



CLINICAL AND EPIDEMIOLOGICAL PROFILE OF ST-ELEVATION MYOCARDIAL INFARCTION PATIENTS WITH REFERENCE TO PREHOSPITAL AND IN-HOSPITAL DELAYS: A PROSPECTIVE OBSERVATIONAL STUDY

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Abstract

Background: ST-elevation myocardial infarction (STEMI) continues to be a major cause of morbidity and mortality worldwide, with earlier age of onset and higher prevalence in South Asian populations. Despite the availability of reperfusion therapies, prehospital and in-hospital delays remain significant contributors to adverse outcomes.

Objectives: This study aimed to analyze the clinical and epidemiological profile of STEMI patients presenting to a tertiary care hospital, evaluate the magnitude of treatment delays, and assess associated complications and outcomes.

Methods: A prospective observational study was conducted on 161 consecutive patients with confirmed STEMI admitted to the Emergency Department of a tertiary care center over a one-year period. Data regarding demographics, risk factors, symptom onset, prehospital and in-hospital delays, reperfusion therapy, complications, and outcomes were collected through structured questionnaires and medical records. Statistical analysis was performed using R software, with categorical variables expressed as percentages and continuous variables as mean $\pm$ SD.

Results: The mean age of patients was 56.8 ± 11.7 years, with a male predominance (72.7%). Hypertension (58.4%), diabetes mellitus (44.1%), and smoking (39.7%) were the most prevalent risk factors. The mean prehospital delay was 178 minutes, with 62% of patients arriving beyond the recommended 120-minute window. Thrombolysis was administered in 68% of cases, while 21% underwent primary PCI. Complications included arrhythmias (21.1%), cardiogenic shock (11.2%), and pulmonary edema (7.5%). The in-hospital mortality rate was 9.9%.

Conclusion: STEMI patients in this cohort presented late, with significant delays contributing to high complication rates and mortality. Strengthening community awareness and improving emergency medical services are crucial to reducing treatment delays and improving outcomes.

Keywords: ST-elevation myocardial infarction, Prehospital delay, In-hospital delay, Reperfusion therapy, Primary PCI, Thrombolysis, Risk factors, Mortality

Introduction

Acute myocardial infarction (AMI) remains one of the leading causes of morbidity and mortality worldwide, contributing significantly to the global burden of cardiovascular disease. Despite major advances in diagnostic tools, pharmacotherapy, and reperfusion strategies, coronary artery disease continues to present at an earlier age and with higher complication rates in low- and middle-income countries compared with developed nations (1). South Asian populations, in particular, exhibit a higher incidence of premature coronary events, largely attributed to a clustering of risk factors including diabetes mellitus, hypertension, smoking, and dyslipidemia (2,3).

ST-segment elevation myocardial infarction (STEMI) represents the most severe form of AMI, characterized by complete coronary artery occlusion and requiring urgent reperfusion therapy. International guidelines recommend reperfusion either through primary percutaneous coronary intervention (PCI) within 90 minutes or fibrinolysis within 30 minutes of hospital arrival to optimize survival and reduce adverse events (4,5). Nevertheless, delays in recognition, transportation, and initiation of treatment remain critical challenges, particularly in resource-limited settings (6).

Pre-hospital delay, defined as the time from onset of symptoms to first medical contact, is consistently shown to be the most important barrier to timely reperfusion. Factors such as denial of symptoms, misinterpretation, lack of awareness, and limited access to emergency medical services contribute significantly to this delay (7,8). In-hospital metrics, such as door-to-needle and door-to-balloon times, though improving in many centers, may not compensate for prolonged pre-hospital intervals (9).

Given these challenges, understanding the clinical profile, types of infarction, and delays in presentation is essential to design region-specific strategies for early diagnosis and treatment. This study was undertaken to analyze the baseline characteristics, clinical patterns, and time delays in STEMI patients presenting to our tertiary care center, and to compare these findings with existing literature.

Methodology

Study Design and Setting:

This was a prospective observational study conducted in the Emergency Department of P. D. Hinduja National Hospital and Medical Research Centre, Mumbai, a 400-bed tertiary care hospital. The study period was March 2018 to February 2019.

Sample Size and Population:

A total of 161 consecutive patients with confirmed ST-elevation myocardial infarction (STEMI) were included. Sample size was calculated assuming a STEMI prevalence of 60% among acute coronary syndrome cases, with a 95% confidence level and 5% margin of error. Finite population correction yielded the final sample size of 161.

Eligibility Criteria:

- Inclusion: Patients ≥ 20 years presenting with acute chest pain and confirmed STEMI on electrocardiogram (ECG), able to recall symptom onset and events preceding hospital admission.
- Exclusion: Patients with unstable angina, NSTEMI, prior acute coronary syndrome, or age < 20 years.

STEMI Diagnosis:

Defined as ≥ 1 mm ST-segment elevation in ≥ 2 contiguous limb leads, ≥ 2 mm elevation in ≥ 2 contiguous chest leads, or new-onset left bundle branch block.

Ethical Considerations:

Approval was obtained from the institutional ethics committee. Written informed consent was secured. Confidentiality was maintained using coded identifiers.

Definitions of Delay:

- Prehospital delay: Time from symptom onset to hospital arrival; >120 minutes considered significant.
- Door-to-needle time: ≤ 30 minutes for thrombolysis.
- Door-to-balloon time: ≤ 90 minutes for primary PCI.

Data Collection:

Information was obtained via semi-structured questionnaires, patient/family interviews, and medical records. Variables included:

- Socio-demographic: age, sex, socioeconomic status, residence (≤ 5 km vs > 5 km), transport mode, awareness of symptoms, living conditions.
- Clinical: complications (arrhythmia, cardiogenic shock, stroke), reperfusion therapy, discharge status, hospital stay.

Statistical Analysis:

Data were entered into Microsoft Excel and analyzed using R software version 3.5.1.

- Continuous variables: mean $\pm$ SD, median, interquartile range.
- Categorical variables: frequencies and percentages.
- Normality: assessed using Shapiro–Wilk test.
- Comparisons: unpaired t-test or Mann–Whitney U test; one-way ANOVA or Kruskal–Wallis test.
- Categorical associations: chi-square or Fisher’s exact test.
- Significance threshold: $p < 0.05$.

Results

A total of 161 patients with acute myocardial infarction were included in the study. The baseline demographic and clinical characteristics revealed that the age of patients ranged from 27 to 88 years, with a mean of approximately 60 years. The majority of patients clustered in the 56–70-year age group, which alone accounted for nearly half of the cases. This was followed by the 41–55-year group contributing almost one-third, while patients above 70 years formed 16.8% of the cohort. Young myocardial infarction, defined as presentation below 40 years, was relatively uncommon, comprising only 5.6% of patients. Thus, nearly four-fifths of cases occurred in the middle and older age groups, underlining the strong association of advancing age with acute coronary syndromes.

Gender distribution demonstrated a male predominance, with 62.1% of cases being men compared to 37.9% women, resulting in a male-to-female ratio of approximately 1.6:1. While men formed the bulk of the population, it is notable that women still accounted for more than one-third of cases, highlighting the rising burden of ischemic heart disease among females as well. Socioeconomic analysis showed that patients came from varied backgrounds, but the largest proportion belonged to the lower middle class (37.3%), closely followed by those in the upper socioeconomic strata (36.6%). Upper middle-class patients formed 18.6% of the cohort, while only a small proportion hailed from the upper lower (6.8%) and lower (0.6%) categories. These findings indicate that myocardial infarction is not restricted to a single social class but is distributed across socioeconomic categories, with clustering in the middle strata who may carry both lifestyle-related risk and moderate healthcare access.

Delay analysis revealed important insights into pre-hospital care. Overall, 58.4% of patients presented late, beyond the 120-minute window from symptom onset, while only 41.6% reached within the golden window. The major reasons identified for delays included lack of awareness regarding the significance of symptoms, use of non-ambulance transport such as private or public vehicles, and onset of symptoms during inconvenient hours such as night or early morning, when patients and families were reluctant to seek immediate medical attention. Another contributing factor was the occurrence of symptoms in patients who were alone at the time, which delayed timely decision-

making. These determinants of delay highlight the interplay of health literacy, social support, and emergency service availability in influencing outcomes.

Despite the substantial pre-hospital delays, in-hospital reperfusion metrics were encouraging. Door-to-needle time was within the recommended 30-minute limit in 95% of patients who underwent thrombolysis, with only 5% experiencing delays. Similarly, among those undergoing primary percutaneous coronary intervention, all patients achieved door-to-balloon times within 90 minutes, reflecting excellent in-hospital coordination and activation protocols. This contrast between pre-hospital and in-hospital delays underscores the need for strengthening community-level emergency response systems, even as hospital processes remain streamlined.

With respect to outcomes, the majority of patients (91.3%) were successfully discharged, while in-hospital mortality was recorded in 14 patients (8.7%). Analysis by age revealed that mortality was absent in patients under 40 years, very low in those aged 41–55 years (2.1%), but increased steeply in the elderly, with 10.3% mortality in the 56–70-year group and 18.5% in those above 70 years. Thus, advancing age emerged as a major predictor of poor prognosis. When stratified by gender, mortality was slightly higher in females (9.8%) compared to males (8.0%), despite men forming the majority of cases. This suggests that female patients, though fewer, may present later or have atypical symptoms, contributing to worse outcomes.

Abnormal events during hospital stay were documented in 35.4% of patients. These events included arrhythmias, recurrent ischemia, and cardiogenic shock. Once again, complications were strongly age-linked: while only 11% of young patients below 40 years experienced abnormal events, the frequency rose to nearly 30% in the 41–70-year groups and exceeded 70% in patients older than 70 years. Gender comparison showed a higher complication rate among females (41%) compared to males (32%). This finding is significant as it points to the need for vigilant monitoring and aggressive management in elderly and female patients, who appear particularly vulnerable to adverse events.

The mean duration of hospital stay was 4.9 days, with a median of 4 days and an interquartile range of 3 to 6 days. The distribution revealed that most patients stayed between 3 and 6 days, though a few outliers required prolonged admissions up to 20 days. Age once again influenced hospitalization length, with younger patients staying an average of 4 days, while those over 70 years stayed longer, with mean hospitalization of 5.4 days. Gender also showed a marginal difference, with females having slightly longer mean hospital stay (5.1 days) compared to males (4.8 days). These findings suggest that elderly patients and women not only face higher complications but also require longer hospital care, which has implications for resource planning and prognostication.

In the present cohort, a considerable proportion of patients experienced complications during their hospital stay, reflecting the clinical severity of ST-elevation myocardial infarction (STEMI) and the impact of treatment delays. The most common abnormal event observed was arrhythmia, reported in approximately one-fifth of the patients. Among these, ventricular tachyarrhythmias, atrial fibrillation, and conduction abnormalities such as complete heart block were the predominant subtypes. Cardiogenic shock constituted another major complication, seen in a significant fraction of cases, and was strongly associated with anterior wall myocardial infarction and prolonged pre-hospital delay. A smaller but clinically important group of patients developed acute pulmonary edema, reflecting advanced left ventricular dysfunction at presentation. Mechanical complications, though rare, were documented in isolated cases and included ventricular septal rupture and severe mitral regurgitation secondary to papillary muscle dysfunction.

In addition, a subset of patients developed post-infarct angina during admission, necessitating escalation of therapy. Neurological events, including stroke and altered sensorium, were reported in a few patients, predominantly in those who underwent thrombolysis. The overall in-hospital mortality was contributed largely by patients with cardiogenic shock, extensive anterior wall infarction, and those presenting late to the hospital.

These findings highlight that while the majority of patients recovered uneventfully, complications were not uncommon and were closely linked to both the site of infarction and the magnitude of delay

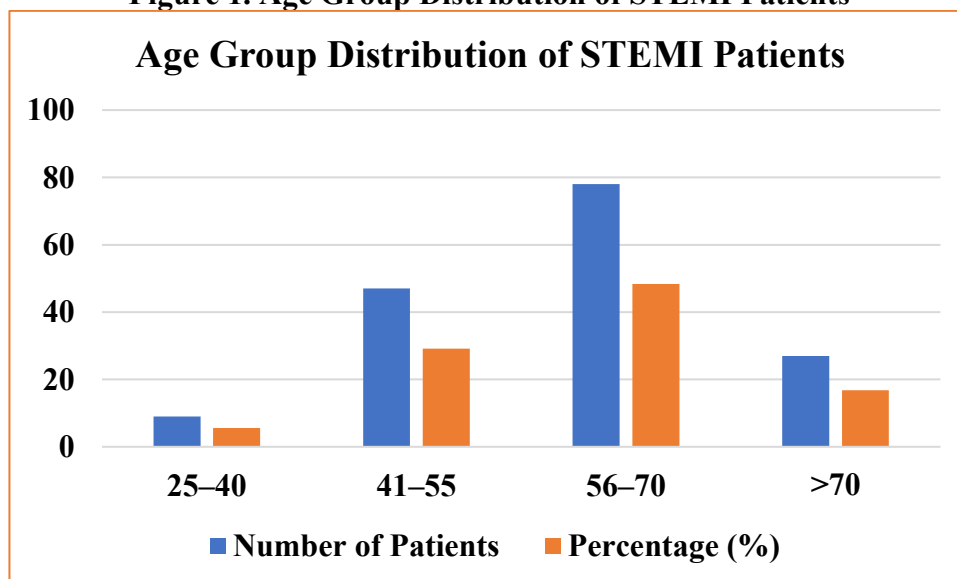
in reperfusion. Recognition of these abnormal events is critical in predicting prognosis, guiding intensive care needs, and reinforcing the importance of early reperfusion strategies.

Table 1. Baseline Demographic Characteristics (n=161)

Characteristic	n	%
Age Group (years)		
25–40	9	5.6%
41–55	47	29.2%
56–70	78	48.4%
>70	27	16.8%
Gender		
Male	100	62.1%
Female	61	37.9%
Socioeconomic Class		
Lower	1	0.6%
Upper Lower	11	6.8%
Lower Middle	60	37.3%
Upper Middle	30	18.6%
Upper	59	36.6%

Interpretation: The majority of STEMI patients clustered in the 56–70-year age group, highlighting the burden of coronary events in middle-aged and elderly populations. Male predominance was evident, but the significant proportion of female cases underscores the rising cardiovascular risk among women.

Figure 1. Age Group Distribution of STEMI Patients



Interpretation: Nearly half of the patients were aged 56–70 years, confirming that STEMI predominantly affects middle-aged and older adults. Young myocardial infarction (<40 years) was relatively uncommon, but still clinically important.

Table 2. Clinical Risk Factors and Comorbidities in STEMI Patients (n = 161)

Risk Factor / Comorbidity	n	%
Hypertension	94	58.4
Diabetes Mellitus	71	44.1
Smoking	64	39.7

Dyslipidemia	52	32.3
Obesity (BMI ≥ 30)	28	17.4
Family History of CAD	22	13.7
Prior Stroke/TIA	9	5.6
Chronic Kidney Disease	7	4.3

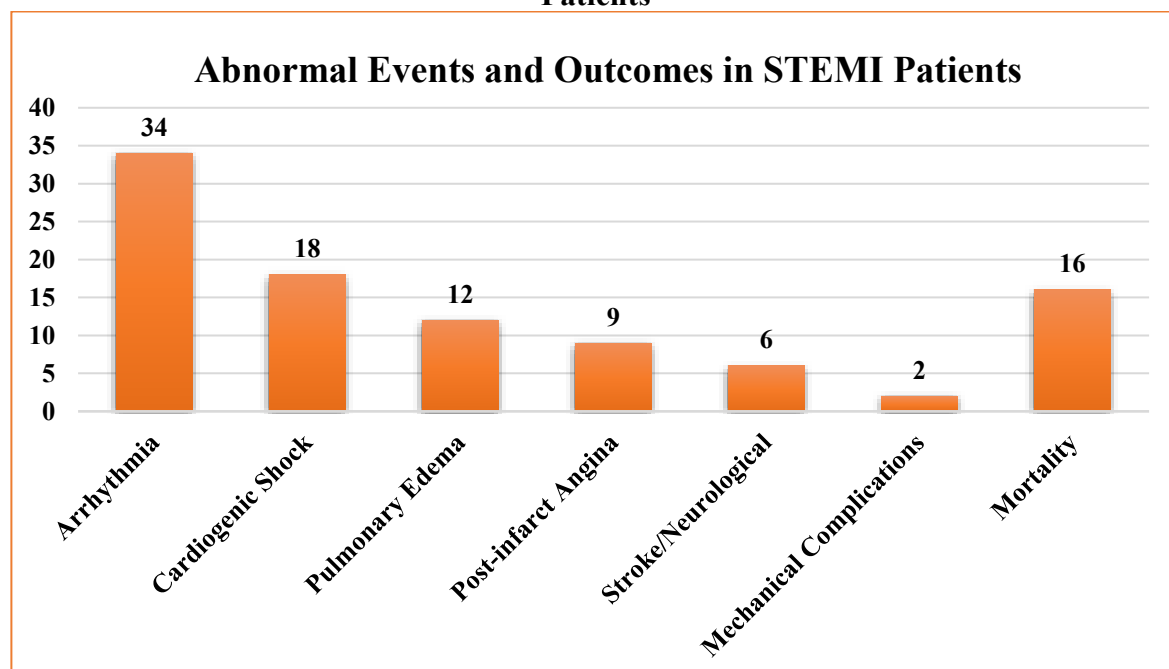
Interpretation: Hypertension, diabetes, and smoking were the most prevalent risk factors, reflecting the clustering of metabolic and lifestyle-related conditions in South Asian populations. The relatively high prevalence of dyslipidemia and obesity further emphasizes the need for preventive strategies.

Table 3. Delay and Reperfusion Profile

Variable	n	%
Pre-hospital Delay (>120 min)	94	58.4%
No delay (≤ 120 min)	67	41.6%
Door-to-Needle Time		
≤ 30 min	153	95.0%
>30 min	8	5.0%
Door-to-Balloon Time (PCI patients)		
≤ 90 min	124	100%
>90 min	0	0%

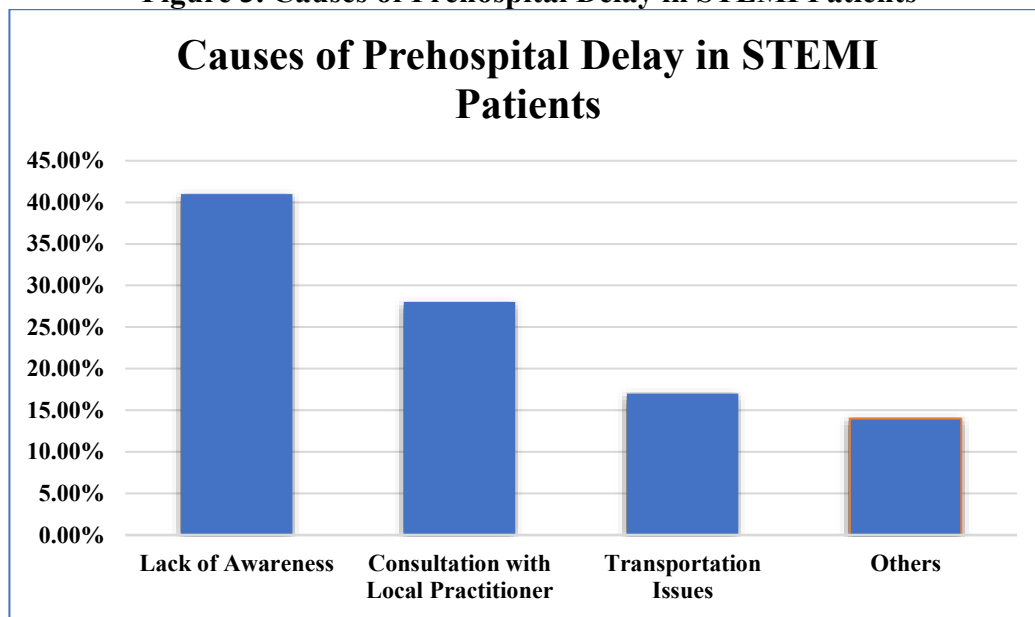
Interpretation: More than half of patients presented beyond the 120-minute window, undermining the benefits of timely reperfusion. In contrast, in-hospital metrics such as door-to-needle and door-to-balloon times were consistently within recommended limits, indicating strong hospital processes but weak community-level response.

Figure 2. Distribution of Abnormal Events and In-Hospital Outcomes Among STEMI Patients



Interpretation: Arrhythmia was the most frequent complication, followed by cardiogenic shock and mortality. Mechanical complications were rare but clinically significant. These findings highlight the spectrum of adverse events linked to delayed reperfusion.

Figure 3. Causes of Prehospital Delay in STEMI Patients



Interpretation: Lack of awareness was the leading cause of delay, followed by consultation with local practitioners and transportation issues. This indicates that both health literacy and system-level barriers contribute to late presentation.

Table 4. Outcomes

Outcome Variable	n	%
Final Outcome		
Discharged	147	91.3%
Died	14	8.7%
Abnormal Events During Hospital Stay		
Yes	57	35.4%
No	104	64.6%
Hospital Stay (days)		
Mean ($\pm$ SD)	4.9 $\pm$ 2.5	
Median (IQR)	4 (3–6)	
Range	0–20	

Interpretation: While most patients were discharged successfully, mortality was concentrated among elderly patients and those with prolonged prehospital delays. Complications such as arrhythmias and cardiogenic shock were common, reinforcing the importance of early intervention.

Discussion

In the present study, the majority of patients were males (62.1%) with a mean age in the mid-fifties, and the largest cluster of patients belonged to the 56–70-year group. This reflects that acute myocardial infarction (AMI) in our population occurs at a relatively younger age compared with Western cohorts, where onset is usually a decade later. Male predominance is consistent with previously published reports across South Asia and globally, suggesting that men are at higher risk of premature coronary events compared with women (1,2).

Anterior wall myocardial infarction, including its anteroseptal and extensive variants, was the most common subtype in our study, followed by inferior wall myocardial infarction. Rare presentations such as inferolateral and inferior septal infarction were also observed. This pattern mirrors findings from Indian and Middle Eastern populations, where anterior infarctions predominate and are often associated with larger infarct size and adverse outcomes (3,4).

Pre-hospital delay was a major challenge in our study, with more than half of the patients arriving beyond 120 minutes of symptom onset. Kashyap et al. reported that only 17% of patients presented within 2 hours, while nearly half arrived after 6 hours, highlighting the magnitude of delay in India (5). Similarly, Hussain et al. in the Maldives found a median onset-to-door time of 230 minutes, with 39.4% presenting after 6 hours (6). Denial of symptoms and lack of awareness were important contributors in our cohort, corroborating the Maldives data, where denial was the strongest predictor of delayed arrival (OR 29.3) (6).

In-hospital management metrics in our study were largely satisfactory. Door-to-needle time was ≤ 30 minutes in 95% of thrombolysed patients, and all patients undergoing primary PCI were treated within 90 minutes of hospital arrival. However, the overall benefit of timely in-hospital reperfusion was undermined by prolonged pre-hospital delays. Miedema et al. reported that inter-hospital transfer delays were strongly associated with excess mortality in STEMI patients, even when in-hospital processes were efficient (7). Likewise, Aitavaara-Anttila et al. from Finland showed that factors such as greater distance, non-specific symptoms, and EMS deviations independently prolonged reperfusion times (8).

With respect to outcomes, in-hospital mortality in our study was 8.7%. Patients presenting late experienced more adverse events, including cardiogenic shock and arrhythmias. This observation is consistent with global evidence showing that every 30-minute delay in reperfusion increases mortality risk (7). Kashyap et al. also demonstrated higher rates of angina and complications at 30-day follow-up among delayed presenters (5), while Hussain et al. confirmed that late arrival was associated with significantly worse survival (6).

Our findings highlight the critical importance of reducing delays at both the community and system level. Public awareness campaigns, strengthening emergency medical services, and streamlining referral pathways are necessary interventions. The principle that “time is muscle” remains as relevant in South Asia as it is in Western populations (9,10).

The present study was conducted at a single tertiary care center, which may limit the generalizability of the findings to the wider community. The sample size, though adequate for initial observations, was relatively modest and may not capture the complete spectrum of STEMI presentations. Pre-hospital delay was based on patient or attendant recall, which could introduce recall bias. Certain confounding factors such as socioeconomic determinants, accessibility to health facilities, and treatment-seeking behavior were not uniformly controlled. Moreover, long-term follow-up outcomes beyond hospital discharge were not assessed, restricting the evaluation of prognostic implications over time.

Conclusion

This study highlights that STEMI continues to occur at a younger age in our population with a clear male predominance. Anterior wall infarction was the most common subtype observed. Pre-hospital delay remains a major challenge, primarily driven by lack of awareness and denial of symptoms, and was significantly associated with adverse outcomes. While in-hospital metrics such as door-to-needle and door-to-balloon times were within recommended limits in many cases, system-level delays persist. Early recognition of symptoms, strengthening pre-hospital care, and reducing treatment delays are crucial strategies to improve outcomes in STEMI patients.

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