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Value of T peak-Tend/QT ratio in prediction of no reflow in acute ST elevation myocardial infarction

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ABSTRACT

Background: The key of acute ST-segment elevation myocardial infarction (STEMI) treatment is to restore myocardial perfusion as soon as possible. Direct percutaneous coronary intervention (PCI), as the most effective means of treatment, it can open up the infarct-related artery (IRA) as early as possible. However, in some cases, myocardial reperfusion cannot restore the myocardium to the optimal level, which is known as the 'no-reflow' phenomenon. Acute MI involves electrochemical and metabolic alterations of cardiac muscles, these changes have a complex effect on the duration of action potentials in the ischemic zone and ischemic border zone; thus, TPE and QT intervals display modestly compatible changes.Patients and methods: This cross sectional study was conducted on 100 patients with acute STEMI managed by PPCI who admitted Cardiology Department, Zagazig University Hospitals.All patients underwent medical history taking, clinical examination and ECG were done to all patients before procedure and after primary PCI to assess changes. Results: The incidence of Post procedure no reflow detect by TIMI flow<3 grade was 30.0%,significant longer post cQTand post cTPE duration in no reflow groupI,LAD as infarct related artery was significant and higher in noreflow group I,multivariate regression predictors of noreflow post PCI were post cTPE ≥112.5, diabetes mellitus, hypertension and smoking. Conclusion: The present study demonstrated that prolonged TPE interval is associated with reperfusion features in patients with STEMI, and that a prolonged post cTPE≥112.5 could be used as a marker for no reflow . It also should be noted that the presence of more frequent history of diabetes , hypertension and smoking were significant predictors of no reflow .

Keywords: TIMI; QT; cTPE

INTRODUCTION

ST elevation myocardial infarction (STEMI) generally results from intraluminal thrombus formation and occlusion of a ruptured or an unstable plaque The main goal of therapy in STEMI is to restore microvascular flow and sustain the myocardial perfusion . A variety of markers including ECG and coronary angiography have been utilized to assess myocardial reperfusion **[1]**. Acute MI involves electrochemical and metabolic alterations of cardiac muscles, these changes have a complex effect on the duration of action potentials in the ischemic zone and ischemic border zone; thus, TPE and QT intervals display modestly compatible changes**[2]**.

The aim of the present study to assess the relationship corrected QT interval &ratio of TPE/QT ratio and reperfusion in patients with ST-elevation myocardial

infarction (STEMI) who were treated with a primary percutaneous coronary intervention (PCI).

PATIENTS AND METHODS

This Cohort prospective study was conducted on 100 patients with acute STEMI managed by PPCI who admitted Cardiology Department, Zagazig University Hospitals.

Ethical considerations:

All participants' parents or relatives signed informed permission forms, and the study was given the green light by the Zagazig University Faculty of Medicine's research ethical committee. The study was conducted in conformity with the World Medical Association's Code of Ethics for Human Research (Declaration of Helsinki).

Inclusion criteria:

Patient with acute STEMI who meets the following criteria: Acute STEMI patients presented to the emergency unit within 12 hours of chest pain in the presence of following criteria were present: the presence of typical chest pain lasting ≥ 20 minutes; and either 1) ST-segment elevation of ≥ 2 mm in at least 2 contiguous precordial leads, or 2) ST-segment elevation of ≥ 1 mm in at least 2 limb leads, 3-) It was later confirmed by the elevation of myocardial enzymes (CK-MB or troponin) **[3]**.

Exclusion criteria

Patients have any of the followings:Patients with old MI or previous PCI, patients managed by thrombolytic therapy, patients with cardiomyopathies ,patients with chronic kidney or liver diseases and patients with structural heart disease**.**

Methods

This study included one hundred patients, 64 females and 36 males where their age ranged between 40 to 75 years, with acute STEMI who were presented to the emergency unit within 12 hours of chest pain when this criteria were present: the presence of continuous chest pain lasting ≥ 20 minutes; and either 1) ST-segment elevation of ≥ 2 mm in at least 2 contiguous precordial leads, or 2) ST-segment elevation of ≥ 1 mm in at least 2 inferior leads, 3-) It was later confirmed by the elevation of myocardial biomarker (CK-MB or troponin).

All patients underwent medical history taking,(Patients' data) were collected including demographic data as age , sex and special habits of Medical Importance (smoking ect.),risk factors for ischemic heart disease such as hypertension, diabetes mellitus, , previous history of myocardial infarction or CABG operations and PCI, clinical examination, cardiac enzymes ECG ; The TPE interval was measured from the lead that had the longest TPE interval to no ST-T wave change**[3].** QT intervals were measured in the electrocardiogram from the beginning of the QRS complex (whether it starts with a Q wave or an R wave) to the point at which the T wave returns to the isoelectric line. Because the QT and TPE intervals vary with heart rate, Bazett's formula (corrected index interval=index interval/√R–R) will

be applied to the QT and TPE intervals to determine corrected values of QT (cQT) and TPE (cTPE) intervals, ratio of cTPE/cQT ratio, respectivelyQT interval varies with heart rate **[3]** .According to post PCI TIMI patients were classified into patients with no reflow (TIMI <3 n=30) and patients with normal flow (TIMI 3 n=70).

Statistical analysis

Data analyzed using Microsoft Excel software. Data were then imported into Statistical Package for the Social Sciences (SPSS version 20.0) **(**Statistical Package for the Social Sciences) software for analysis. According to the type of data qualitative represent as number and percentage, quantitative continues group represent by mean ± SD, the following tests were used to test differences for significance; Difference and association of qualitative variable by Chi square test (X^2). Differences between quantitative independent groups by t test or Mann Whitney, P value was set at <0.05 for significant results &<0.001 for high significant result. We divided the cases into two groups according post PCI TIMI; no reflow (TIMI<3 (n=30) success reflow (TIMI 3 (n=70).

RESULTS

There were 10 aged below 60 in group I, 20 above 60, in group II 40 aged below 60, 30 above 60(P-value significant 0.02). There were 18 were female in group I, 12 were male, in group II 46 were female, 24 were male, (P-value significant 0.5). There were 23 with diabetes in group I, in group II 38 with diabetes , (P-value significant 0.03). There were 28 with hypertension in group I, in group II 50 with hypertension (P-value significant 0.01). There were 16 with Smoking in group I, in group II 18 with Smoking (P-value significant 0.008).**(Table 1)**.

In group I, the mean ckMB was 244±0.55, in group II was 123±0.74 (significant P-value 0.001). The mean troponin was 134±6.2, in group II was 112±4.9(P-value not significant 0.7) **(Table 2)**.

Pre TPE in group I was 122±5.9 while in group II was 105±5.1 (non significant p value0.4) .Post TPE in group I was 139.8±4.1 while in group II was 105.6±5.9(significant p value 0.001) .Pre QT interval was in group I 377.1±12.2 while in group II was 360.3±11.4(non significant p value 0.1).Post QT interval was in group I 388.4±12.2 while in group II was 374.3±11.4(non significant p value 0.1). Pre c QT interval was in group I 399.4±31 while in group II was 378.4±27.6(non significant p value 0. 2). post c QT interval was in group I 422.1±22.7 while in group II was 388.3±21.2(significant p value 0.04). Pre cTPE was in group I 124.4±13.8 while in group II was 105 (non significant p value 0. 3).Post cTPE was in group I 138.3±5.7 while in group II was 117.6±8.5 (significant p value 0.03). Pre cQT/c TPE ratio was in group I 3.21±0.12 while in group II was 3.5±0.13(non significant p value 0.7).Post cQT/c TPE ratio was in group I 3±2.1 while in group II was 3.4±0.1 (non significant p value 0.8**) (Table 3).**

T wave change (pre) was tall peaked 6 (20%) in group I ,20 (28.8%) in group II. Negative was 16 (53.3%) in group I, 24 (34.3%) in group II. Isoelectric was 2 (6.7%) in group I, 18 (25.7%) in group II . Biphasic was 6 (20%) in group I, 8 (11.4%) in group II (P-value not significant 0.06). T wave change (post) was tall peaked 4(13.3%) in group I, 4 (5.7%) in group II. Negative was 24 (80%) in group I, 40 (57.14%) in group II. Isoelectric was 0 in group I, 2 (2.9%) in group II. Biphasic was 2(6.7%) in group I, 24 (34.3%) in group II (P-value 0.017) **(Table 4)**.

ROC Curve to detect the best cut-off value of Post cTPE intervals in the prediction of post PCI no reflow of Acute STEMI patients detect via Post TIMI . Area under curve (AUC) 0.832 **(Figure 1).** ROC Curve to detect the best cut-off value of Post cQT intervals in the prediction of post PCI no reflow of Acute STEMI patients detect via Post TIMI . Area under curve (AUC) 0.943 **Figure (2).** Postc TPE; cutoff was ≥112.5, sensitivity 71.67%, specificity 66.57%, AUC =0.832, PPV=51.75,NPV=77.97, post cQT; cutoff was ≥402.5, sensitivity 77.33%,specificity 69.86%p value 0.001,AUC=0.943 ,PPV=55.83,NPV=87.62 **(Table 5).**

Infarct related artery (IRA), LAD was 22(73.3%) in group I while was34(48.5%)in group II (significant p value 0.02), RCA was2(6.7%) in group I while it was 25(35.7%) in group II (non significant p value 0.7), LCX was 6(20%) in group I while it was 11(15.7%) in group II (non significant p value 0.1) **(Table 6).**

Post PCI MBG, was in group I 5 (16.7%), while in group II was 63(90%)(significant p value 0.001) **(Table 7**).

Univariate regression of independent predictors of no reflow were age more than 60yeas , hypertension ,diabetes, smoking, cutoff post cTPE≥112.5, ,CKMB,then after step wise multivariate logestic regression we found that predictors of noreflow were smoking,diabetes,hypertension cut off of post cTPE**(Table 8).**

There was Positive significant correlation between Post cTPE and CKMB (r=0.2 p=0.003)(**Figure 3).**

Table (1): Demographic Data of Patients with No-Reflow and Success Reflow post PCI TIMI:

	Post PCI TIMI				n.	χ^2	p-value
	Group I n.30		Group II n.70				
	No.	%	No.	%			
Age							
≤60 years	10	33.3	40	57.1	50	4.8	0.029
>60years	20	66.7	30	42.9	50		(S)
Sex							
Females	18	60	46	65.7	64	0.29	0.58
Males	12	40	24	34.3	36		
Diabetes							
Yes	23	76.7	38	54.3	61	4.4	0.035
No	7	23.3	32	45.7	39		(S)
Hypertension							
Yes	28	93.3	50	71.4	78	5.9	0.015
No	2	6.7	20	28.6	22		(S)
Smoking							
Smoker	16	53.3	18	25.7	34	7.1	0.008
Non smoker	14	46.7	52	74.3	66		(S)

χ 2 Chi square test t test of significant f=Fisher exact test (S)=significant p<0.05

Table (2): laboratory data in the study groups :

Variable	Group I (n.30)	Group II (n.70)		P
Ck MB	244±0.55	123±0.74	T 5.2	0.001
Troponin	134±6.24	122±4.9	t 3.4	0.7

Table (3) : Electocardiographic data in the study groups:

Variables	Post PCI TIMI		T	P
	Group I (n.30)	Group II (n.70)		
Pre TPE	122±5.9	105 ±5.1	0.848	0. 498
Post TPE	139.8±4.1	105.6±5.9	3.66	.0001** (HS)
Pre QT interval	377.1±12.2	360.3±11.4	1.46	0.149
Post QT interval	388.4±10.6	374±8.3	1.74	0.386
Pre CQT	399.4±31	378.4±27.6	1.13	0.260
Post CQT	422.1±22.7	388.3±21.2	0.058	0.0453*
Pre Ctpe	124.4±13.8	105.9±10.8	2.14	.35
Post Ctpe	138.3±5.7	117.6±8.5	3.9	.03
Pre cQT/c TPE ratio	3.21±0.12	3.5±0.13	0.32	.748
Post cQT/c TPE ratio	3±2.1	3.4±0.1	0.5	0.8

Table (4) T wave changes pre and post PCI:

Variable	Group I (n.30)	Group II (n.70)		x2	P
T wave change(pre)					
Tall peaked Positive	6(20)	20(28.6)	26	7.4	0.06
Negative	16(53.3)	24(34.3)	40		
Isoelectric	2(6.7)	18(25.7)	20		
Biphasic	6(20)	8(11.4)	14		
T wave change(post)					
Tall peaked Positive	4(13.3)	4(5.71)	8	10.5	*0.017(S)*
Negative (-)	24(80)	40(57.14)	64		
Isoelectric	0(0.0)	2(2.9)	2		
Biphasic	2(6.7)	24(34.3)	26		

Table (5) : post cTPE,post cQT sensitivity ,specificity,PPV,NPV, Accuracy:

Cut off	Sensitivity	Specificity	PPV	NPV	Accuracy	P	AUC
Post cTEP ≥ 112.5	71.67%	66.57%	51.75%	77.97%	61%	0.001	0.832
Post cQT ≥ 402	77.33%	69.86%	55.83%	87.62%	68%	0.0001	0.943

PPV=Positive predictive value, NPV= negative predictive value, AUC=Area under curve

Table (6) show IRA in the study groups:

	Group I n.30		Group II n.70		n.	χ^2	p-value
	No.	%	No.	%			
(IRA)							
LAD	22	73.3	34	48.5	54	3.9	*0.026*
RCA	2	6.7	25	35.7	40	0.4	0.7
LCX	6	20	11	15.7	17	0. 3	0.1

IRA: Infarctrelatedartery, LAD:left anterior descending, RCA:right coronary artery, LCX:left circumflex

Table (7) : Incidence of MBG flow basal and post PCI among studied groups:

Post PCI MBG	Group I		Group II		P
	n.30	%	n.70	%	
Post MBG 3	5	16.7	63	90	0.001**

Table (8): Univariate regression,multivariate regression of predictors of no reflow detected by post PCI TIMI<3:

Parameter	Univariate analysis 95%CI (upper, lower bond) , OR, P value				Multivariate analysis 95%CI (upper, lower bond) , OR, P value			
	Lower	upper	OR	P value	Lower	Upper	OR	P value
Age	1.038	1.13	1.07	0.009	1.013	1. 481	1.048	0.07
Smoking	2.663	7.39	4.43	<0.001	1.455	5.676	2.874	0.002
HTN	2.54	8.04	4.52	<0.001	2.065	14.181	5.411	0.001
DM	3.36	6.09	3.65	<0.001	2.362	6.088	5.5	0.035
CKMB	4.54	5.89	4.5	0.003	1.542	3.61.232	5.2	0.823
LAD	2.67	6.56	3.21	0.098	-	-	-	-
Cutoff postcTPE ≥112.5	1.46	3.28	3.2	0.001	1.56	3.87	4.2	0.001
Cutoff post cQT≥402	3.43	4.9	3.9	0.07	-	-	-	-

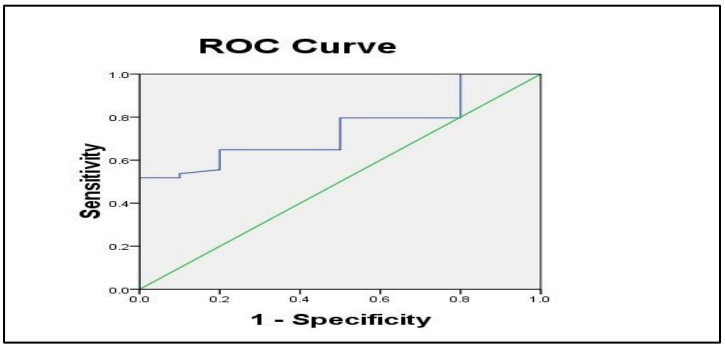

Figure (1) : ROC curve of post cTPE

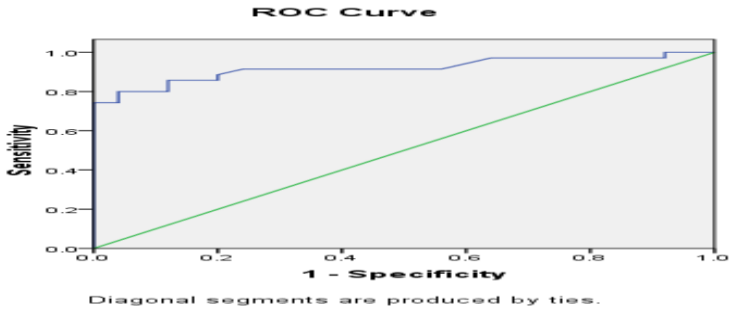

Figure (2) ROC curve of post cQT

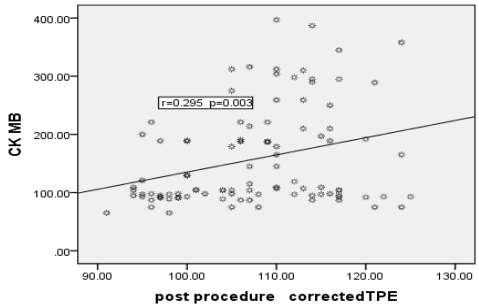

Figure (3): Scatter dot of +ve correlation between post cTPE and CKMB

DISCUSSION

In acute ST-segment elevation myocardial infarction (STEMI), primary percutaneous coronary intervention (PPCI), and stent implantation are the first choice of treatment **[4].** However, earlier studies demonstrated a high incidence of coronary slow/ no-reflow in 1-40% of the patients that may be associated with stoppage of myocardial perfusion restoration, whereby patients continued to suffer from the severe impairment **[5].** No reflow is recorded in large registries based on thrombolysis in myocardial infarction (TIMI) flow grade, myocardial blush grade, ST resolution myocardial contrast echocardiographyand cardiac magnetic resonance imaging that assessed microcirculatory dysfunction **[6].**

Acute MI involves electrochemical and metabolic alterations of cardiac muscles, these changes have a complex effect on the duration of action potentials in the ischemic zone and ischemic border zone; thus, TPE and QT intervals display modestly compatible changes**[2]**.

Our study aimed to get association between corrected QT interval, TPE interval TPE/QT and no reflow status among STEMI patients after PCI.

Regarding demographic data, there was statistical significant difference between the study groups regarding age ,HTN,DM and smoking with higher percentage in favour of group I. This was concordant with **Re fat et al. [7]** found significant difference regarding hypertension , diabetes, age but smoking wasn't significant in his study.

Regarding laboratory data, it was revealed that there was statistically significant higher values of CKMB in group I. This was concordant with **Mayr et al. [8]** who found significantly elevated CK following PCI in those later confirmed to have microvascular obstruction.

Regarding ECG parameters ; there was statistically significant higher post TPE in group I , post cTPE was significantly higher in group I, post cQTwas significantly higher on group I this was cordant with **Çağdaş et al. [3]** who found significant TPE, cTPE post intervention while QT in his study wasn't significant. Unfortunately ,Ratio of pre and post QT\TPE ,c QT\TPE weren't significant in our study,it was discordant with **Wang et al. [9]** found significant difference in his study groups ($p < 0.001$) it may be due to near mean value between our study groups, his larger sample size 316 in each groups.

Interestingly; there was positive correlation between post procedure cTPE and and CKMB(r=p.2, p=0.003)this was concordant with **Çağdaş et al [3]** who found (r=0. 40,p=<0.001) in his study.

Regarding IRA; There was statistical significant difference between the study groups regarding only LAD, with higher percentage70% in no reflow .This was concordant with **Celık et al.[10]** who observed that the LAD was the most common IRA in both study groups where in reflow group 46 % with LAD.

There was a statistical significant difference regarding Post PCI MBG3 which was higher in group II, this was concordant with **Refaat et al. [7]** who found significant difference in his study groups with higher MBG3in group of normal flow TIMI 3in his study.

In the current study, after univariate regression a step wise multivariate regression found that no reflow predictors were hypertension, diabetic patients, smokers, post cTPE≥112.5.This agree with the fact that patients with no reflow had more frequent risk factors for noreflow development , history of HT, DM, and smoking in the present study. These factors may have contributed to the expansion of the infarct size and thus the prolongation of the TPE interval. Finally, the association of prolonged TPE interval with hypertension and diabetes could not only be explained by these being risk factors for NR but also by the results of recent studies which demonstrated that hypertension and diabetes could cause prolongation of TPE interval in patients without acute medical illness **Tokatlı et al.[11] Demir et al.[12]**. Also, in agreement with **Çağdaş et al. [3]** who found that post cTPEwas significant predictor in his study in addision to age, symptoms to ballon time.

CONCLUSION

The present study demonstrated that prolonged TPE interval is associated with reperfusion features in patients with STEMI, and that a prolonged post cTPE≥112.5 could be used as a marker for no reflow . It also should be noted that the presence of more frequent history of diabetes, hypertension and smoking were significant predictors of no reflow.

No conflict of interests.

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