http://jmscr.igmpublication.org/home/
ISSN (e)-2347-176x ISSN (p) 2455-0450
crossref DOI: https://dx.doi.org/10.18535/jmscr/v8i11.101

IGM Publication
Journal Of Medical Science And Clinical Research
An Official Publication Of IGM Publication

Prolonged QTc interval as a predictor of outcome in acute ischemic stroke

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Introduction

Ischemic stroke specifically refers to a central nervous system infarction that is accompanied by overt symptoms.[1] Ischemic stroke is the most common type of stroke. Electrocardiographic (ECG) changes are frequently observed in ischemic stroke, and they are noticed gradually by clinicians. ECG changes often occur 12 to 48 hours after illness onset, and are transient, lasting for no more than 1 week. Nearly every type of ECG change, including cardiac arrhythmias, such as ventricular premature beats (VPB) or supraventricular ectopic beats, ventricular tachycardia (VT) and atrial flutter (AFL)/ fibrillation (AF), and repolarization abnormalities (ST-segment changes, QT interval prolongation and increased QT interval dispersion) have been described in stroke patients.[2]

QTc interval on ECG, is calculated from the beginning of Q wave to end of T wave. It measures the duration of both cardiac depolarization and repolarization. Prolonged QTc interval may result from either a genetic or acquired conditions[(3)].

Many factors affect myocardial repolarization either by blocking ion channels of myocardium and producing structural changes in myocardium or both resulting in QTc prolongation. Studies primarily focusing on a particular condition have found many demographic variables, comorbidities and biochemical abnormalities to be associated with prolonged QTc interval.[3-4]

A prolonged QT interval corrected for heart rate (QTc) was reported in 23% to 45% of patients during acute stroke[5] and it was associated with cardiac arrhythmias and sudden death. We conducted this study to know the association between prolonged QTc interval and outcome of acute ischemic stroke.

Materials & Methods

Design of Study: Prospective observational study

Study Setting: A study was conducted in the Department of General Medicine at Sri Devaraj Urs medical college, Kolar, Karnataka.

Source of Data: Patients who present to our EMD with Acute Ischemic stroke are included in this study

Duration of Study: January 2020 to June 2020

Sample Size: 35 patients

Sampling Method: Random sampling

Method of Data Collection: Patients who present to our EMD with Acute Ischemic stroke who fulfil the inclusion/exclusion criteria was taken in to study after obtaining a written informed consent

Inclusion Criteria: Acute ischemic stroke

Exclusion Criteria:

Atrial fibrillation or ventricular conduction defects (QRS interval of 120 ms or longer), high heart rates (⩾100 beats per minute) and patient with no available ECG report.

Patients who present to our EMD with Acute Ischemic stroke are included in this study. Clinical, echocardiographic and laboratory profile, CT/MRI brain and in-hospital outcome of patients with medical emergencies will be assessed as a part of work up. QTc interval will be calculated by using Bazzets formula within 24hrs of admission by using standard 12 lead ECG. Patients with QTc ≥0.44 sec in male and QTc ≥0.46 sec in females will be taken as the cutoff value for prolonged QTc interval and values are compared with outcome and duration of stay in hospital.

Statistical Analysis

Data was entered into Microsoft excel data sheet and was analyzed using SPSS 22 version software. Categorical data was represented in the form of Frequencies and proportions. **Chi-square test or Fischer's exact test** (for 2x2 tables only) was used as test of significance for qualitative data.

Continuous data was represented as mean and standard deviation. **Independent t test** was used as test of significance to identify the mean difference between two quantitative variables

P value (Probability that the result is true) of <0.05 was considered as statistically significant after assuming all the rules of statistical tests.

Statistical software: MS Excel**,** SPSS version 22 **(**IBM SPSS Statistics, Somers NY, USA) was used to analyze data

Results

In our study we have included 35 acute ischemic stroke patients. Among 35 subjects 10(28.5%) subjects were female and 25(71.5%) subjects were male. Mean age of our study was 62.21 ± 16.38 yrs. with minimum 21yrs and maximum 92yrs.

11 (31.42%) subjects had diabetes and 17(48.57%) subjects had hypertension

Smoking history was present in 6(17.14%) subjects and alcoholic history was present in 5(14.28%) subjects.

In our study 16(45.7%) subjects had prolonged QTc interval and remaining 19(54.3%) subjects had normal QTc interval.

60% of the female had prolonged QTc interval and 40% of the female had normal QTc interval whereas in male it is 40% had prolonged QTc interval and 60% had normal QTc interval. There was no statistically significant difference found between gender and QTc interval.

Table 1: Comparison of demographic profile, comorbidities according to QTc interval

	Normal QTc interval (n=19)	**Prolonged QTc interval (n=16)**	P value
Age in years	62.79±16.66	61.31±15.05	0.787
Female	4(40%)	6(60%)	0.454
Male	15(60%)	10(40%	
Diabetes	7(63.6%)	4(36.4%)	0.493
Hypertension	9(52.9%)	8(47.1%)	0.877
Smoking	3(50%)	3(50%)	0.817
Alcohol	3(60%)	2(40%)	0.782

Mean age among the subjects who had normal QTc interval was 62.79±16.66yrs and among subjects who had prolonged QTc interval was 61.31±15.05 yrs. There was no statistically significant difference found between age and QTc interval.

63.6% of diabetic subjects had normal QTc interval and 36.4% of diabetic subjects had prolonged QTc interval. There was no statistically significant difference found between diabetes and QTc interval.

52.9% of hypertensive subjects had normal QTc interval and 47.1% of hypertensive subjects had prolonged QTc interval. There was no statistically significant difference found between hypertension and QTc interval. There was no statistically significant difference found between smoking and QTc interval. There was no statistically significant difference found between alcohol and QTc interval.

Table 2: Comparison of various parameters according to QTc interval

	Normal QTc interval		**Prolonged QTc interval**		**P value**
	Mean	SD	Mean	SD	
HB	13.4000	2.2806	12.4375	2.2470	0.219
Total count	12960	8585	12380	5036	0.814
ESR	23	19	29	24	0.413
RBS	139	74	125	54	0.540
Serum Creatinine	2.0	2.8	1.0	0.4	0.199
Serum Sodium	136	6	137	7	0.719
SerumPotassium	4.32	0.91	4.13	0.70	0.516

There was no statistically significant difference found between two groups with respect to hemoglobin, total count, ESR, RBS, Serum creatinine, serum sodium, serum potassium

Table 3 Comparison of outcome according to QTc interval

	Normal QTc interval	**Prolonged QTc interval**	Total
Against Medical Advice	2	0	2
Death	0	1	1
Improved	13	10	23
Not improved	4	5	9
Total	19	16	35

In our study 2(5.7%) subjects had discharged Against Medical Advice, 1(2.9%) subjects had death, 9(25.7%) subjects had not improved and 23(65.7%) subjects had improved.

P value 0.352, there was no statistically significant difference found between two groups with respect outcome.

Hospital stay among the subjects who had normal QTc interval was 90.21±72.4 days and among subjects who had prolonged QTc interval was 94.75± 86.65yrs. There was no statistically significant difference found between Hospital stay and QTc interval

Discussion

Various factors affects QTc interval which includes increasing age, female gender, several medical conditions, electrolyte abnormalities, and many drugs.[6-10] Alteration of ion channels and intracellular potassium leading to heterogeneous intra-cardiac repolarization and early after-depolarization is the Pathogenesis of QTc interval prolongation. Life threatening cardiac arrhythmias can be caused by Prolonged QTc interval, especially duration of repolarization is well known.[6-10]

In our study prevalence of prolonged QTc interval was 45.7% which is similar to the study done by Chhagan Lal Birda et al[11] prevalence of prolonged QTc interval was 34.1%.

In a study done by Swiss teaching hospital in medical inpatients reported prevalence of prolonged QTc interval was 22.3% in medical inpatients.[12]

In our study 60% of the female had prolonged QTc interval whereas in male 40% had prolonged

QTc interval. Similar to our study many of the previous studies reported a higher number of female patients with prolonged QTc interval.[6, 7,8,13] Whereas In study done by Chhagan Lal Birda et al[11] higher number of male patients had prolonged QTc interval when compared with female.

In our study there was no statistically significant difference found between age and QTc interval which was similar to study done by Chhagan Lal Birda[11]

In our study no association was found between co morbidities like hypertension, Diabetes and QTc interval which was similar to study done by Chhagan Lal Birda.[11]

In our study there was no statistically significant difference found between two groups with respect to hemoglobin, total count, ESR, RBS, Serum creatinine, serum sodium, serum potassium.

In a study done by Chhagan Lal Birda[11] mean hemoglobin was significantly lower in patients with prolonged QTc interval, and even more, severe anemia was noted in patients with QTc interval >500 ms. A Serbian study in chronic anemia patients, without any comorbidity also showed significantly prolonged QTc interval in these anemic patients.[14]

In a retrospective study among non selected medical patients, Seftchick *et al*. reported that QTc prolongation was significantly associated with structural heart disease, stroke, and renal failure.[15]

In our study there was no statistically significant difference found between QTc interval and outcome. Previous studies have shown that prolonged QT intervals are predictors of early mortality in acute ischemic stroke patients. Intracranial pathology is frequently associated with ECG changes, including ST-segment depression, QT interval prolongation, ventricular arrhythmias, and heart rate variability.[16,17].

Conclusion

Arrhythmias and ischemic-like and repolarization changes are common in ischemic stroke patients. Therefore, appropriate management and optimal care are needed for these patients.

Limitations

This study was done in single center in emergency medical department and also had relatively smaller study population, hence the finding cannot be extrapolated to patients in general. We had done assessment of ECG at presentation only for QTc calculation and continuous ECG monitoring was not done so episodes of QTc prolongation during hospital course could have been missed

Acknowledgements

Authors would like to acknowledge all the subjects participated in the study. Everyone who contributed in the completion of the study including the technical staff

Declarations

Funding: No funding sources

Conflict of Interest: None declared

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