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Original Article

Comparison of Intracoronary and Intravenous Administration of High Dose Bolus Tirofiban in Patients of St Elevation Myocardial Infarction Undergoing Primary Percutaneous Coronary Intervention

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ABSTRACT

Acute ST-elevation myocardial infarction (STEMI) is a condition in which transmural myocardial ischemia causes myocardial necrosis and is the leading cause of death. **Objectives:** To compare the efficacy of tirofiban bolus administration via percutaneous coronary intervention (PCI) and intravenous route (IV) in STEMI patients for restoration of myocardial perfusion. **Methods:** A retrospective cross-sectional study was conducted at Cardiology Department, Hayatabad Medical Complex, Peshawar, during 2021-22. The study comprised 168 STEMI patients divided into Group A and B (n=84), treated with tirofiban PCI and IV route, respectively. **Results:** Incidence of STEMI was three folds higher in males than females, and the mean age of the patients was 55 years. Smoking and obesity were the potential risk factors. Patients in Group A had a better clinical outcome and prognosis than Group B. In comparison to the IV treatment group (91.66%), the ST-segment resolution time was considerably lower ($P<0.05$) in the PCI group(48.80%). In both groups, the observational parameters for TIMI flow grade, TIMI major and minor bleeding, MBG, and MACE were not-significantly different ($P\geq0.05$), comprising percentages 94, 3.57, 9.52, 71.42, 5.95%, and 84.52, 2.38, 13.09, 75, 15.47%, respectively. In comparison to IV therapy group, the LVEF percentage in PCI group was statistically significant ($P<0.05$) after 24 hours and 30 days (57, 63 and 52, 58%, respectively). **Conclusions:** It was concluded that STEMI patients treated with PCI tirofiban bolus had significantly greater ($p<0.05$) recovery rates, left ventricular ejection fractions and better clinical outcomes than IV-treated group.

INTRODUCTION

Myocardial infarction (MI), sometimes known as a heart attack, occurs when blood flow to the coronary artery of the heart diminishes or stops, resulting in damage to the heart muscle. The most prevalent symptoms are chest pain or discomfort that might radiate to the shoulder, arm, back, neck, or jaw. The most significant of the four primary abnormalities that underlie under the myocardial infarction are acute ST- segment elevation myocardial infarction (STEMI), followed by abnormalities of the QRS complex, early repolarization, and acute pericarditis. Acute STEMI is a condition in which transmural myocardial ischemia causes myocardial necrosis and is the leading cause of death. When patients are admitted to the emergency room with elevated ST-segments, the cardiologist's primary concern is STEMI [1]. The STEMI is leading cause of death in both men and women, accounting for 57 and 43% of acute coronary syndrome patients admitted to hospitals, respectively [2, 3]. The ST- segment elevation is often determined at J-point, where it meets the end of QRS complex, and is compared to TP or PR segment. While,

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some medical professionals prefer to assess the ST elevation when all cardiac fibers are lying in the isoelectric ST- segment, which is when its size ranges from 40 to 80 msec post-J-point [4]. The cutoff values are (a) 1 mm for all leads except V2, V3; (b) 2.5 mm for V2 and V3 (under 40 years old), 2 mm for V2 and V3 (over 40 years old), and 1.5 mm for all other leads (in women), (c) 0.5mm in V7 to V9 (posterior chest leads have minimal cutoff values due to their increased distance from the heart) [1]. The European Society of Cardiology (ESC) advises prompt PCI treatment for STEMI patients to prevent infarction from causing hypoxia and other Major Adverse Cardiac Events (MACE) [5]. The mortality rate, stroke, re-infarction, and intracranial hemorrhages were all reported to be dramatically decreased by 25, 53, 64, and 95%, respectively, following percutaneous coronary intervention (PCI) [6]. With a successful recovery rate and an improved myocardial blush grade, emergency PCI with tirofiban has significantly demonstrated its effectiveness as a therapy for the management of Acute MI and MBG. A novel GP (Glycoprotein) IIb/IIIa receptor antagonist is called tirofiban [7]. It is an antiplatelet medication that relieves myocardial perfusion injuries and MACE by preventing platelet aggregation, activation, and adhesion in coronary vessels [8]. The first therapeutic candidate with origins traceable to a pharmacophore-based virtual screening lead is the small molecule inhibitor of the protein-protein interaction between fibrinogen and the platelet integrin receptor GP- IIb/IIIa [9]. Approval for the use of tirofiban in patients with non-ST-elevation acute coronary syndrome was based on its ability to reduce the rate of thrombotic cardiovascular events, specifically the combined endpoint of mortality and myocardial infarction [10]. Therefore, this study aimed to investigate the efficacy of tirofiban bolus administration via PCI and IV routes in STEMI patients, in terms of patients' safety profile, reduced infarction size, MBG, restoration of myocardial perfusion, and LVEF.

METHODS

The study comprised the metadata of 168 patients presented at the Cardiology Department, Hayatabad Medical Complex (HMC) Teaching Hospital, Peshawar, Khyber Pakhtunkhwa, Pakistan, during the year 2021-22, diagnosed with STEMI**.** The patients were allocated in two groups *viz* Group A and Group B, comprising 84 patients (n=84) in each group. Patients with ST-segment elevation >0.1mV in at-least two leads, clinical evidence of AMI, age>40 years, elevated creatinine-kinase of muscle-brain (CK-MB), and Troponin were included in the study; patients sensitive to tirofiban, persistently hypertensive, at risk for bleeding, hemodynamically unstable, and those requiring emergency coronary artery bypass grafting or rescue PCI were excluded. Prior to intervention, patients in all treatment groups received intravenous doses of clopidogrel (600mg) and acetylsalicylic acid (300mg), and tirofiban was always provided concurrently with an IV bolus of un-fractionated heparin (50-IU/Kg). Patients in Group A were treated with PCI bolus infusion of tirofiban, followed by the administration of intravenous maintenance dosage of tirofiban, while, Group B patients were only treated with a bolus intravenous infusion of tirofiban. Initially, in STEMI cases, tirofiban was infused intravenously at 0.4micrograms/Kg body weight, per minute for 30 minutes, and its infusions were continued at 0.1 micrograms per kilogram per minute. In STEMI the PCI, tirofiban was infused @0.25 micrograms/KG/minute for three minutes, and it was continued at 0.15 micrograms/Kg/per minute for 18 hours [11]. The initial care given to patients in both groups is depicted. Various risk factors including age, gender, genetic predisposition, smoking, diabetes mellitus, obesity, dyslipidemia, angiotensin-converting enzyme-II insertion/ deletion (ACE- I/D+ II), hypertension [12] were also recorded and analyzed. Before and during the coronary intervention, the reduction in the primary endpoint of infarct size, myocardial blush grade (MBG) and TIMI flow grades were evaluated. After the tirofiban PCI, 48 hours later, and then 30 days later, the LVEF was assessed. The TIMI flow grades, high-sensitivity Troponin T (hs-TnT), LVEF, MBG, C-reactive protein (CRP), CK-MB, MACE rates after 30 days, and 50% ST-segment resolution time were all compared between the two therapeutic groups [8]. Ethically the patients' social and moral values were not debilitated during the study's execution, and their authorized family member or the patients themselves provided informed consent in writing. The data was analyzed using Mean±SD, one-way ANOVA followed by the Tukey HSD test, while, between-group statistical analysis was performed using the Chi-Square (x2) test. The statistical analysis was performed in SPSS 20.

RESULTS

There were a total of 168 patients (111 male and 57 females) in the study diagnosed with STEMI (Figure 1).

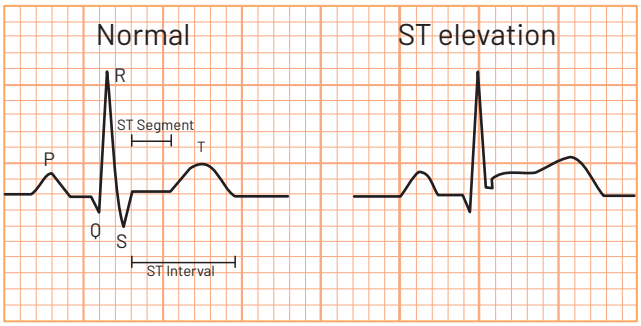

Figure 1: ST-segment elevation recorded in STEMI patients

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Patients in the PCI group and IV group had similar mean ages (54.99 +10.54 and 54.88+8.55 years, respectively). However, statistically significant difference (P<0.05) was found between the genders, with males having twice the susceptibility to STEMI than females (66.07 vs. 33.90%, respectively)(Table 1).

Drugs administration	Group A		Group B	
	Initial Dose	Maintenance Dose	Initial Dose	Maintenance Dose
Tirofiban	0.25µg/ Kg/min	0.15µg/ Kg/min	0.4µg/ Kg/min	0.1µg/ Kg/min
Route	PCI bolus infusion	Intravenous route	Intravenous route	Intravenous route
Treatment Duration	3minutes	18hours	30minutes	12-24hours

Table 1: Drug administration posology of Tirofiban

Clinical outcome is the evaluation of the patients to determine the degree of symptoms alleviation, the return of their health and physiology, and the case's prognosis. In our study, patients treated with tirofiban bolus PCI had significantly better clinical outcomes and prognosis (P<0.05) than those treated with tirofiban bolus intravenously(Figure 2).

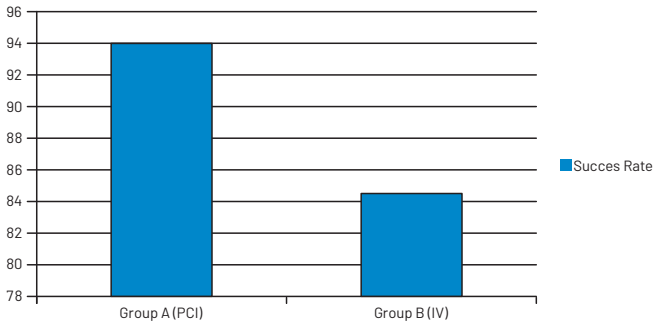

Figure 2: The success rate of the PCI group was higher than IV group

In the PCI group, the primary endpoint of infarction size was 22.61%, which was considerably greater (P<0.05) than the IV treatment group's infarction size of 5.95%. However, compared to the IV-treated group (91.66%), the ST-segment resolution time was substantially lower(P<0.05)in the PCI group(48.80%)(Table 2). .

Risk Factor	No. of Patients	Incidence in Males (n=111)	Incidence in Females (n=57)	Means+ SD	p - value
Age	168	56.49+11.88	53.58+7.21	55.03+9.54	0.9107
Gender	168	111/168 (66.07%)	57/168 (33.90%)	___	0.006349*
Genetic predisposition	168	18(16.21%)	7(12.28%)	14.24+2.21	0.6126
Smoking	168	31(27.92%)	2(3.50%)	15.71+0.21	0.000092*
Diabetes mellitus	168	69(62.62%)	39(68.42%)	65.52+1.21	0.681
Obesity	168	26(15.47%)	19(33.33%)	24.40+1.01	0.0239*
Dyslipidemia	168	76(68.46)	39(68.42%)	68.44+2.65	0.943
ACE- (I/D+II)	168	20(18.01%)	11(19.29%)	37.30+2.30	0.9777
Hypertension	168	81(72.97)	43(75.4%)	74.18+3.10	0.0063

Table 2: Incidence of STEMI associated with the risk factors in genders.

*Indicated the significant difference in the factors at (P<0.05)

In both the treatment groups PCI and IV, the observational parameters for TIMI flow grade, TIMI major bleeding, TIMI minor bleeding, MBG, and MACE did not differ significantly (P≥0.05), with percentages of 94, 3.57, 9.52, 71.42, 5.95%, and 84.52, 2.38, 13.09, 75, 15.47%, respectively(Figure 3).

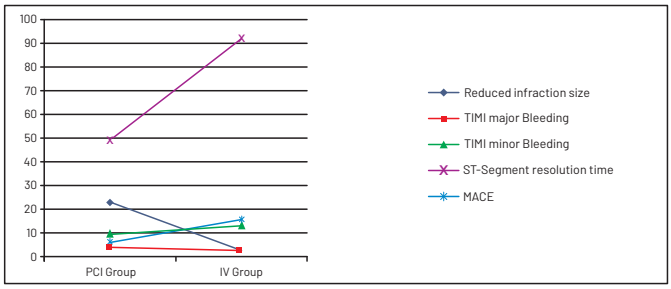

Figure 3: The pictorial of clinical outcome parameters in PCI vs IV treated group

Hence, all the variables and parameters indicated that the PCI group had a better chance of recovering than the IV treated group did(Table 3).

S. No	Variables Observed	Group A (n=84)	Group B (n=84)	Chi-square (χ2)	P-Value
1	Reduced infarction size	19(22.61%)	5(5.95%)	6.059	0.0138*
2	TIMI flow grades post-intervention	79(94%)	71(84.52%)	0.1314	0.7169
3	TIMI major bleeding	3(3.57%)	2(2.38%)	0.0002	0.9895
4	TIMI minor bleeding	8(9.52%)	11(13.09)	0.1684	0.6815
5	MBG after intervention	60(71.42%)	63(75%)	0.0075	0.9370
6	ST-segment resolution	41(48.80%)	77(91.66%)	5.9501	0.0147*
7	MACE	5 (5.95%)	13 (15.47%)	2.3885	0.1222

Table 3: The clinical outcomes of the patients treated with PCIvsIV bolus.

*Indicated the significant difference in the factors at (P<0.05)

Compared to the IV-treated group, LVEF percentage in the PCI group was statistically significant (P<0.05), 24 hours and 30 days post intervention (57, 63 and 52, 58%, respectively). Similarly the Peak CPK-MB value in the PCI group (298+56) was much lower than IV group (543+67), indicating that the patients in the PCI group had a better prognosis. Peak levels of hs-TnT, CK-MB, and CPK were lowest in the PCI group (5111+1011, 7.12+2.12, and 2377+912, respectively), whereas these enzymes were higher in the IV group patients (5587+1298, 9.98+2.33, and 2456+876, respectively). Additionally, these values favored the post-intervention prognosis of the PCI-treated group(Table 4).

S. No	Variables Observed	Group A (n=84)	Group B (n=84)	Chi-square (χ2)	P-Value
1	LVEF at 24 hours (%)	57	52	7.987	0.0479*
2	LVEF at 30 days (%)	63	58	5.994	0.0457*
3	Peak hs-TnT (ng/dl)	5111+1011	5587+1298	0.0376	0.8461
4	Peak CK-MB (U/l)	7.12+2.12	9.98+2.33	0.1989	0.6554
5	Peak CPK, U/L	2377+912	2456+876	0.0010	0.9753
6	Peak CPK-MB, U/L	298+56	543+67	4.7735	0.0289*

Table 4: Determination of the LVEF and cardiac enzymes in patients treated with PCIvsIV bolus

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*Indicated the significant difference in the factors at (P<0.05)

DISCUSSION

It was found that out of 934 STEMI patients 83.6% were males with an average age of 54.09±12.4 [13]. Our findings were also confirmed that men had three-fold greater incidence of STEMI than females and patients with STEMI had mean age of 55years [14]. It was evident that patients with a family history, smoking, diabetes mellitus, obesity, dyslipidemia, and hypertension had a greater risk of STEMI, with mean ratio of 14.24±2.21, 15.71±0.21, 65.52±1.21, 24.40±1.01, 68.44±2.65 and 74.18±3.10, respectively. Similar findings concurred our study, that high frequency of 74.18±3.10; hypertension significantly increased the incidence of STEMI [15-17]. It was noted that the ST-segment elevation in the STEMI population was significantly influenced by hypertension [18]. The patients with STEMI with hypertension had the highest chances of death while hospitalized and suffered from recurrent MI [19]. There was non-significant difference (P ≥ 0.05) in the ACE (I/D+ II) of the STEMI patients, in male and female patients at 34.9 and 29.5%, respectively [13]. The individuals who received PCI had considerably lower ST-segment resolution times than those who did not [11]. The findings of a trial that treated patients with a bolus of tirofiban during PCI greatly enhanced myocardial perfusion and significantly reduced infarction size, providing additional support for our research [20]. It was found that PCI treatment significantly reduced infarction size in STEMI patients compared to IV treatment by 14.46 and 18.06%, respectively [21]. Similar findings reported that clinical outcomes in STEMI patients treated with PCI and IV therapy groups' had non-significant difference in MACE, TIMI major, and minor bleeding rates [11]. Another study reported that MBG and TIMI flow had superior effects in PCI treated group [6]. Pertaining to MACE and TIMI bleeding there was no discernible difference between the PCI and IV treatments [21]. The PCI-treated group's LVEF was much higher than IV-treated group, and MACE was also reduced [8]. The LVEF in the PCI group was considerably enhanced (P<0.05) by the administration of tirofiban bolus in comparison to the STEMI patients who received tirofiban injection intravenously, provided strong support to our study [7]. Another study found that STEMI patients receiving tirofiban PCI had Peak hs-TnT, Peak CK-MB, and Peak CPK levels that were significantly lower (P<0.05) than IV-treated group [11].

CONCLUSIONS

It was concluded that patients who received tirofiban bolus treatment for STEMI showed significantly greater (P<0.05) recovery rates and comparably better left ventricular ejection fraction. Clinically, the PCI group performed better than the IV treated group and the risk of MACE was also lower in them. The post-intervention cardiac perfusion rate was greater in the PCI group. Therefore, according to perspectives of this study, tirofiban should be preferably given to patients with STEMI through PCI.

Conflicts of Interest

The authors declare no conflict of interest

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