Al Ameen J Med Sci 2025;18(2):146-152 ● US National Library of Medicine enlisted journal ● ISSN 0974-1143

ORIGINAL ARTICLE CODEN: AAJMBG

A cross sectional study on thrombolysis in ST elevation myocardial infarction and its assessment with respect to ST segment resolution and time delay

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Received: 05th November 2024; ***Accepted:*** 19th March 2025; ***Published:*** 01st April 2025

Abstract: *Background:* ST elevation myocardial infarction is a leading cause of death in India. Several socio-economic factors lead to delay in seeking thrombolysis. *Aims and Objectives:* To analyse the effect of time delay on the success of thrombolysis. To study the influence of the anatomical location and risk factors like diabetes mellitus, hypertension, dyslipidemia, and smoking on the success of thrombolysis. *Materials and Methods:* It was a cross-sectional study conducted at Shifaa Hospital, Bangalore, over 12 months among 100 patients. The time delay in initiation of thrombolysis was recorded. Post thrombolysis ECG was compared for ST segment resolution. *Results:* The mean delay in thrombolysis was 12.1 hours, with an overall success rate of 51%. The success rates in patients with time delay of less than 3 hours, 3-6 hours, 6–12 hours, and more than 12 hours were 93.1%, 92.3%, 55.6%, and 5%, respectively (p value 0.0001). We found that 58.6% of patients with DM (p value 0.02) and 62.5% of patients with HTN (p value 0.009) had failed thrombolysis. *Conclusions:* Earlier initiation of thrombolysis increases the success rate of thrombolysis. Diabetes mellitus and hypertension lead to significant failure of thrombolysis.

Keywords: STEMI, ECG criteria, Time delay, Streptokinase

Introduction

Acute myocardial infarction (AMI) results from myocardial cell necrosis caused by an imbalance between oxygen supply and demand. Acute ST elevation myocardial infarction (STEMI) occurs when blood flow to coronary arteries decreases abruptly after a complete thrombotic occlusion of a coronary artery previously affected by atherosclerosis. Despite advances in diagnosis and management, STEMI remains a major public health problem in the industrialised world and is on the rise in developing countries, including India [1]. Chest pain at rest is the cardinal symptom of AMI, but breathlessness, vomiting, and syncope can also occur. A painless or silent AMI can occur, particularly in patients with diabetes mellitus and the elderly population. A diagnosis of STEMI is made when the ECG shows a new ST segment elevation at the J point in at least two anatomically contiguous leads. The anatomical location of STEMI can be identified using a 12-lead ECG. The presentation and outcome can also vary depending on the anatomical location of AMI, such as anterior wall myocardial infarction (AWMI), inferior wall myocardial infarction (IWMI), and posterior wall myocardial infarction (PWMI).

The major risk factors for STEMI arediabetes mellitus (DM), hypertension (HTN), dyslipidemia (DLP) and smoking. These risk factors frequently complicate successful thrombolytic therapy and influence long-term outcomes. All patients with STEMI should receive coronary reperfusion therapy in the form of primary percutaneous coronary intervention (PCI) or thrombolysis. Primary PCI is the preferred treatment if it can be initiated in a timely manner [3]. However, many patients in India are given fibrinolytic therapy due to the limited number of centres offering primary PCI. Hence, fibrinolytic therapy is used if the time from first medical contact to performing primary PCI is

anticipated to exceed 120 minutes. Streptokinase was the first thrombolytic agent with mortality benefits and continues to be the agent used in many centres across the world.

In resource-limited countries like India, streptokinase continues to be widely used as a thrombolytic agent even in 2025, despite the availability of more effective alternatives like tenecteplase. This is primarily due to cost constraints and accessibility issues in public healthcare settings. ST segment resolution is a useful marker of successful thrombolysis and relates to clinical outcome. Successful thrombolysis is generally associated with resolution of chest pain and resolution of at least > 50% of ST elevation in the ECG. Since myocardial infarction progresses over several hours, many patients present while salvageable myocardium remains. Timely intervention can significantly improve outcomes by preserving cardiac function. Factors such as lack of knowledge of symptoms, self-treatment,andthe unavailability of rapid transport, especially in rural areas, lead to delayed hospitalisation.

The present study aims to analyse the importance of the time interval between the onset of chest pain and the initiation of thrombolysis and its outcome with respect to ST segment resolution. Additionally, the impact of the anatomical location of AMI and risk factors such as DM, HTN, DLP, and smoking on the outcome of thrombolysis was studied.

Material and Methods

Study Area: The study was conducted at Shifaa Hospital, Bangalore.

Study Duration: The study was conducted for a period of 12 months from June 2022 to May 2023.

Study Population: The study was conducted in patients diagnosed with STEMI at Shifaa Hospital, Bangalore.

Study Design: It was an observational cross-sectional study.

Inclusion Criteria:

- Patients who were diagnosed with acute STEMI in the age group of 25-85 years.
- Patients presented within 12 hours of symptom onset or beyond 12 hours with persistent chest pain and ST segment elevation will be included in the study.
- A diagnosis of STEMI was made when ECG showed a new ST segment elevation at the J point in two anatomically contiguous leads with the following criteria: ≥ 1 mm inall leads except V2 and V3. In leads V2 and V3, the cut off points are ≥2 mm ST elevation in men ≥ 40 years, ≥2.5 mm in men < 40 years, or ≥ 1.5 mm in women.

Exclusion Criteria:

- Patient with NSTEMI.
- Patients with previous AMI.
- Patients with LBBB.

Methodology:

- In patients presenting with symptoms of AMI, STEMI and anatomical location were identified based on ECG criteria. The height (in mm) of ST segment elevations was measured.
- All patients in the study received Streptokinase 1.5 million units in 100 ml of normal saline over60 minutes.
- The time delay between the onset of chest pain and the initiation of thrombolysis was recorded along with risk factors such as diabetes mellitus, hypertension, dyslipidemia, and smoking.
- A repeat ECG was taken 90 minutes after the completion of the thrombolysis, and ST segment elevation was compared with the initial ECG.

Criteria for the success of thrombolysis:

- More than 50% decrease in ST segment elevation in a lead with maximum initial ST segment elevation.
- The decrease in ST segment elevation will be measured 90 minutes after the initiation of thrombolysis.
- Based on the above criteria, patients are grouped into
  Successful: >50% ST segment resolution.
  Unsuccessful: <50% ST segment resolution.

Sample Size: According to a study by Dr. Karthik et al [2] 2020, the success of thrombolysis was 69% in their study. Assuming this rate with a 95% confidence interval and 10% precision, the required sample size is 83. The following formula was used to derive the sample size.

$$n = \frac{(1.96)^2 p(1-p)}{d^2}$$

Where p is prevalence (=0.69) and d is the precision (=0.10). Sample size was increased from 83 to 100 to improve the statistical power of the study.

Statistical Method: Qualitative data was summarised by frequency, and percentage and quantitative data was summarised by mean and SD if symmetric, otherwise median and interquartile range. The impact of the time from the onset of chest pain to the initiation of thrombolysis to successful thrombolysis was assessed by comparing ST segment resolution before and after thrombolysis by independent t-test. The impact of the risk factors on the success of thrombolysis was assessed by logistic regression. P-value<0.05 was considered as statistical significance.

Ethics:

- Participants were explained about the study, and informed consent was obtained.
- Participation was voluntary.
- If the patient did not want to participate, no discrimination was made. He or she was given the standard of care.

Results

Table-1: Distribution based on ST segment resolution

ST Segment resolution	Frequency	Percentage
Resolution	51	51%
Non-Resolution	46	46%
Anaphylaxis	1	1%
Death	2	2%
Total	100	100%

Fig-1: Time delay and ST segment resolution

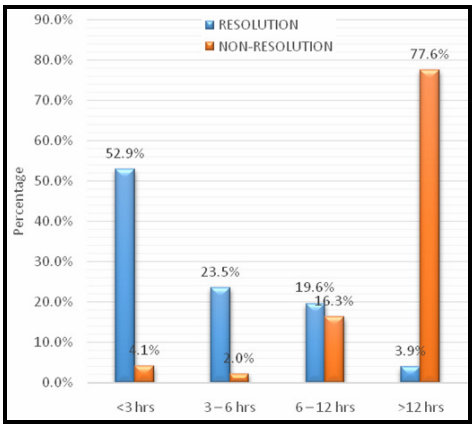

Fig-2: Anatomical location of Ami and ST Segmemt resolution

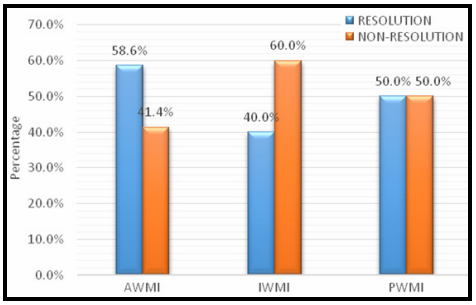

Table-2: T2DM, HTN, DLP & Smoking and ST segmemt resolution

		Resolution				P value
		Yes		No		
		N	%	N	%	
T2DM	Yes	24	41.4%	34	58.6%	0.02*
	No	27	64.3%	15	35.7%	
HTN	Yes	18	37.5%	30	62.5%	0.009*
	No	33	63.5%	19	36.5%	
DLP	Yes	9	40.9%	13	59.1%	0.28
	No	42	53.8%	36	46.2%	
Smoking status	Yes	21	50.0%	21	50.0%	0.86
	No	30	51.7%	28	48.3%	

Discussion

The present study was a cross-sectional observational study conducted in the department of general medicine at Shifaa Hospital, Bangalore over a period of 12 months. It was conducted among 100patients with STEMI who satisfied the inclusion and exclusion criteria, after obtaining informed consent. The time interval between the onset of chest pain and the initiation of thrombolytic therapy was recorded. ECG taken before and 90 minutes after completion of thrombolysis with Streptokinase was compared for ST segment resolution. The patients were categorised as successful thrombolysis if they achieved more than 50% of ST segment resolution.

In the present study, mean age was 56.72 years, which ranged between 30 and 85 years with 75% of patients were males and 25% were females. In the study conducted by Mohanan PP et al.[3] the mean age of presentation was 60 years. The majority of the patients in our study group were males (75%).

The overall success rate of thrombolysis with Streptokinase in patients with STEMI was 51%, while 1 patient had anaphylaxis and 2 patients died during thrombolysis [Table 1]. The result was in accordance with the landmark Gusto trial [4] where the 90-minute patency rate of occluded artery was 54% with Streptokinase. Similar observations were seen in study by Shazia Hamid et al [5] in 2015, where the success rate of thrombolysis was 55%.In our study, 81% (9) of patients below 40 years of age achieved successful thrombolysis, while only 28.57% (2) of those in the age group 71-80 years achieved the same (p value - 0.13). It was observed that as age advances, there is a non-significant increase in thrombolytic failure. These findings were in accordance with the observations in the study conducted by Miller TD et al [6] which stated that age is an independent risk factor for poor thrombolytic outcome.

Among the 75 male patients, 56% (42) achieved ST segment resolution, and among 25 female patients, 36% (9) achieved successful thrombolysis. The higher success rate in males may be due to male predominance in our study. However, there was no statistically significant correlation between the success of thrombolysis and the gender of the patients in the study.

It was observed that 29% (29) of the study group presented within 3 hours, 13% (13) between 3-6 hours, 18% (18) between 6-12 hours and 40% (40) took more than 12 hours to receive thrombolysis. The mean time delay in the presentation was 12.10 hours. Studies by Goel PK et al [7] and Jadhav DR et al [8] also observed that more than half of the patients could not reach the hospital in golden hour. The greater delay in receiving fibrinolytic therapy in our study could be due to neglect of symptoms of AMI and heavy traffic in Bangalore city.

The success rate of thrombolysis in patients with symptoms to needle time less than 3 hours, 3-6 hours, 6-12 hours, and more than 12 hours were 93.1%, 92.3%, 55.6% and 5% respectively. There was a statistically significant reduction in the ST segment resolution as time delay increased (p0.001) (Figure-1). The benefit was greatest when thrombolysis was initiated early, particularly within the first 6 hours. These results were in concordance with the findings of the landmark GISSI trial [9] and study by Gibson CM et al [10] which concluded thatshorter the time delay in thrombolysis, higher the success rate and chance of survival. Similar results were observed in the study conducted by Durdana S et al [11] and Thiele H et al [12], which stated that patients presented in golden hour had greatest benefit in terms of TIMI 3 flow rate, which assesses the patency of coronaries following thrombolysis.

In the study conducted by Boersma et al [13], it was observed that the benefit of fibrinolytic therapy was highest in patients who presented within six hours in terms of lives saved per 1000 treated patients. However, in the study conducted by Chareonthaitawee P et al [14], the re-infarction rate was higher in patients with earlier fibrinolytic therapy. In our study, among the patients with delay in thrombolysis, one developed allergic reaction and one died during thrombolysis due to arrhythmia. In the study conducted by Ghasemi R et al [15], the incidence of life

threatening arrhythmia was higher in those with longer door-to-needle time for receiving Streptokinase.

Among the 58 patients with AWMI, 58.6% (34) achieved success in terms of ST segment resolution. Out of 40 IWMI patients 40% (16) achieved successful thrombolysis, and among the 2 patients with PWMI, 50% (1) had ST segment resolution (Figure-2). However, these observations were not statistically significant. These results were in accordance with the GUSTO-I trial [4], where thrombolysis in AWMI had a better outcome in terms of mortality and morbidity. On the contrary to our study, Padmalal Gunagama et al [16] in 2014 stated that IWMI had a better success rate of thrombolysis compared to AWMI.Similar to our study, Burns RJ et al [17] stated there was no statistically significant association between the anatomical location of AMI and the success of thrombolysis.

The prevalence of diabetes mellitus, systemic hypertension, and dyslipidemia in our study was 58%, 48% and 22% respectively. Among the 58 patients with DM in the study group, 58.6% (34) failed to achieve ST segment resolution compared to non diabetic patients (p=0.02). It was observed that there was a statistically significant association between DM and the success of thrombolysis, where the majority of patients with DM had failed thrombolysis (Table 2).

In the study conducted by Zairis MN et al [18] in 2004, it was also stated that DM is a strong risk factor for thrombolytic failure in STEMI. Delayed presentation was also observed in patients with DM in the study by Newby LK et al [19] and Zijlstra F et al [20], which may be due to the milder degree of symptoms. Similarly, thrombolytic failure was seen in 62.5% (30) of the patients with hypertension compared to normotensive patients, which showed that hypertension has a statistically significant impact on the failure of fibrinolytic therapy (p value = 0.009) (Table 2).

Among the 22 patients with dyslipidemia, 59.1% (13) of patients failed to achieve successful thrombolysis compared to those without dyslipidemia. However, there was no statistically significant association between dyslipidemia and the success of thrombolytic therapy (p value = 0.28) (Table 2). Out of the 42 patients with smoking habits, 50% (21) of the patients failed to achieve successful thrombolysis, compared to non-smokers. There was no statistically significant association between smoking status and failure of thrombolytic therapy (p value=0.86) (Table 2).

These findings were in accordance with the study conducted by Shazia Hameed et al [5] in 2015, which concluded that risk factors such as DM, HTN, and smoking lead to increased failure of thrombolysis. In the study conducted by Dr. Karthik et al [2], young age and non-diabetics had a higher success rate for thrombolysis, while gender, hypertension, and smoking did not influence the outcome.

Conclusion

Our study showed that the earlier the initiation of thrombolysis, better the treatment outcome. Risk factors such as DM and HTN were associated with increased failure of thrombolysis, while the anatomic location of AMI, DLP, and smoking had no statistically significant impact on the treatment outcome. Thus, patients with delayed presentation with AMI should be anticipated to have a poor outcome with thrombolysis and should be offered early coronary intervention. Further prospective studies are required to analyse the effect of risk factors such as DM, HTN, DLP and smoking on the long term morbidity and mortality of patients following thrombolysis.

Limitations of the study:

- The study was a hospital-based study, and as such findings may not be a true representative of what is obtained in the general population.
- As it is a cross-sectional study, only ECG criteria were used to determine the success of thrombolysis.
- The long term outcome of patients undergoing thrombolysis was not studied in the present study.
- The existence of other co-morbid conditions such as rheumatological diseases, thyroid disease, malignancy, and alcoholism were not taken into consideration, which can contribute to the outcome of thrombolysis.

Acknowledgement

I begin with the utmost sincere gratitude to the Almighty, I am deeply grateful to Dr. Altaf Ahmed, MD, MRCP (UK), HOD of General Medicine, who is my thesis guide,Dr. Ishtiaq Ahmed Khan, MD, General Medicine, and Dr. Sha Ruknuddin, DNB General Medicine, my co-guide, and Dr. Zahid Ahmed, DNB Family Medicine, Diploma Anaesthesia, IDCCM, EDIC for encouraging and extending invaluable guidance to perform and complete this article.

I would like to specially thank my dear parents and wife and last but not the least, I sincerely thank all those patients who participated in this study for their kind cooperation.

Financial Support and sponsorship: Nil

Conflicts of interest: There are no conflicts of interest.

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Cite this article as: Bijeesh PR, Altaf A, Sha R and Zahid A. A cross sectional study on thrombolysis in ST elevation myocardial infarction and its assessment with respect to ST segment resolution and time delay. *Al Ameen J Med Sci* 2025; 18(2): 146-152.

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