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Original Research Article

Door-to-Balloon Time and 30-Day Outcomes Across Three Age Groups in ST-Elevation Myocardial Infarction: A Single-Centre Retrospective Study

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Abstract:

Background: Timely primary percutaneous coronary intervention (pPCI) is essential in ST-elevation myocardial infarction (STEMI), but reperfusion delays may differ by age. Objective: To describe door-to-balloon (D2B) times and 30-day clinical outcomes in patients aged <75, 75–84 and ≥85 years.

Methods: This single-center retrospective observational study included 50 consecutive patients with STEMI who underwent primary percutaneous coronary intervention at Jawaharlal Nehru Medical College, Bhagalpur, between April 2025 and April 2026. Patients were stratified into three age groups: <75 years (n=26), 75–84 years (n=16), and ≥85 years (n=8). Door-to-balloon (D2B) times, achievement of the <90-minute reperfusion target, in-hospital complications, and 30-day major adverse cardiac events (MACE) were evaluated. Clinical characteristics and outcomes were compared across age groups using appropriate descriptive and statistical methods.

Results: Median D2B time was 78 minutes overall (interquartile range 62–104) and 68, 86 and 108 minutes across increasing age groups. The proportion achieving D2B <90 minutes was 73.1%, 56.3% and 37.5%, respectively. Thirty-day MACE occurred in 3/26 (11.5%), 4/16 (25.0%) and 4/8 (50.0%) patients, respectively (11/50; 22.0% overall).

Conclusion: Advancing age was associated with prolonged door-to-balloon time and increased 30-day major adverse cardiac events in patients with STEMI undergoing primary PCI. Patients aged ≥85 years experienced the greatest delays and highest adverse event rates. Early recognition, rapid reperfusion, and optimized emergency cardiac care pathways are essential to improve outcomes, particularly in elderly patients.

Keywords: ST-elevation Myocardial Infarction; Door-To-Balloon Time; Primary Percutaneous Coronary Intervention; Age; Major Adverse Cardiac Events.

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Introduction

ST-elevation myocardial infarction (STEMI) is an acute coronary emergency in which prompt restoration of coronary blood flow is a central treatment objective. Primary percutaneous coronary intervention (pPCI) is an established reperfusion strategy when it can be delivered within recommended timeframes. Contemporary professional guidance emphasizes rapid diagnosis, coordinated emergency pathways and timely invasive management [1]. Earlier international guidelines similarly established the importance of minimizing treatment delay and organizing efficient reperfusion networks [2,3]. The interval from hospital arrival to coronary device intervention, commonly termed door-to-balloon (D2B) time, has long been used as an indicator of in-hospital reperfusion efficiency.

Observational studies involving large STEMI cohorts have reported associations between longer D2B intervals and greater mortality, although such associations should not be interpreted as proof of causality [4,5]. Reducing delays requires coordination among emergency services, triage personnel, cardiologists and catheterization laboratory teams. Specific workflow strategies, including early laboratory activation and streamlined communication, have been associated with shorter treatment times [6]. Age may complicate these processes: older patients can present without typical chest pain, have more comorbidities and require complex clinical decision-making. Nevertheless, chronological age should not itself justify avoidable reperfusion delay. Evidence describing D2B performance and short-term outcomes in very old patients from smaller regional centres remains limited. This study therefore describes D2B timing and 30-day clinical

outcomes in three prespecified age strata (<75, 75–84 and ≥85 years) among patients undergoing pPCI at a single tertiary centre in Bhagalpur, India.

Materials and Methods

Design and Population: This single-centre retrospective observational study reviewed 50 consecutive adults treated with primary PCI for STEMI at Jawaharlal Nehru Medical College, Bhagalpur, between 1 April 2025 and 1 April 2026. Eligible patients underwent primary PCI and had documented procedural timing and 30-day follow-up. Patients treated with fibrinolysis before PCI, those with severe out-of-hospital arrest and hypoxic encephalopathy, and records lacking essential timestamps or follow-up were excluded.

Definitions and Endpoints: Age groups were <75 years (n=26), 75–84 years (n=16) and ≥85 years (n=8). D2B time was defined as emergency-department arrival to first balloon inflation or thrombectomy-device deployment. The source defined 30-day MACE as a composite of all-cause death, recurrent myocardial infarction, target-lesion revascularization and acute heart failure. Additional outcomes included cardiogenic shock and achievement of D2B <90 minutes.

Statistical Analysis: Continuous variables were expressed as mean ± standard deviation (SD) or median with interquartile range (IQR), as appropriate, while categorical variables were presented as frequencies and percentages. Comparisons among the three age groups were performed using one-way analysis of variance (ANOVA) or the Kruskal–Wallis test for continuous variables and the chi-square test or Fisher's exact test for categorical variables, as appropriate. Statistical significance was defined as a two-sided p-value <0.05.

Results

Patient Characteristics: Fifty patients were included, comprising 26 aged <75 years, 16 aged 75–84 years and eight aged ≥85 years. There were 31 men (62%). Baseline characteristics are presented in Table 1.

Table 1: Baseline characteristics by age group

Characteristic	<75 (n=26)	75–84 (n=16)	≥85 (n=8)
Age, years, mean ± SD	62.4 ± 6.1	78.8 ± 2.7	87.3 ± 2.1
Male sex	18 (69.2)	9 (56.3)	4 (50.0)
Hypertension	15 (57.7)	11 (68.8)	6 (75.0)
Diabetes	10 (38.5)	7 (43.8)	3 (37.5)
Chronic kidney disease	2 (7.7)	3 (18.8)	3 (37.5)

Door-to-balloon time: Overall median D2B time was 78 minutes (IQR 62–104). Median D2B time increased from 68 minutes in patients aged <75 years to 108 minutes in patients aged ≥85 years. The target of <90 minutes was met by 19, nine and three patients, respectively (Table 2; Figure 1).

Table 2: Door-to-balloon measures by age group

D2B measure	<75	75–84	≥85
Median minutes (IQR)	68 (55–84)	86 (71–112)	108 (88–138)
<90 minutes	19 (73.1)	9 (56.3)	3 (37.5)
≥90 minutes*	7 (26.9)	7 (43.8)	5 (62.5)

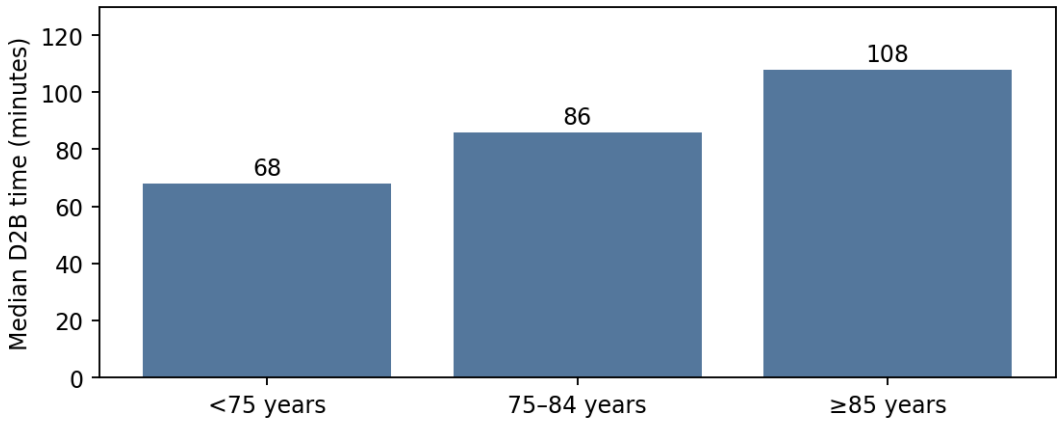


Figure 1: Median door-to-balloon time by age group. Bars depict group medians.

Clinical outcomes: Composite 30-day MACE was reported in 11/50 patients (22.0%): three, four and

four events across increasing age strata. There were five deaths in total: one in the youngest group, two in the 75–84-year group and two in the ≥85-year group (Table 3).

Table 3: Recorded clinical outcomes by age group

Outcome	<75	75–84	≥85
All-cause mortality	1 (3.8)	2 (12.5)	2 (25.0)
Cardiogenic shock	2 (7.7)	3 (18.8)	3 (37.5)
Acute heart failure	3 (11.5)	4 (25.0)	3 (37.5)
30-day MACE	3 (11.5)	4 (25.0)	4 (50.0)

Discussion

The present retrospective observational study evaluated age-related differences in door-to-balloon (D2B) time and short-term clinical outcomes among patients with ST-elevation myocardial infarction (STEMI) undergoing primary percutaneous coronary intervention (PCI). A progressive increase in median D2B time was observed across the three age groups, accompanied by higher rates of 30-day major adverse cardiac events (MACE) among older patients. These findings suggest an association between advancing age, delayed coronary reperfusion, and an increased burden of adverse cardiovascular outcomes.

The median D2B time increased from 68 minutes in patients aged <75 years to 86 minutes in those aged 75–84 years and 108 minutes in patients aged ≥85 years. Correspondingly, the proportion of patients achieving the D2B target of <90 minutes decreased from 73.1% to 56.3% and 37.5%, respectively. These observations indicate a progressive reduction in timely reperfusion with advancing age. Contemporary clinical guidelines emphasize early STEMI recognition, prompt initiation of reperfusion therapy, and coordinated systems of care to minimize treatment delays and optimize clinical outcomes [1–3]. Age-related differences in clinical presentation, comorbidity burden, and emergency care processes may contribute to these disparities, although their individual contributions were not established in this study.

The incidence of 30-day MACE increased progressively across the age groups, from 11.5% in patients aged <75 years to 25.0% in those aged 75–84 years and 50.0% among patients aged ≥85 years. A similar age-related pattern was observed for all-cause mortality and cardiogenic shock. These findings indicate a greater observed burden of adverse cardiovascular events among elderly patients following primary PCI. Previous observational investigations have demonstrated associations between prolonged D2B time and increased mortality among patients undergoing primary PCI for STEMI [4,5]. The present findings are consistent with the broader evidence supporting timely coronary reperfusion, although the observed associations do not establish a direct causal relationship between treatment delay and adverse clinical outcomes.

Timely reperfusion remains a fundamental component of effective STEMI management. Prolonged myocardial ischemia may contribute to greater myocardial injury, impaired ventricular function, and subsequent cardiovascular complications. Older patients may be particularly vulnerable because of reduced physiological reserve and a greater prevalence of cardiovascular comorbidities. Nevertheless, the relationship between age, reperfusion delay, and clinical outcomes is complex and may be influenced by baseline disease severity, hemodynamic status, and other clinical characteristics. Accordingly, age-specific differences in D2B time should be considered when evaluating institutional reperfusion performance and opportunities for quality improvement.

The findings also have important implications for emergency cardiovascular care in tertiary referral centers. Early electrocardiographic assessment, rapid catheterization laboratory activation, effective communication between emergency and interventional cardiology teams, and streamlined clinical decision-making may help minimize avoidable delays. Previous research has demonstrated that coordinated institutional strategies and systematic improvements in STEMI care pathways can substantially reduce reperfusion times [6]. Incorporating greater awareness of atypical clinical presentations among elderly patients into existing emergency protocols may further support timely diagnosis and treatment.

Overall, the present study highlights clinically relevant age-related differences in reperfusion timing and short-term outcomes among patients undergoing primary PCI for STEMI. The observed increase in D2B time and adverse cardiovascular events with advancing age underscores the importance of optimizing emergency reperfusion pathways, particularly for older patients. Strengthening institutional STEMI protocols, facilitating prompt diagnosis, and improving coordination of acute cardiac care may contribute to more timely reperfusion and better patient management. These findings provide a basis for further prospective investigations evaluating

strategies to reduce age-related disparities in STEMI care and improve cardiovascular outcomes.

Conclusion

This retrospective observational study demonstrated an age-related increase in door-to-balloon (D2B) time and 30-day major adverse cardiac events (MACE) among patients with ST-elevation myocardial infarction undergoing primary percutaneous coronary intervention. Patients aged ≥85 years experienced the longest reperfusion delays, the lowest achievement of the recommended D2B target of less than 90 minutes, and the highest proportion of adverse cardiovascular events. These findings highlight the importance of early STEMI recognition, prompt electrocardiographic assessment, rapid catheterization laboratory activation, and coordinated emergency cardiac care, particularly in elderly patients. Larger prospective multicenter studies are warranted to validate these observations and evaluate strategies for improving reperfusion efficiency and clinical outcomes.

Declarations

Ethics approval and consent to participate: Institutional Ethics Committee approval is reported for the study at Jawaharlal Nehru Medical College, Bhagalpur.

Consent for publication: No identifiable individual patient information is presented; consent for publication is not applicable, subject to journal policy.

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Competing interests: The authors report no competing interests.

Data availability: De-identified patient-level data may be considered for access subject to institutional approval, privacy safeguards and applicable regulations.

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