

IMPACT OF EARLY SUCCESSFUL PPCI ON LEFT VENTRICULAR EJECTION FRACTION AMONG STEMI CASES

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Abstract: Cardiovascular disease (CVD) remains a leading cause of morbidity and mortality worldwide, making holistic health management essential for patients. Psychological well-being, particularly stress, depression, and anxiety management, is critical for effective CVD rehabilitation. Interventions focused on stress management hold promise for reducing these negative psychological impacts, thereby enhancing patient health and recovery. **Objective:** To determine the early impact of successful primary percutaneous coronary intervention (PPCI) on left ventricular ejection fraction (LVEF) and clinical outcomes in patients with ST-segment elevation myocardial infarction (STEMI). **Methods:** This study included 60 STEMI patients who underwent PPCI from July 2023 to July 2024. Patients were included if presented within 6 hours of onset of symptom. LVEF was assessed at presentation and six months post-PPCI. The post-procedural TIMI flow grade was recorded. Data on patient demographics, comorbidities, and procedural outcomes were collected. **Results:** The mean age was 59.57 ± 10.46 years, with 71.7% male. LVEF at presentation was $36.70 \pm 4.76\%$, which significantly improved to $54.88 \pm 2.73\%$ at six months ($p = 0.0001$). Post-PPCI, 66.7% of patients achieved TIMI grade 3 flow, and 33.3% had TIMI grade 2 flow. In-hospital mortality was 3.3%, and major adverse cardiac events (MACE) occurred in 5% of patients. **Conclusion:** Early successful PPCI in STEMI patients results in significant improvement in LVEF and favorable clinical outcomes.

Keywords: STEMI, primary percutaneous coronary intervention, left ventricular ejection fraction, TIMI flow, early intervention, major adverse cardiac events.

Introduction

Percutaneous coronary intervention (PCI) has transformed the treatment of ST-elevation myocardial infarction (STEMI), a serious disorder marked by the swift onset of significant ischemia resulting from blocked coronary arteries (1). The prompt restoration of blood flow is essential for maintaining myocardial viability and function. Left ventricular ejection fraction (LVEF) is a crucial metric for assessing cardiac performance following myocardial infarction (2, 3).

The LVEF represents a notable factor of cardiac death. LVEF has emerged as the principal criterion for defibrillator implantation. The MADIT II trial demonstrated a significant reduction in both sudden cardiac death and overall mortality in patients with a prior myocardial infarction and a LVEF below 30% after receiving an implantable cardioverter-defibrillator. LVEF is currently pivotal in recommendations for the utilisation of ICD for the primary prevention of cardiac arrest (4-7).

STEMI transpires when a coronary artery is entirely obstructed, resulting in considerable myocardial injury if not swiftly managed. The left ventricle, tasked with delivering oxygenated blood to the body, frequently has impaired function after ischemic incidents. LVEF, quantified as the percentage of blood volume expelled from the left ventricle every heartbeat, is an essential parameter in assessing cardiac function and prognosis (8, 9).

Effective PPCI reinstates blood circulation to the compromised myocardium, potentially yielding many

advantageous effects on LVEF. Initially, it mitigates ischemia, facilitating the restoration of myocardial function. The recovery is especially crucial in the initial hours following the infarction when the myocardium is at its most susceptible state. Reperfusion not only restores nutritional supply but also triggers a series of biological processes, including the release of protective substances that may improve myocardial healing (10-12).

The rationale for examining the effects of early successful PPCI on LVEF in STEMI cases is rooted in the necessity to optimize myocardial preservation and improve cardiac outcomes after ischaemic events. Early intervention via PPCI correlates with enhanced reperfusion rates, diminished infarct size, and improved myocardial function recovery. The relationship between the timing and success of PPCI and the extent of LVEF improvement has not been sufficiently investigated. This study systematically examines the relationship to elucidate the mechanisms of LVEF recovery post-PPCI, identify critical time thresholds for intervention, and inform clinical guidelines to enhance treatment strategies for STEMI patients, ultimately improving both short-term and long-term cardiovascular outcomes.

Methodology

This prospective observational study was conducted on 60 patients who were admitted with acute ST-segment elevation myocardial infarction (STEMI) and subsequently

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underwent primary percutaneous coronary intervention (PPCI) from July 2023 to July 2024 at Peshawar Institute of Cardiology. Ethical approval was obtained from the hospital.

Patients included in the study were those who presented with STEMI and received treatment via PPCI within 6 hours of symptom onset. Patients had ages 40 to 75 years, with no prior history of myocardial infarction, coronary artery bypass graft (CABG), or PCI. All participants had to have a culprit lesion in a major coronary artery suitable for percutaneous intervention. Patients who had significant multi-vessel coronary artery disease that required surgical intervention, suffered from severe left ventricular failure necessitating mechanical support such as intra-aortic balloon pump (IABP) or extracorporeal membrane oxygenation (ECMO), or if they experienced complications such as ventricular septal rupture or papillary muscle rupture were not enrolled in the study.

All patients underwent transthoracic echocardiography to assess LVEF at the time of presentation and at a follow-up period of six months. Additionally, the Thrombolysis in Myocardial Infarction (TIMI) flow grade was analyzed after the PPCI procedure. The primary outcome was the change in LVEF from baseline to six months post-PPCI. Secondary outcomes included TIMI flow grade post-PPCI and the incidence of major adverse cardiac events (MACE) during the hospital stay, including in-hospital mortality.

The collected data were analyzed using IBM SPSS Statistics software, with continuous variables presented in form of

mean and standard deviation, and categorical presented as frequencies and percentages. Paired samples t-tests were used to compare changes in LVEF between groups, P value less than 0.05 was taken as significant.

Results

The study involved 60 patients with an age range of 40 to 75 years, with a mean age of 59.57 ± 10.46 years. In terms of gender distribution, 43 patients (71.7%) were male, and 17 (28.3%) were female. Regarding comorbidities, 18 patients (30.0%) had diabetes, while 42 (70.0%) did not. Hypertension was present in 32 patients (53.3%), with 28 (46.7%) being non-hypertensive. Smoking was reported in 15 patients (25.0%), while 45 (75.0%) were non-smokers (Table 1).

At the time of presentation, the mean left ventricular ejection fraction (LVEF) was $36.70 \pm 4.76\%$. After 6 months of follow-up, the LVEF had improved significantly to $54.88 \pm 2.73\%$ ($p = 0.0001$) (Table 2). Post-PCI TIMI flow grades showed that 20 patients (33.3%) had TIMI 2 flow, while 40 patients (66.7%) achieved TIMI 3 flow (Figure 1). Regarding adverse events, 2 patients (3.3%) did not survive during the hospital stay, while 58 patients (96.7%) survived. Major adverse cardiac events (MACE) occurred in 3 patients (5.0%), with 57 patients (95.0%) having no MACE (Table 3).

Table 1 Demographics

Demographics		Frequency	Percentage
Gender	Male	43	71.7%
	Female	17	28.3%
Diabetes	Yes	18	30.0%
	No	42	70.0%
Hypertension	Yes	32	53.3%
	no	28	46.7%
Smoking status	Yes	15	25.0%
	No	45	75.0%

Table 2 Comparison of LVEF at presentation and at 6 months

Comparison of LVEF at presentation and at 6 months	Mean	N	Std. Deviation	P value
LVEF at presentation	36.70	60	4.763	0.0001
LVEF at 6 months follow up	54.88	60	2.731	

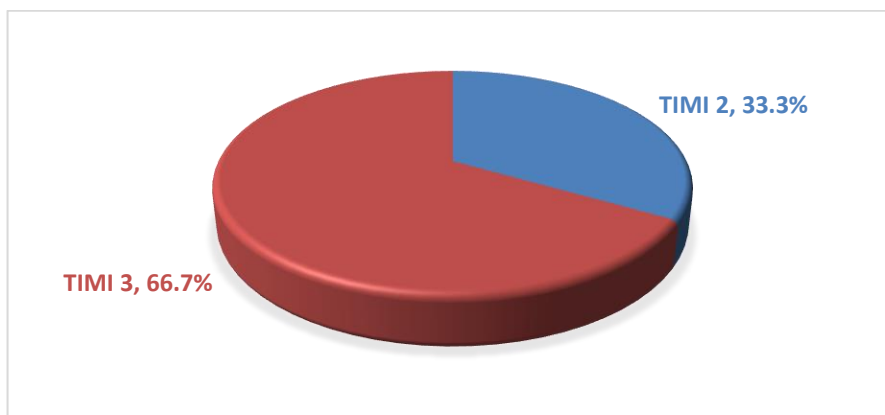


Figure 1 Post PPCI TIMI grade

Table 3 Adverse events

Adverse events		Frequency	Percentage
In hospital mortality	Survived	2	3.3%
	Not survived	58	96.7%
MACE (Major Adverse Cardiac Events)	Yes	3	5.0%
	No	57	95.0%

Discussion

In our study, the patients had mean age of 59.57 ± 10.46 years. This is quite comparable to the study by Haq et al., which had 50 patients with a mean age of 61.48 ± 12.26 years. Both studies featured a predominance of male participants, with our study reporting 71.7% males and the Haq et al. study reporting 62%. This male-dominated demographic is typical for studies on STEMI patients undergoing PPCI, reflecting the higher frequency of coronary artery disease in men. (13)

Regarding comorbidities, our study reported that 30% of patients had diabetes and 53.3% had hypertension, which is in line with the Haq MR et al. study, where 26% had diabetes and 40% had hypertension. (13) This is also consistent with the findings of other studies on PPCI for STEMI, such as the study by Rakowski T et al., where comorbid conditions like diabetes and hypertension were common among participants, influencing outcomes. (14)

In terms of the key outcome measure, LVEF, our study showed a significant improvement in LVEF from $36.70 \pm 4.76\%$ at presentation to $54.88 \pm 2.73\%$ at 6 months post-PPCI. This improvement is consistent with the findings of Haq MR et al., where Group A (patients treated within 6 hours of symptom onset) showed an increase in LVEF from $45.49 \pm 3.99\%$ at presentation to $55.66 \pm 0.92\%$ at 3 months, while Group B (patients treated between 6 and 24 hours) showed a smaller improvement from $35.25 \pm 3.85\%$ at presentation to $45.75 \pm 1.44\%$ at 3 months. (13) Our study's improvement in LVEF was more pronounced, which could be attributed to the earlier intervention and the characteristics of our patient population. This is also similar to the findings of Rakowski T et al., where early administration of abciximab prior to PPCI resulted in a significant improvement in LVEF at follow-up, emphasizing the importance of early intervention in preserving left ventricular function. (14) In comparison, Roshdy S et al. also reported a significant correlation between early PPCI and improvement in LVEF, emphasizing the importance of timely intervention. In their study, patients who underwent early PPCI exhibited better LVEF outcomes, highlighting that early revascularization leads to improved ventricular function and reduced mortality. (15) The LVEF improvement observed in our study aligns with this, further supporting the benefit of early intervention.

Post-PPCI TIMI flow is another important outcome measure. In our study, TIMI grade 2 was achieved by 33.3% of patients, while 66.7% achieved TIMI grade 3 flow. This is slightly lower than the results from Haq MR et al., where 100% of Group A (early presenters) achieved TIMI grade 3 flow, and 85% of Group B (late presenters) achieved TIMI grade 3 flow ($p = 0.02$). (1) The difference in TIMI flow success rates between our study and the Haq MR et al. study could be explained by the difference in the timing of intervention, as earlier intervention is more likely to result in complete reperfusion and better TIMI flow grades. (13) In Rakowski T et al.'s study, the early administration of

abciximab was also associated with higher rates of TIMI grade 3 flow, further supporting the role of early pharmacologic and mechanical intervention in achieving optimal reperfusion. (14)

With regard to adverse events, our study reported that 3.3% of patients did not survive during the hospital stay, and MACE occurred in 5% of patients. Haq MR et al. did not specifically report in-hospital mortality rates or MACE, but they did emphasize the improved clinical outcomes associated with early PPCI, which likely contributed to the lower complication rates in their study, especially in the early-presenter group. (13) The occurrence of MACE in our study is consistent with rates observed in other studies, such as Rakowski T et al., where early intervention was associated with reduced LV remodeling and fewer adverse events at follow-up. (14)

Conclusion

In conclusion, our study demonstrates that early successful PPCI in STEMI patients significantly improves left ventricular ejection fraction (LVEF) and clinical outcomes, with a notable increase in LVEF from presentation to 6-month follow-up. Achieving optimal reperfusion, as indicated by TIMI grade 3 flow, was associated with better recovery of cardiac function and reduced adverse events. These findings underscore the critical importance of minimizing delays in reperfusion therapy to enhance patient outcomes in STEMI management.

Declarations

Data Availability statement

All data generated or analyzed during the study are included in the manuscript.

Ethics approval and consent to participate.

Approved by the department concerned. (IRBEC-0333/23)

Consent for publication

Approved

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Conflict of interest

The authors declared an absence of conflict of interest.

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