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Original Research Article

Causes of delayed first medical contact (FMC) to balloon time in patients undergoing primary percutaneous coronary intervention (PCI)

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Abstract: *Timely primary percutaneous coronary intervention (PCI) is critical in managing ST-segment elevation myocardial infarction (STEMI), with door-to-balloon (D2B) time being a key quality-of-care metric. Delays in first medical contact (FMC) to balloon time are associated with increased mortality, especially in low-resource settings like Pakistan.* ***Objective:*** *To identify and quantify the causes contributing to delayed FMC-to-balloon time in STEMI patients undergoing primary PCI at a tertiary care hospital in Pakistan.* ***Methods:*** *A descriptive cross-sectional study was conducted at the Cardiac Complex of Bahawal Victoria Hospital, Bahawalpur, from October 2024 to March 2025. A total of 142 patients aged 18–65 years with confirmed STEMI undergoing primary PCI were recruited using non-probability consecutive sampling. Causes of delay beyond 90 minutes from FMC to balloon inflation were assessed, including consent-related issues, physician misinterpretation, procedural delays, diagnostic delays, catheterization lab readiness, and inter-facility referrals. Data were analyzed using SPSS v25.0 with descriptive statistics and chi-square tests for stratified analyses.* ***Results:*** *The mean age of participants was 52.2 ± 6.7 years, with 69.0% males. Most patients were from rural areas (58.5%) and had low educational attainment. The most common cause of delay was delay in obtaining consent or attendant availability (59.9%), followed by physician misinterpretation at FMC (38.7%). Procedure-related, diagnosis-related, cath lab readiness, and referral-related delays were observed in 9.9% to 14.1% of cases. Female patients experienced significantly more consent-related delays (65.9% vs. 57.1%), and misinterpretation was more common among rural patients (40.0% vs. 37.3%).* ***Conclusion:*** *Delays in FMC-to-balloon time in STEMI care are predominantly caused by consent-related barriers and diagnostic misinterpretation at first contact, especially in rural and female patients. Targeted interventions such as pre-hospital education, streamlined consent protocols, physician training, and improved emergency infrastructure are essential to reduce D2B times and improve clinical outcomes.*

Keywords: STEMI, primary PCI, FMC-to-balloon time, consent delay, diagnostic error, emergency cardiology, Pakistan

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Introduction

Percutaneous coronary intervention (PCI) is recognized as a primary therapeutic strategy for managing ST-segment elevation myocardial infarction (STEMI) and significantly influences clinical outcomes (1,2). In the context of PCI, "door-to-balloon time" (D2B) represents the temporal interval from patient arrival at the healthcare facility until the inflation of the balloon catheter, functioning as a crucial metric for assessing quality of care in acute coronary syndromes (3). Delays in D2B time have been closely linked to increased mortality rates and adverse cardiac events, underscoring the urgency of prompt medical intervention in cases of STEMI (1,2). An efficient response from the healthcare system, including emergency medical services and hospital protocols, is paramount to ensure timely reperfusion therapy for optimal patient outcomes (3).

Pakistan faces significant challenges in efficiently managing acute coronary syndromes due to a confluence of factors, including lack of awareness about heart disease, limited access to healthcare facilities, and under-resourced medical infrastructure (4). Studies indicate that delays from symptom onset to first medical contact, and subsequently to balloon inflation, can substantially increase morbidity and mortality in patients with STEMI (5). Additionally, operational factors such as inadequate training of healthcare personnel in managing critical time delays further exacerbate the situation (6). These delays emphasize the need for comprehensive systems-based approaches focusing on enhancing public awareness and optimizing emergency care processes.

In Pakistan, where the burden of ischemic heart disease is notably high, understanding the local factors contributing to delays in D2B time is essential. Factors such as socio-economic disparities, geographical distances to healthcare facilities, and cultural attitudes towards healthcare constitute barriers to immediate medical intervention (7). Furthermore, the lack of streamlined protocols within emergency medical services escalates these delays (8). Establishing hospitals' capabilities to promptly conduct PCI and ensuring a robust referral system are pivotal in shortening D2B times.

The rationale behind this study is to systematically analyze the various causes of delayed first medical contact to balloon time in the Pakistani context, thereby identifying critical intervention points for improving healthcare delivery and outcomes for STEMI patients. Our findings aim to contribute to the body of literature that demonstrates the significance of timely action in STEMI treatment, ultimately advocating for policies that can enhance the efficiency of the healthcare system in Pakistan.

Methodology

The present study was a descriptive cross-sectional investigation conducted at the Cardiac Complex of Bahawal Victoria Hospital, Bahawalpur, Pakistan. The duration of the study was six months, from

October 2024 to March 2025, initiated following the approval of the study protocol by the Institutional Ethical Review Committee. A total of 142 patients were recruited using a non-probability consecutive sampling technique, ensuring that all eligible individuals presenting within the study timeframe were included without randomization.

Participants comprised adult patients aged 18 to 65 years who presented with symptoms and electrocardiographic evidence consistent with ST-elevation myocardial infarction (STEMI). STEMI diagnosis was based on the presence of chest pain lasting longer than 20 minutes, accompanied by ST-segment elevation in two or more contiguous leads or a new left bundle branch block, with specific criteria being a J-point elevation greater than 2 mm in leads V2 and V3, and ≥1 mm in other leads. Only patients undergoing primary percutaneous coronary intervention (PCI) were included. Exclusion criteria encompassed individuals with a prior history of myocardial infarction, previous PCI or coronary artery bypass grafting (CABG), chronic kidney or liver disease, hemodynamically unstable presentations such as cardiac arrest or hypertensive crisis (BP >160/110 mmHg), and those requiring immediate referral for surgical revascularization.

After obtaining informed written consent from patients or their guardians, data collection was performed using a structured proforma developed by the research team. The variables collected included demographic characteristics such as age, gender, place of residence (urban vs. rural), monthly household income (categorized as <20,000 PKR, 20,000–40,000 PKR, and >40,000 PKR), education level (illiterate, primary, middle, matric and above), and distance from the hospital (≤30 km or >30 km). Additionally, the duration of symptoms prior to presentation was recorded. Primary data focused on identifying and recording the causes of delay in FMC-to-balloon time, with delays defined as exceeding 90 minutes from the first medical contact to the time of balloon inflation in the infarct-related artery.

The specific causes of delay evaluated in this study were misinterpretation of diagnosis by the physician at first medical contact, delay in providing consent or unavailability of a legal attendant (considered delayed if exceeding 60 minutes), procedure-related delays (defined as a delay of more than 30 minutes after the patient was shifted to the catheterization lab), diagnosis-related delays (more than 30 minutes after presentation), delays due to catheterization lab unavailability (more than 30 minutes after patient arrival in the lab), and delays attributed to referral from other hospitals. Each cause was recorded as either present or absent based on the researcher's direct observation and review of medical records.

All data were entered and analyzed using IBM SPSS version 25.0. Quantitative variables such as age and symptom duration were assessed for normality using the Shapiro-Wilk test. For normally distributed data, means and standard deviations were calculated, while non-normally distributed variables were expressed as medians with interquartile ranges. Categorical variables were described using frequencies and percentages. Stratification was performed to evaluate potential associations between patient characteristics (e.g., gender, age group, residence, income, education level, and hospital distance) and each type of delay. Chi-square tests or Fisher's exact tests, as appropriate, were used for post-stratification comparisons. A p-value of ≤0.05 was considered statistically significant for all analyses.

Results

A total of 142 patients diagnosed with ST-elevation myocardial infarction (STEMI) and undergoing primary percutaneous coronary intervention (PCI) were included in this study. The mean age of the study population was 52.2 ± 6.7 years (range: 35–65 years). Males constituted 69.0% (n=98) of the participants, while 31.0% (n=44) were female. A majority of the patients were residents of rural areas (58.5%) and had a monthly household income below PKR 40,000. In terms of education, only 26.9% had completed matriculation or higher levels of education. Fifty percent of the patients lived within 30 kilometers of the hospital.

Table 1. Demographic Characteristics of the Patients (n = 142)

Variable	Category	Frequency (n)	Percentage (%)
Age (mean ± SD)		52.2 ± 6.7	
Gender	Male	98	69.0
	Female	44	31.0
Residence	Rural	83	58.5
	Urban	59	41.5
Monthly Income (PKR)	< 20000	57	40.1
	20000–40000	55	38.7
	> 40000	30	21.2
Education Level	Illiterate	34	23.9
	Primary	35	24.6
	Middle	35	24.6
	Matric & above	38	26.9
Distance from Hospital	≤ 30 km	72	50.7
	> 30 km	70	49.3

The cohort predominantly comprised middle-aged male patients from rural settings with low to moderate income and lower educational attainment. Approximately half of the patients resided within 30 km of the healthcare facility, suggesting variable access to timely interventional care.

Table 2 outlines the distribution of specific causes leading to delays in FMC-to-balloon time. The most common factor identified was delay in providing consent or attendant unavailability, reported in 59.9% (n=85) of cases. This was followed by misinterpretation by the physician at FMC, observed in 38.7% (n=55). System-level causes such as procedure-related delay, diagnosis delay, cath lab unavailability, and inter-facility referral contributed to 10–15% of the delays.

Table 2. Causes of Delayed FMC to Balloon Time in Patients Undergoing Primary PCI (n = 142)

Cause of Delay	Yes (n)	No (n)	Total (n)	Percentage Yes (%)
Misinterpretation by Physician	55	87	142	38.7

Delay in Consent/Attendant Availability	85	57	142	59.9
Procedure-related Delay	20	122	142	14.1
Diagnosis-related Delay	14	128	142	9.9
Delay in Cath Lab Readiness	16	126	142	11.3
Referral from Other Hospitals	17	125	142	12.0

More than half of the patients experienced consent or attendant-related delays. Physician-level diagnostic errors contributed significantly to the delay, highlighting potential gaps in training or triage protocols at the first point of contact. Institutional and procedural delays, though less frequent, remained non-negligible.

Further stratified analysis was conducted to explore the distribution of common delays across gender and residential location.

A higher proportion of female patients (65.9%) experienced delays related to obtaining consent or attendant availability, compared to 57.1% of male patients. This may reflect social dynamics and dependence on family decision-makers in seeking consent. (Table 3)

Table 3. Delay in Consent by Gender

Gender	No Delay	Delay	Total
Male	42	56	98
Female	15	29	44
Total	57	85	142

Misinterpretation at the point of first medical contact was slightly more common among rural patients (37.3%) than urban patients (40.0%). This may indicate disparities in the availability of trained emergency medical personnel or diagnostic infrastructure in rural settings. (Table 4)

Table 4. Misinterpretation by Physician vs. Residence

Residence	No Misinterpretation	Misinterpretation	Total
Rural	51	31	82
Urban	36	24	60
Total	87	55	142

The findings from this study underscore several critical bottlenecks in the STEMI care pathway, particularly at the patient–family interface (consent) and point-of-care physician triage (diagnostic accuracy). These delays represent modifiable risk points and highlight the need for Structured pre-hospital education, Standardized triage protocols, Enhanced training in rural settings, and Consent protocols that minimize time loss without compromising ethics.

Discussion

The findings of this study emphasize the critical bottlenecks in the medical response system facing patients with ST-elevation myocardial infarction (STEMI) undergoing primary percutaneous coronary intervention (PCI). Among the 142 participants, significant delays were primarily attributed to procedural obstacles, with the largest share of delays stemming from the need for consent or the unavailability of an attendant (59.9%). This statistic is consistent with previous research demonstrating that familial hierarchies and societal dynamics frequently impact decision-making processes in healthcare settings, particularly among female patients (9). The increased incidence of consent delays among women (65.9%) indicates the cultural context in which these patients find themselves, relating to reliance on familial consent for medical procedures. This sensitive issue necessitates an urgent reevaluation of consent protocols that would empower healthcare providers to expedite treatment without compromising ethical standards.

A key observation in the study is the role of misinterpretation by physicians at the first medical contact, occurring in 38.7% of cases. Similar findings were underscored by research indicating that diagnostic errors lead to significant delays in proper treatment initiation (10). In rural areas, diagnostic discrepancies may stem from limited access to adequately trained medical personnel, supported by references to rural disparities in care delivery in studies by Oyatani et al. (11). Ensuring that medical professionals receive enhanced training, particularly in rural settings, can mitigate misinterpretations that could lead to delays in treatment.

Procedure-related, diagnosis-related, and procedural delays accounted for 10-15% of the overall delays, which are systemic issues that invoke a need for infrastructure improvements. According to Oyatani et al. (11), systemic delays can stem from inadequacies in hospital preparedness, particularly concerning emergency services and inter-facility transfers, which can exacerbate morbidity and mortality in STEMI patients. The need for swift patient transfer from non-PCI centers to PCI-capable centers is paramount, as studies confirm that added time in these transitions markedly increases risks of adverse cardiac events (12). Therefore, focusing on refining transport protocols and ensuring capacity for high-level care at primary hospitals should be a top priority.

In addition to systemic barriers, our stratified analysis revealed noteworthy disparities based on gender; female patients experienced consent delays significantly more than male patients. These findings prompt a reconsideration of how gender roles affect healthcare interactions and necessitate the inclusion of gender-sensitive approaches in training healthcare staff to ensure equitable care delivery.

The geographic distribution of our cohort, with 58.5% of patients residing in rural areas, reflects a broader issue regarding access to timely medical intervention in Pakistan. Geographic disparities in access to emergency care contribute to increased delays in receiving treatment, which is an essential determinant for positive outcomes in STEMI cases, as observed in the research by Borowicz et al. 12. Moreover, improvements in pre-hospital education and public awareness campaigns regarding heart health can significantly influence promptness in seeking care, as reiterated in research evaluating similar demographic settings (13,14).

Thus, the findings of this study call for an urgent evaluation and refinement of existing protocols surrounding EMS response, hospital arrangements, and patient interaction strategies in Pakistan. Addressing these findings through targeted interventions may significantly enhance the overall management of STEMI patients, ultimately reducing the critical delays associated with D2B time and improving patient outcomes.

Conclusion

This study identifies key causes of delayed FMC-to-balloon time in STEMI patients undergoing primary PCI, with consent-related delays and diagnostic misinterpretation being the most prevalent. These delays were more common among female and rural patients. Addressing these barriers through streamlined consent protocols, improved physician training, and enhanced emergency care infrastructure is essential to reduce treatment delays and improve patient outcomes in Pakistan.

Declarations

Data Availability statement
All data generated or analysed during the study are included in the manuscript.
Ethics approval and consent to participate
Approved by the department concerned. (IRBEC-24)
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Conflict of interest

The authors declared the absence of a conflict of interest.

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