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IMPACT OF PHARMACOLOGICAL REPERFUSION AND PRIMARY PCI ON 30-DAY CLINICAL OUTCOMES IN ACUTE MYOCARDIAL INFARCTION: A MULTI-CENTER PROSPECTIVE STUDY OF 100 PATIENTS IN PESHAWAR

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Abstract

Background: *In Peshawar, the management of ST-elevation myocardial infarction (STEMI) frequently necessitates the decision between pharmacological reperfusion and primary percutaneous coronary intervention (PCI) based on the resources in the region.*

Purpose: The study aims to compare and estimate the 30-day clinical outcomes between Streptokinase and primary PCI in a resource-constrained reality.

Methods: *The study was a prospective, multicenter study of 100 consecutive STEMI patients in three tertiary care hospitals in Peshawar (Khyber Teaching Hospital, Lady Reading Hospital and Hayatabad Medical Complex). Patients were randomized to receive either Streptokinase (n=72), or primary PCI (n=28). The main finding was the successful reperfusion (>50 percent ST-segment resolution). The secondary outcomes were 30-day mortality and major bleeding.*

Findings: *The reperfusion success rate was much higher with primary PCI (92.9%), as opposed to Streptokinase (77.8%). There were also significant differences in 30-day mortality rate with the primary PCI group recording 3.6% against 11.1% in Streptokinase group. Moreover, the significant bleeding events were only noted with the Streptokinase cohort (4.2%), and did not occur in the primary PCI (0.0%).*

Conclusion: *Primary PCI has better reperfusion success and short-term survival than Streptokinase. But due to the lack of immediate access to PCI in peripheral regions, a health system in resource limited regions should adopt a hub-and-spoke pharmacoinvasive model. It is needed to offer early fibrinolysis at the local centers and then transfer rapidly to a facility with the capability of providing PCI to reduce delays in treatment and enhance survival of patients.*

1. Introduction

Acute myocardial infarction is one of the major causes of untimely mortality and disability around the globe. ST-elevation myocardial infarction (STEMI) in its turn is the cause of a significant percentage of acute coronary syndrome manifestations and contributes a significant share of mortality and morbidity in the short-term and long-term in ischemic heart disease (Bouisset et al., 2021). The development

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of reperfusion therapy in the last 30 years has significantly enhanced the outcomes of reperfusion therapy in high-resource environments. Primary percutaneous coronary intervention (PCI) should be used as reperfusion strategy in the situation where it is rapid and conducted by trained personnel because it has been established as a better method of achieving complete coronary reperfusion, less reinfarction and lower short term mortality than fibrinolytic therapy (Gershlick, Banning, Myat, Verheugt, & Gersh, 2013). Nevertheless, the burden of STEMI in the world remains since the distribution of access to timely, guideline-based care is not even among various regions and healthcare services.

Clinical benefits of reperfusion therapy are extremely time sensitive and delays in mechanical reperfusion can grossly undermine its benefit. It has been highlighted that the longer the delay between the development of the symptoms and reperfusion, the larger the infarct sizes and the mortality rates at one year regardless of whether or not reperfusion is eventually successful (Guerchicoff et al., 2014). Moreover, an extension of the period between symptom onset and primary PCI, particularly longer than 12 hours, has a strong impact, as it increases the risk of unfavorable clinical outcomes, such as heart failure and all-cause mortality (Nepper-Christensen et al., 2021). Therefore, although primary PCI is considered the gold standard, its effectiveness is closely connected with the timeliness of a healthcare system to provide it.

In Pakistan, structural or socioeconomic factors restrict the provision of modern STEMI care within the best time frames universally in the country (Nawaz et al., 2025). The catheterization laboratories are mainly located in large urban centers and the remaining large numbers of the population have to rely on the peripheral hospitals and clinics which do not have any PCI facilities. The issue is further compounded by financial barriers, limited emergency medical services coupled with long delays in inter-facility transfer.

In such locations as Peshawar, clinicians have to often have pragmatic, time conscious decisions between immediate pharmacological reperfusion, which is usually with a ready-to-hand agent such as Streptokinase, and a patient transfer to primary PCI. The recent local studies in Peshawar, including the ones that were carried out in Hayatabad Medical Complex, provide an insight into the ongoing regional attempts to optimize the results of primary PCI using adjunctive pharmacological measures, but they also demonstrate the systemic issues surrounding the need to manage STEMI in real-world settings (Khan et al., 2024). Under these circumstances, fibrinolytic therapy being a life-saving intervention is urgently required, and pharmacoinvasive therapy serves as a pragmatic compromise to timely PCI.

In spite of these realities, most of the large randomized trials and guideline recommendations are based in high resource settings with widespread PCI access (Deckers et al., 2005). A significant gap in potential, multicenter evidence relating to low- and middle-income environments that directly compares the results of pharmacological reperfusion and primary PCI within local limitations exists. To fill this evidence gap, this study seeks to compare 30-day clinical outcome, namely reperfusion success, mortality, post-MI heart failure and major bleeding, prospectively in consecutive STEMI patients receiving Streptokinase-based pharmacological reperfusion versus primary PCI in three tertiary hospitals in Peshawar (Khyber Teaching Hospital, Lady Reading Hospital, and Hayatabad Medical Complex). This research aims to inform pragmatic, scalable reperfusion pathways, including hub-and-spoke pharmacoinvasive approaches, to enhance survival in resource-constrained healthcare settings through an assessment of both biological efficacy as well as the effects of modifiable system variables, including door-to-needle intervals.

2. Materials and Methods

2.1 Study Design and Population

This is a prospective, multicentric, observational registry study planned to take place among the Cardiology Units of three tertiary care hospitals located in Peshawar: Khyber Teaching Hospital (KTH), Lady Reading Hospital (LRH), and Hayatabad Medical Complex (HMC) between January 2025 and January 2026. With the help of a consecutive sampling technique, 100 adult patients (18 years or older) with a proven ST-elevation myocardial infarction (STEMI) within

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12 hours of symptom changes were recruited into the study. Patients were also not included when they had a history of having undergone fibrinolysis, or had developed clinical contraindications to thrombolytic therapy, or had cardiogenic shock that necessitated the use of mechanical circulatory support. All the enrolment, allocation, and outcome pathway of the study population is presented in Figure 1.

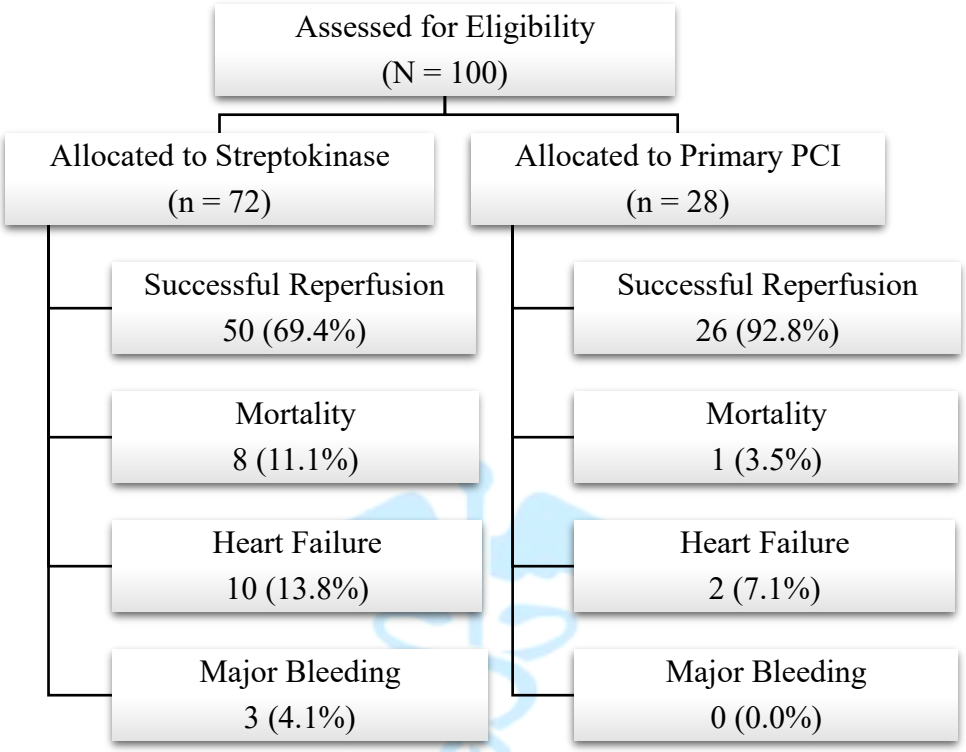

Figure 1. Study Flow Chart

2.2 Ethical Approval

The study protocol was reviewed and approved by the Institutional Research and Ethics Board at all participating institutions. Written informed consent was formally obtained from all patients or their legally authorized representatives prior to enrollment and data collection.

2.3 Treatment Protocols

Patients were stratified into two treatment cohorts based on the reperfusion strategy deployed upon presentation:

- Group A (Pharmacological Reperfusion, n=72): Patients received systemic fibrinolysis with Streptokinase, administered as a 1.5 million IU intravenous infusion over 30 to 60 minutes.
- Group B (Primary PCI, n=28): Patients underwent prompt mechanical reperfusion via standard primary percutaneous coronary intervention with stent implantation.

All patients across both groups received standard adjunctive medical therapy in adherence to current clinical guidelines. This regimen included Aspirin (300 mg loading dose), a P2Y12 inhibitor (Clopidogrel 600 mg, or Ticagrelor 180 mg for patients undergoing PCI), high-intensity statin therapy (Atorvastatin 80 mg), and therapeutic anticoagulation (Enoxaparin 1 mg/kg or unfractionated Heparin 5000 IU).

2.4 Study Outcomes

The primary clinical outcome was successful reperfusion, defined non-invasively as ≥50% resolution of the elevated ST-segment on an electrocardiogram (ECG) assessed at 90 minutes post-intervention. Secondary outcomes evaluated over a 30-day follow-up period included all-cause mortality, the incidence of post-myocardial infarction heart failure, and the occurrence of major bleeding events.

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2.5 Statistical Analysis

IBM SPSS Statistics, version 26.0 was used to conduct all statistical analyses. Means and standard deviations were used to indicate continuous variables and absolute frequencies and percentages were used to indicate categorical variables. Categorical baseline data and clinical outcomes were compared in the Streptokinase and Primary PCI groups using different tests. Multivariate logistic regression analysis was conducted to determine the effect of clinical and system-level predictors. In these regression analyses, the dependent variables were adverse clinical outcomes (in terms of 30-day mortality and failed reperfusion). The independent variables considered were the presence of diabetes mellitus, hypertension, active tobacco use, as well as long door-to-needle times (e.g., delays longer than 60 minutes). All the analyses were deemed to have a statistically significant p-value of less than 0.05.

3. Results and Analysis

3.1 Baseline Demographics

There were 100 patients included in the study population with ST-elevation myocardial infarction (STEMI). The sample was mainly male as 68.0% (n=68) of the population were men and 32.0% (n=32) were women. The age distribution was analyzed and showed that the highest proportion of patients was between the age group of 51-60 years (45.0%), then between 60 and above (30.0%), and between 41-50 years (25.0%). On initial reperfusion approach on admission, 72.0% (n=72) of the patients received pharmacological reperfusion with the use of Streptokinase and 28.0% (n=28) received primary Percutaneous Coronary Intervention (PCI).

Table 1: Baseline Demographics of the Study Population

		Frequency	Percent
Patient Age	41-50	25	25.0
	51-60	45	45.0
	60+	30	30.0
	Total	100	100.0
Patient Gender	Female	32	32.0
	Male	68	68.0
	Total	100	100.0
Reperfusion Strategy	Streptokinase	72	72.0
	Primary PCI	28	28.0
	Total	100	100.0

3.2 Reperfusion Success

Reperfusion success was measured non-invasively, which was a greater than 50 percent ST-segment resolution (STR) in electrocardiography. Primary PCI showed a significant reperfusion success rate as opposed to pharmacological treatment. In the primary PCI group, 92.9% (n=26) of the patients had successful reperfusion, with only 7.1% (n=2) having failed reperfusion. In the Streptokinase group, on the other hand, 77.8% (n=56) of the patients achieved successful reperfusion, and 22.2% (n=16) did not achieve a successful reperfusion. The high effectiveness of PCI in the development of optimal coronary flow and myocardial tissue perfusion is consistent with the clinical consensus on highlighting the importance of mechanical intervention over fibrinolysis (Dudek, Rakowski, Dziewierz, & Kleczynski, 2008).

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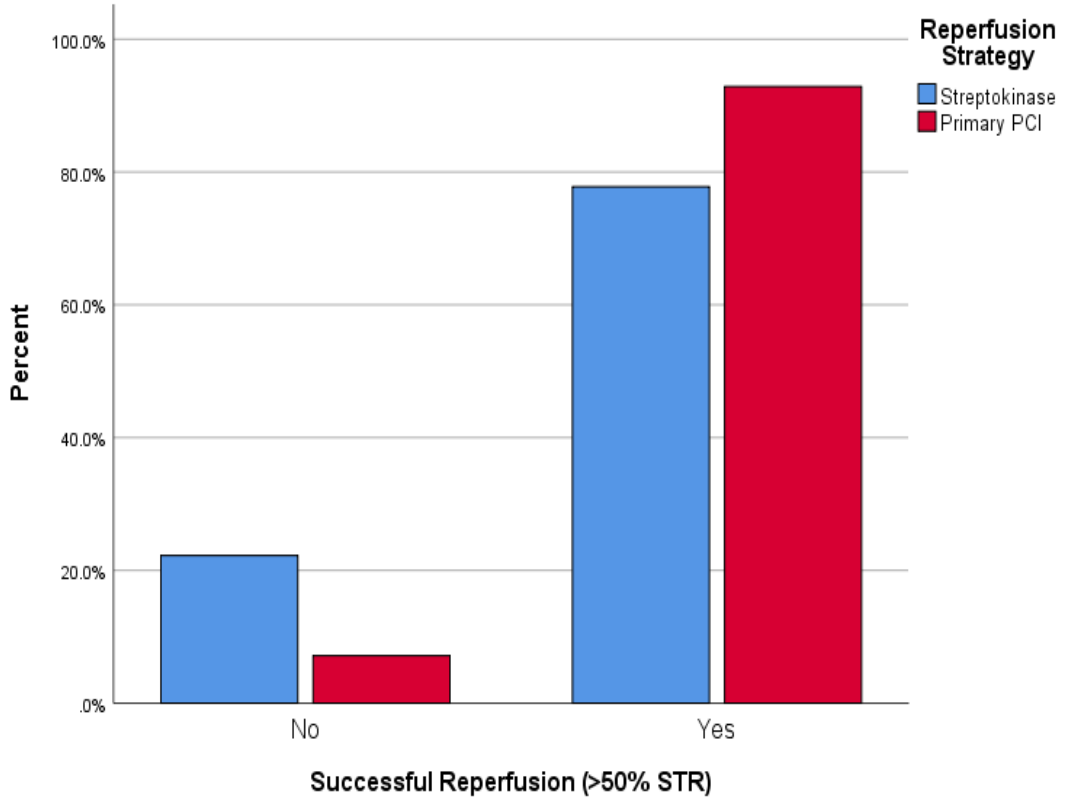

Figure 2: Comparison of Successful Reperfusion Rates (>50% STR) between Streptokinase and Primary PCI

4.3 30-Day Clinical Outcomes

The comparative benefits of mechanical reperfusion and pharmacological therapy are clinical outcomes assessed during a 30-day follow-up period. Table 2 shows the combined outcomes of successful reperfusion, mortality and major bleeding.

Table 2: 30-Day Clinical Outcomes Stratified by Reperfusion Strategy

Clinical Outcome	Streptokinase (n=72)	Primary PCI (n=28)	Total (N=100)
Successful Reperfusion (>50% STR)	56 (77.8%)	26 (92.9%)	82 (82.0%)
30-Day Mortality	8 (11.1%)	1 (3.6%)	9 (9.0%)
Major Bleeding Event	3 (4.2%)	0 (0.0%)	3 (3.0%)

Primary PCI proved to be more effective and safe in all clinical endpoints of the 30-day period measured (Stone et al., 1998). Reperfusion was successful in 92.9% of the primary PCI group, versus 77.8% in the Streptokinase group.

The overall 30-day mortality rate of the entire cohort was 9.0% in terms of short-term survival. However, there was a significant difference in mortality (11.1 vs. 3.6) in the Streptokinase group (n=8) and the primary PCI group (n=1), respectively. This is consistent with current literature that timely mechanical reperfusion greatly reduces the risks of short-term mortality in comparison to fibrinolytic therapy, especially when transfer delays are minimal (Lamberts et al., 2014).

Moreover, only the pharmacological reperfusion cohort experienced major bleeding incidences. In particular, 4.2% (n=3) of patients who received Streptokinaz suffered a major bleeding event, and none of them suffered bleeding events in the primary PCI group. Since systemic

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fibrinolysis has an inherent high hemorrhagic risk, patient selection and compliance with adjunctive management strategies are critical in areas lacking PCI (Investigators et al., 2021).

3.4 Survival Analysis

To determine the likelihood of survival within the 30 days period, a Kaplan-Meier survival analysis was done to estimate the survival probability of either treatment strategy. The survival curve thus obtained shows a clear separation between the two cohorts. The survival probability curve of patients with primary PCI was close to 1.0 and remained relatively stable during the 30 days. Conversely, the Streptokinase group showed a progressive decrease in the cumulative survival probability in the same period. These time-related survival patterns highlight the significant influence of the initial reperfusion policy on the prognosis in the short term and repeat the idea of minimizing treatment delays in order to maintain myocardial viability (Guerchicoff et al., 2014).

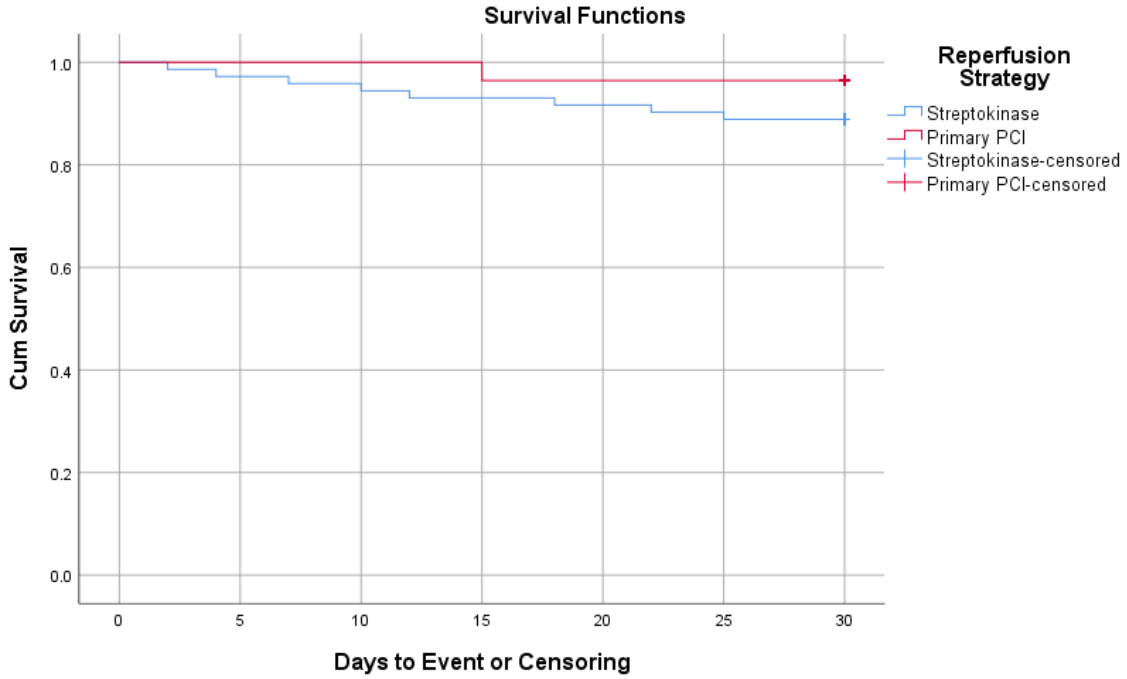

Figure 3: Kaplan-Meier Survival Curves Comparing 30-Day Mortality

4. Discussion

The project is a prospective multicenter study that provides real-life and practical information about the treatment of STEMI patients in the resource-limited environment of Peshawar. The main objective was to evaluate the efficacy and safety of pharmacological reperfusion with Streptokinase in contrast to primary percutaneous coronary intervention (PCI). The results indicate that primary PCI has a major clinical benefit, with a higher success rate of reperfusion and a reduced mortality rate at 30 days.

We have a successful reperfusion of 92.9 percent after administration of primary PCI and 77.8 percent after the administration of Streptokinase. This increased epicardial patency directly translates into better survival demonstrated by a dramatic difference in 30-day mortality (3.6% with PCI verses 11.1% with Streptokinase). This is further supported by the Kaplan-Meier survival analysis which indicates that there is early and sustained survival advantage of patients undergoing mechanical reperfusion (Ndrepepa, Kastrati, Mehilli, Antoniucci, & Schömig, 2009). These findings are consistent with proven trials around the world, which have made timely primary PCI the treatment of choice. Nevertheless, the 11.1% mortality rate of the pharmacological group is indicative of the inherent limitations of fibrinolysis especially in cases where there are

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delays in the transfer of patients to tertiary centers.

The safety analysis revealed that the major bleeding events were all in the Streptokinase cohort (4.2%), and there were no major bleeding events in the PCI group. Systemic fibrinolysis is inherently more dangerous to hemorrhage (Saes, Schols, Van Heerde, Nijziel, & Haemostasis, 2018). Although the overall rate of bleeding was relatively low, this observation suggests the importance of a meticulous screening of patients and close attention when using Streptokinase, particularly when it is used together with dual antiplatelet therapy and anticoagulants.

The clinical superiority of PCI is obvious, but the truth on the ground in Peshawar is that a good number of patients report to the peripheral hospitals that do not have catheterization facilities. The benefits of reperfusion therapy are greatly compromised by systemic delays including long door to needles or inter-facility transfer times.

Since in this area the possibility of providing universal access to immediate PCI is not yet available, the use of primary PCI strategy alone exposes a significant number of people to risk. The evidence highly indicates the need to adopt a formalized hub-and-spoke pharmacoinvasive model. In this strategy, the peripheral hospitals (the spokes) promptly administer early fibrinolysis to the patients who are eligible, and then prompt and coordinated transfer to a tertiary center with PCI (the hub) to have routine angiography. This plan is a viable middle ground between evidence-based ideals and local socioeconomic realities.

The primary strength of this research is its prospective, multicentric design in 3 large hospitals, which offers a true picture of the present clinical practice in Peshawar. Nevertheless, the research has a number of limitations. First, the number of patients (n=100) is rather limited, and the non-randomized observational design makes the sample subject to the selection bias with respect to the type of patient that gets PCI versus Streptokinase. Second, the follow-up period is only 30 days; a follow-up should be more long to evaluate late mortality and incidence of heart failure in the long term. Lastly, all patients were measured non-invasively by ST-segment resolution as opposed to angiographic confirmation to measure reperfusion.

5. Conclusion

Primary PCI is the superior reperfusion strategy for STEMI patients, offering significantly higher reperfusion success and better 30-day survival rates compared to Streptokinase. However, in regions like Peshawar where immediate access to catheterization laboratories is limited, Streptokinase remains a vital, life-saving intervention. To reduce mortality and minimize the impact of treatment delays, regional health authorities should prioritize the development of a coordinated pharmacoinvasive network. Empowering peripheral centers to deliver early pharmacological therapy, combined with rapid transfer protocols to PCI-capable hubs, is essential to improving patient outcomes in this resource-constrained environment.

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