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QT Dispersion after Thrombolytic Therapy

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ABSTRACT

Background: QT dispersion (QTd) is equal to longer QTc minus shorter QTc measured by 12-lead electrocardiogram (ECG). QTd reflects inhomogeneity in repolarization of ventricular myocardium and because of easy and fast measurement of QTd, it can be used to predict high-risk patients for dysrhythmia after Acute Myocardial Infarction (AMI).
Objectives: This study aimed to assess the effect of thrombolytic therapy on QTd before and 1 hour and 4 days after beginning of thrombolytic therapy.
Patients and Methods: The patients with chest pain and ST Elevated Myocardial Infarction (STEMI) that underwent thrombolytic therapy were enrolled into this study. Streptokinase was the thrombolytic agent in all the patients. Standard 12-lead (ECG) was evaluated before beginning of thrombolytic therapy (QTd 1) and 1 hour (QTd2) and 4 days (QTd3) after thrombolytic therapy. First, ECG was magnified × 10 for exact calculation of QT and QTd. After all, the variables were compared using one–way analysis of variance (ANOVA). Besides, $P \leq 0.05$ was considered as statistically significant.
Results: This study was conducted on 160 patients. The results revealed no significant differences among QTd 1, QTd 2, and QTd 3 ($P > 0.05$). At inferior AMI, however, a significant difference was observed among QTd1, QTd2, and QTd3 ($P = 0.031$).
Conclusions: Thrombolytic therapy had no significant effects on QTd. Thus, thrombolytic therapy does not increase the risk of arrhythmia.

►*Implication for health policy/practice/research/medical education:*
Because of easy and fast measurement of QTd, it can be used to predict high-risk patients for dysrhythmia after Acute Myocardial Infarction (AMI). A limited number of studies have been conducted on QT dispersion in Iran. Thus, we designed this study to determine over time QT dispersion variation and measure QT dispersion after AMI in Urmia, Iran.

1. Background

QT interval is defined as the distance from the onset of QRS complex to the end of T wave on electrocardiogram. QT dispersion (QTd) is equal to longer QTc minus shorter QTc measured by 12-lead Electrocardiogram (ECG). QTd reflects inhomogeneity in myocardial and ventricular repolarization (1, 2). Because of easy and fast measurement of QTd, it can be used to predict high-risk patients for dysrhythmia after Acute Myocardial Infarction (AMI) (3). QTd is 30 - 60 milliseconds (ms) in healthy patients, but increases to 60 - 80 ms in patients with Coronary Artery Disease (CAD) (4). QTc dispersion > 60 ms has independent predictive value for the severity of CAD (5). In addition, QTd increases after the acute phase of AMI (6). Increased QTd can cause ventricular arrhythmia, such as torsade de pointes (7-10). Reperfusion therapy is the cornerstone of treatment for AMI. Reperfusion therapy is done with thrombolytic drugs and Percutaneous Coronary Intervention (PCI). PCI can decrease QTd (11). PCI, within 90 minutes after the beginning of MI, is the choice of reperfusion therapy. Unfortunately, there is no PCI facility at many hospitals,

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especially in developing countries. Thus, thrombolytic therapy is done for treatment of AMI in such hospitals. In some patients, ventricular arrhythmias occur during or after reperfusion therapy.

2. Objectives

Hence, the present study aims to assess the effect of thrombolytic therapy on QTd as a predictive value for ventricular arrhythmias.

3. Patients and Methods

This descriptive-analytical (observational) study was conducted on all the patients with acute ST Elevated Myocardial Infarction (STEMI) and chest pain who underwent thrombolytic therapy in Seyedoshohada hospital, Urmia, Iran. Overall, 183 patients were enrolled into the study. Streptokinase was the thrombolytic agent in all the patients. The exclusion criteria of the study were electrolyte disturbances, conduction disturbances, Atrial Fibrillation (AF), and chronic use of drugs, such as digital drugs, antidepressants, and antipsychotics. Thus, 23 patients were excluded from the study due to electrolyte disturbances (hyponatremia) (N = 2), chronic use of digoxin (N = 5), AF (N = 5), conduction disturbances (N = 10; 4, 5, and 1 patients had left bundle branch block, right bundle branch block, and complete heart block, respectively), and death (N = 1).

After all, 160 patients were recruited into this study. Standard 12-lead ECG (Speed: 25 millimeter per second) was evaluated before thrombolytic therapy (QTd 1), one hour after therapy (QTd2), and four days after therapy (QTd QTd 3). First, the ECG was magnified × 10 to clarify ECG paper for precise measurements. Longer and shorter QTs of 12-lead ECG were measured manually, and QTd was measured using the following formula: longer QT minus shorter QT. Then, corrected QTd was calculated through Bazett's formula (QTd corrected = QTd / $\sqrt{}$ RR) (Bazett's formula: Corrected QT = QTc = QT / $\sqrt{}$ RR).

All the statistical analyses were performed using the SPSS statistical software (v. 19). Normally distributed continuous variables were expressed as mean ± standard deviation. Abnormally distributed variables were expressed as median. Non-continuous data were expressed as number of events and percentage. Student T-test and one–way analysis of variance (ANOVA) were used to compare normally distributed continuous variables. $P \leq 0.05$ was considered as statistically significant.

4. Results

This study was conducted on 160 patients. In all the patients, reversing ST elevation of ECG showed successful reperfusion therapy, but no angiographic data were available to exactly determine the success of reperfusion therapy and this defect of data was one of the study limitations.

In this study, 122 patients were male and 38 ones were female. In addition, 105 and 55 patients were above and below 65 years old, respectively. Table 1 summarizes the patients' characteristics and demographic data.

QTd interval, mean QTd, and standard deviation over time have been presented in Table 2. Accordingly, although QTd 2 was lower than QTd 1, the difference was not statistically significant (P = 0.831).

In this study, error bars graphs were drawn to indicate the estimated error in a measurement (Figure 1). In this figure, the Y-axis represents the column mean and the upper and lower errors represent the two columns' upper error and lower error, respectively.

Moreover, over time QTd variation based on sex, age, site of infarction, previous smoking, hypertension, and diabetes mellitus has been shown in Table 3. As the table depicts, no significant differences were found among QTd 1, QTd 2, and QTd 3 (P > 0.05). At inferior AMI, however, a significant difference was observed among QTd1, QTd2, and QTd3 (P = 0.031). Over time QTd mean variations based on the site of infarction have been presented in Figure 2.

5. Discussion

This study was performed on 160 patients with AMI. Based on the study results, although QTd decreased during thrombolytic therapy, thrombolytic therapy had no significant effects on QTd3 (QTd after 4 days). Thus, the risk of arrhythmia did not increase 4 days after thrombolytic therapy.

Similar to our study, Lörincz et al. assessed the effect of intravenous streptokinase on QT and JT dispersions. They reported that QTd increased at early hours after

Table 1. The Patients' Characteristics and Demographic Data

	Frequency	Percent
Male	122	76.25
Female	38	23.75
Age < 65	55	34.375
Age ≥ 65	105	65.625
Anterior MI	84	52.5
Inferior MI	54	33.75
Lateral MI	7	4.375
Extensive or mixed MI	15	9.375
With previous hypertension	53	33.125
Without previous hypertension	107	66.875
With previous DM	24	15
Without previous DM	136	85
Smoker	72	45
Non-smoker	88	55
Total	160	100

Abbreviations: MI, myocardial infarction; DM, diabetic mellitus

Table 2. Over Time QTd Interval

	QTd 1	QTd 2	QTd 3
Minimum QTd	0	0	0
Maximum QTd	204.96 ms	194.03 ms	244.95 ms
Mean QTd	76.15 ms	70.93 ms	76.69 ms
SD	35.502	27.98	47.81

Abbreviations: QTd 1, QTd at first ECG; QTd 2, QTd 1 hour after beginning of reperfusion therapy; QTd 3, QTd 4, days after beginning of reperfusion therapy; SD, standard deviation; ms, millisecond

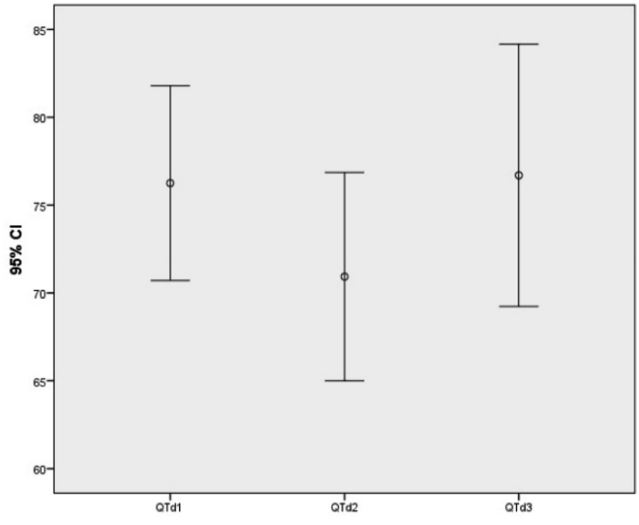

Figure 1. Error Bar Variation of Mean QTd

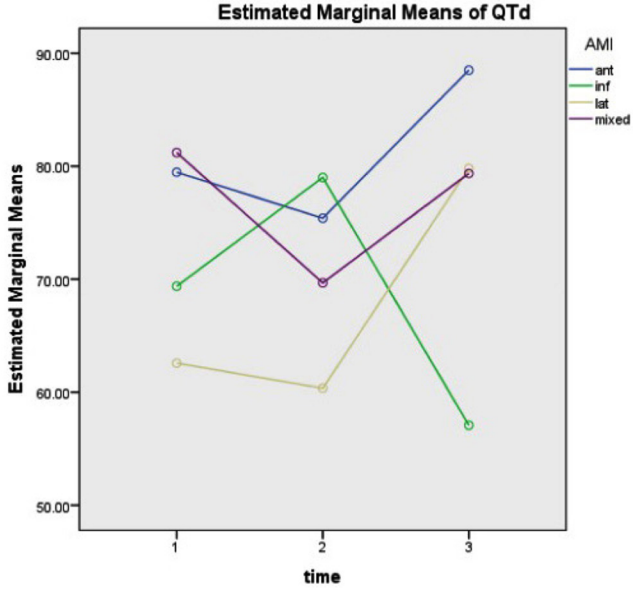

Figure 2. QTd Mean Variation over Time Based on the Site of Infarction

infarction and thrombolytic therapy, but decreased 8 ± 2 hours after thrombolytic therapy (12). Moreover, Snikiforos et al. studied 60 patients with AMI to assess the effect of reperfusion therapy [streptokinase or r-TPA and primary Percutaneous Transdermal Coronary Angioplasty (PTCA)] on QTd. They concluded that after AMI, successful thrombolysis was associated with a significant decrease in QTd on the standard 12-lead ECG (13). Furthermore, Mohammad et al. evaluated the effect of PCI on QTd in 96 patients with stable angina in 2010 and demonstrated that PCI decreased QTd (14). Karagounis et al. also conducted a study on 207 patients who underwent thrombolytic therapy with alteplase or anistreplase. Their findings indicated that after AMI, successful thrombolysis was associated with lower QTd (15). Chi-Cheng Lai et al. established that although shortened QTd showed successful reperfusion therapy, the patients with shortened QTd had significantly higher incidence of in-hospital cardiac deaths after receiving PCI (16). However, Nirav J. Mehta et al. studied the effect of thrombolytic therapy on QTd in 72 patients

Table 3. QTd Variations Based on Sex, Age, Site of Infarction, Previous Smoking, Hypertension, and Diabetes Mellitus

	QTd1	QTd2	QTd3	P value
Sex				
Male	79.94 ± 37.68	68.49 ± 39	87.56 ± 50.06	0.068
Female	67.83 ± 27.05	73.74 ± 33.00	62.05 ± 36.04	0.120
With previous HTN	76.86 ± 35.14	73.71 ± 48.16	74.18 ± 36.15	0.560
Without previous HTN	69.73 ± 32.16	68.93 ± 45.72	77.89 ± 37.46	0.028
With previous DM	72.37 ± 39.17	74.18 ± 42.15	84.86 ± 32.11	0.780
Without previous DM	73.92 ± 33.65	68.81 ± 25.29	68.14 ± 39.41	0.451
With previous smoking	74.78 ± 32.17	67.90 ± 40.14	79.26 ± 28.25	0.348
Without previous smoking	71.86 ± 37.14	74.66 ± 39.36	73.80 ± 29.15	0.751
Age < 65	68.11 ± 15.48	66.16 ± 11.6	71.11 ± 46.57	0.979
Age ≥ 65	78.24 ± 25.18	76.28 ± 45.6	79.72 ± 52.54	0.852
Anterior AMI	79.91 ± 25.37	75.14 ± 32	88.11 ± 47	0.063
Inferior AMI	69.27 ± 30	78.22 ± 41	66.86 ± 34	0.031
Lateral AMI	62.75 ± 28	60.11 ± 41	78.86 ± 37	0.056
Mixed or extensive AMI	81.14 ± 25	69.26 ± 40	78.45 ± 32	0.089

Abbreviations: DM, Diabetes mellitus; HTN, Hypertension; AMI, Acute myocardial infarction

with AMI. They revealed that QTd did not change early after thrombolytic therapy (17). Moreover, Fukushima et al. evaluated the effect of successful recanalization on QTd in AMI patients and disclosed that successful recanalization significantly decreased QTd (18).

In conclusion, thrombolytic therapy had no significant effects on QTd over time. Thus, thrombolytic therapy does not increase the risk of arrhythmia over time.

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Authors' Contribution

Saeed Oni Heris collected all data, Behzad Rahimi and Mojgan Hajahmadi supervised data collection process, Hojjat Sayyadi analyzed the data, Gholamreza Faridaalaee drafted the manuscript, and Bahman Naghipour revised the manuscript.

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