Original Article

Study of the effects of streptokinase versus primary PCI on QT dispersion in patients with acute STEMI

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Abstract

Background: The QT interval dispersion (QTd) was first developed as a measure of the variability in ventricular repolarization times over space. **This study aimed** for comparing Streptokinase vs primary PCI for ST-elevation myocardial infarction: a comparison of QTD before and after therapy. **Methods:** Two hundred patients who had a STEMI and were treated with streptokinase or primary PCI were included in this prospective observational trial. Two groups of identical size were created, one for patients who received fibrinolytic therapy and the other for those who underwent primary PCI. Reperfusion therapy was administered to all patients via primary PCI or fibrinolytics after a thorough history and physical examination, including a 12-lead electrocardiogram. Quantifying the QT interval and its variability. **Results**: The PCI group demonstrated significantly higher percent change of max QTD (P=0.001) and QTcD (P < 0.001). In patients with anterior or inferior infarctions, the median percent change of QTD was significantly higher in those who underwent PCI (-33%) than in those who underwent SK (-21.43%). Additionally, in patients with lateral or posterior infarctions, the median percent change of QTD was significantly higher in those who underwent PCI (-37.05%) than in those who underwent SK (-16.67%). **Conclusion:** QTD values were shown to decrease more in the primary PCI technique. This study demonstrated a greater reduction in the incidence of harmful arrhythmia after primary PCI was used to treat the arrhythmia, and an elevated QT interval is a risk factor for the development of such an arrhythmia.

Key words : QT Dispersion; Acute STEMI Streptokinase; Primary PCI.

INTRODUCTION

QT interval is a measure of how long ventricular electrical activity takes to complete, as measured by depolarization and repolarization phases; QT dispersion (QTd) was first proposed as an index of the geographic variation in QT interval.(1).

The QT interval in a 12-lead electrocardiogram (ECG) has been demonstrated to differ between leads in prior research. The variation in a 12-lead ECG's QT interval, measured as the gap between the minor and major QT values, is referred to as QTd. This variability is indicative of regional differences in ventricular repolarization, which can lead to reentry and potentially life-threatening ventricular arrhythmias.(2).

Proposed causal pathways for QT prolongation after acute myocardial ischemia include alterations in myocardial response to catecholamines or cholinergic stimulation, disruption of calcium or potassium ion channels, and induction of variations in intracellular hydrogen concentration.(3).

Streptokinase, a fibrinolytic drug, or primary percutaneous coronary intervention (PCI) can re-open a blocked coronary artery and restore blood flow, resulting in reperfusion of ischemic areas, enhanced myocardial electrical and mechanical activity, and reduced risk of ventricular repolarization heterogeneity and arrhythmias.(4).

The aim of this work was for comparing Streptokinase vs primary PCI for ST-elevation myocardial infarction: a comparison of QTD before and after therapy.

Patients and methods

This prospective observational study included 200 patients with STEMI who were treated by either streptokinase or primary PCI. Patients were selected from those who admitted to CCU in Benha University. Research ethics committee, Faculty of Medicine, Benha University accepted the study, and participants gave their agreement before it was carried out.

Inclusion Criteria were normal chest pain leading to hospital admission (retrosternal chest pain or discomfort which lasted for at least 30 min). Two main electrocardiograms (ECGs) in a row showed an increased ST segment, indicating that their condition was serious. Creatine kinase-MB (CK-MB) and troponin T levels were also higher in those with abnormal laboratory results.

Exclusion Criteria were patients with any of the following criteria, patients who have had symptoms for more than 48 hours, whose electrocardiograms display a QRS length in excess of 120 ms (right or left bundle branch block), have a documented history of using medicines known to prolong the QRS complex or the QT interval, etc (anti-arrhythmic, anti-psychotic, and antidepressant drugs), Patients with cardiomyopathies, heart valve-related problems, electrolyte imbalances, and/or confirmed diagnoses of heart diseases such congestive heart failure and/or valvular diseases, all of which can induce changes to the QT interval dispersion or heart rate.

Patients were classified into 2 groups: Group one: patient who had fibrinolytic therapy and **Group two:** patients who had primary PCI.

All patients were subjected to socio-demographic data: age, sex, full history including smoking, hypertension, diabetes, hyperlipidemic any history of previous cardiac diseases or procedures, full clinical examination: BMI, heart rate and blood pressure, 12_ leads ECG, laboratory investigation: CBC, CK-MB, Troponin, reperfusion therapy either by primary PCI or fibrinolytics.

QT interval as well as QT interval dispersion determination: QT interval was calculated at presentation and after repolarization either via means of primary PCI or fibrinolysis using the following formula. QT interval was determined by measuring the time between the U wave and the subsequent T wave if the U wave was present.

$$QTc = \frac{QT}{\sqrt{R - Rinterval}}$$

The QT interval difference (QTD) is calculated by subtracting the greatest (QTmax) QT interval from the shortest (QTmin) QT interval in a 12lead ECG. QTc interval dispersion is defined as the range between the shortest and longest QTc intervals. Evaluation of PCI and SK groups in patients with ST-elevation myocardial infarction with respect to baseline and clinical characteristics. Mean QT intervals for various arrhythmia types following PCI and SK therapy in patients with STEMI are compared. Quantitative thrombolysis and angioplasty (PCI/SK) treatment outcomes for ST-elevation myocardial infarction (STEMI) patients compared across MI Quantitative thrombolysis duration (QTD) mean values were compared between STEMI patients treated with PCI and SK using a paired t-test before and after the procedures. Patients in the study were monitored for arrhythmias and changes to the QT interval for 48 hours after the surgery.

Statistical analysis:

The data management and statistical analysis were performed using SPSS version 28. (IBM, Armonk, New York, United States). Quantitative data normality was examined using the Kolmogorov-Smirnov test and direct data visualisation techniques. Quantitative data were analysed by computing means and standard deviations or medians and ranges under the assumption of normality. The categorical data was broken down numerically and in percentage terms. Quantitative data from the two groups were compared with independent t-tests and Mann-Whitney U tests. The categorical variables were compared using a chi-square test. There was no two-way communication in any of the statistics. A p-value less than 0.05 was arbitrarily set as the threshold for statistical significance.

Results

There were no obvious distinctions between the two groups in terms of overall appearance. There was no significant difference between the two groups in terms of systolic blood pressure, diastolic blood pressure, resting heart rate, post-exercise heart rate, troponin positivity, thrombolytic cytokine positivity, platelet negativity, hemoglobin negativity, or the location of an ST-elevation myocardial infarction (STEMI).s. Regarding EF, the baseline was comparable, but the post EF was significantly higher in group II (46 ±6 vs.41 ±6 %, P < 0.001). **Table 1 and Figure 1**

Regarding QT segment characteristics: The PCI group demonstrated significantly higher percent change of max QT (-4.88 vs. -2.44%, P < 0.001), min QT (3.13 vs. 1.35%, P < 0.001), QTD (-33.3 vs. -2%, P < 0.001), max QTc (-5.85 vs. -2.56%, P <0.001), min QTc (3.34 vs. 1.02, P < 0.001), and QTcD (34.51 vs. 20%, P < 0.001). **Table 2**

Regarding post perfusion arrhythmia: Group I demonstrated higher premature ventricular contractions (33% vs. 22%), premature atrial contractions (8% vs. 3%), complete heart block (3% vs. 1%), paroxysmal AF (4% vs. 2%), ventricular tachycardia (20% vs. 12%), and ventricular fibrillation (14% vs. 8%) than group II but without statistical significance. **Table 3 and Figure 2**

Regarding QTD change according to perfusion method and site of infarction: In patients with anterior or inferior infarctions, the median percent change of QTD was significantly higher in those who underwent PCI (-33%) than in those who underwent SK (-21.43%) (P < 0.001). Additionally, in patients with lateral or posterior infarctions, the median percent change of QTD was significantly higher in those who underwent PCI (-37.05%) than in those who underwent SK (-16.67%) (P < 0.001). In patients who received SK, the median percent change of QTD was significantly higher in those with anterior or inferior infarction (-21.43%) than in those with lateral or posterior infarction (-16.67%) (P < 0.001). In contrast, in patients who underwent PCI, no significant difference was observed regarding QTD percent change between those with anterior or inferior infarction and those with lateral or posterior infarction. Furthermore, in the total patients, no significant difference was observed

in QTD percent change between those with anterior or inferior infarction and those with lateral or posterior infarction (P = 0.422). **Table 4 and Figure 3**

Table 1: General characteristics, Clinical and laboratory findings of the studied groups

	Group I (n = 100)	Group II (n = 100)	P-value
Age (years)	53 ±10	53 ±10	1.0
Sex			
Males	60 (60)	64 (64)	0.56
Females	40 (40)	36 (36)	
Hypertension	68 (68)	63 (63)	0.457
Diabetes	56 (56)	52 (52)	0.57
Hyperlipidemia	40 (40)	48 (48)	0.254
Smoking	56 (56)	60 (60)	0.567
BMI	29.9 ±3.7	29.2 ±4.3	0.202
Clinical and laboratory findings			
Systolic blood pressure	122 ±15	122 ±15	1.0
Diastolic blood pressure	78 ±9	78 ±9	1.0
Heart rate pre	79 ±8	80 ±12	0.323
Heart rate post	79 ±6	80 ±9	0.423
Total leucocyte count	14 ±3	14 ±3	0.264
Platelets	341 ±80	341 ±80	1.0
Hemoglobin	12 ±2	12 ±1	0.773
Anterior STEMI	44 (44)	48 (48)	0.570
Inferior STEMI	36 (36)	36 (36)	1.0
Lateral STEMI	12 (12)	8 (8)	0.346
Posterior STEMI	8 (8)	8 (8)	1.0
Ejection fraction pre	36 ±6	36 ±6	0.372
Ejection fraction post	41 ±6	46 ±6	<0.001

* Significant; Data were presented as mean ±SD or number (percentage)

Table 2: QT segment characteristics of the studied groups

	Group I (n = 100)	Group II (n = 100)	P-value
Max QT			
Pre	410 ±26	413 ±23	0.527
Post	398 ±27	392 ±21	0.076
% change	-2.44 (-8.43 - -1.14)	-4.88 (-9.09 - -2.53)	<0.001*
Min QT			
Pre	341 ±27	320 ±22	<0.001*
Post	343 ±26	331 ±22	<0.001*
% change	1.35 (-5.71 - 3.45)	3.13 (0 - 6.9)	<0.001*
QTD			
Pre	70 ±8	93 ±10	<0.001*
Post	55 ±8	60 ±11	<0.001*
% change	-20 (-7.14 - -42.86)	-33.33 (-19.05 - -50)	<0.001*
Max QTc			
Pre	468 ±14	475 ±33	0.057
Post	455 ±21	450 ±25	0.159
% change	-2.56 (-9.6 - 1.68)	-5.85 (-7.87 - -0.47)	<0.001*
Min QTc			

Pre	388 ±15	367 ±22	<0.001*
Post	392 ±20	381 ±20	<0.001*
% change	1.02 (-6.93 - 5.66)	3.34 (-1.08 - 8.89)	<0.001*
QTcD			
Pre	80 ±10	107 ±16	<0.001*
Post	63 ±10	70 ±14	<0.001*
% change	-20 (-9.2 - -44.32)	-34.51 (-2 - -49.43)	<0.001*

* Significant; Data were presented as mean ±SD, median (min-max), or number (percentage)

Table 3: Arrhythmia post perfusion in the studied groups

	Group I (n = 100)	**Group II (n = 100)**	**P-value**
Premature ventricular contractions	33 (33)	22 (22)	0.082
Premature atrial contractions	8 (8)	3 (3)	0.121
Complete heart block	3 (3)	1 (1)	0.621
Paroxysmal AF	4 (4)	2 (2)	0.683
Ventricular tachycardia	20 (20)	12 (12)	0.123
Ventricular fibrillation	14 (14)	8 (8)	0.175

Data were presented as number (percentage)

Table 4: QTD percent change according to perfusion method and site of infarction.

Infarction location	**Total (200)**	**Group I (n = 100)**	**Group II (n = 100)**	**P-value**
Anterior or inferior	27.27 (7.14 – 47.06)	-21.43 (-7.14 - -38.46)	-33.33 (-19.05 - -47.06)	<0.001*
Lateral or posterior	26.67 (14.29 – 50)	-16.67 (-14.29 - -42.86)	-37.05 (-26.67 - -50)	<0.001*
P-value	0.422	0.001*	0.470	

* Significant; Data were presented as median (min-max)

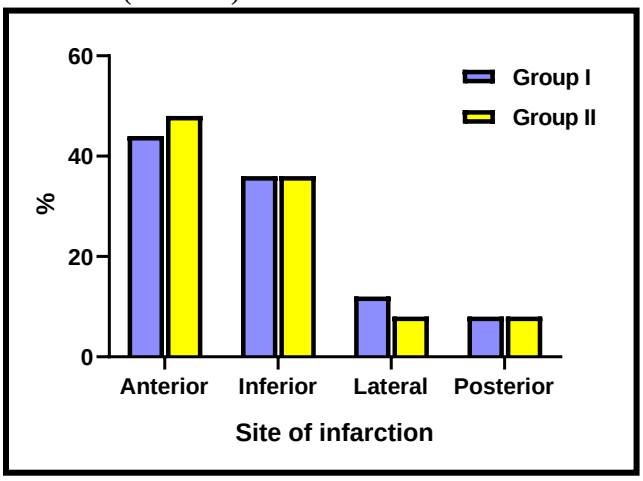

Figure 1: Site of infarction in the studied groups

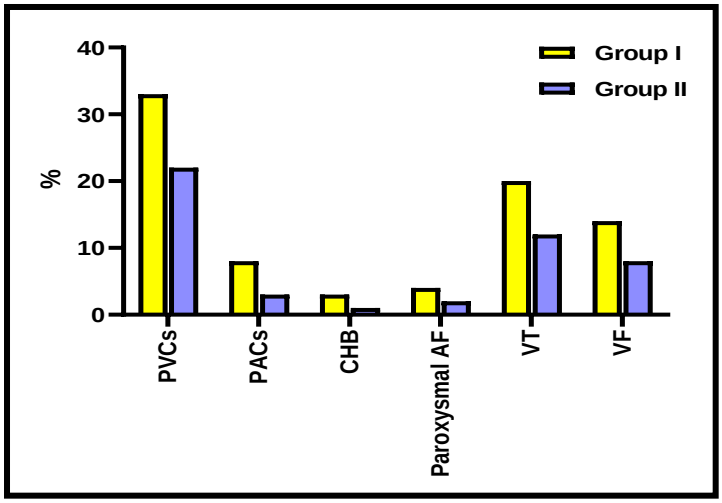

Figure 2: Arrhythmia post perfusion in the studied groups

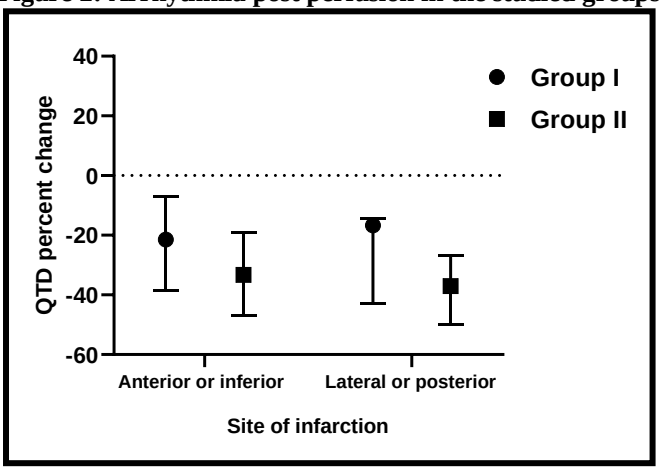

Figure 3: QTD percent change according to perfusion method and site of infarction.

Discussion

QT dispersion (QTd), (highest QT interval - minimum QT interval), was originally developed as an index of the spatial dispersion of ventricular recovery durations; QT interval (QT) indicates the duration of ventricular electrical activity, characterised by phases of depolarization and remoralization.(5).

There were no significant differences in STEMI incidence across the groups in this study (P=0.808). A case-control research indicated no statistically significant difference in MI location distribution between the fibrinolytic group and the PCI group, thus these results are consistent with that.(6).

Group II had a considerably greater post-test EF than Group I did (46.6% vs. 41.6%, P 0.001). Consistent with a previous study, the mean ejection fraction (EF) for PCI patients was 46.25 9.08, while it was only 42.48 11.11 for streptokinase patients (P=0.02). (6). In the modern era of therapy, cardiac remodelling following severe ST-elevation myocardial infarction has been observed. According to their findings, EF and LV volumes increased noticeably, with the most dramatic gains seen in the first month following PCI therapy.(7).

This study only assessed the effectiveness of primary PCI and thrombolytic therapy within a 90-minute window, but another study compared their effects on the Left Ventricular Ejection Fraction three months following STEMI. observed that the small sample size may explain why there was no significant difference between P-PCI and thrombolytic therapy in terms of EF at baseline (41% vs 42.6%) and 3 months' follow-up (50.2 % vs 50.3 %) (P = 0.05). (42 patients)(8).

In the current study The PCI group demonstrated significantly higher percent change of max QT (-4.88 vs. -2.44%, P=0.001), min QT (3.13 vs. 1.35%, P=0.001), QTD (-33.3 vs. -2%, P=0.001), max QTc (-5.85 vs. -2.56%, P: 0.001), min QTc (3.34 vs. 1.02, P=0.001), and QTcD (34.51 vs. 20%, P=0.001). This was similar to ***Bakr et al. (2020)*** stated that Compared to group II (SK), QTD and QTcD were both significantly shorter 24 hours post-treatment in group I (PCI) (53±19 vs. 60±18 msec, P=0.003 and 60±21 vs. 69+22 msec, P=0.004, respectively).

Additionally, a study found that the QTmax (P=0.001), QTc (P=0.001), QTd (P=0.003), and TPe (P: 0.008) values were significantly reduced after PCI therapies compared to thrombolytic therapy.(5).

QT and QTc dispersion were found to be significantly different between the fibrinolytic group and the PCI group before and after PCI and SK therapies, but this finding may have been attributable to the fact that the study in question measured QT and QTc dispersion more than 24 hours after reperfusion therapy.(6).

In the current study Group I demonstrated higher premature ventricular contractions (33% vs. 22%), premature atrial contractions (8% vs. 3%), complete heart block (3% vs. 1%), paroxysmal AF (4% vs. 2%), ventricular tachycardia (20% vs. 12%), and ventricular fibrillation (14% vs. 8%) than group II but without statistical significance.

This was similar to a study stating that there was no significant difference in frequency of ventricular arrhythmias VT, PVCs and VF (P: 0.575, P: 0.168, P: 0.875) between two groups after 48h follow up (7).

In contrast with a study showed that arrhythmias were significantly increased after thrombolytic reperfusion (38.3%) compared to after PPCI (10.8%) (P=0.001) may be due to including more patients and more types of arrhythmias (9).

In the current study patients with anterior or inferior infarctions, the median percent change of QTD was significantly higher in those who underwent PCI (-33%) than in those who underwent SK (-21.43%) ($P < 0.001$). Additionally, in patients with lateral or posterior infarctions, the median percent change of QTD was significantly higher in those who underwent PCI (-37.05%) than in those who underwent SK (-16.67%) (P=0.001).

This was consistent with a study that compared fibrinolytic treatment with primary percutaneous coronary intervention for the incidence of QTd and QTcD and arrhythmias. confirmed that patients with anterior and inferior myocardial infarction had significantly different QTd and QTcD values in the main PCI group compared to the fibrinolytic group (P=0.01 and P=0.03, respectively). (10).

In the current study regarding total patients, no significant difference was observed in QTD percent change between those with anterior or inferior infarction and those with lateral or posterior infarction (P=0.422). This was similar to with a study stating as Comparing PCI (P=0.88) and SK (P=0.81) among MI sites, no statistically significant QTD differences were observed.(6).

Although one study observed substantial changes in QTd and QTcD between the primary PCI group and the fibrinolytic group, this may have been due to a lack of patients with posterior or lateral myocardial infarction being included in the study.(10).

Conclusion

After reperfusion, QT and QTc interval dispersions were significantly reduced regardless of whether patients underwent primary PCI or thrombolytic treatment, as shown in the current study. QTD values were shown to decrease more in the primary PCI technique. Given that an elevated QT interval can lead to potentially life-threatening arrhythmia, and given that this study found a higher reduction rate with arrhythmia treated by primary PCI, and also significantly recovered cardiac function in PCI method, all of this could suggest the priority of this method over the thrombolytic therapy. Thus, QTD and QTcD are crucial arrhythmogenic parameters responding to reperfusion treatment in STEMI patients.

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