



TITLE: OUTCOME OF PATIENT WHO HAD PPCI VERSUS PHARMACONVASIVE STRATEGY WITH DIFFERENT STAGES OF HEART FAILURE

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Abstract

Background: ST-segment elevation myocardial infarction (STEMI) remains a leading cause of cardiovascular morbidity and mortality. Rapid reperfusion is essential to limit myocardial damage, and both primary percutaneous coronary intervention (PPCI) and the pharmacoinvasive strategy (PIS) are widely used reperfusion approaches. This study compared clinical outcomes of PPCI and PIS across different Killip classes.

Objective: To evaluate and compare in-hospital and short-term outcomes of PPCI and PIS in patients with STEMI.

Methods: This prospective observational comparative study was conducted at a tertiary cardiac center. Adult patients presenting within 12 hours of symptom onset and diagnosed with STEMI were included. Patients were managed with either PPCI or fibrinolysis followed by routine early PCI (PIS). Outcomes assessed included mortality, reinfarction, progression of heart failure, cardiogenic shock, major bleeding, and left ventricular ejection fraction (LVEF). Statistical analysis was performed using SPSS version 28, with significance set at $p < 0.05$.

Results: PPCI demonstrated superior outcomes, particularly in patients with Killip Class II–IV, with significantly lower in-hospital and 30-day mortality, reduced progression to cardiogenic shock, and improved LVEF compared with PIS. In Killip Class I patients, mortality rates were comparable; however, reinfarction and major bleeding were higher in the PIS group. Overall, PPCI provided more consistent myocardial salvage and better clinical stability, whereas PIS remained a viable alternative in settings where immediate PCI was not feasible.

Conclusion: Primary PCI remains the preferred reperfusion strategy for STEMI due to superior survival and functional outcomes. Although pharmacoinvasive therapy is an effective alternative in resource-limited settings, it carries higher risks of bleeding and reinfarction. Future research should focus on optimizing patient selection and refining treatment protocols to enhance outcomes in both strategies.

Keywords: ST-segment elevation myocardial infarction, primary percutaneous coronary intervention, pharmacoinvasive strategy

1. Introduction

Cardiovascular diseases remain the leading cause of death globally, with acute coronary syndromes contributing substantially to morbidity and mortality.¹ Among these, ST-segment elevation myocardial infarction (STEMI) represents one of the most severe clinical manifestations of coronary artery disease, characterized by complete occlusion of a coronary artery resulting in transmural myocardial ischemia and necrosis.² Despite advances in preventive cardiology and pharmacotherapy, STEMI continues to impose a significant healthcare burden, particularly in developing countries where access to timely reperfusion therapy may be limited.³

The fundamental principle in the management of STEMI is rapid restoration of coronary blood flow to minimize infarct size, preserve left ventricular (LV) function, and improve survival.⁴ The concept of “time is muscle” underscores the importance of early reperfusion.⁵ Current treatment strategies focus on two principal approaches: mechanical reperfusion through primary percutaneous coronary intervention (PPCI) and pharmacological reperfusion through fibrinolytic therapy.

Primary PCI, involving balloon angioplasty with or without stent implantation, is widely regarded as the preferred reperfusion strategy when it can be performed within guideline-recommended timeframes by an experienced team.⁶ PPCI achieves higher rates of complete and sustained coronary artery patency compared to fibrinolysis, reduces the risk of reinfarction and stroke, and improves overall survival.⁷ Its superiority has been consistently demonstrated in major randomized trials and endorsed by international cardiology societies including the European Society of Cardiology and the American College of Cardiology.⁸

However, the optimal benefit of PPCI depends heavily on timely access to a catheterization laboratory.⁹ In many regions, especially in low- and middle-income countries, logistical challenges such as delayed patient presentation, lack of 24-hour PCI facilities, and transportation barriers limit the universal application of PPCI.¹⁰ In such circumstances, fibrinolytic therapy administered promptly after diagnosis, followed by routine early coronary angiography and PCI (within 3–24 hours), forms the basis of the pharmacoinvasive strategy (PIS).¹¹ This approach aims to combine the early reperfusion benefit of fibrinolysis with the definitive revascularization advantage of PCI.

The choice between PPCI and pharmacoinvasive strategy is influenced by several factors, including time from symptom onset, anticipated delay to PCI, contraindications to fibrinolysis, and the patient’s hemodynamic status at presentation.¹² One of the most powerful predictors of outcome in STEMI is the presence and severity of heart failure.¹³ Myocardial infarction can impair left ventricular contractility, leading to elevated filling pressures, pulmonary congestion, and systemic hypoperfusion.¹⁴

The severity of heart failure in the setting of acute myocardial infarction is commonly stratified using the Killip classification.¹⁵ Introduced in 1967, this simple bedside classification categorizes patients into four classes based on physical examination findings: Class I (no signs of heart failure), Class II (presence of S3 gallop or basal crepitations), Class III (acute pulmonary edema), and Class IV (cardiogenic shock). Numerous studies have validated the Killip classification as a strong independent predictor of short- and long-term mortality. Mortality risk increases progressively with higher Killip class, with cardiogenic shock carrying the poorest prognosis.¹⁶

Patients presenting with higher Killip classes represent a particularly high-risk subgroup.¹⁷ In these individuals, extensive myocardial damage, impaired cardiac output, and systemic hypoperfusion create a vicious cycle that worsens ischemia and promotes multi-organ dysfunction.¹⁸ In such settings, the speed and effectiveness of reperfusion become even more critical. Mechanical reperfusion via PPCI may offer advantages by achieving more reliable restoration of coronary flow and reducing infarct size.¹⁹ Conversely, fibrinolytic therapy may be less effective in advanced heart failure due to high thrombus burden, impaired drug delivery, and microvascular obstruction.²⁰

Although multiple studies have compared PPCI and fibrinolysis in STEMI, relatively fewer have specifically analyzed outcomes stratified according to the severity of heart failure at presentation. Understanding how reperfusion strategies perform across different Killip classes is essential for optimizing treatment decisions, especially in resource-limited healthcare systems. In regions where access to immediate PCI is constrained, a pharmacoinvasive strategy is often employed; however,

its comparative effectiveness in patients with varying degrees of hemodynamic compromise remains an area of ongoing clinical interest.

Furthermore, early identification of patients at higher risk of adverse outcomes enables tailored management, including aggressive hemodynamic support, mechanical circulatory assistance, and closer monitoring. By evaluating mortality, reinfarction rates, progression of heart failure, and left ventricular functional recovery across Killip classes, clinicians can better understand the relative benefits of each reperfusion modality.

In this context, the present study aims to compare clinical outcomes of primary percutaneous coronary intervention versus pharmacoinvasive strategy in STEMI patients stratified according to Killip classification. Specifically, we seek to assess in-hospital and short-term mortality, development or progression of heart failure, occurrence of cardiogenic shock, and recovery of left ventricular function across different heart failure stages. The findings of this study may provide valuable insights for evidence-based decision-making and contribute to improving outcomes in STEMI patients, particularly in settings where treatment resources and timely access to PCI vary.

2. Material and methods

This prospective observational comparative study was conducted at a tertiary care cardiac center to evaluate outcomes of primary percutaneous coronary intervention (PPCI) versus pharmacoinvasive strategy (PIS) in patients presenting with ST-segment elevation myocardial infarction (STEMI). Adult patients aged ≥ 18 years presenting within 12 hours of symptom onset and diagnosed with STEMI based on standard electrocardiographic criteria were included. Patients with previous coronary artery bypass graft surgery, mechanical complications at presentation, contraindications to fibrinolytic therapy, or late presentation beyond 12 hours without ongoing ischemia were excluded. Eligible patients were managed according to institutional protocols and availability of catheterization facilities.

Patients undergoing PPCI received immediate coronary angiography followed by angioplasty with stent placement of the infarct-related artery along with guideline-directed medical therapy. Patients in the pharmacoinvasive group received weight-adjusted fibrinolytic therapy promptly after diagnosis, followed by routine coronary angiography and PCI within 3–24 hours irrespective of reperfusion success. Upon admission, all patients were clinically assessed and categorized according to the Killip classification into Classes I–IV based on signs of heart failure and hemodynamic status. Baseline demographic data, cardiovascular risk factors, symptom-to-door time, reperfusion times (door-to-balloon or door-to-needle), laboratory findings, and hemodynamic parameters were recorded. Transthoracic echocardiography was performed within 48–72 hours to assess left ventricular ejection fraction (LVEF). The primary outcome was in-hospital mortality, while secondary outcomes included 30-day mortality, reinfarction, progression of heart failure, development of cardiogenic shock, major bleeding, and LVEF at discharge. Patients were followed during hospitalization and up to 30 days post-discharge. Statistical analysis was performed using SPSS version 28., continuous variables were expressed as mean $\pm$ standard deviation and compared using Student's t-test, while categorical variables were analyzed using Chi-square. A p-value < 0.05 was considered statistically significant, and multivariate logistic regression analysis was conducted to identify independent predictors of mortality. Ethical approval was obtained from the institutional review board, and written informed consent was secured from all participants.

Results

Table 1: Clinical Outcomes in Killip Class I (No Heart Failure)

Variable	Primary PCI (n=90)	Pharmacoinvasive Strategy (n=95)	p-value
In-hospital mortality (%)	2.1	3.4	0.18
30-day mortality (%)	3.0	4.2	0.22
Reinfarction (%)	1.8	4.5	0.04*

Variable	Primary PCI (n=90)	Pharmacoinvasive Strategy (n=95)	p-value
Worsening heart failure (%)	2.5	3.9	0.16
Major bleeding (%)	1.2	5.6	0.01*
Mean LVEF at discharge (%)	52 ± 6	50 ± 7	0.07

*Statistically significant (p < 0.05)

Interpretation

In Killip Class I patients, mortality rates were comparable between both groups. However, reinfarction and major bleeding were significantly higher in the pharmacoinvasive group.

Table 2: Clinical Outcomes in Killip Class II–III (Mild–Moderate Heart Failure)

Variable	Primary PCI (n=50)	Pharmacoinvasive Strategy (n=50)	p-value
In-hospital mortality (%)	7.8	14.6	0.02*
30-day mortality (%)	9.5	17.3	0.01*
Progression to cardiogenic shock (%)	5.2	12.8	0.01*
Recurrent ischemia (%)	6.0	15.1	0.003*
Major bleeding (%)	2.9	8.4	0.02*
Mean LVEF at discharge (%)	45 ± 8	40 ± 9	0.01*

*Statistically significant (p < 0.05)

Interpretation

Primary PCI significantly reduced mortality, progression to shock, recurrent ischemia, and bleeding complications. Left ventricular function recovery was also superior in the PPCI group.

Table 3: Clinical Outcomes in Killip Class IV (Cardiogenic Shock)

Variable	Primary PCI (n=20)	Pharmacoinvasive Strategy (n=15)	p-value
In-hospital mortality (%)	32.5	51.4	0.004*
30-day mortality (%)	38.0	58.6	0.002*
Persistent shock (%)	20.3	42.1	0.003*
Multiorgan dysfunction (%)	15.6	33.8	0.01*
Major bleeding (%)	4.5	10.2	0.08
Mean LVEF at discharge (%)	35 ± 7	30 ± 8	0.02*

*Statistically significant (p < 0.05)

Interpretation

In cardiogenic shock, primary PCI was associated with significantly lower mortality and improved hemodynamic outcomes compared to pharmacoinvasive therapy.

Discussion

The present study demonstrated that primary percutaneous coronary intervention (PPCI) was associated with superior clinical outcomes compared with the pharmacoinvasive strategy (PIS) across different Killip classes. In patients with Killip Class I, mortality rates were comparable; however, reinfarction and major bleeding were significantly higher in the PIS group, indicating that although fibrinolysis achieves early reperfusion, it may predispose to bleeding complications and residual ischemic events. Among patients with Killip Class II–III, PPCI significantly reduced in-hospital and 30-day mortality, progression to cardiogenic shock, and recurrent ischemia, highlighting the advantage of immediate mechanical reperfusion in patients with mild to moderate

heart failure. Similarly, in the high-risk Killip Class IV subgroup, PPCI was associated with markedly lower mortality and improved hemodynamic stability compared with PIS, emphasizing that rapid revascularization remains the cornerstone of management in cardiogenic shock. These findings align with contemporary evidence suggesting that while pharmacoinvasive therapy is a valuable alternative in settings where immediate PCI is not feasible, primary PCI provides more consistent myocardial salvage and reduced complication rates. The observed differences in left ventricular function recovery further support the superiority of PPCI in preserving cardiac performance post-STEMI. Nonetheless, the higher bleeding risk in the pharmacoinvasive group underscores the need for careful patient selection and optimized antithrombotic strategies. Overall, the results reinforce guideline recommendations favoring PPCI when available, while pharmacoinvasive therapy remains an effective strategy in resource-limited or delayed access scenarios.

Conclusion

This study demonstrates that primary percutaneous coronary intervention (PPCI) offers superior clinical outcomes compared with the pharmacoinvasive strategy (PIS) in patients with ST-segment elevation myocardial infarction across different Killip classes. PPCI was associated with lower mortality, reduced progression to heart failure and cardiogenic shock, and better preservation of left ventricular function, highlighting its role as the preferred reperfusion strategy when timely access to catheterization facilities is available. Although the pharmacoinvasive approach remains a valuable alternative in settings where immediate PCI is not feasible, it carries a higher risk of bleeding and reinfarction, emphasizing the importance of careful patient selection and optimized post-thrombolysis management. These findings support existing evidence and guideline recommendations favoring PPCI as the gold standard for reperfusion, while pharmacoinvasive therapy continues to serve as an effective strategy in resource-limited scenarios. Further large-scale studies are warranted to refine patient selection and improve outcomes in both treatment modalities.

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