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ORIGINAL ARTICLE

Effects of Different Strategies on High Thrombus Burden in Patients with ST-Elevation Myocardial Infarction Undergoing Primary Percutaneous Coronary Catheterization

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ABSTRACT

Objective: The aim of this study is to evaluate the impact of thrombus aspiration and intracoronary-targeted thrombolysis on myocardial perfusion. The study also analyses the effect of different technological approaches on ST-elevation myocardial infarction (STEMI) patients undergoing primary percutaneous catheterization (IMR and SPECT).

Study Design: Randomized control trial

Place and Duration: Cardiology Department of Punjab institute of cardiology Lahore from September 2021 to September 2022.

Methodology: Sixty six STEMI patients of either gender were enrolled in this study. Detailed demographics were recorded after taking informed written consent. All the patients were equally divided into two groups (TA and IT group) 33 patients in each group. Blood samples from the venous veins were collected for routine laboratory examinations, biochemical tests included blood sugar test, lipid profile test, C reactive protein test, liver and kidney function tests, myocardial indicators as troponin I and blood tests for other organs. Vital sign changes and intracoronary thrombolysis were investigated intensively when the drug was injected. Additionally, patients in the TA group would get an extra 5 or 10mg of Pro-UK if there was a residual thrombus and they had repeated thrombus aspirations utilizing Export AP. SPSS software 24.0 was used for the data analysis.

Results: The analysis showed that the IT group has greater values of thrombus burden, TIMI myocardial perfusion %, and TIMI frame count. The statistical analysis revealed that during the 90-day follow-up, there is no change in MACEs or heart function was observed. The values of 12-month follow-up illustrated that there is significant differences in the infarct size assessed by SPECT, the left ventricular ejection fraction evaluated by echocardiography, and the composite MACEs between the 2 groups (P=0.034).

Conclusion: Effective therapies include intracoronary-targeted thrombolysis and thrombus aspiration and safe ways to treat STEMI patients with an increased coronary thrombus burden.

Keywords: ST-Elevation Myocardial Infarction, Primary Percutaneous Coronary Catheterization, Thrombus Aspiration, Thrombolysis

INTRODUCTION

In recent times, ST-segment elevation myocardial infarction (STEMI), a phenomenon caused by coronary plaque rupture and abrupt thrombus development, has risen to the top of the list of deaths worldwide. Reperfusion treatment must be administered as quickly as feasible for STEMI patients to salvage the ischemic myocardium, stop the spread of the infarction, and recover effective cardiac tissue perfusion. Restoring the flow of the artery connected to the infarct does this (IRA). Despite the 3-grade epicardial blood flow after recanalization in myocardial infarction, the importance of myocardial microcirculation perfusion restoration and maintenance, which are strongly connected to the prognosis and the development of cardiovascular disorders, must be carried out (Niccoli et al., 2016).

It has been established that inadequate thrombus management during catheterization and direct stent insertion leads to distal embolization, resulting in a second attack on the coronary microvascular circulation and cardiac myocytes. Therefore, it is not advised to use stents directly for STEMI patients who have a large thrombus load. As a result, several interventions, including thrombus aspiration and drug pretreatment, have been recommended to address and prevent this problem. According to the recent guidelines with a level of III-A, frequent thrombus aspiration has not been adopted as a main therapeutic strategy, taking into account the results of the overall study and the current recommendations. Aspiration is seen to be a successful strategy for urgent recanalization in patients with a significant residual thrombus load (Jolly et al., 2015).

Additionally, intracoronary thrombolysis has been demonstrated to be a successful option for managing the burden of residual thrombi in clinical practice. Despite the absence of the recommendation, Patients with left main thrombus, Kawasaki disease, stent thrombosis, ineffective aspiration, and other complicated conditions have been studied to determine the good therapeutic benefits of this treatment. Intracoronary-targeted thrombolysis has recently gained popularity and has proven to be effective in treating coronary thrombotic lesions (Jolly et al., 2018).

Two possible methods for reducing the significant remaining intracoronary load are aspiration and intracoronary thrombolysis; Comparison of the effects of different approaches on myocardial perfusion is still debatable. The index of microcirculatory resistance (IMR), a distinct invasive measurement of the microvascular flow, has been established (Boscarelli et al., 2014).

IMR reveals the advantages of high reliability, accuracy, and Dynamics and epicardial vascular stenosis are independent. When used in conjunction with earlier techniques, this special indicator seems to increase accuracy in determining the amount of perfusion in the heart tissue. This study examines the effectiveness and safety of aspiration and intracoronary-targeted thrombolysis on coronary thrombus burden in STEMI patients undergoing first catheterization utilizing IMR and single photon emission computed tomography (SPECT) (Luo et al., 2021).

The Objectives of the Study:

- The aim of this study is to evaluate the impact of thrombus aspiration and intracoronary-targeted thrombolysis on myocardial perfusion
- The study also analyses the effect of different technological approaches on ST-elevation myocardial infarction (STEMI) patients undergoing primary percutaneous catheterization (IMR and SPECT)

Review of Literature: Acute myocardial infarction is the leading cause of death worldwide. Acute ST-segment elevation myocardial infarction (STEMI), which has a high mortality risk, is caused by the rupture of vulnerable coronary plaques. The primary percutaneous coronary intervention (PCI) was recommended as an effective therapy for acute STEMI in this other research (Lee et al., 2015).

Primacy cardiac catheterization intervention is the recognized and recommended course of therapy for ST-segment elevation myocardial infarction because it is more successful in opening the occluded artery associated to the infarct (STEMI). Following primary PCI, manual thrombus aspiration is seen to be viable and appropriate in addition to other adjuvant therapy for patients (Farman et al., 2014).

Managing normal coronary blood circulation during early PCI is a significant problem when treating patients with acute STEMI. Distal embolization and decreased coronary blood circulation are directly related to reperfusion injury, which results in arrhythmias, microvascular disruption, inability of the left ventricle to contract, and permanent myocardial infarction. Heart failure and mortality are also caused by a reduction in myocardial perfusion. As a result, it's imperative to find ways to avoid coronary microvascular blockage and significant thrombus-burden plaques during first PCI (Zheng et al., 2016).

Manual thrombus aspiration following accepted standards is the primary PCI that is advised and is intended to minimize the load of thrombi in arteries related to infarcts. The effectiveness of thrombus aspiration is unknown, nonetheless, due to the aspiration catheters' several drawbacks in terms of thrombus retrieval. After manual thrombus aspiration, remaining thrombi are frequently detected by optical coherence tomography in clinical practice. As a result, distal protection devices play a significant role in limiting the degree of distal embolization during primary PCI (Chen et al., 2013).

METHODOLOGY:

Study participants: Patients hospitalized at the Cardiology Department of Punjab institute of cardiology Lahore from September 2021 to September 2022 were sequentially included in this prospective, randomized, control trial. All of the signed-up individuals fulfilled the following criteria: they got a diagnosis of STEMI following the standard recommended by the guidelines; (ii) Within 12 hours of the onset of chest symptoms and hospital admission, the main percutaneous coronary intervention (PCI) or percutaneous transluminal coronary angioplasty were arranged in the urgent catheterization lab (iii) The burden of intracoronary thrombus increased on angiographic imaging (iv) The IMR assessment done after the permission of patient and SPECT scan was performed . By Yip's definitions, a large thrombus load was defined as having the following characteristics: cutoff occlusion, a liner thrombus with a linear dimension greater than three times the diameter, Thrombus production is indicated by thrombus developing on the proximal blockage (>5.0mm), a floating thrombus at the proximal end, and dye stasis at the distal end. An authorization document was signed by each of the chosen patients. The study's protocol was approved by the local ethics board, and all regulations were followed in accordance with the Ethical Guidelines (Mangiacapra et al., 2017).

Sample size calculation: Based on our pre-experiment findings and previously written research, the proportion of STEMI patients with TMPG grade 3 after primary PCI was close to 50 percent. This proportion would increase to 95 and 70 percent, respectively, while getting intracoronary fibrinolysis and aspiration. With the use of the PASS 11.0 program, a sample size for this investigation was determined. It was necessary to have 33 patients in each group, with the values of the test maintained at 0.70 and the error set at 0.05, and statistical significance threshold at 0.05 (Hoole et al., 2015).

Study Protocol: As soon as a patient was admitted, a basic physical examination and basic medical history were begun. An electrocardiogram was conducted in 10 minutes. All subjects received recommended doses of ticagrelor (180 mg) and aspirin (300 mg) after being diagnosed with STEMI. Blood samples from the venous veins were collected for routine laboratory examinations, biochemical tests included blood sugar test, lipid profile test, C reactive protein test, liver and kidney function tests, myocardial indicators as troponin I and blood tests for other organs. The informed consent proforma for the operation were completed by all the subjects. The interventional technique was carried out in accordance with established clinical practice by at least two licensed cardiac physicians. The thrombus load of IRA was evaluated and assessed as soon as the culprit lesions were passed by guidewire or being inflated by balloon. Following examination, eligible individuals were divided into 2 groups at a ratio of 1: 1 for TA and IT group, respectively, using a random sampling method. Intravascular-focused thrombolysis was administered to patients in the IT group. From the distal end of the IRA, an intracoronary fibrinolytic agent was injected using a Fine cross microcatheter. While the withdrawal of microcatheter ,the medication was slowly infused, this promoted thrombus exposure to the agent, strengthening the targeted thrombolytic effects (Mastoris et al.,2016).

Vital sign changes and intracoronary thrombolysis were investigated intensively when the drug was injected. Additionally, patients in the TA group would get an extra 5 or 10mg of Pro-UK if there was a residual thrombus and they had repeated thrombus aspirations utilizing Export AP. The subjects were transferred to the IT group and began on intracoronary thrombolysis. if artery circulation was not made to restore or the thrombus could not be entirely aspirated, patients were removed and offered other therapies (Xiao et al., 2019)..

Exclusion Criteria: Patients who did not meet the requirements listed below were excluded from the study: those who were unwilling a primary operation or planning a specific intervention; those who were using intravenous thrombolytic medications; those who had myocardial infarctions in situ; those who had a history of serious liver or kidney impairment; those who had cancer; and those who were contraindicated for antithrombotic and anticoagulation treatment.

Statistical analysis: SPSS software 24.0 was used for the data analysis. Smirnov's was used in conjunction with the Kolmogorov-test to determine if continuous variables had a normal distribution. Data that were normally distributed and shown as mean±SD were compared using the student's t-test. The median was used to highlight the non-normally distributed data using Mann-Whitney U-test procedures. Categorical variables were compared and provided as proportions using the 2 or Fisher's exact test. Statistical significance was defined as a two-sided P value less than 0.05 (Kunadian et al., 2013).

RESULTS

The study contains two groups, name as IT group and TA group and both groups composed of 33 subjects equally. The analysis showed that the IT group has greater values of thrombus burden, TIMI myocardial perfusion %, and TIMI frame count. The statistical analysis revealed that during the 90-day follow-up, there is no change in MACEs or heart function was observed. The values of 12-month follow-up illustrated that there is significant differences in the infarct size assessed by SPECT, the left ventricular ejection fraction evaluated by echocardiography, and the composite MACEs between the 2 groups (P=0.034). In the echocardiography evaluation the overall findings showed that TA group in hospital have greater values of LVEF (%), EDVI (ml/m2), ESVI (ml/m2, WMSI respectively (52.78±6.01, 66.42±14.8, 39.18±8.87, and 2.55±1.34) and same trend was observed in 90 days after the procedure (56.64±4.01, 62.32±17.11, 34.19±8.94, 2.78±0.97) and 12 months after the procedure (59.23±6.40, 61.66±14.62, 33.78±9.77, 1.90±0.93). respectively.

Continuous variables with a normal distribution are displayed as mean + SD.

Intracoronary thrombolysis (IT group), end-diastolic volume index (EDVI), end-systolic volume index (ESVI), left ventricular ejection fraction (LVEF), and thrombus aspiration group (TA group) are some of the terms used. Wall Motion Score Index (WMSI).

*P<0.05, compared to baseline values within the same group.

#P<0.05, As opposed to the disparities in levels between the 2 groups.

Table 1: Two groups were subjected to an echocardiography evaluation as a follow-up.

	In-hospital		90 days after the procedure		12 months after the procedure	
	IT group (n=38)	TA group (n=33)	IT group (n=36)	TA group (n=32)	IT group (n=36)	TA group (n=30)
LVEF (%)	52.19±.43	52.78±6.01	55.62±6.32*	56.64±4.01*	57.83±6.12*	59.23±6.40*#
EDVI (ml/m2)	61.17±18.5	66.42±14.8	58.75±15.04	62.32±17.11	59.14±16.33	61.66±14.62
ESVI (ml/m2)	35.35±6.3	39.18±8.87	31.11±8.75*	34.19±8.94*	28.32±11.05*	33.78±9.77*#
WMSI	2.47±1.9	2.55±1.34	1.92±0.94*	2.78±0.97*	1.49±0.72*	1.90±0.93*

In the case of cardiovascular events, stroke, and bleeding problems during follow-up. Statistical finding of 90-day follow-up MACEs revealed that the cardiac death, worsening heart failure, and Malignant arrhythmia values is lower in IT group than TA groups respectively, (3 (4.12), 7 (23.12), 4 (17.13) and (1 (4.05), 8 (34.17), 2 (8.11). The minor bleeding complications also greater in IT group than TA group (8 (25.73), 4 (8.05) respectively.

In the case of 12-month follow-up MACEs the cardiac death, worsening heart failure, and Malignant arrhythmia values is greater in IT group than TA groups respectively (3 (4.32), 11 (34.72), and 6 (22.18)) and (4 (8.11), 14 (46.16), and 6 (26.32)) respectively. And minor bleeding complications greater in IT group than TA group (13 (43.71), 6 (12.52) respectively.

Table 2: Significantly adverse cardiovascular events, stroke, and bleeding problems during follow-up.

Variables	IT group (n=38)	TA group (n=33)	P value
90-day follow-up MACEs			
Cardiac death	3 (4.12)	1 (4.05)	1.0
Worsening heart failure	7 (23.12)	6 (34.17)	0.474
Malignant arrhythmia	4 (17.13)	2 (8.11)	0.812
The bleeding complication			
Major bleeding	0 (0.00)	0 (0.00)	0
Minor bleeding	8 (25.73)	4 (8.05)	0.201
Transfusion	0 (0.00)	0 (0.00)	0
12-month follow-up MACEs			
Cardiac death	3 (4.32)	4 (8.11)	0.439
Worsening heart failure	11 (34.72)	14 (46.16)	0.273
Malignant arrhythmia	6 (22.18)	7 (26.32)	1.0
The bleeding complication			
Major bleeding	0 (0.00)	0 (0.00)	0 (0.00)
Minor bleeding	13 (43.71)	6 (12.52)	0.238
Transfusion	0 (0.00)	0 (0.00)	0 (0.00)

Continuous variables with a normal distribution are displayed as mean + SD.

TVR stands for target vessel revascularization; IT stands for intracoronary thrombolysis; MACE stands for significant adverse cardiac events; and TA stands for thrombus aspiration group.

*P0.05 when compared to the same group's values.

DISCUSSION

The pathophysiology of STEMI is strongly influenced by acute coronary thrombus development as a result of unstable endothelial plaque rupture, ulceration, and erosion. The current study indicates that the intracoronary high thrombus is more prevalent. According to Sianos et al., about 70 percent of STEMI patients having primary recanalization had a significant intracoronary thrombus load (Sianos et al., 2007).

In approximately 73 percent of STEMI patients, an experiment by Stone et al. revealed that visible thrombus debris could be obtained. In particular to being common, thrombus lesions are challenging to treat during an emergency intervention. Inadequate mechanical inflating and stenting would cause damage to the microcirculation to worsen and would clog the microvascular distal end (Stone et al., 2005).

Up to 15 percent of patients might experience distal embolization throughout primary PCI, according to Henriques et al. As a result, in recent times, there has been debate on how to manage the thrombus load in clinical practice. This study aimed to examine the effectiveness and safety of 2 experimental therapy, thrombus aspiration and intracoronary thrombolysis, as well as any potential preventative effects on myocardial perfusion, which is closely linked to patient outcomes and development (Henriques et al., 2002).

The study's results showed that patients of IT groups showed less residual thrombus after the percutaneous intervention than subjects in the TA group. The ratio of TMPG grade 3 and IMR value in the IT group appeared to be more satisfactory when matched to the TA group subjects, cTFC. Patients who receive retrograde thrombolysis have improved cardiac function and experience fewer MACEs at a long-term follow-up. These findings showed that aspiration did not increase myocardial microvascular perfusion most likely for the reasons. In order to increase the possibility that the intracoronary-targeted fibrinolysis would be successful, a Fine cross microcatheter was 1st put on the distal end of the artery. A fibrinolytic substance was then delivered via it rather than through a guiding catheter. II, it has been demonstrated that the use of Pro-UK, a precursor to urokinase, in intravenous thrombolysis may successfully open blocked arteries and manage rare bleeding issues. Pro-UK, which is inactive until it comes into contact with the thrombus, then transforms into urokinase.

III, increasing myocardial perfusion after an infarction can be settled by intracoronary fibrinolytic drugs that destroy thrombi in microvascular and epicardial arteries. Tiny emboli cannot be extracted while removal of large clots externally.

CONCLUSION

Effective therapies include intracoronary-targeted thrombolysis and thrombus aspiration and safe ways to treat STEMI patients with an increased coronary thrombus burden. Aspiration is less beneficial than intracoronary-targeted thrombolysis for improving myocardial microcirculation perfusion.

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