Original Article

Post-Thrombolytic St-Segment Resolution Outcome in Acute Myocardial Infarction Patients Treated with Streptokinase: A Prospective Observational Study from Koppal

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Abstract

Background: Acute myocardial infarction remains a leading cause of cardiovascular mortality worldwide, with early reperfusion therapy being critical for myocardial salvage. ST-segment resolution following thrombolytic therapy serves as a practical, non-invasive marker for assessing reperfusion success. This study aimed to evaluate post-thrombolytic ST-segment resolution outcomes in acute myocardial infarction patients treated with streptokinase at a tertiary care center in Koppal. **Material and Methods:** This prospective observational study was conducted at KIMS Teaching Hospital, Koppal over 12 months. Fifty-six patients diagnosed with ST-elevation myocardial infarction presenting within 12 hours of symptom onset were included. Patients received intravenous streptokinase (1.5 million units). Electrocardiograms were recorded at baseline and 90 minutes post-thrombolysis. ST-segment resolution was categorized as complete (≥70%), partial (30-69%), or absent (<30%). Patients were followed for in-hospital complications including arrhythmias, cardiogenic shock, heart failure, and mortality. **Results:** Among 56 patients (mean age 54.82±11.43 years, 78.6% male), complete ST-segment resolution was achieved in 32 patients (57.1%), partial resolution in 16 patients (28.6%), and no resolution in 8 patients (14.3%). Complications occurred in 1 patient (3.1%) with complete resolution compared to 7 patients (87.5%) without resolution ($p<0.001$). Cardiogenic shock was the most common complication in the non-resolution group (50%), while mortality was significantly higher in patients without ST-segment resolution (25% vs 0%, $p=0.003$). **Conclusion:** ST-segment resolution at 90 minutes post-thrombolysis is a reliable, cost-effective predictor of successful reperfusion and favorable clinical outcomes in STEMI patients. Patients without adequate ST-segment resolution should be considered for early invasive intervention.

Keywords: Acute Myocardial Infarction; ST-segment Resolution; Streptokinase; Thrombolysis; Reperfusion.

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Introduction

Cardiovascular diseases represent the leading cause of mortality globally, with India experiencing a disproportionately high burden. The Global Burden of Disease study estimates the age-standardized cardiovascular death rate in India at 272 per 100,000 population, substantially exceeding the global average of 235 per 100,000.[1] Coronary artery disease prevalence continues to rise in India due to rapid epidemiological transition, having surpassed communicable diseases as the primary cause of mortality.[2] The incidence of myocardial infarction in India is estimated at 64.37 per 1,000 individuals among men aged 29-69 years, with approximately 31.7% of cardiovascular deaths attributed to acute myocardial infarction.[3]

Early restoration of coronary blood flow remains the cornerstone of acute myocardial infarction management, significantly reducing mortality and improving clinical outcomes.[4] While primary percutaneous coronary intervention (PCI) represents the gold standard for reperfusion therapy, its availability remains severely limited in resource-constrained settings across India. Consequently, fibrinolytic therapy with streptokinase continues to serve as the primary reperfusion strategy in many developing regions where access to catheterization facilities is restricted.[5]

The assessment of reperfusion success following thrombolytic therapy is crucial for guiding subsequent management decisions. Coronary angiography, while providing direct visualization of vessel patency, is invasive, expensive, and not universally accessible. ST-segment resolution on electrocardiography has emerged as a practical, readily available, and cost-effective method for evaluating myocardial reperfusion.[6] Resolution of ST-segment elevation reflects restoration of microvascular perfusion and correlates strongly with infarct size, left ventricular function, and clinical prognosis.[7]

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Need for the Study in Our Setup: Koppal district in Karnataka represents a typical semi-urban Indian setting where access to primary PCI remains extremely limited due to lack of catheterization laboratories, trained interventional cardiologists, and financial constraints faced by patients. The nearest PCI-capable center is several hours away, making timely intervention challenging. In such settings, streptokinase-based thrombolysis remains the only feasible reperfusion strategy for the majority of STEMI patients. However, regional data on thrombolytic outcomes and ST-segment resolution patterns in this population are lacking. Understanding these patterns will help clinicians identify high-risk patients early who may benefit from urgent transfer to higher centers for rescue PCI. Furthermore, this study addresses the critical need for locally relevant evidence to optimize acute myocardial infarction management protocols in resource-limited healthcare settings prevalent across rural and semi-urban India.

Aims and Objectives

Primary Aim:

- To assess the effectiveness of thrombolytic therapy with streptokinase in patients with acute ST-elevation myocardial infarction by evaluating post-thrombolytic ST-segment resolution patterns

Specific Objectives:

- To determine the proportion of patients achieving complete, partial, or absent ST-segment resolution at 90 minutes following streptokinase administration
- To evaluate the effect of timing of thrombolytic therapy (symptom-to-needle time) on ST-segment resolution outcomes
- To document in-hospital complications including arrhythmias, cardiogenic shock, heart failure, and mortality in relation to ST-segment resolution status
- To analyze demographic and clinical factors associated with successful versus unsuccessful reperfusion

Materials and Methods

Study Design and Setting: This prospective observational study was conducted at the Department of General Medicine, KIMS Teaching Hospital, Koppal, Karnataka, India over a period of 12 months. The study was approved by the Institutional Ethics Committee prior to commencement, and written informed consent was obtained from all participants or their legally authorized representatives.

Study Population and Sample Size: A total of 56 consecutive patients presenting with acute ST-elevation myocardial infarction to the Emergency Medicine Department were enrolled. The sample size was calculated based on previous literature reporting ST-segment resolution rates of approximately 55-60% following streptokinase thrombolysis, with expected precision of 15% and confidence level of 95%.

Inclusion Criteria:

- Age ≥18 years
- Typical chest pain of cardiac origin
- ST-segment elevation ≥1 mm in two or more contiguous limb leads OR ≥2 mm in two or more contiguous precordial leads
- Presentation within 12 hours from onset of chest pain
- Candidates for thrombolytic therapy with streptokinase

Exclusion Criteria:

- Age <18 years
- Presentation beyond 12 hours from symptom onset
- Contraindications to streptokinase (active bleeding, recent surgery, stroke within 6 months, severe uncontrolled hypertension)
- Pre-existing cardiac conditions (complete heart block, cardiomyopathies, severe valvular heart disease)
- Refusal of consent or inability to provide informed consent

Study Procedure

All enrolled patients underwent comprehensive clinical evaluation including detailed history and physical examination. A 12-lead electrocardiogram was recorded at baseline. Following confirmation of STEMI diagnosis, patients received intravenous streptokinase at 1.5 million International Units infused over 60 minutes. Concurrent medications including aspirin, clopidogrel, and heparin were administered per institutional guidelines.

Electrocardiographic Assessment

A repeat 12-lead electrocardiogram was obtained 90 minutes after initiation of streptokinase infusion. ST-segment elevation was measured at the J-point in all involved leads. The percentage of ST-segment resolution was calculated as: [(Sum of baseline ST elevation - Sum of post-thrombolysis ST elevation) / Sum of baseline ST elevation] × 100.

Classification of ST-Segment Resolution:

- Complete resolution: ≥70% reduction
- Partial resolution: 30-69% reduction
- Absent/No resolution: <30% reduction

Follow-up and Outcome Assessment

Patients were monitored continuously during hospital stay for complications including arrhythmias, cardiogenic shock, acute heart failure, mechanical complications, and mortality.

Statistical Analysis

Data were analyzed using SPSS version 20.0. Categorical variables were expressed as frequencies and percentages; continuous variables as mean ± standard deviation. Chi-square test was used for categorical comparisons; independent t-test for continuous variables. P-value <0.05 was considered statistically significant.

Results

A total of 56 patients meeting the inclusion criteria were enrolled over the 12-month study period. The baseline demographic, clinical characteristics, and infarct distribution are presented in [Table 1].

Table 1: Baseline Demographic, Clinical Characteristics, and Infarct Location (N=56)

Characteristic	Frequency (n)	Percentage (%)
Age (years)		
Mean ± SD	54.82 ± 11.43	-

18-40 years	8	14.3
41-60 years	32	57.1
>60 years	16	28.6
Gender		
Male	44	78.6
Female	12	21.4
Risk Factors		
Hypertension	34	60.7
Diabetes Mellitus	22	39.3
Smoking	26	46.4
Obesity	14	25.0
Family History of CAD	18	32.1
Dyslipidemia	16	28.6
Infarct Location		
Anterior Wall MI	24	42.9
Inferior Wall MI	20	35.7
Lateral Wall MI	8	14.3
Anterolateral MI	4	7.1

The mean symptom-to-door time was 4.26±2.18 hours, while mean door-to-needle time was 42.34±18.56 minutes. Twenty-two patients (39.3%) presented within 3 hours, 24 patients (42.9%) between 3-6 hours, and 10 patients (17.8%) between 6-12 hours.

Complete ST-segment resolution (≥70%) was achieved in 32 patients (57.1%), partial resolution (30-69%) in 16 patients (28.6%), and absent resolution (<30%) in 8 patients (14.3%). The overall successful reperfusion rate was 85.7%. The comparison of characteristics between patients with and without ST-segment resolution is shown in [Table 2].

Table 2: ST-Segment Resolution Distribution and Comparison by Resolution Status (N=56)

ST-Segment Resolution Category	**Frequency (n)**	**Percentage (%)**
Complete Resolution (≥70%)	32	57.1
Partial Resolution (30-69%)	16	28.6
No Resolution (<30%)	8	14.3
Characteristic	**Resolution Present (n=48)**	**Resolution Absent (n=8)**
Mean Age (years)	53.33 ± 10.91	63.75 ± 10.82
Male Gender	38 (79.2%)	6 (75.0%)
Diabetes Mellitus	16 (33.3%)	6 (75.0%)
Hypertension	28 (58.3%)	6 (75.0%)
Smoking	22 (45.8%)	4 (50.0%)
Symptom-to-door time (hours)	3.91 ± 1.98	6.38 ± 2.07
Door-to-needle time (minutes)	41.52 ± 17.84	47.25 ± 22.16
Anterior Wall MI	18 (37.5%)	6 (75.0%)

*Statistically significant (p<0.05)

Patients without ST-segment resolution were significantly older (63.75 vs 53.33 years, p=0.014), had higher diabetes prevalence (75.0% vs 33.3%, p=0.029), longer symptom-to-door time (6.38 vs 3.91 hours, p=0.003), and more frequent anterior wall involvement (75.0% vs 37.5%, p=0.048).

The distribution of in-hospital complications and factors associated with complete ST-segment resolution are presented in [Table 3].

Table 3: In-Hospital Complications and Factors Associated with Complete Resolution (N=56)

Complication	**Complete Resolution (n=32)**	**Partial Resolution (n=16)**	**No Resolution (n=8)**	**p-value**
Cardiogenic Shock	0 (0%)	1 (6.3%)	4 (50.0%)	<0.001*
Heart Failure	0 (0%)	1 (6.3%)	3 (37.5%)	0.002*
Arrhythmias	1 (3.1%)	2 (12.5%)	3 (37.5%)	0.018*
Mechanical Complications	0 (0%)	0 (0%)	1 (12.5%)	0.143
Mortality	0 (0%)	0 (0%)	2 (25.0%)	0.003*
Any Complication	1 (3.1%)	3 (18.8%)	7 (87.5%)	<0.001*
Factor	Complete Resolution n (%)	No Complete Resolution n (%)	p-value	
Symptom-to-door <3 hours (n=22)	16 (72.7%)	6 (27.3%)	0.018*	
Symptom-to-door 3-6 hours (n=24)	13 (54.2%)	11 (45.8%)		
Symptom-to-door 6-12 hours (n=10)	3 (30.0%)	7 (70.0%)		
Diabetes Present (n=22)	8 (36.4%)	14 (63.6%)	0.021*	
Diabetes Absent (n=34)	24 (70.6%)	10 (29.4%)		
Age ≤60 years (n=40)	26 (65.0%)	14 (35.0%)	0.043*	
Age >60 years (n=16)	6 (37.5%)	10 (62.5%)		

*Statistically significant (p<0.05)

The overall complication rate was significantly higher in patients without ST-segment resolution (87.5% vs 8.3%, p<0.001). Cardiogenic shock occurred in 50% of patients without resolution versus none in the complete resolution group (p<0.001). Mortality was 25% in the non-resolution group compared to 0% in those with resolution (p=0.003). Patients presenting within 3 hours achieved significantly higher complete resolution rates (72.7%) compared to those presenting at 6-12 hours (30.0%, p=0.018).

Discussion

The present study evaluated post-thrombolytic ST-segment resolution outcomes in STEMI patients treated with streptokinase at a tertiary care center in Koppal. The overall successful ST-segment resolution rate was 85.7%, with complete resolution achieved in 57.1% of patients. These findings are comparable to Ahmad et al[8] who demonstrated ST-segment resolution in 89% of patients following streptokinase thrombolysis, but higher than Iqbal et al,[9] who reported successful resolution in only 53-54% of patients. The relatively favorable outcomes in our study may be attributed to shorter symptom-to-door times and prompt initiation of thrombolytic therapy.

Several factors significantly predicted failure of ST-segment resolution. Advanced age emerged as an important predictor (63.75 vs 53.33 years, p=0.014), aligning with established evidence that elderly patients have lower reperfusion success rates due to more extensive atherosclerotic burden and altered fibrinolytic response.[10] Diabetes mellitus was significantly more prevalent among patients without resolution (75.0% vs 33.3%, p=0.029), corroborating findings by Iqbal et al[9] who demonstrated significantly lower resolution rates in diabetic STEMI patients due to endothelial dysfunction and enhanced thrombus burden.

The timing of presentation emerged as a critical determinant, with patients presenting within 3 hours achieving complete resolution in 72.7% of cases compared to only 30.0% among those presenting at 6-12 hours (p=0.018). This finding underscores the time-dependent nature of myocardial salvage and supports early presentation strategies.[11]

The complication distribution demonstrated striking differences between groups. Cardiogenic shock occurred in 50% of patients without resolution versus none in the complete resolution group (p<0.001). Mortality was significantly higher in the non-resolution group (25% vs 0%, p=0.003), consistent with landmark observations demonstrating that absence of ST-segment resolution is the most potent independent predictor of early mortality following thrombolytic therapy.[12]

The study limitations include relatively small sample size, single-center design, and absence of coronary angiographic correlation. However, ST-segment resolution has been validated as a reliable surrogate marker for successful reperfusion in multiple studies.

Conclusion

ST-segment resolution at 90 minutes following streptokinase thrombolysis is a reliable, practical, and cost-effective predictor of successful reperfusion and favorable clinical outcomes in STEMI patients. In resource-limited settings like Koppal where primary PCI access is restricted, this simple electrocardiographic assessment provides invaluable prognostic information. Patients without adequate ST-segment resolution, particularly those with advanced age, diabetes, delayed presentation, or anterior wall infarction, represent a high-risk group requiring early consideration for rescue angioplasty or intensive monitoring. Strategies to reduce symptom-to-door time through community awareness and healthcare system optimization are essential for improving thrombolytic outcomes in semi-urban and rural India.

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Conflicts of interest

There are no conflicts of interest.

References

1. Roth GA, Mensah GA, Johnson CO, Addolorato G, Ammirati E, Baddour LM, et al. Global burden of cardiovascular diseases and risk factors, 1990-2019: update from the GBD 2019 study. J Am Coll Cardiol. 2020;76(25):2982-3021.
2. Prabhakaran D, Jeemon P, Sharma M, Roth GA, Johnson C, Harikrishnan S, et al. The changing patterns of cardiovascular diseases and their risk factors in the states of India: the Global Burden of Disease Study 1990-2016. Lancet Glob Health. 2018;6(12):e1339-51.
3. Gupta R, Mohan I, Narula J. Trends in coronary heart disease epidemiology in India. Ann Glob Health. 2016;82(2):307-15.
4. Ibanez B, James S, Agewall S, Antunes MJ, Bucciarelli-Ducci C, Bueno H, et al. 2017 ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation. Eur Heart J. 2018;39(2):119-77.
5. Mohanan PP, Mathew R, Harikrishnan S, Krishnan MN, Zachariah G, Joseph J, et al. Presentation, management, and outcomes of 25,748 acute coronary syndrome admissions in Kerala, India: results from the Kerala ACS Registry. Eur Heart J. 2013;34(2):121-9.
6. Guo Z, Yang X. Does pre-angiography total ST-segment resolution reliably predict spontaneous reperfusion of the infarct-related artery in patients with acute myocardial infarction? BMC Cardiovasc Disord. 2019;19(1):1-8.
7. van Oosterhout RE, de Boer AR, Maas AH, Rutten FH, Bots ML, Peters SA. Sex differences in symptom presentation in acute coronary syndromes: a systematic review and meta-analysis. J Am Heart Assoc. 2020;9(9):e014733.
8. Ahmad A, Shah SMA, Ullah R, Shah SMS, Rehman SMU, Zuhaid M. Post thrombolytic ST-segment resolution outcome in acute myocardial infarction patients. J Gandhara Med Dent Sci. 2022;9(2):38-42.
9. Iqbal S, Bari MS, Bari MA, Islam MM, Majumder MA, Islam Z, et al. A comparative study of ST segment resolution between diabetic and non-diabetic ST segment elevation myocardial infarction patients following streptokinase thrombolysis. Cardiovasc J. 2019;11(2):118-22.
10. Gharacholou SM, Lopes RD, Alexander KP, Mehta RH, Stebbins AL, Pieper KS, et al. Age and outcomes in ST-segment elevation myocardial infarction treated with primary percutaneous coronary intervention. Arch Intern Med. 2011;171(6):559-67.
11. Agrawal VV, Sarawag M. Prediction of ST elevation resolution on the basis of time interval of onset of chest pain to intervention among AMI patients undergoing PCI. J Dent Med Sci. 2019;18(6):7-17.

12. Ahmad M, Yasir M, Rahmat A. Acute ST elevation myocardial infarction: 70% or more ST segment resolution on 90 minutes post thrombolysis electrocardiogram as a predictor of in hospital outcomes. Prof Med J. 2018;25(5):777-83.