Corrected QT Dispersion within the First 72 Hours of Acute ST Elevation Myocardial Infarction in JLNMCH, Bhagalpur, Bihar

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Abstract

Background: Greater ventricular repolarization heterogeneity after acute myocardial infarction has been linked to increased QT dispersion, which is associated with a poor prognosis in a variety of patients. This study's goal is to determine how QTc dispersion affects patients with acute ST elevation myocardial infarction (STEMI) both at the time of admission and after 72 hours.

Method: In a cross-sectional study, 60 patients with acute STEMI who were admitted to the department of medicine at the JLNMCH in Bhagalpur, Bihar, between November 2021 and October 2022 were included. All patients had their corrected QT (QTc) dispersion measured, which is the difference between the maximum and minimum QTc intervals for a given heart rate.

Results: In this study, 60 patients with acute STEMI were included, and 41 (68.3%) of those patients were male. Male patients were significantly younger than female patients in terms of mean age, which was 54.66±12.13 years for men and 62.84±13.00 years for women. When patients arrived with anterior and inferior acute myocardial infarction rather than lateral and posterior acute myocardial infarction, there were significant reductions in QTc dispersion at admission versus QTc dispersion at 72 hours. In addition, 8 (13.3%) individuals had malignant ventricular arrhythmias (VT and VF). In comparison to the non-arrhythmia group (59.18±26.98 msec), the QTc dispersion at admission was greater in the group with ventricular tachyarrhythmias (97.07±27.27 msec).

With a significant difference between QTc dispersion at admission and QTc dispersion at 72 hours in this group, QTc dispersion was higher in the heart failure group, with a P value <0.001 for this difference.

Conclusion: When patients with acute STEMI are admitted, QTc dispersion is higher. Patients with acute STEMI of the front wall have increased QTc dispersion. In individuals with acute STEMI, increased QTc dispersion can predict the onset of ventricular tachyarrhythmias and heart failure.

Keywords: QT Dispersion, STEMI, Ventricular Arrhythmias.

Introduction

An abrupt ST rise A clinical phenomenon known as myocardial infarction (STEMI) is defined by persistent ischemic chest pain along with electrocardiographic ST elevation and the subsequent release of biochemical markers of myocardial necrosis. One of the main causes of mortality and morbidity on a global scale is STEMI. According to statistics, 50% of myocardial infarction-related deaths occur within the first hour of the attack and are frequently attributed to malignant ventricular arrhythmias, which are brought on by early abnormalities in the heart's autonomic nervous system [1]. QT dispersion has been proposed as one such indicator of the heart's autonomic tone [2].

The QT interval reflects changes in the local cardiac environment because it measures how long the ventricular myocardium was depolarized and then repolarized [3]. An region of necrosis that is surrounded by ischemic myocardium causes post-myocardial infarction electro-physiological inhomogeneity, which heightens QT dispersion. These circumstances alter the myocardium's electrophysiological properties and cause localised dispersion of repolarization activity [3,4].

The discrepancy between the maximum and least QT interval readings on a typical 12 lead ECG is known as QT dispersion [4,5]. Varied parts of the heart have different times for the ventricles to repolarize. Because of this, increased rate-adjusted corrected QT dispersion (QTc dispersion) on the surface ECG has been linked to increased ventricular repolarization heterogeneity, implicated in the development of ventricular arrhythmias, and has been associated with a poor prognosis in a variety of patients [6,7].

Following an acute STEMI, myocardial viability is a great predictive indicator of patient survival. Powerful and costly tests including stress electrocardiography, magnetic resonance imaging, single-photon emission computed tomography, and positron emission tomography can be used to determine the viability of the myocardium.

However, many scientists believe that QT dispersion is a straightforward, affordable, and widely accessible marker for determining the viability of the myocardium [8]. Evaluation of QT dispersion following STEMI is becoming more popular, not only for ventricular arrhythmias but also for additional problems such heart failure, heart block, and post-infarction angina [3].

This study objective is to assess the impact of QTc dispersion in acute STEMI patients at admission and after 72 hours.

Material and Methods

60 patients with acute ST elevation myocardial infarction (STEMI) who were admitted to the department of medicine at the Jawaharlal Nehru Medical College and Hospital between November 2021 and October 2022 were included in a cross-sectional prospective study. This study included patients with increased serum troponin levels, ST elevation greater than 1 mm in two or more limb leads, ST elevation greater than 2 mm in two or more chest leads, and ischemic chest discomfort lasting longer than 30 minutes. (9,10) Patients that show up 48 hours later. patients with Wolff-Parkinson-White syndrome, full heart blockages, or bundle branch blocks patients who have flutter or atrial fibrillation. Patients taking medications that influence QT interval, such as digoxin, amiodarone, or tricyclic antidepressants. those suffering from valvular heart disease. Paced rhythm patients were not included [10,11].

Following the patients' admission to the CCU, information regarding their demographics, risk factors for coronary artery disease, and clinical signs of heart failure was gathered. At admission and after 72 hours, a 12-lead ECG was taken for each

patient under study (at a speed of 25 mm/sec with a setting of 1mv=10 mm). The time in milliseconds between the beginning of the QRS and the end of the T wave (when the T wave returns to the isoelectric line or the nadir between the T and U waves) was recorded as the QT interval (msec). All leads had their QT interval measured, however a lead was excluded if the end of the T wave could not be located [5]. The QT interval was corrected (QTc) by using Bazett's formula (QTc= QT interval/square root of R-R interval in seconds).

Corrected QT dispersion (QTc dispersion) was defined as the difference between the maximum QTc interval and minimum QTc interval for a given heart rate. So QTc dispersion= QTc maximum– QTc minimum [12]

Version 23 of the statistical package for social science (SPSS) was used to statistically analyse the data. To compare the statistical difference between the variables, an independent T-test was utilised. Statistical significance was defined as a P value of less than 0.05.

Results

In this study, 60 patients with acute ST elevation myocardial infarction (STEMI) were included, of whom 41 (68.3%) were men and 19 (31.7%) were women. Patients who were male on average were 54.66±12.13 years old, whereas those who were female on average were 62.84±13.00 years old. When compared to the mean QTc dispersion at 72 hours, which was 37.08±28.30 msec, the mean QTc dispersion upon admission was higher at 68.65±31.51 msec. In terms of age, body mass index, and smoking, there were significant differences between the sexes, but not in terms of other risk factors, QTc maximum at admission, QTc minimum at admission, QTc dispersion at admission, QTc maximum at 72 hours, QTc minimum at 72 hours, or QTc dispersion at 72 hours. (Table 1).

Table 1: General characteristics of study patients with acute STEMI

Variables (No. 60 (100%))	Males 41 (68.3%)	Females19(31.7%)	P value*
Age mean ± SD (57.25±12.88) years	54.66±12.13	62.84±13.00	0.021**
BMI mean ± SD (26.88±3.77) kg/m^2	26.09±3.59	28.57±3.68	0.016**
Hypertension 32 (53.3%)	19 (46.3%)	13 (68.4%)	0.165
Diabetes mellitus 23 (38.3%)	13 (31.7%)	10 (52.6%)	0.157
Smoking 30 (50.0%)	26 (63.4%)	4 (21.1%)	0.005**
Previous IHD 13 (21.7%)	8 (19.5%)	5 (26.3%)	0.737
QTc maximum at admission mean ± SD (467.10±41.70) msec	464.44±40.92	472.84±43.90	0.473
QTc minimum at admission mean ± SD (398.45±28.74) msec	397.27±28.68	401.00±29.48	0.644
QTc dispersion at admission mean ± SD (68.65±31.51) msec	67.17±32.50	71.84±28.85	0.594
QTc maximum at 72 hours mean ± SD (429.28±33.95) msec	428.78±34.48	430.37±33.68	0.868
QTc minimum at 72 hours mean ± SD (392.20±24,59) msec	390.39±26.93	396.11±18.63	0.407
QTc dispersion at 72 hours mean ± SD (37.08±28.30) msec	38.39±29.35	34.26±26.41	0.603

*Independent T-test. **Significant level ≤ 0.05

Furthermore, Table 2 demonstrates that the anterior wall present in 32 (53.3%) patients was the most frequent site of acute STEMI in this study, followed by the inferior wall present in 15 (25.0%) patients, the lateral wall present in 10 (16.7%) patients, and the posterior wall present in 3 (5.0%) patients.

When patients arrived with anterior and inferior acute myocardial infarction rather than lateral and posterior acute myocardial infarction, there were significant reductions in QTc dispersion at admission versus QTc dispersion at 72 hours.

Table 2: QTc dispersion according to location of acute STEMI

Location of STEMI	No. 60 % = 100%	QTc dispersion at admission (msec)	QTc dispersion at 72 hour (msec)	P value*
Anterior	32 (53.3%)	74.41±27.05	38.37±24.61	<0.001**
Inferior	15 (25.0%)	58.27±32.24	27.73±21.82	0.005**
Lateral	10 (16.7%)	71.80±38.50	44.60±42.30	0.15
Posterior	3 (5.0%)	48.67±44.95	45.00±42.32	0.923

*Independent T-test. **Significance level ≤ 0.05

Ventricular ectopic beats were the most prevalent cardiac arrhythmias in this study, occurring in 8 (13.3%) patients, followed by ventricular tachycardia, atrial ectopic beats, and ventricular fibrillation in 5 (8.3%), 4 (6.7%), and 3 (5%) patients, respectively (Table 3).

Table 3: Types of arrhythmias in patients with acute STEMI

Arrhythmias	Number	Percentage
Atrial ectopics	4	6.7
Ventricular ectopics	8	13.3
Ventricular tachycardia	5	8.3
Ventricular fibrillation	3	5

In this study, 16 (26.7%) patients had ventricular tachyarrhythmias, which were represented by ventricular ectopic, ventricular tachycardia (VT), and ventricular fibrillation (VF). In addition, 8 (13.3%) individuals had malignant ventricular arrhythmias (VT and VF). In comparison to the non-arrhythmia group (59.18±26.98 msec), the QTc dispersion at admission was greater in the group with ventricular tachyarrhythmias (97.07±27.27 msec). According to data from both groups' QTc dispersion at admission and QTc dispersion at 72 hours, there was a substantial difference (Table 4).

Table 4: QTc dispersion in patients with or without ventricular tachyarrhythmias (ventricular ectopic, ventricular tachycardia and ventricular fibrillation) in acute STEMI

Ventricular tachyarrhythmias	No. 60 % = 100%	QTc dispersion at admission (msec)	QTc dispersion 72 hour(msec)	P value*
Absent	44 (73.3%)	59.18±26.98	33.18±26.08	<0.001**
Present	16 (26.7%)	97.07±27.27	48.80±32.26	<0.001**

*Independent T-test. **Significant level ≤ 0.05

Additionally, throughout the three days of admission to CCU, clinical signs of heart failure were seen in 15 (25%) of the patients in the current study. With a significant difference between QTc dispersion at admission and QTc dispersion at 72 hours in this group, with a P value 0.001, QTc dispersion was larger in the heart failure group, as indicated in (Table 5).

Table 5: QTc dispersion in patients with or without heart failure in acute STEMI.

Heart Failure	No. 60 % = 100%	QTc dispersion at admission	QTc dispersion at 72 hour	P value*
Absent	45 (75%)	66.05±25.60	44.06±34.45	0.123
Present	15 (25%)	75.81±44.18	34.55±25.69	< 0.001**

*Independent T-test. **Significant level ≤ 0.05

Discussion

In the current study, men made up 68.3% of patients, while women made up 31.7% of patients. Male patients were significantly older than female patients in terms of mean age, which was 54.66 12.13 years for men and 62.84 13.00 years for women. Men are more likely than women to experience acute myocardial infarction (77% versus 23%), and affected men are younger than women (59 versus 66 years old). Loyeau A *et al*. and Smilowitz NR *et al*. explained their findings by the rising prevalence of cardiovascular risk factors among men, particularly smoking, which is the primary cardiovascular risk factor among younger patients [13,14].

In addition, evaluation of QTc dispersion at admission and at 72 hours was employed in this study to identify individuals who would likely suffer negative outcomes from acute STEMI. When compared to the mean QTc dispersion at 72 hours, which was 37.0828.30 msec, the mean QTc dispersion upon admission was higher at 68.6531.51 msec. In patients with STEMI, Chittora S. *et al*. and Wahab A. *et al*. reported progressive QT results that reflect regional heterogeneity during myocardial recovery and increase the risk of life-threatening ventricular arrhythmias and sudden cardiac death from the time of admission to the time of discharge [5,15]

In the current study, patients with anterior STEMI showed greater QTc dispersion upon admission compared to those at other sites, which significantly decreased at 72 hours. Acute anterior myocardial infarction patients had much larger QTc dispersion than patients with STEMI from other sites, according to research by Siddiqui MS *et al* and Pinem PS *et al*.

These patients also have a higher risk of developing ventricular arrhythmias [16,17] In addition, González EC *et al*. found that impaired conduction within an ischemic area causes longer QRS, ST segment, and QTc dispersion durations than in non-ischemic areas. The degree of conduction delay is proportional to the size of the ischemic area, which explains why anterior STEMI has a higher value of QTc dispersion than other areas [18]

Additionally, in this study, malignant ventricular arrhythmias (VT and VF) were present in 8 (13.3%) patients while ventricular tachyarrhythmias (ventricular ectopic, ventricular tachycardia, and ventricular fibrillation) were present in 26.7% of patients. Similar findings were made by Takada T *et al*, who found that 12% of patients experience VT/VF within 48 hours of an acute myocardial infarction [19].

This study also showed that individuals with ventricular tachyarrhythmias had larger QTc dispersion at admission (97.07±27.27 msec) than patients without ventricular tachyarrhythmias (59.18±26.98 msec), which decreased over the course of the next 72 hours. Similar QTc dispersion results were observed in patients with acute myocardial infarction, according to Agrawal MK *et al*.

Conclusion

According to the results of the current study, individuals with acute STEMI have larger

QTc dispersion at the time of admission. Patients with acute STEMI of the front wall have increased QTc dispersion. In individuals with acute STEMI, increased QTc dispersion can predict the onset of ventricular tachyarrhythmias and heart failure.

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