

EVALUATION OF T Peak–T End (Tp-Te) INTERVAL REDUCTION AS A PREDICTOR OF SUCCESSFUL FIBRINOLYSIS IN PATIENTS WITH ACUTE ST SEGMENT ELEVATION MYOCARDIAL INFARCTION. A CROSS SECTIONAL STUDY.

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Abstract:

Background: Acute ST-segment elevation myocardial infarction (STEMI) is a life-threatening emergency requiring rapid diagnosis and treatment. Timely treatment with fibrinolytic drugs can restore blood flow to the heart, minimize tissue damage, preserve heart function, and improve survival rates. The dispersion of electrical activity during heartbeats (repolarization) is affected by the size of the damaged area. Understanding the relationship between the Tp-Te interval (a specific ECG measurement) and fibrinolysis success could be clinically valuable.

Objective: This study aimed to assess the Tp-Te interval as a predictor of successful fibrinolysis in patients with acute STEMI.

Methods: The study included 110 consecutive patients with acute STEMI admitted to a cardiology department between April 2020 and March 2021. Patients were divided into two groups based on fibrinolysis outcome (successful vs. failed). Standard electrocardiograms (ECGs) were obtained before and 30 minutes after treatment. A $\geq 50\%$ reduction in ST-segment elevation on the ECG was considered successful fibrinolysis. Changes in the Tp-Te interval between the two ECGs were compared between the groups.

Results: Among 110 patients, 65 had successful fibrinolysis (Group A) and 45 had failed treatment (Group B). Baseline Tp-Te intervals were similar between groups. However, 30 minutes after treatment, Tp-Te significantly decreased in Group A compared to Group B. A change in Tp-Te (Δ Tp-Te) of 19 milliseconds was identified as a potential indicator of successful fibrinolysis.

Conclusion: This study suggests that a greater reduction in the Tp-Te interval after fibrinolysis is associated with successful treatment in acute STEMI patients. A Δ Tp-Te of 19 ms might be a useful parameter for assessing fibrinolysis success.

Keywords: Myocardial infarction, Tp-Te interval, Fibrinolysis

Introduction:

Cardiovascular disease (CVD) is a growing concern, particularly in low- and middle-income countries (LMICs) like Bangladesh. Risk factors for CVDs are prevalent, especially in urban areas. While aging plays a role, urbanization likely influences dietary habits and physical activity levels [1]. STEMI is a life-threatening condition caused by a complete blockage in a coronary artery. This blockage typically results from a plaque rupture and subsequent blood clot formation [2]. Prompt diagnosis and treatment are crucial for optimal outcomes. This study focuses on STEMI patients in Bangladesh. We investigate the T peak-T end interval (Tp-Te) as a potential marker for successful fibrinolytic therapy, a common treatment for STEMI. Fibrinolysis aims to dissolve the clot and restore blood flow to the heart muscle [3, 4]. Traditionally, assessing successful reperfusion has relied on methods like ST-segment resolution, which may lack precision [5, 6]. Tp-Te reflects repolarization dispersion, a phenomenon linked to arrhythmias and sudden cardiac death in STEMI patients [7]. Studies suggest failed thrombolysis increases mortality and worsens heart function [8]. Therefore, readily available bedside tools to assess reperfusion success are valuable. Tp-Te interval, easily measured on an electrocardiogram (ECG), has been proposed as a marker for arrhythmia risk in various conditions, including myocardial infarction [9]. Recent studies suggest Tp-Te and its ratio with the QT interval (Tp-Te/QTc) might indicate myocardial perfusion [10]. However, their role in evaluating fibrinolytic therapy in Bangladeshi STEMI patients remains unexplored. **Our aim:** To investigate whether changes in Tp-Te interval before

and after fibrinolysis can serve as a novel marker for successful reperfusion in acute STEMI patients in Bangladesh.

Materials & Methods:

This study was conducted at the department of cardiology, Sir Salimullah Medical College & Mitford Hospital, Dhaka. Patients included in this study had acute ST elevation myocardial infarction (STEMI) and admitted in hospital within 12 hours of onset of the symptoms. Exclusion patients with ventricular fibrillation, ventricular tachycardia, LBBB, total AV block, pacing rhythm, or pre-excitation, chronic heart failure, valvular heart disease, congenital heart disease, electrolyte disturbances and contraindications to thrombolytics, past drug history amiodarone and digitalis, duration of QRS more than 120 msec and T-wave in the ECG difficult to assess were excluded. Ethical clearance for the study was obtained from the institutional ethical review committee of Sir Salimullah Medical College & Mitford Hospital, Dhaka. Sample size of this study was one hundred and ten. The study protocol included a detailed history taking regarding age, onset, duration of symptoms, associated medical problem and complaints related to any complications. A thorough clinical examination including general physical examination, relevant investigations were conducted meticulously. Out of 200 consecutive cases of ASTEMI 110 were included. Informed written consent from the patients were taken from all.

ECG Recording:

ECG recording was conducted using a standard 12 lead ECG with a speed of 25 mm / sec and gain of 10 mm/mV by using standard ECG system (CardiofaxV model 9320, Nihon Kohden, Tokyo, Japan), by medical or paramedical personnel at the Department of cardiology of SSMC Hospital in accordance with the standard operating procedures. Patients having acute ST-segment elevation of ≥ 1 mm in at least 2 limb leads or ST-segment elevation of ≥ 2 mm in ≥ 2 contiguous precordial leads were included in this study. After administration of streptokinase, ECG was done at 30 minutes to see whether ST segment resolution occurs or not. ST segment resolution was set as 50 % or more fall of elevated ST segment from baseline value within 90 minutes of starting streptokinase. On the basis of reperfusion the study population were divided into two groups: Group-A Successful fibrinolysis after streptokinase therapy as assessed by ST segment resolution $\geq 50\%$. Group-B Failed fibrinolysis after streptokinase therapy as assessed by ST segment resolution $< 50\%$. Acute anterior wall myocardial infarction was defined as ST-segment elevation in V1-V3 or V1-V6 leads, whereas inferior & lateral wall myocardial infarction defined as ST-segment elevation in Lead II & III, aVF, and Lead I, aVL, V5-V6 leads.

Tp-Te Interval Measurement: Tp-e was measured from T-peak to T-end. Tp-Te measurements were performed on precordial leads. Measurements were done using standard ECG at V5, V4 and V6 lead.

T wave with low voltage < 0.1 mV was not analyzed. Then Tp-Te interval measurements were correlated with outcome of fibrinolysis therapy (Successful & Failed)

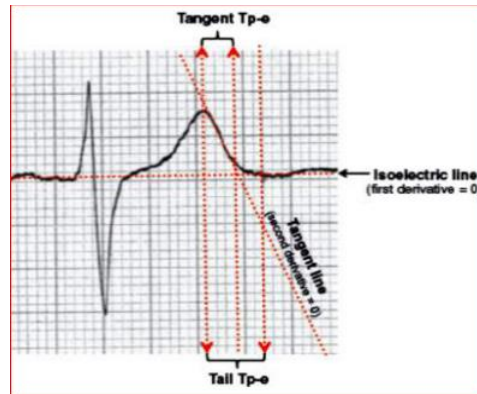


Figure 1: Measurement of the Tp-Te interval

(Source: Eriksson et al., 2012)

Results:

There were a total of 200 respondents involved in this study and the overall response rate 110(55%). All these respondents were with acute ST elevated myocardial infarction and had registered at the Department of Cardiology, Sir Salimullah Medical College & Mitford Hospital, Dhaka. After fulfilling inclusion and exclusion criteria 110 STEMI patient were selected for the study. The table -i indicates that Patients with failed fibrinolysis (group B) were generally older than the patients with successful fibrinolysis (group-A) (54.18 ± 10.11 vs. 51.54 ± 10.12 , $p=0.43$). However the difference in mean age between the two groups was not statistically significant. In both groups, there was male predominance, however, the difference in gender between the two groups was not statistically significant ($p=0.76$). This table also provides that among the study patients, male patients were 80 (72.78%) and female patients were 30(27.22%). Among the traditional risk factors for CAD, smoking, diabetes mellitus, hypertension, family history of CAD and obesity, presented in the above table did not differ significantly between two groups. Only dyslipidemia was found significantly higher in group B than group A. Time between symptom onset and initiation of thrombolytic therapy was more in group -B (4.8 ± 2.30) hours then group-A (3.4 ± 1.53) hours. Group comparison was not statistically significant ($p > .05$). Infarct location was related to fibrinolysis that was significantly successful in group – A then group –B. In Table iii the t-test was statistically significant, with mean Tp-Te interval- 30 minutes after fibrinolysis group-A ($M= 89.34$, $SD= 34$) was significantly lower. In table 1V compare the mean Tp-Te interval changes of group-A ($n=65$) & group – B ($n=45$) was significant. In figure 1 the receiver-operator characteristic curve analysis revealed that Tp-Te interval changes ($\Delta Tp-Te$) 19 msec was a strong indicator to success of fibrinolysis with an area under the curve of 0.711.

Table 1 Sample characteristics

Total	110		
	Group-A	Group-B	P-Value
Male/Female	3.33 : 1	2 :1	0.76 ^{ns}
Age	51.54±12.60 yr.	54.18±10.11yr	0.43 ^{ns}
Risk Factors ((%)			
Smoking	55.4	55.6	
Hypertension	61.5	53.3	0.088 ^{ns}
Diabetes mellitus	43.07	33.33	0.06 ^{ns}
Family h/O CAD	41.5	37.80	0.215 ^{ns}
Dyslipidemia	58.46	71.11	0.013 ^s
Obesity	14.1	17.77	0.74 ^{ns}
Infract location (%)			
Anterior	40	80	
Inferior	38.46	13.33	
Lateral	21.54	6.67	

Table II: Comparison of the study subjects according to time between symptom onset and initiation of thrombolytic therapy (N=110)

Groups	Symptom onset	In hours	p-value
	Number(n)	Mean±SD	
Group-A	65	3.4±1.53	
Group-B	45	4.8± 2.30	0.06 ^{ns}

Table III: Tp-Te interval comparison before fibrinolysis and 30 minute after fibrinolysis based on the success of fibrinolysis (N=110).

Table IV: Comparison of Tp-Te interval changes (Δ Tp-Te) based on the outcome of fibrinolysis (N=110).

Tp- Te interval status	Group –A (N=65)	Group –B (N=45)	p-value
Tp- Te interval before fibrinolysis(mean \pm SD)	120.53 \pm 53msec	116.48 \pm 19.12msec	0.36 ^{ns}
Tp- Te interval 30 minutes after fibrinolysis(mean \pm SD)	89.34 \pm 34msec	101.44 \pm 24.89msec	<0.024 ^s

Δ Tp-Te interval before fibrinolysis and 30 minutes after fibrinolysis			
	Number (n)	Mean \pm SD	p-value
Group –A	65	31.21 \pm 39.63msec	<0.001 ^s
Group –B	45	15.04 \pm 28.50msec	

Table V: Comparison of successful & failed fibrinolysis as measured by Tp –Te interval changes & ST segment resolution (N=110).

Tpeak-Tend interval	ST segment resolution		Total
	Yes(successful)	No (failed)	
Reduced(Successful)	50	10	60
Not reduced(failed)	15	35	50
Total	65	45	110

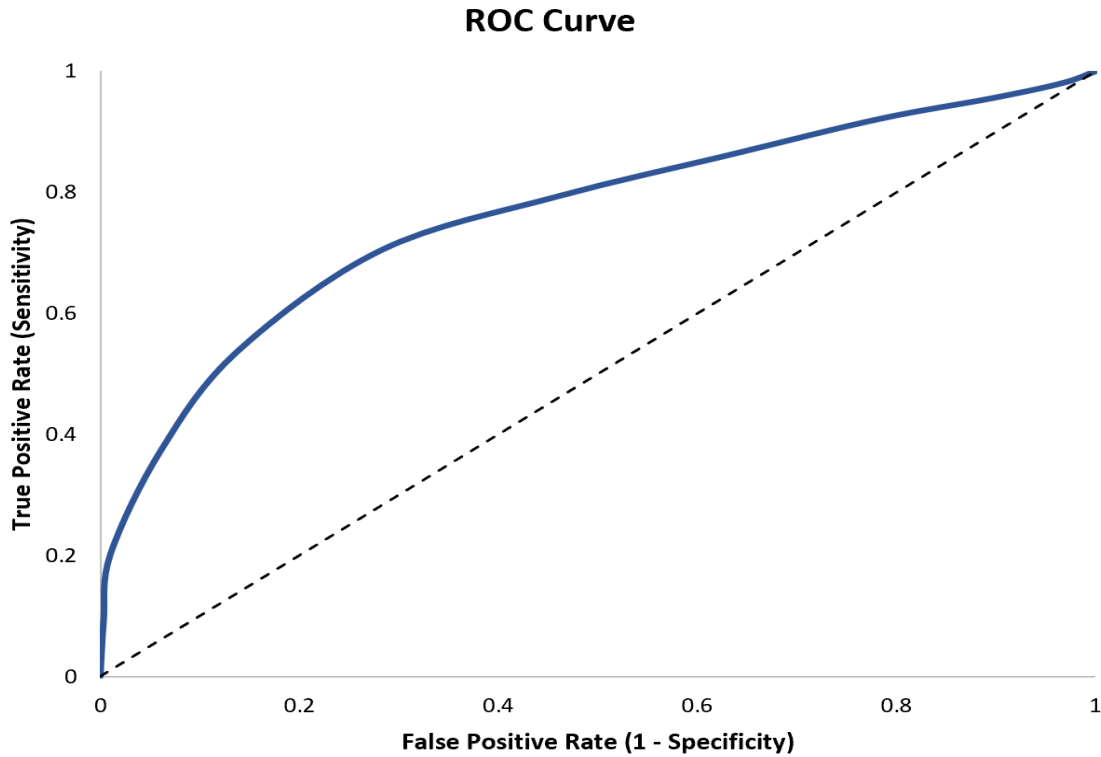


Fig. 1: Receiver – operator characteristic curve (ROC) analysis of Δ Tp-Te at 30 minutes predicting to success of fibrinolysis

Area	Std. Error	Asymptomatic Sib	Asymptomatic 95% Confidence Interval	
			Lower Bound	Upper Bound
0.711	0.063	0.057	0.607	0.815

Discussion:

This study aimed to evaluate Tp-Te interval as a predictor of successful fibrinolysis in acute STEMI patients. We enrolled 110 patients from April 2020 to March 2021. Baseline characteristics, including age, gender, and traditional CAD risk factors, were similar between successful (Group A) and failed fibrinolysis (Group B) groups, except for dyslipidemia. Group B had a higher prevalence of dyslipidemia compared to Group A, which aligns with established

knowledge of dyslipidemia as a CAD risk factor [11]. Interestingly, smoking rates were high in both groups, highlighting a crucial target for preventive measures. Time from symptom onset to fibrinolysis initiation did not significantly differ between groups. Tp-Te Interval and Fibrinolysis Success consistent with previous research [8, 12], both groups exhibited prolonged Tp-Te intervals before fibrinolysis. This finding suggests Tp-Te may reflect electrical abnormalities associated with STEMI. Importantly, 30 minutes after receiving fibrinolysis, the Tp-Te interval significantly decreased in Group A (successful) compared to Group B (failed). This aligns with other studies showing a decrease in Tp-Te after successful reperfusion with PCI or fibrinolysis [9, 14]. This decrease likely reflects improved electrical stability due to reperfusion [13]. Notably, our study found that a change in Tp-Te interval (Δ Tp-Te) of 19 milliseconds at 30 minutes post-fibrinolysis may be a potential indicator of successful reperfusion. This study has limitations. The sample size was modest, and further research with larger cohorts is needed. Additionally, long-term outcomes were not assessed. Future studies could explore the association of Δ Tp-Te with mortality and other clinical outcomes. This study suggests that a greater reduction in Tp-Te interval after fibrinolysis is associated with successful reperfusion in acute STEMI patients. A Δ Tp-Te of 19 milliseconds at 30 minutes might be a valuable parameter for assessing fibrinolytic therapy success. Further investigation with larger cohorts and long-term outcome evaluation is warranted.

Conclusion:

- There was a greater reduction of Tp-Te interval in acute STEMI patients with successful fibrinolysis compared to failed fibrinolysis.
- Δ Tp-Te value of 19 msec can be used as a cut off value.
- So it may be used as a parameter of successful fibrinolysis.

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