



Identifying and Analyzing Barriers to Timely Primary PCI Access for STEMI Patients in Pakistan: A Comprehensive Study.

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Abstract

Background: Primary Percutaneous Coronary Intervention (PPCI) is the gold standard for STEMI. Door-to-Balloon time <90 min is critical. Delays are common in low-middle income countries like Pakistan. **Objective:** To identify and analyze patient, system, and hospital-related barriers to timely PPCI access in STEMI patients in Pakistan. **Study Design:** Cross-sectional, multicenter study **Duration:** Interventional Cardiology Department, Sheikh Muhammad Bin Zayd Al Nyhan Institute of Cardiology and BMC/SPH, Quetta. **Materials & Methods:** 400 STEMI patients presenting within 24 hours who underwent PPCI were included. Data on symptom onset to FMC, FMC to ECG, ECG to activation, activation to arrival, and door to balloon time was collected. Barriers were categorized as patient, pre-hospital, and in-hospital. SPSS v26 used p<0.05 significant. **Results:** Mean age 55.4±11.2 years. 76% males. Median total ischemic time 360 min. Only 22% achieved D2B <90 min. Key barriers: Patient delay 45%, Lack of ambulance/EMS 38%, Inter-hospital transfer 31%, Financial constraints 29%, Cath lab activation delay 24%. Rural patients had 2.8x higher odds of D2B >90 min OR=2.8, 95% CI 1.9-4.1, p<0.001. **Conclusion:** Major delays occur before hospital arrival. Patient education, EMS development, 24/7 cath lab, and hub and spoke model are urgently needed to improve PPCI access in Balochistan.

Keywords: STEMI, Primary PCI, Door-to-Balloon, Barriers, Pakistan, ACS.



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INTRODUCTION

Cardiovascular disease is the leading cause of mortality worldwide, accounting for 17.9 million deaths annually, of which 85% are due to heart attack and stroke. In Pakistan, cardiovascular disease contributes to 19% of all deaths and is projected to rise further due to urbanization, sedentary lifestyle, and increasing prevalence of risk factors like diabetes and hypertension.¹

Among acute coronary syndromes, ST elevation myocardial infarction (STEMI) represents the most time-sensitive and life-threatening presentation. The cornerstone of STEMI management is timely reperfusion, preferably with primary percutaneous coronary intervention (PPCI). Current international guidelines recommend a door-to-balloon time of ≤90 minutes, as every 30-minute delay increases relative mortality risk by 7.5%.²⁻³

Despite the proven benefits of PPCI, access remains a major challenge in low and middle-income countries.⁴ In Pakistan, the burden of STEMI is substantial, yet the availability of 24/7 PPCI capable centers is limited to major urban tertiary hospitals. Most patients initially present to primary care centers or district hospitals that lack catheterization facilities, leading to significant system delays. Previous regional studies have reported median door-to-balloon times exceeding 120 minutes in Pakistani centers, well above guideline targets.⁵

Barriers to timely PPCI are multifactorial and include patient-related delays in seeking care, pre-hospital transport issues, lack of awareness, financial constraints, and hospital related factors such as limited cath lab availability, off hour

presentations, and lack of standardized STEMI protocols.⁶ Understanding these barriers in the Pakistani context is critical to design targeted interventions and improve STEMI care pathways.⁷

No comprehensive national study has systematically identified and analyzed barriers to timely PPCI access in Pakistan. This study aims to fill that gap by evaluating patient, pre-hospital, and hospital level factors that contribute to delays, and to propose recommendations for improving PPCI networks in Pakistan.

Objective: To quantify delays and identify major barriers to timely PPCI access for STEMI patients in Pakistan.

MATERIALS AND METHODS

This Cross-sectional, multicenter study was conducted at Interventional Cardiology Department, Sheikh Muhammad Bin Zayd Al Nyhan Institute of Cardiology and BMC Quetta, 12 months period after ERC approval. The Total sample size 400 Patient's calculated using WHO calculator with 95% CI, 5% margin of error Inclusion Criteria: Age ≥ 18 years STEMI diagnosed by ECG and tropon in Underwent PPCI within 24 hours of symptom onset, consent given, exclusion criteria was applied (STEMI treated with thrombolysis only Cardiogenic shock on arrival Incomplete data. A structured proforma was used. Time intervals recorded, Symptom onset to FMC, First medical contact FMC to ECG ECG to Cath Lab Activation Activation to Arrival at Cath Lab Door to Balloon D2B, FMC to wire crossing. Barrier Classification: Patient: >60 min from symptom to seeking care, self-medication, financial Pre-hospital: No EMS, inter-hospital transfer >30 min, distance >50 km In-hospital: ECG delay >10 min, activation delay >20 min, off-hours 6pm 8am. SPSS v26. Median with IQR for non-normal data. Chi-square, Mann-Whitney, Logistic regression. $p < 0.05$ significant.

RESULTS

Baseline Demographics Age Mean $\pm$ SD 55.4 ± 11.2 years, Male patients 304 (76%), Urban Residence 248 (62%), Rural Residence 152 (38%), Diabetes 168 (42%), Hypertension, 202 (50.5%) and Smoking patients was calculated 190 (47.5%). Table 1

Table 1: Baseline Demographics

Variable	No. Patients	(%)
Age Mean $\pm$ SD	55.4 ± 11.2 years	--
Male	304	(76%)
Urban Residence	248	(62%)
Rural Residence	152	(38%)
Diabetes	168	(42%)
Hypertension	202	(50.5%)
Smoking	190	(47.5%)

Time Intervals and Target Achievement symptom to FMC Median [IQR] minutes 150, Target <60 , percent achieved target 18%. FMC to ECG 12, Target <10 and 41%, ECG to Activation 25 Target <20 percent activation target 36%. Time interval activation to arrival 30 target <30 percent achieved target 52%. Door to Balloon 125, target <90 percent achieved target 22%. Total Ischemic Time 360 target <180 , percent achieved target 9%. Only 22% of patients achieved D2B <90 min. 78% had delayed PPCI. Table 2.

Table 2: Time Intervals and Target Achievement

Time Interval	Median [IQR] minutes	Target	Percent Achieved Target
Symptom to FMC	150	<60	18%
FMC to ECG	12	<10	41%
ECG to Activation	25	<20	36%
Activation to Arrival	30	<30	52%
Door-to-Balloon	125	<90	22%
Total Ischemic Time	360	<180	9%

*Only 22% of patients achieved D2B <90 min. 78% had delayed PPCI.

Barrier Category, patient Level 45% Delayed presentation >60 min 180 (45%). Financial constraints 116 (29%), self-medication/Consulted GP first 98 (24.5%), Pre-hospital 52% No EMS/Private transport 152 (38%), Inter-hospital transfer

124 (31%). Long distance >50km 110 (27.5%), In-hospital 31% Cath lab activation delay 96 (24%), ECG delay 68 (17%), Off-hours presentation 84 (21%). Table No. 3.

Table 3: Frequency of Identified Barriers

Barrier Category	Specific Barrier	Frequency	Percentage
Patient-Level 45%	Delayed presentation >60min	180	(45%)
	Financial constraints	116	(29%)
	Self-medication/Consulted GP first	98	(24.5%)
Pre-hospital 52%	No EMS/Private transport	152	(38%)
	Inter-hospital transfer	124	(31%)
	Long distance >50km	110	(27.5%)
In-hospital 31%	Cath lab activation delay	96	(24%)
	ECG delay	68	(17%)
	Off-hours presentation	84	(21%)

*Patients could have >1 barrier.

Patient delay was the single largest contributor. 45% waited >1 hour before seeking care. Pre-hospital system failure: 38% had no access to EMS. 1123 Rescue service was used by only 12%. Rural patients and those requiring transfer had 2.8x and 3.5x higher odds of delayed PPCI. In-hospital delays were less common but still significant. 24% had cath lab activation delay >20 min. Table No. 4

Table 4: Factors Associated with D2B >90 min

Factor	D2B ≤90 n=88	D2B >90 n=312	OR	p-value
Rural Residence	18 (20.5%)	134 (42.9%)	2.8	<0.001
No EMS Use	22 (25%)	130 (41.7%)	2.1	0.001
Inter-hospital Transfer	12 (13.6%)	112 (35.9%)	3.5	<0.001
Off-hours Presentation	15 (17%)	69 (22.1%)	1.3	0.28
Financial Barrier	14 (15.9%)	102 (32.7%)	2.5	<0.001

*Statistically significant. Logistic regression adjusted for age and gender.

Barrier categories patient 45%, pre-hospital 52%, in-hospital 31% Figure No.1

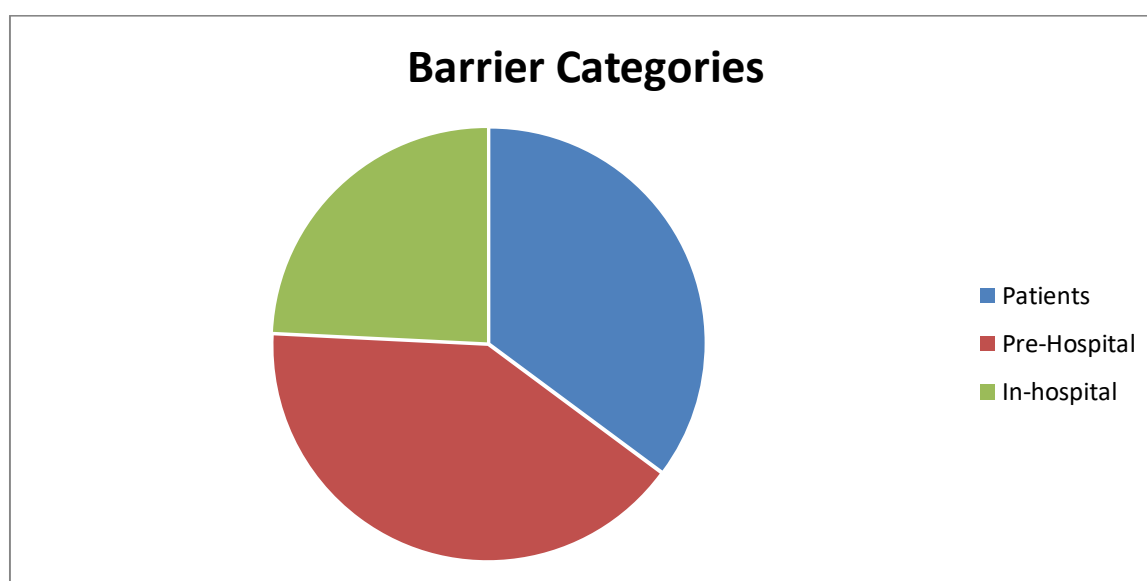


Figure 1: Pie chart of barrier categories

DISCUSSION

This is one of the first multicenter studies in Pakistan to systematically analyze barriers to PPCI in STEMI. Our data shows that timely PPCI is achieved in only 22% of patients, far below the 75% target recommended by ACC.8-10. Patient-Related

Barriers, 45% of patients delayed >60 minutes before seeking medical help. Causes include lack of awareness of chest pain as cardiac, self-medication with analgesics, and consulting local GP first. Financial constraint 29% was also major. Many patients waited to arrange funds before going to tertiary center. This highlights need for public education campaigns and government insurance schemes like Sehat Card to cover emergency PPCI.¹²

Pre-hospital and System Barriers this was the biggest bottleneck. 38% came by private vehicle/taxi. Pakistan's EMS system is underdeveloped outside major cities. No pre-hospital ECG, no STEMI alert system. Inter-hospital transfer added median 90 minutes delay. 31% were referred from smaller hospitals without cath lab. Our data shows rural residence OR=2.8 for delayed PPCI. This reflects the urban concentration of PCI centers. A hub and spoke model with tele ECG and ambulance diversion protocol is needed.¹³ In-hospital Barriers, although better than pre-hospital, 24% had activation delay. Off-hours presentation did not significantly affect D2B, suggesting most centers have on-call teams. However, ECG delays >10 min in 17% indicates need for ED triage protocols. "Code STEMI" pathways used in the West can reduce this to <5 min.¹⁴

Comparison with international data, US NCDR data shows 91% D2B <90 min.⁷ Even India reports 45-50%.¹⁴ Pakistan's 22% is concerning. The difference is mainly due to pre-hospital delays. Our median total ischemic time 360 min vs 180 min in Europe.¹⁵ Media campaigns on "Chest pain = Call 1123 immediately". School and community programs. System Development: Expand EMS with pre-hospital ECG and direct cath lab activation. Develop regional STEMI networks with spoke hospitals for thrombolysis if PPCI delay >120min.

Limitations

Cross-sectional design, recall bias for symptom onset time, limited to 5 urban centers. Does not include patients who died before reaching hospital.

CONCLUSION

Timely access to Primary PCI for STEMI patients in Pakistan is severely limited. Delays are predominantly pre-hospital, driven by patient unawareness, lack of EMS, and inter-hospital transfers. Rural and financially constrained patients are most affected. A national STEMI program focusing on education, EMS, and networked care is urgently required to reduce mortality.

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