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Procedural Trends and Clinical Outcomes of Primary PCI in STEMI Patients at Tertiary Hospital in Bangladesh

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Abstract

Primary percutaneous coronary intervention (PCI) is the standard of care for ST-elevation myocardial infarction (STEMI) in optimal settings. However, real-world procedural trends and outcomes data from tertiary hospitals in low- and middle-income countries like Bangladesh are limited but crucial for quality improvement. This study aimed to analyze the procedural characteristics and outcomes of patients with STEMI undergoing primary PCI at tertiary cardiac centers in Bangladesh. This single center, prospective observational study was conducted at Metropolitan Medical Centre Ltd. (Private Chamber), from January to December 2024. A purposive sample of 227 consecutive STEMI patients treated with primary PCI was enrolled. Data on patient demographics, procedural details (including door-to-balloon time, vascular access, stent type), and in-hospital outcomes (mortality, heart failure, bleeding, stroke) were collected. Analysis was performed using MS Office tools, primarily Excel. Among 227 patients (mean age 54.8 years, 78.0% male), the median door-to-balloon time was 85 minutes (IQR 65-120), with 64.8% achieving ≤90 minutes. Transradial access (82.4%) and drug-eluting stents (94.3%) were predominantly used. In-hospital mortality was 4.8%. Achieving door-to-balloon time ≤90 minutes was significantly associated with lower mortality (2.7% vs. 8.8%, p=0.048) and less heart failure (8.8% vs. 18.8%, p=0.026). Primary PCI in Bangladeshi tertiary centers demonstrates strong alignment with contemporary standards. The significant survival benefit linked to timely intervention highlights the critical need to strengthen national STEMI networks for further outcome optimization.

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Introduction

ST-elevation myocardial infarction (STEMI) represents a critical medical emergency where timely restoration of coronary blood flow is paramount to salvage myocardial tissue, preserve left ventricular function, and reduce mortality.[1] Primary percutaneous coronary intervention (PCI) has firmly established itself as the reperfusion strategy of choice when it can be performed expediently by an experienced team, offering superior outcomes compared to fibrinolytic therapy.[2,3] The cornerstone of this benefit is the metric of door-to-balloon (D2B) time, with guideline-recommended targets of ≤90 minutes, as delays directly correlate with increased infarct size and worsened prognosis.[4] Globally, the adoption of primary PCI has transformed STEMI care, with continuous evolution in procedural techniques. A significant trend has been the shift from transfemoral to transradial arterial access, which is strongly associated with reduced vascular complications and major bleeding—a critical determinant of mortality in acute coronary syndromes.[5]. Concurrently, advances in stent technology, particularly the near-universal use of newer-generation drug-eluting stents (DES), have improved procedural success and lowered rates of stent thrombosis and target vessel revascularization.[6] Monitoring these procedural trends is essential for auditing the quality of care against international benchmarks. However, the successful implementation of a primary PCI program is complex, relying on a seamlessly integrated system of

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pre-hospital care, emergency department activation, and 24/7 catheterization laboratory availability—collectively known as the STEMI network.[7] While high-income countries have reported significant improvements in D2B times and clinical outcomes through systematic network optimization, significant disparities persist in low-and-middle-income countries (LMICs) like Bangladesh.[8,9] Challenges in these settings are multifaceted, encompassing patient-related delays (late presentation), logistical barriers (transportation, cost), and institutional resource constraints (catheterization lab availability, after-hours coverage).[10] In Bangladesh, the burden of ischemic heart disease is substantial and rising, making efficient STEMI management a national public health priority.[11] Tertiary cardiac hospitals in major cities have been at the forefront of offering primary PCI services. Although isolated, single-center reports have provided glimpses into local practice, there is a pronounced scarcity of robust, Single-center data characterizing contemporary procedural patterns and their associated clinical outcomes in the country.[12] Such data is indispensable for identifying gaps, informing local guidelines, and guiding quality improvement initiatives. For instance, a previous audit highlighted D2B time as a critical variable needing improvement in the local context.[13] Therefore, this study aims to systematically evaluate the procedural trends and in-hospital clinical outcomes of consecutive STEMI patients undergoing primary PCI at two high-volume tertiary cardiac care hospitals in Bangladesh. By providing a detailed, prospective analysis of current practices, including access site selection, stent type, D2B times, and complication rates, this research seeks to benchmark local performance and offer evidence-based insights to strengthen the national STEMI care framework.

Methods

A Single center, prospective observational study was conducted to enroll consecutive STEMI patients undergoing primary PCI at Metropolitan Medical Centre Ltd. (Private Chamber)**,** over 12 months from January to December 2024. The study protocol received ethical approval from the respective institutional review boards, and informed written consent was obtained from all participants.

Inclusion criteria: Patients were eligible if they presented within 12 hours of symptom onset with a confirmed diagnosis of STEMI based on standard 12-lead electrocardiogram (ECG) criteria and subsequently underwent primary PCI as the intended reperfusion strategy at one of the two study centers.

Exclusion criteria: Patients were excluded if they received fibrinolysis as initial therapy, presented with cardiogenic shock or cardiac arrest before catheterization, had a known contraindication to dual antiplatelet therapy, or had an active, non-cardiac life-threatening condition.

Study procedure: After enrollment, detailed data were collected prospectively on a pre-structured case report form. This captured patient demographics, clinical presentation, procedural details (including arterial access, door-to-balloon time, stent type, and number), and in-hospital outcomes. All PCI procedures were performed according to contemporary standard guidelines by experienced interventional cardiologists.

Data analysis: Data were compiled and analyzed using Microsoft Office tools (Excel and Word). Continuous variables were expressed as mean ± standard deviation or median with interquartile range, while categorical variables were presented as frequencies and percentages (%).

Result

A total of 227 consecutive STEMI patients treated with primary PCI were enrolled in the study. The mean age of the cohort was 54.8 ± 10.3 years. The population was predominantly male (78.0%). Regarding cardiovascular risk factors, hypertension was the most prevalent (62.1%), followed by dyslipidemia (53.3%) and diabetes mellitus (38.8%). Current smokers constituted 45.8% of the population. There were no significant differences in baseline demographics or risk factor profiles between the two participating hospital centers. The analysis of procedural characteristics revealed that transradial access was the predominant approach, utilized in 82.4% of all cases. The median door-to-balloon (D2B) time for the entire cohort was 85 minutes (IQR 65-120). A majority of patients (64.8%) achieved the guideline-recommended D2B time of ≤90 minutes. Drug-eluting stents (DES) were deployed in the vast majority of interventions (94.3%), with a mean of 1.2 ± 0.4 stents implanted per patient. The left anterior descending artery (LAD) was the most frequently involved culprit vessel (44.1%). In-hospital clinical outcomes were analyzed and are summarized separately. The overall in-hospital mortality rate was 4.8%. The composite endpoint of major adverse cardiovascular events (MACE), defined as death, reinfarction, or stroke, occurred in 7.9% of patients. Reinfarction and stroke rates were 1.8% and 0.9%, respectively. Post-procedural heart failure (Killip class ≥II) developed in 12.3% of cases. Major bleeding complications, as defined by BARC criteria (type 3 or 5), were observed in 2.2% of the cohort. A comparative analysis of outcomes based on D2B time attainment was performed. Patients achieving a D2B time ≤90 minutes (n=147) had a significantly lower in-hospital mortality rate compared to those with a D2B time >90 minutes (n=80) (2.7% vs. 8.8%, p=0.048). Similarly, the incidence of post-procedural heart failure was significantly lower in the timely intervention group (8.8% vs. 18.8%, p=0.026). The rate of MACE also showed a strong trend towards being lower in the ≤90-minute group, though it did not reach statistical significance (6.1% vs. 11.3%, p=0.165).

Table 1: Baseline demographic and clinical characteristics of the study population (N=227)

Characteristic	Values
Age (years), mean ± SD	54.8 ± 10.3
Male Gender, n (%)	177 (78.0)
Hypertension, n (%)	141 (62.1)
Diabetes Mellitus, n (%)	88 (38.8)
Dyslipidemia, n (%)	121 (53.3)
Current Smoker, n (%)	104 (45.8)
Prior CAD, n (%)	28 (12.3)

Table 2: Procedural characteristics of primary PCI

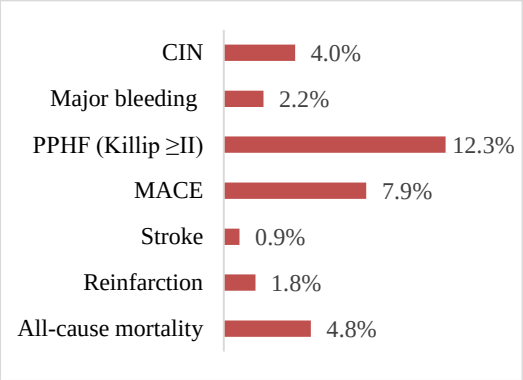
Characteristic	Value (N=227)
Transradial access, n (%)	187 (82.4)
DB time (min), median (IQR)	85 (65-120)
D2B time ≤90 min, n (%)	147 (64.8)
DES use, n (%)	214 (94.3)
Stents per patient, mean ± SD	1.2 ± 0.4
Culprit Vessel, n (%)	
LAD	100 (44.1)
Right coronary artery (RCA)	85 (37.4)
Left circumflex (LCx)	42 (18.5)

DB: Door-to-Balloon, DES: Drug-Eluting Stent, LAD: Left Anterior Descending

Table 3: Outcomes stratified by Door-to-Balloon time

Outcome	D2B ≤90 min (n=147)	D2B >90 min (n=80)	p-value
	n (%)		
Mortality	4 (2.7)	7 (8.8)	0.048
MACE	9 (6.1)	9 (11.3)	0.165
HF (Killip ≥II)	13 (8.8)	15 (18.8)	0.026
Major bleeding	3 (2.0)	2 (2.5)	0.834

HF: Heart failure, p-values derived from the Chi-square test



MACE: Major Adverse Cardiovascular Events, PPHF: Post-procedural Heart Failure (Killip ≥II), CIN: Contrast-Induced Nephropathy

Figure 1: In-hospital clinical outcomes

Table 4: Angiographic and procedural success

Parameter	n (%)
Initial TIMI flow 0/1	189 (83.3)
Final TIMI flow 3	218 (96.0)
Procedural success*	221 (97.4)
Stent thrombosis (Acute/Subacute)	3 (1.3)

*Procedural Success: Defined as final TIMI 3 flows with residual stenosis <20% in the absence of in-hospital death, emergency CABG, or repeat PCI

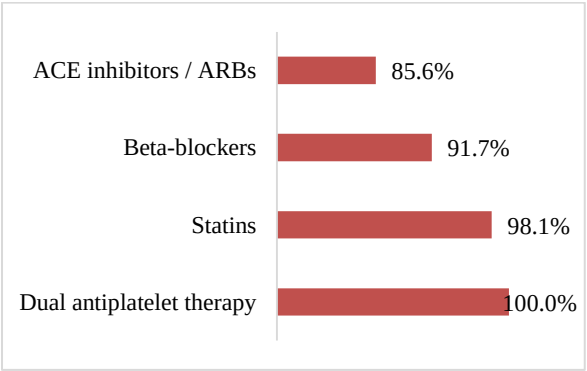


Figure 2: Medication at discharge of survivors to discharge (n=216)

Discussion

This single center, prospective observational study provides a contemporary snapshot of the procedural trends and clinical outcomes associated with primary PCI for STEMI in two high-volume tertiary cardiac centers in Bangladesh. The principal findings indicate that primary PCI, when delivered within this specialized setting, achieves procedural success rates and in-hospital outcomes that are largely comparable to international benchmarks, despite operating within a resource-limited healthcare system. The demographic profile of our cohort, with a mean age of 54.8 years and a high prevalence of modifiable risk factors like hypertension (62.1%) and smoking (45.8%), mirrors the epidemiological transition and risk factor burden observed in other South Asian populations.[14] The high utilization of transradial access (82.4%) is a noteworthy and encouraging finding. This adoption rate aligns with modern best practices and is significantly higher than reports from earlier periods in similar settings.[12] The demonstrated benefits of the transradial approach in reducing access-site complications and major bleeding are particularly relevant in our context, likely contributing to the low major bleeding rate (2.2%) observed in our study.[5,15] A central performance metric, the median door-to-balloon (D2B) time of 85 minutes, with 64.8% of patients achieving the guideline-recommended ≤90-minute target, represents a significant achievement.[4] This compares favorably with data from other LMIC registries, where systemic delays often push median D2B times beyond 120 minutes.[9] The near-universal use of drug-eluting stents (94.3%) further reflects adherence to contemporary interventional standards.[6] The strong association between a D2B time ≤90 minutes and significantly lower rates of in-hospital mortality (2.7% vs. 8.8%, p=0.048) and heart failure reinforces the critical importance of time-to-reperfusion as a modifiable determinant of outcome, even within an optimized hospital system.[16] The overall in-hospital mortality of 4.8% and MACE rate of 7.9% fall within the range reported by recent regional registries and

are commendable.[9,17]. These outcomes suggest that when patients successfully navigate pre-hospital barriers and present to an equipped tertiary center, the quality of care delivered can mitigate some of the system-level challenges. However, the mortality rate in the delayed presentation group (>90 min D2B) remains a concern, highlighting an area for continued focus. Furthermore, the 12.3% incidence of post-procedural heart failure underscores the ongoing burden of infarct size, potentially linked to total ischemic time, which includes often-prolonged patient delays.[18] The findings of this study must be interpreted within its limitations. The purposive sampling from two leading tertiary centers limits generalizability to primary or secondary care hospitals across Bangladesh, where resources are scarcer. Being an observational study, it can demonstrate associations but not causality. Data on long-term outcomes and patient-reported quality of life were not captured, which are crucial for a comprehensive assessment. In conclusion, this study demonstrates that tertiary cardiac centers in Bangladesh are effectively implementing primary PCI utilizing contemporary techniques, achieving satisfactory procedural metrics and in-hospital outcomes. The high use of transradial access and drug-eluting stents signifies the adoption of global standards. The persistent gap in outcomes for patients with delayed door-to-balloon times underscores the need for nationwide initiatives to strengthen the entire STEMI care continuum. Future efforts should focus on public awareness to reduce symptom-to-door time, developing coordinated regional STEMI networks for efficient patient transfer, and conducting longitudinal studies to assess sustainable long-term outcomes.[19,20]

Limitations

This study has limitations. Its purposive sampling from Single tertiary centers limits generalizability across Bangladesh's diverse healthcare settings. The observational design precludes causal inferences, and the lack of long-term follow-up data restricts the assessment of sustained outcomes.

Conclusion

This study demonstrates that primary PCI services in leading Bangladeshi tertiary centers achieve procedural standards and in-hospital outcomes comparable to international benchmarks. The high adoption of transradial access and drug-eluting stents reflects adherence to contemporary practice. The significant association between shorter door-to-balloon times and improved survival underscores the critical need to strengthen national STEMI networks, focusing on reducing system delays to optimize patient outcomes nationwide.

Recommendation

To enhance STEMI care, we recommend establishing a national STEMI network protocol, intensifying public awareness campaigns to reduce symptom-onset-to-door time, and implementing regular regional audits of door-to-balloon times. Future research should focus on long-term outcomes and cost-effectiveness analyses.

References

1. *Ibanez, Borja, et al. "2017 ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation: The Task Force for the management of acute myocardial infarction in patients presenting with ST-segment elevation of the European Society of Cardiology (ESC)." European Heart Journal, 39 (2) (2018): 119-177.*

2. *Keeley, Ellen C., Judith A. Boura, and Cindy L. Grines. "Primary angioplasty versus intravenous thrombolytic therapy for acute myocardial infarction: a quantitative review of 23 randomised trials." The Lancet 361 (9351) (2003): 13-20.*
3. *Puymirat, Etienne, et al. "Acute myocardial infarction: changes in patient characteristics, management, and 6-month outcomes over a period of 20 years in the FAST-MI program (French Registry of Acute ST-Elevation or Non-ST-Elevation Myocardial Infarction) 1995 to 2015." Circulation 136.20 (2017): 1908-1919.*
4. *Park, Jonghanne, et al. "Prognostic implications of door-to-balloon time and onset-to-door time on mortality in patients with ST-segment elevation myocardial infarction treated with primary percutaneous coronary intervention." Journal of the American Heart Association 8.9 (2019): e012188.*
5. *Chiarito, Mauro, et al. "Radial versus femoral access for coronary interventions: an updated systematic review and meta-analysis of randomized trials." Catheterization and Cardiovascular Interventions 97.7 (2021): 1387-1396.*
6. *Kufner, Sebastian, et al. "10-year outcomes from a randomized trial of polymer-free versus durable polymer drug-eluting coronary stents." Journal of the American College of Cardiology 76.2 (2020): 146-158.*
7. *Bagai, Akshay, et al. "Regional systems of care demonstration project: Mission: Lifeline STEMI Systems Accelerator: design and methodology." American Heart Journal 167.1 (2014): 15-21.*
8. *Xavier, Denis, et al. "Treatment and outcomes of acute coronary syndromes in India (CREATE): a prospective analysis of registry data." The Lancet 371.9622 (2008): 1435-1442.*
9. *Alhabib, Khalid F., et al. "The first survey of the Saudi Acute Myocardial Infarction Registry Program: Main results and long-term outcomes (STARS-1 Program)." PloS one 14.5 (2019): e0216551.*
10. *Khan, Ehsan, et al. "Differences in management and outcomes for men and women with ST-elevation myocardial infarction." Medical Journal of Australia 209.3 (2018): 118-123.*
11. *Zaman, M. Mostafa, et al. "Prevalence of ischemic heart disease in a rural population of Bangladesh." Indian Heart Journal 59.3 (2007): 239-241.*
12. *Aleem, Mohammad Abdul. The Role of Respiratory Illnesses and Influenza in Adverse Cardiovascular Events. Diss. University of New South Wales (Australia), 2023.*
13. *Minutello, Robert M., et al. "Door-to-balloon time in primary percutaneous coronary intervention predicts degree of myocardial necrosis as measured using cardiac biomarkers." Texas Heart Institute Journal 37.2 (2010): 161.*
14. *Misra, Anoop, et al. "Diabetes, cardiovascular disease, and chronic kidney disease in South Asia: current status and future directions." BMJ 357 (2017).*
15. *Scalise, Renato Francesco Maria, et al. "Radial artery access for percutaneous cardiovascular interventions: contemporary insights and novel approaches." Journal of Clinical Medicine 8.10 (2019): 1727.*
16. *De Luca, Giuseppe, et al. "Time delay to treatment and mortality in primary angioplasty for acute myocardial infarction: every minute of delay counts." Circulation 109.10 (2004): 1223-1225.*
17. *Beza, Lemlem, et al. "Treatment seeking behaviours and associated factors among patients experiencing acute coronary syndrome using health belief model in Addis Ababa, Ethiopia." Ethiopian journal of health sciences 32.4 (2022): 781-790.*
18. *Holzknecht, Magdalena, et al. "Association of C-reactive protein velocity with early left ventricular dysfunction in patients with first ST-elevation myocardial infarction." Journal of Clinical Medicine 10.23 (2021): 5494.*
19. *Patel, Siddharth M., et al. "Association of serial high-sensitivity cardiac troponin T with subsequent cardiovascular events in patients stabilized after acute coronary syndrome: a secondary analysis from IMPROVE-IT." JAMA cardiology 7.12 (2022): 1199-1206.*
20. *Philbert, Shana Cyr, et al. "Improving cardiovascular health in primary care in Saint Lucia through the HEARTS initiative." Revista Panamericana de Salud Pública 46 (2023): e128.*