% confidence interval
p = prevalence of diabetes mellitus in Jharkhand. 5.3 % as per 2011 ICMR-INDIAB study.
q = (100 - P)
d = allowable error - 5%

Statistical methods:
Data were entered and analyzed using Excel & SPSS software. Prevalence and mean with S.D. and P-value were calculated with the help of software.

RESULTS:

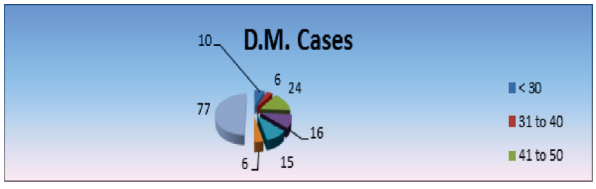

Figure1: showing study population and age group

The largest numbers of cases were in age group of 41 - 60 years i.e. 40 cases comprising of 52% of the total 77 cases. Mean age of patients was 48.14 ±16.58 years.

77 cases of D.M were categorized at the interval of 5 year duration into 5 groups. Out of the majority of case were in ≤ 5 year duration 44 cases (57%), 18 cases (23%) were 6 – 10 years duration, 7 cases (9%) were newly diagnosed cases. Mean duration of diabetes was 6.42 ± 3.54 years with range from 0.08 - 24 years duration.

Table 1: showing Duration of Diabetes in years and number / % of cases

Duration of Diabetes in years	No. of D.M. cases	Percentage
≤ 5	44	57%
6 – 10	18	23%
11 – 15	8	11%
16 – 20	5	6%
> 21	2	3%
Total Cases	77	100%

Out of 77 cases majority were of type 2 DM i.e.: 67 (87%) and only 10(13%) were of type 1 DM. Prevalence of prolong QT interval among Diabetic Population of Jharkhand was 27%.

Mean corrected QT interval (QTc) interval was 421.40±27.42. Three patients (4%) out of 77 had recorded QTc input less than 350 milliseconds. QTc interval was normal in 53 (69%) cases and Prolong QTc in 21 (27%) cases.

Table 2: showing QTc Interval and No. of DM Cases

QTc Interval	Range in msec.	No. of DM Cases	Percentage
Decreased	< 350	3	4%
Normal	350 – 440	53	69%
Prolong QTc	> 440	21	27%
Total Cases		77	100%

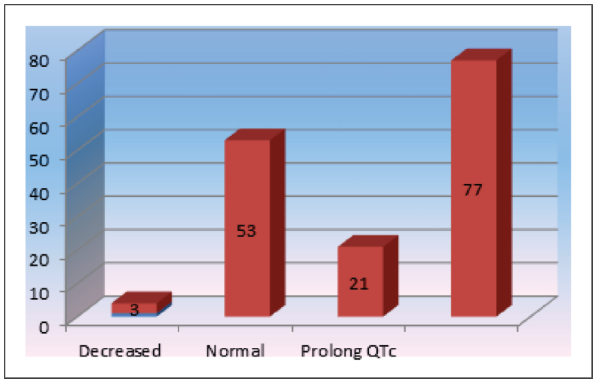

Figure2: showing 21(27%) prolong QTc out of 77(100%) DM Patients

QTc interval was compared with the duration of diabetes, we found mean QTc of 415.40 ± 18.40msec in 44 cases that had duration of diabetes less than equal to 5 years and in 16-20 yrs. Duration of Diabetes Mellitus (DM) mean was 455.20 ± 8.80msec for 5 cases. When compared with different group's difference is statistically significant (P value 0.0001) showing an increasing trend of QTc with duration of DM.

Table3: showing chi-square test of DM and QTc interval.

	Normal QTc	Prolong QTc	Marginal Row Totals
Normal	73 (63) [1.59]	1 (11) [9.09]	74
DM	53 (63) [1.59]	21 (11) [9.09]	74
Marginal Column Totals	126	22	148 (Grand Total)

The chi- square statistic is 21.356. The p-value is less than 0.00001. The relationship between these variables was significant, $X2(1, N=74) = 21.356$. Three (03) subjects, from both Normal and DM group had QTc less than normal, was excluded from chi-square test.

DISCUSSION:
There are 2 mechanisms that have been discussed to explain the increased cardiovascular risk in the presence of prolong QTc interval are dispersion of repolarisation as a consequence of predominance of left sympathetic nerve activity is held responsible for high risk of ventricular fibrillation[12] and a disturbed myocardial membrane function that is believed to lead to electrical instability.[13] Sympathetic stimulation balanced by vagal activity induces ventricular electrical instability, arrhythmia and sudden death.[14] R. Marfella *et.al*. In the year 2000 shows that the prevalence of QTc prolongation among type 2 DM was 26% and it was associated with heart disease[15]. Present study shows the Prevalence of prolong QT interval among Diabetic Population of Jharkhand was a 27% and it was related to duration of Diabetes mellitus. Furthermore exploratory study will be needed to answer the increasing trend of prolongation of QTc with duration of DM and to apply in general population.

CONCLUSION:
Prevalence of prolong QT interval among Diabetic Population of Jharkhand was a 27% and it is also common finding in diabetes mellitus. Prolongation of QTc interval was significantly (p value<0.00001) related to duration of DM.

Funding: self funded

Conflict of interest: nil.

Aknowledgment:
We thank all the patients, of Diabetes mellitus attending at tertiary care teaching institute, Ranchi, Jharkhand and to the institute, RIMS, Ranchi, Jharkhand, India.

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