

ORIGINAL ARTICLE

In-hospital outcomes in patients of STEMI (STsegment elevation MI) undergoing PPCI (Primary Percutaneous Coronary Intervention) with Intra Coronary Tirofiban vs Intravenous Tirofiban.

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ABSTRACT... Objective: To compare the frequency of in hospital outcomes in patients of acute ST segment elevation myocardial infarction undergoing primary percutaneous coronary intervention with intracoronary Tirofiban vs intravenous Tirofiban. **Study Design:** Non-randomized Controlled Trial. **Setting:** Department of Cardiology, Faisalabad Institute of Cardiology, Faisalabad. **Period:** Six months Nov 2025 to April 2026. **Methods:** Included 210 patients aged 20–65 years with STEMI undergoing primary PCI. Patients were equally divided into intracoronary (Group A) and intravenous (Group B) tirofiban groups. Outcomes assessed included Thrombolysis in Myocardial Infarction (TIMI) grade 3 flow, TMP grade 2–3 flow, and MACE during hospital stay. **Results:** Intracoronary tirofiban resulted in significantly higher TIMI grade 3 flow (96.2% vs 80.0%, $p < 0.001$) and TMP grade 2–3 flow (89.5% vs 67.6%, $p < 0.001$) compared to intravenous administration. The incidence of MACE was significantly lower in the intracoronary group (11.4% vs 27.6%, $p = 0.003$). **Conclusion:** Intracoronary administration of tirofiban was superior to intravenous administration route showing more improved coronary and myocardial perfusion and reduced in-hospital MACE in STEMI patients undergoing primary PCI.

Key words: Intracoronary, Intravenous, MACE, Primary PCI, STEMI, Tirofiban, TIMI Flow.

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INTRODUCTION

A complete obstruction/reduction of blood flow to a coronary artery results in ischemic injury and leads to heart attack/myocardial infarction (MI). Discomfort/chest pain which may radiate to arm, shoulder, neck, back or the jaw, are the commonest clinical presentation/symptoms. Of the four main abnormalities that cause the ST elevation in the ECG, acute ST-segment elevation myocardial infarction (STEMI) is the most important following acute pericarditis, early repolarization, and abnormalities of the QRS complex follow.¹ ST-segment elevation myocardial infarction (STEMI) being the most life threatening condition is a severe manifestation of acute coronary syndrome (ACS), defined by activation of coagulation and platelet aggregation.²

As compared to other ACS, STEMI is responsible for a higher chance of severe complications and cardiac death including arrhythmias and heart failure. Therefore, early reperfusion therapy is

crucial to reduce irreversible myocardial damage.³ The primary treatment for STEMI is primary percutaneous coronary intervention (PPCI)⁴; however, myocardial reperfusion following PPCI is frequently ineffective because of the no-reflow phenomenon, which increases the risk of cardiac mortality and other adverse cardiac events. The no-reflow phenomenon has been attributed to various mechanisms, particularly Embolization, platelet aggregation, oxygen free radicals, and an inflammatory responses are considered as potential contributors.³

The most effective inhibitors of platelet aggregation are considered to be glycoprotein IIb/IIIa inhibitors (GPIs), which include tirofiban, abciximab, and eptifibatide. A modest, non-peptide cyclin-reversible antagonist of the platelet GpIIb/IIIa receptor is tirofiban. Platelet function can recover more than half in 2 hours after stopping tirofiban. Tirofiban inhibits von Willebrand factor (vWF) and fibrinogen

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from binding to platelet glycoprotein (GP) IIb/IIIa receptors.

This limits platelet aggregation, hence preventing stent thrombosis. Additionally, tirofiban has been proven to improve ST resolution and decrease infarct area in STEMI patients without enhancing the risk of bleeding episodes or major adverse cardiac and cerebrovascular events (MACCE).⁵

Intravenous and intracoronary injections are the most common delivery routes of GPIs. Intravenous GPIs can completely and promptly disaggregate preexisting thrombus, inhibit platelet aggregation and reduce the periprocedural adverse events related to PCL Tirofiban administered intracoronary may have some benefits. Higher local concentrations of antiplatelet agents at the level of the obstructive thrombus of coronary artery may result from intracoronary delivery; this may increase receptor occupancy, disrupt platelet crosslinking, and more significantly improve thrombus removal.⁶ Grade 3 TIMI flow, grade 2-3 TMP flow and MACE during hospital stay in intravenous vs intracoronary route were 86% vs 96%, 73% vs 88% and 43% vs 26% respectively.⁷

Patients with STEMI are typically administered tirofiban before to undergoing initial PCI. However, tirofiban administration follows no particular route. Data comparing these two methods of tirofiban administration prior to primary PCI are scarce in Pakistan. The purpose of this study is to assess the optimal tirofiban delivery route for STEMI patients undergoing primary PCI in order to improve patient compliance and achieve better outcomes (good coronary perfusion and efficient myocardial perfusion) as well as decreased rates of MACE throughout hospital stays.

METHODS

This study was conducted in the Cardiology Deptt of Faisalabad Institute of Cardiology with the study design of Non-Randomized Trial Control over a 6 months duration Nov 2025 to April 2026. Approval from the Institutional Ethical Review Committee was obtained before the study commenced (Letter No. 10-2024/DME/FIC/FSD, dated: 5th June, 2024). The estimated sample size was 210 cases, calculated with the help of WHO sample size by comparing two

proportions, with anticipation of TIMI grade 3 flow in 86% in patients group with intravenous and 96% in group of patients with intracoronary, significant level was 5% and power was 80%. The enrollment of patients was done with non-probability consecutive sampling technique with equal two division in two groups and 105 cases in each group. The age range of the participants was 20-65 yrs of both gender and diagnosed STEMI cases undergoing primary PCI. STEMI was defined as chest pain lasting more than 30 minutes, ST-segment elevation ≥ 1 mm in two or more contiguous leads (or ≥ 2 mm in men >40 years, ≥ 2.5 mm in men <40 years, and ≥ 1.5 mm in women in leads V2-V3), along with elevated cardiac troponin levels (>0.01 ng/mL). Those presenting with cardiac shock, severe renal/hepatic impairment, malignancy, anemia, LV dysfunction, history of ischemic heart disease, mechanical complications of myocardial infarction or cardiomyopathies were excluded.

The cardiac catheterization laboratory was used to treat the patients in a cardiac catheterization laboratory under the supervision of an experienced cardiologist after securing the consent of all the subjects and the institutional ethical review committee. The population of the study was subdivided into two groups. Group A was tirofiban (10 $\mu\text{g/kg}$ over 13 minutes) intracoronary infused then tirofiban (0.15 $\mu\text{g/kg/min}$) infused intravenously over 24 hours. Group B was treated with intravenous tirofiban using the same dosage regimen (10 $\mu\text{g/kg}$ during 1-3 minutes followed by an infusion of 0.15 $\mu\text{g/kg/min}$ during 24 hours).

The measures of post-procedural outcomes included TIMI flow grade, TMP flow grade and major adverse cardiac events (MACE) throughout hospital stay. TIMI flow was also graded as grade 0 to 3 with 3 being normal coronary perfusion. TMP flow was rated on a scale of 0 to 3 with grades 2-3 being regarded as normal myocardial perfusion. TIMI and TMP flow were dichotomized in terms of grade 3 versus grades 0-2 and 2-3 versus 0-1 to conduct statistical analysis. MACE was post-angina, cardiac death, rehospitalization, reinfarction, repeat revascularization and heart failure (Killip class II to IV) measured clinically until discharge. A structured proforma was used in the collection of data. The SPSS version 25 was used to perform

a statistical analysis. Both groups were compared and presented in tables.

RESULTS

Table 1 shows the baseline data of the population included in the study of 210 patients. Most of the participants (53.3%) were within the 41-65 years age bracket, with the remaining 46.7% having an age group of 20-40 years, which was fairly balanced with a minor bias towards older population. Male subjects were 64.3% being majority in our sample population. Regarding co-morbidities, 21% of the cases had dyslipidemia followed by 19.5% diabetes mellitus and 19% hypertension. Family history of IHD was found in 24.8% of the subjects. However, a significant prevalence of cardiovascular risk i.e. smoking was recorded in 47.1% of the subjects.

TABLE-I

Baseline characteristics of study population (n = 210)

Variable	Category	Frequency	Percentage (%)
Age Group	20–40 years	98	46.7
	41–65 years	112	53.3
Gender	Male	135	64.3
	Female	75	35.7
Hypertension	Yes	40	19.0
	No	170	81.0
Smoking	Yes	99	47.1
	No	111	52.9
Diabetes Mellitus	Yes	41	19.5
	No	169	80.5
Dyslipidemia	Yes	45	21.4
	No	165	78.6
Family History of IHD	Yes	52	24.8
	No	158	75.2

The data shown in Table-II indicates comparison of TIMI grade 3 flow attainment in the intracoronary and intravenous tirofiban groups. Higher proportion of patients in Intracoronary group achieved TIMI grade 3 flow i.e. 96.2% whereas 80% in intravenous group, it shows a significant difference by calculating p-value=<0.001.

In Table-III, a higher proportion of patients in the intracoronary group achieved efficient myocardial perfusion (TMP grade 2–3) compared to the intravenous group (89.5% [94/105] vs 67.6%

[71/105]). Conversely, poor perfusion was more common in the intravenous group. This difference was statistically significant ($p < 0.001$), indicating that intracoronary tirofiban significantly improves myocardial (microvascular) perfusion, which is an important determinant of myocardial recovery.

TABLE-II

Comparison of TIMI Grade 3 Flow Between Groups

Outcome	Intracoronary (n=105)	Intravenous (n=105)	Total	P-Value
TIMI Grade 3	Yes 101 (96.2%)	84 (80.0%)	185 (88.1%)	<0.001*
	No 4 (3.8%)	21 (20.0%)	25 (11.9%)	

*Chi-square test

TABLE-III

Comparison of TMP Grade 2–3 Flow between groups

Outcome	Intracoronary (n=105)	Intravenous (n=105)	Total	P-Value
TMP Grade 2–3	Yes 94 (89.5%)	71 (67.6%)	165 (78.6%)	<0.001*
	No 11 (10.5%)	34 (32.4%)	45 (21.4%)	

*Chi-square test

The comparison of major adverse cardiac events of the two groups during the hospital stay is presented in Table-IV. The rate of MACE was significantly lower in the intracoronary group (11.4%) than in the intravenous group (27.6%). On the other hand, a greater percentage of patients in the intracoronary group had no adverse occurrences (88.6%) than did the intravenous group (72.4%), ($p = 0.003$) and it refers to the fact that intracoronary tirofiban leads to a lower risk of in-hospital complications indicating clinical advantage of intracoronary delivery to enhance potential outcomes after STEMI.

TABLE-IV

Comparison of MACE between groups

Outcome	Intracoronary (n=105)	Intravenous (n=105)	Total	P-Value
MACE	Yes 12 (11.4%)	29 (27.6%)	41 (19.5%)	0.003*
	No 93 (88.6%)	76 (72.4%)	169 (80.5%)	

*Chi-square test

DISCUSSION

In this study, we compared the effectiveness of intracoronary delivery with intravenous delivery of tirofiban in STEMI cases with PCI. The statistical analysis reveals that intracoronary tirofiban achieved higher rate of TIMI 3 flow and TMP 2-3 flow in addition to lower in-hospital MACE, showing intracoronary delivery with better epicardial and microvascular reperfusion resulting ultimately better short-term clinical outcomes.

The demographics of the study population were similar to those that are recorded in the literature. Most patients in the current study were middle-aged and majority was males, which is in line with the known epidemiological trend of STEMI.

Trends have also been reported by Tang et al⁸ and Saddique et al⁹ with the majority of patients being male and the average age being between the fourth and sixth decades of life. But, there were differences in comorbidities across studies. Saddique et al. also reported a comparatively higher prevalence of hypertension and diabetes, though smoking was more prevalent, but it might also be possible due to regional differences in cardiovascular risk profiles.⁹

High-level evidence in this study is strongly positive as to support the superiority of intracoronary tirofiban. A meta-analysis by Tian et al. found that intracoronary administration was a significant decrease in 30-day MACE and an increase in TIMI grade 3 flow with no increase in bleeding risk.¹⁰ In the same way, Shi et al. verified these results with an increased meta-analysis on low-dose tirofiban with significant improvements in MACE, TIMI flow, myocardial perfusion, and left ventricular ejection fraction.¹¹ These meta-analyses included heterogeneous populations with different baseline characteristics but the similarity of the results supports the argument that intracoronary administration is evidence-based.

These findings are further corroborated by randomized clinical data. According to Tang et al., intracoronary tirofiban had significant beneficial effects on the TIMI flow and TMP grade, as well as it also led to a decrease in the number of major adverse cardiac events in comparison to intravenous

administration.⁸ Furthermore, their analysis showed long-term outcomes, such as enhanced left ventricular ejection fraction and decreased inflammatory indices, indicating myocardial healing after the acute procedure.⁸

These findings have a probable mechanistic basis associated with the improved delivery of drugs locally. The intracoronary administration is better in providing greater drug concentrations in the location of thrombus which results in more effective platelet inhibition and thrombus dissolution. El-Hefny et al. confirm this idea, showing that infarct size was significantly reduced and the occurrence of heart failure was significantly lower with intracoronary tirofiban but there was no significant difference in short-term MACE.¹² Likewise, Saddique et al. have found that there was an improved TIMI flow and myocardial blush grades, which has shown that intracoronary administration is beneficial to the epicardial and microvascular perfusion.⁹ Secondly, refined imaging findings by Asfour et al. indicated that optimized intracoronary delivery methods greatly decrease microvascular blockage highlighting the need to target drug delivery.¹³

Not each study shown better clinical outcomes, Bukhari et al. did not find any statistically significant difference in cerebrovascular event or MACE when comparing intracoronary and intravenous administration.¹⁴ Similarly, in a larger observational study, Liu et al. did not see any significant difference in hospitalization outcomes with the adjustment of baseline confounders.¹⁵ Such discrepancies could be attributed to the variations in study design, patient selection, thrombus burden, and baseline severity. Interestingly, patients who were treated with tirofiban in the study by Liu et al. had worse baseline features, which could have affected preliminary results.¹⁵

Although the evidence is generally positive, not the each study has shown clinical superiority. According to Bukhari et al., intravenous administration was not statistically different in terms of MACE or cerebrovascular events compared to intracoronary.¹⁴ Similarly, in a large observational study, Liu et al. observed no significant difference in the outcomes of hospitalization after the adjustment of baseline confounders.¹⁵ These inconsistencies could be

attributed to variations in the design of studies, patient selection, thrombus burden, and baseline severity. It is important to note that in the study by Liu et al., patients undergoing tirofiban had more severe baseline characteristics which might have affected the initial results.¹⁵

In general, the existing evidence indicates that intracoronary tirofiban is a reliable means of enhancing surrogate endpoints of reperfusion, such as TIMI flow and myocardial perfusion, and has the potential to decrease the size of infarcts and increase ventricular performance. Nevertheless, its impact on short-term clinical outcomes including MACE can be different according to the study design and patient features. The current research is relevant to this evidence because it not only shows better reperfusion parameters, but also a substantial decrease in in-hospital MACE. Clinically, the enhanced myocardial reperfusion decreases the size of the infarct, maintains left ventricular functioning and diminishes the chances of heart failure. The lack of further blood loss risk also promotes the safety of intracoronary administration to be considered as a therapeutic option in the choice of STEMI patients undergoing primary PCI.

The strength of this research is that a clear patient population, standard procedural guidelines, and full assessment of both angiographic and clinical outcomes were utilized. There are some shortcomings, though. The research was carried out in one center and it was non-randomized limiting generalisations. The sample size might not be adequate to identify infrequent outcomes like death or stroke. Furthermore, there was also no follow up in the long term and use of sophisticated imaging modalities.

Smaller multicenter randomized studies with a longer follow-up should be conducted in the future in order to better support these findings and help optimize the clinical application of intracoronary tirofiban.

CONCLUSION

Intracoronary administration of tirofiban was superior to intravenous administration route showing more improved coronary and myocardial perfusion and reduced in-hospital MACE in STEMI patients

undergoing primary PCI.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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AUTHORSHIP AND CONTRIBUTION DECLARATION	
1	Waseem Ahmad: Conceptualization, methodology, investigation, formal analysis, writing.
2	Shahid Abbas: Data curation, data analysis.
3	Kubra Anjum: Methodology, drafting.