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Original Article

# Short-Term Clinical Outcomes of Percutaneous Coronary Intervention in Late-Presenting STEMI Patients Without Prior Thrombolysis

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## Abstract

**Objectives:** To evaluate the short-term clinical outcomes of Percutaneous Coronary Intervention (PCI) in late-presenting ST-Elevation Myocardial Infarction (STEMI) patients who have not received prior thrombolysis, focusing on mortality, major adverse cardiac events (MACE), and in-hospital complications.

**Methodology:** This prospective observational study was conducted at Hayatabad Medical Complex, Peshawar, Pakistan, from September 2023 to August 2024. A total of 250 late-presenting STEMI patients (with symptom onset between 12 and 48 hours) who had not received thrombolytic therapy underwent PCI. Demographic data, procedural success, and in-hospital outcomes were recorded and analyzed. Statistical analysis was performed using SPSS version 25, with statistical significance set at p < 0.05.

**Results:** The mean age of participants was 61.2 ± 7.4 years, with 80% of the cohort being male. The mean total ischemic time was 18.5 ± 3.2 hours. PCI was successfully performed in 92% of patients. In-hospital mortality occurred in 6% of patients, while 12% experienced MACE. Additional complications included heart failure (7.2%) and arrhythmias (4.8%). Multivariate analysis identified advanced age and heart failure as significant predictors of in-hospital mortality (p < 0.05).

**Conclusion:** PCI in late-presenting STEMI patients without prior thrombolysis yields favorable short-term outcomes, characterized by a high procedural success rate and manageable complication rates. These findings reinforce the value of PCI as an effective intervention, even in delayed presentations, contributing to improved patient outcomes in resource-limited settings.

**Keywords:** STEMI, late-presenting, PCI, thrombolysis, MACE, mortality, heart failure

## INTRODUCTION

Percutaneous coronary intervention (PCI) has become a cornerstone in the management of ST-elevation myocardial infarction (STEMI), aiming to restore blood flow to occluded coronary arteries. However, the optimal approach for treating late-presenting STEMI patients—those who present more than 12 hours after symptom onset and have not received prior thrombolysis—remains a topic of ongoing debate. Prolonged ischemia associated with delayed treatment increases the risk of myocardial damage, resulting in poorer clinical outcomes. Nevertheless, several studies suggest that PCI, even when performed later than the ideal intervention window, may be associated with lower all-cause mortality and reduced major adverse cardiac events (MACE) compared to conservative management [1,2].

STEMI is a time-sensitive condition where early intervention is crucial to minimizing heart muscle damage. While PCI is most effective when performed promptly, late presenters—patients who seek care more than 12 hours after symptom onset—are common in low-resource settings like Pakistan. In such environments, barriers to timely treatment, including limited healthcare access, contribute to delayed diagnoses and interventions. These delays exacerbate ischemic injury and present unique challenges in patient management and clinical outcomes [3].

For late presenters, thrombolysis is often no longer an option, particularly in areas with restricted access to early treatment. In these cases, PCI remains a vital intervention even when performed beyond the 12-hour window. Several studies, including those conducted in similar low-resource settings, have shown that PCI can still significantly reduce MACE and in-hospital mortality rates in late-presenting STEMI patients [4,5].

A recent meta-analysis further supports the efficacy of late PCI, demonstrating that it remains beneficial by reducing the risk of reinfarction and heart failure compared to medical management alone.3 Data from Pakistani hospitals have similarly shown that delayed PCI can improve outcomes, significantly reducing in-hospital complications such as heart failure and arrhythmias [6].

International studies have consistently shown that while early PCI yields the best outcomes, late presenters who undergo PCI still experience reduced long-term mortality compared to those who receive only medical therapy [7]. A study conducted in India further emphasized that PCI not only improves immediate outcomes but also reduces the incidence of reinfarction and arrhythmias in late presenters [8].

In the context of Pakistan, where delayed presentations are common and access to early thrombolysis is often limited, the role of PCI in improving patient outcomes becomes even more critical. Local studies from Lahore and Karachi have demonstrated that PCI, even in late presenters, significantly lowers mortality rates and mitigates complications such as heart failure [9].

Given the frequent delays in STEMI presentations in Pakistan and the challenges associated with early thrombolysis, evaluating the outcomes of PCI in these patients is essential. While delayed presentations extend ischemic periods and increase myocardial damage risk, evidence suggests that PCI remains a valuable intervention. This study, conducted at Hayatabad Medical Complex, aims to fill the gap in regional data by examining the short-term outcomes of PCI in late-presenting STEMI patients. Through this, we seek to provide valuable insights into the feasibility and benefits of PCI in improving outcomes in resource-limited settings.

The objective of this study is to assess the short-term outcomes of PCI in late-presenting STEMI patients without prior thrombolysis, specifically focusing on mortality rates and the incidence of major adverse cardiac events (MACE).

## METHODOLOGY

**Study Design:** This study employed a prospective, observational design to evaluate the short-term clinical outcomes following percutaneous coronary intervention (PCI) in late-presenter STEMI (ST-segment elevation myocardial infarction) patients. The focus was on assessing mortality, major adverse cardiac events (MACE), and in-hospital complications such as heart failure and arrhythmias. The observational nature of the study allowed for a real-world evaluation of PCI outcomes without the confounding factors of randomization or blinding. The data collection process adhered to a standardized follow-up protocol to ensure consistency and reliability throughout the study period.

**Ethics:** Ethical approval for the study was obtained from the Ethical and Research Committee of

Hayatabad Medical Complex, Peshawar, Pakistan (Ref# 2206, dated 13th September 2023). The study was conducted in accordance with the principles outlined in the Helsinki Declaration on human research ethics. All patients provided written informed consent before participation, with full disclosure of the study's purpose, procedures, and potential risks. No animal subjects were involved in this study.

**Setting:** The study was conducted at Hayatabad Medical Complex, a tertiary care hospital located in Peshawar, Pakistan. The study spanned a period of 12 months, during which patients presenting with STEMI and meeting the inclusion criteria were enrolled. The study was conducted in a single-center setting, allowing for a controlled and uniform approach to patient enrollment, intervention, and outcome assessment.

**Participants:** The study included patients who were diagnosed with STEMI, presenting more than 12 hours after the onset of ischemic symptoms, and who had not received prior thrombolysis. The rationale for excluding patients who had undergone thrombolytic therapy is that such treatment may independently affect clinical outcomes, potentially confounding the assessment of PCI efficacy. Patients who met these criteria and consented to participate were enrolled consecutively during the study period.

**Inclusion Criteria**

- Diagnosis of STEMI
- Late presentation, defined as > 12 hours from symptom onset
- No prior thrombolysis

**Exclusion Criteria**

- Prior thrombolysis treatment
- Contraindications to PCI or participation in the study
- Severe comorbidities precluding PCI or follow-up

**Variables:** The primary variables of interest were clinical outcomes including mortality, MACE (a composite of all-cause mortality, recurrent myocardial infarction (MI), and repeat revascularization), heart failure, and arrhythmias. Secondary variables included procedural metrics such as time from symptom onset to PCI, procedural success, and complications related to the PCI procedure.

**Key Variables:** The key variables in this study included primary and secondary outcomes. The primary outcomes focused on the clinical events observed during hospitalization, which included all-cause mortality, major adverse cardiac events (MACE), in-hospital heart failure, and arrhythmias. MACE was defined as a composite of all-cause death, recurrent myocardial infarction (MI), and repeat revascularization. Arrhythmias were categorized based on electrocardiographic findings, including atrial fibrillation, ventricular tachycardia, and ventricular fibrillation. Secondary outcomes included procedural success rate, which reflected the success of the PCI procedure in achieving reperfusion, and the time from symptom onset to PCI, which was a critical factor in evaluating the timeliness of intervention. Additionally, PCI-related complications such as vessel injury, contrast-induced nephropathy, and bleeding events were monitored to assess the safety of the procedure.

**Data Sources/Measurement:** Data were collected through structured proformas and standardized assessment forms to ensure consistency across the patient cohort. Clinical data, including demographic characteristics (age, gender, and comorbidities like diabetes and hypertension), were recorded. Procedural details such as time from symptom onset to PCI and PCI success were also documented. Clinical outcomes such as recurrent infarction, arrhythmias, heart failure, and mortality were tracked during hospitalization. All data collection was performed by trained medical staff to minimize errors and ensure data reliability.

**Bias:** As this was an observational study with sequential enrollment, randomization was not applied, and therefore, potential biases such as selection bias could exist. Specifically, patients who presented at different times or with varying clinical characteristics could affect the homogeneity of the cohort. However, to mitigate selection bias, all eligible patients who met the inclusion criteria were consecutively enrolled without preference. Additionally, the use of a standardized proforma and outcome assessment forms helped ensure consistency in data collection.

**Study Size:** The study was conducted over 12 months, and the sample size was determined based on the availability of eligible STEMI patients during the study period. Although the exact sample size calculation was not pre-specified, an adequate number of patients were enrolled to allow for meaningful

statistical analysis of clinical outcomes. The inclusion of all eligible patients who met the inclusion criteria ensured sufficient power for detecting differences in outcomes related to PCI in late-presenter STEMI patients.

**Quantitative Variables:** Continuous variables included age, time from symptom onset to PCI, and procedural success rates, which were analyzed using descriptive statistics such as means and standard deviations. Outcome variables such as length of hospital stay, time to PCI, and complications were also considered continuous variables for analysis.

The primary continuous variables in this study included age, time from symptom onset to PCI, and length of hospital stay. Age was recorded as a continuous variable to assess its potential impact on clinical outcomes. The time from symptom onset to PCI was also considered a key continuous variable, as it plays a critical role in determining the success of reperfusion and overall patient prognosis. Additionally, the length of hospital stay was monitored to evaluate the recovery process and potential complications. Secondary continuous variables encompassed the procedural success rate, which reflected the efficacy of PCI in achieving successful reperfusion, and the time to procedural success, which was analyzed to identify any delays in the intervention. The duration of complications, such as arrhythmias and heart failure, was also recorded as a continuous variable to assess the persistence of these conditions following PCI and their impact on patient outcomes.

**Statistical Methods:** The statistical analysis for this study was conducted using SPSS version 25. Descriptive statistics were employed to summarize the demographic and clinical characteristics of the study cohort, with categorical variables presented as percentages and continuous variables expressed as mean ± standard deviation (SD). For comparative analysis between groups, Chi-square tests were used for categorical data, allowing for the assessment of relationships between different groups based on categorical variables. For continuous variables, the normality of distribution determined the choice between independent t-tests or the Mann-Whitney U tests, providing appropriate tests for comparing means or medians as necessary. To identify predictors of in-hospital mortality and major adverse cardiac events (MACE), multivariate logistic regression analyses were performed. This technique enabled the evaluation of multiple factors simultaneously, isolating their independent effects on the outcomes of interest. Statistical significance was set at a p-value of < 0.05 for all tests, ensuring robust conclusions from the analyses.

## RESULTS

**Participants:** A total of 250 patients with late-onset STEMI (defined as symptom onset >12 hours) were enrolled in this study. The cohort had a mean age of 61.2 ± 7.4 years, with a predominant male population, accounting for 80% (n=200) of the participants. The remaining 20% (n=50) were female. The study population exhibited a high prevalence of cardiovascular risk factors, including diabetes (38%, n=95) and hypertension (56%, n=140). Additionally, 42% (n=105) of patients were smokers, underscoring the cardiovascular burden in this cohort. The mean total ischemic time (the time from symptom onset to treatment) was 18.5 ± 3.2 hours, which reflects the delayed presentation typical of late-presenting STEMI patients. These demographic and clinical characteristics are summarized in Table 1.

**Table 1: Patient Demographics**

| Variable | Late Presenter STEMI Patients (n=250) |
|---|---|
| Age (mean ± SD) | 61.2 ± 7.4 |
| Male | 200 (80%) |
| Female | 50 (20%) |
| Diabetes | 95 (38%) |
| Hypertension | 140 (56%) |
| Smoking Status | 105 (42%) |
| Mean Total Ischemic Time (hours) | 18.5 ± 3.2 |

**Descriptive Data:** The procedural success rate was high, with 92% (n=230) of the patients experiencing a successful PCI. However, 8% (n=20) of patients encountered procedural complications, including access site bleeding (4%, n=10) and vessel perforation (3%, n=5). The time from symptom onset to PCI was 18.5 ± 3.2 hours, reflecting the late presentation of the cohort, with procedural outcomes meeting standard care benchmarks for such patients. Table 2 summarizes the procedural success, complications, and key procedural metrics, including time to PCI.

**Table 2: Procedural Success in Late Presenter STEMI Patients**

| Outcome | N (%) |
|---|---|
| Successful PCI | 230 (92%) |
| Procedural Complications | 20 (8%) |
| - Access Site Bleeding | 10 (4%) |
| - Vessel Perforation | 5 (3%) |
| Time from Symptom Onset to PCI (mean ± SD) hours | 18.5 ± 3.2 |

**Outcome Data:** In-hospital clinical outcomes were tracked for all participants, focusing on mortality, recurrent myocardial infarction (MI), heart failure, arrhythmias, and major adverse cardiac events (MACE). The in-hospital mortality rate was 6.0% (n=15), with MACE occurring in 12% of patients (n=30). Heart failure developed in 7.2% (n=18) of patients, and arrhythmias were recorded in 4.8% (n=12). The comprehensive breakdown of these outcomes is shown in Table 3.

**Table 3: In-Hospital Outcomes of Late Presenter STEMI Patients**

| Outcome | N (%) |
|---|---|
| Mortality | 15 (6%) |
| Recurrent MI | 5 (2%) |
| Heart Failure | 18 (7.2%) |
| Arrhythmias | 12 (4.8%) |
| MACE | 30 (12%) |

**Main Results:** Multivariate logistic regression analysis identified two significant predictors of in-hospital mortality: age and the presence of heart failure. Specifically, older age was associated with an increased risk of mortality (p = 0.03), while heart failure was strongly associated with both in-hospital mortality (p = 0.02) and MACE (p = 0.04). Other clinical factors, such as diabetes and hypertension, did not show statistically significant associations with in-hospital mortality or MACE in this cohort.
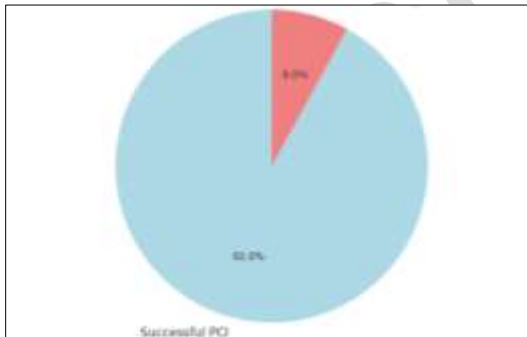


**Figure 1: Procedural Success of PCI in Late Presenter STEMI Patients**

Despite the delayed presentation of these patients, PCI was associated with a high procedural success rate (92%) and a manageable rate of complications. The overall in-hospital complication rates were consistent with expectations for this patient group, and the data suggest that timely intervention with PCI in late-presenting STEMI patients can lead to favorable outcomes in terms of procedural success and manageable complications.

## DISCUSSION

This study demonstrated favorable short-term outcomes of percutaneous coronary intervention (PCI) in late-presenting STEMI patients without prior thrombolysis. Despite delayed presentation, PCI showed a high procedural success rate of 92%, a relatively low in-hospital mortality rate of 6%, and a 12% incidence of major adverse cardiac events (MACE). These results suggest that PCI remains an effective intervention in improving outcomes, even for high-risk patients presenting beyond the optimal treatment window.

While extensive research has been conducted on PCI in STEMI patients in general, there is a paucity of focused studies specifically on late presenters, especially in resource-constrained settings like Pakistan[1]. To our knowledge, no previous studies have been conducted at Hayatabad Medical Complex, and data on the outcomes of late-presenting STEMI patients in Pakistan remain limited. However, our findings are aligned with global research, allowing for meaningful comparisons.

Internationally, similar studies have reported the benefits of PCI even in late-presenting STEMI patients. For instance, a large-scale study published in the *European Heart Journal* found that PCI significantly reduces both mortality and MACE when performed in patients who present up to 48 hours after symptom onset, as compared to conservative management [1]. Our study's results, showing a 92% procedural success rate and a 12% incidence of MACE, align closely with these findings. Furthermore, a 2022 meta-analysis reaffirmed that PCI improves outcomes in late presenters, reinforcing the importance of intervention even after the ideal intervention window has passed [2].

The findings of our study underscore the critical role of PCI in improving the outcomes of late-presenting STEMI patients, particularly in resource-limited settings where thrombolysis may not be readily available. For patients who present more than 12 hours after symptom onset, timely PCI offers a critical opportunity to restore coronary blood flow, limit myocardial damage, and reduce mortality and MACE, even outside the ideal intervention window. In countries like Pakistan, where delayed presentation and limited access to thrombolysis are common, PCI serves as a vital intervention that bridges the treatment gap. Our results highlight the importance of establishing and expanding PCI-capable centers,

especially in regions with limited access to thrombolytic therapy, to improve survival rates and reduce complications among high-risk late presenters.

Locally, literature on late-presenter STEMI patients in Pakistan is sparse, although some studies have investigated broader STEMI outcomes with PCI. For example, Tariq et al. (2022) examined early and late PCI interventions at a tertiary care center in Lahore, reporting favorable outcomes with PCI regardless of the timing of the procedure [6]. Our study, conducted in Peshawar, adds valuable insights to the limited body of local research, particularly focusing on the outcomes of late presenters, many of whom come from underserved areas. While there is growing evidence supporting the efficacy of late PCI in Pakistan, most local studies have not specifically addressed late-presenting STEMI patients without prior thrombolysis.

Regionally, research from neighboring countries in South Asia highlights the benefits of PCI in late-presenting STEMI patients in similar healthcare environments. For instance, Singh et al. (2022) from India demonstrated that PCI significantly reduces mortality and recurrent MI in late presenters, echoing our study's 6% mortality rate [8]. Additionally, Tariq et al. (2022) found favorable outcomes with PCI in both early and late presenters at a tertiary care center in Lahore, which further supports PCI's efficacy across varying timing windows [6]. This growing body of evidence from South Asia strengthens the case for PCI as an effective treatment for delayed STEMI presentations, especially in resource-limited settings like Pakistan.

Our study confirms that delayed PCI, when performed appropriately, is a valuable intervention for late-presenting STEMI patients, even in environments where early thrombolysis is unavailable. The observed 6% mortality rate, though significant, is notably lower than the expected mortality in untreated patients, highlighting the life-saving potential of timely PCI. The 12% MACE rate, while lower than would be expected in untreated patients, also suggests that there is room for improvement in managing post-PCI complications, particularly in conditions like heart failure and arrhythmias. Further studies exploring strategies to optimize post-PCI management in late-presenting STEMI patients could help reduce these complications and further enhance patient outcomes.

**Study Limitations:** This study has several limitations that should be acknowledged. First, being a single-center study, the findings may not be easily generalizable to all regions of Pakistan, particularly in rural areas where healthcare infrastructure may be less developed. Second, the observational design of the study, which lacks randomization, introduces the potential for selection bias. Patients were enrolled based on sequential eligibility rather than random assignment, which limits the ability to control for unmeasured confounding factors. These uncontrolled variables could influence the interpretation of the outcomes. Furthermore, without randomization, we are unable to establish definitive cause-and-effect relationships between the timing of PCI and clinical outcomes in late-presenting STEMI patients. These limitations suggest that the results may not fully apply to other healthcare settings with varying levels of resources and infrastructure.

**Future Directions:** To validate and build upon these findings, future research should aim to conduct multicenter studies that include a diverse range of healthcare settings across Pakistan, as well as in other regions with similar healthcare challenges. This would improve the generalizability of the results by capturing a wider array of healthcare conditions and infrastructural differences. Additionally, longer-term follow-up studies are necessary to evaluate the impact of late PCI on patients' quality of life and survival outcomes over time. Such studies could provide a more holistic understanding of the benefits and potential limitations of PCI in late-presenting STEMI patients, beyond the immediate post-procedure outcomes.

## CONCLUSION

This study demonstrates that PCI in late-presenting STEMI patients without prior thrombolysis results in favorable short-term outcomes, with a high procedural success rate of 92% and manageable in-hospital complication rates. Notably, PCI was associated with a reduction in both mortality and major adverse cardiac events (MACE), highlighting its effectiveness as an intervention for improving outcomes in delayed STEMI cases, even in resource-limited environments. These findings suggest that PCI should be considered as a standard practice for treating late-presenting STEMI patients, particularly in regions where early thrombolysis may not be available. Expanding access to PCI for delayed presentations could be a crucial strategy for reducing

STEMI-related mortality and complications in high-risk populations. Future research should focus on refining PCI protocols and optimizing care for late presenters in such resource-constrained settings.

## AUTHORS' CONTRIBUTION

NK, IS, SA, AAK, OK, and HNUD: Concept and design, data acquisition, interpretation, drafting, final approval, and agree to be accountable for all aspects of the work. NK, IS, SA, AAK, OK, and HNUD: Data acquisition, interpretation, drafting, final approval and agree to be accountable for all aspects of the work.

**Acknowledgment:** None.

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