

Effect of High-Intensity Atorvastatin on the Prevalence of No-Reflow Phenomenon in Patient Undergoing Primary PCI: A Cross-Sectional Study

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ABSTRACT

Introduction: ST-segment elevation myocardial infarction (STEMI) is one of the most common heart problems worldwide. So far percutaneous coronary intervention (PCI) has proved to be the most successful method to restore blood flow after a STEMI attack. However, the breakdown of coronary plaques often results in a failed restoration of blood. The no-reflow phenomenon complicates the treatment and delays the patient's recovery. Statins have helped reduce cholesterol levels in the blood and have thus been used during primary PCI to enhance the chance of blood reflow. Atorvastatin is a promising candidate drug that reported promising results.

Objective: In this study, the effect of high-intensity Atorvastatin has been assessed in preventing the no-reflow phenomenon.

Study Design: Cross-sectional study

Study Setting: Department of interventional Cardiology Hayatabad Medical Complex, Peshawar from 10-06-2022 to 10-10-2022.

Material and Methods: A sample size of 149 was collected using non-probability consecutive sampling and was examined using Chi-Square for independence via the SPSS program.

Results: The patients had several comorbidities, with hypertension being the most common. Over half of the patients were given atorvastatin, and over 97% of patients received balloon and stent procedures. 15% of patients experienced a no-reflow phenomenon, while 85% had a successful primary PCI. High-intensity atorvastatin was found to significantly reduce the risk of no-reflow ($p < 0.001$).

Conclusion: The statistical outcome revealed that loading atorvastatin during the primary percutaneous coronary intervention (PCI) significantly reduces the risk of a no-reflow phenomenon.

Keywords: ST-segment elevation myocardial infarction (STEMI), Atorvastatin, primary percutaneous coronary intervention (PCI), No-reflow phenomenon

INTRODUCTION

Percutaneous coronary intervention remains one of the most successful ways to restore blood flow to persons with ST-segment elevation myocardial infarction. The breakdown of Coronary arterial plaques often results in ST-segment elevation myocardial infarction (STEMI) by preventing the blood flow to the heart. As a result of the plaque rupture, foamy macrophages are produced leading to further obstructions which depend on the blood lipid and cholesterol levels.^{1,2} Statins like Atorvastatin have been demonstrated to be useful in lowering free fatty acid levels in the coronary artery after an ST-segment elevation myocardial infarction (MI). It also helped reduce LV remodeling and improve overall LV function. No reflow, after a failed reperfusion has a drastic effect on clinical results. Prolonged no reflow increases the chance of early deaths. It is more likely to occur in an individual with impaired left ventricular systolic function, big plaque grades, and LV remodeling.^{3,4} The time between the onset of symptoms and primary PCI, a stent of larger diameter used in primary PCI to LAD, people over the age of 60, and women are also likely to experience no-reflow.⁵ The normal blood flow achieved within the first 6 months of the primary PCI leads to improved LV function reducing mortality in patients.⁶

Urgent reperfusion after STEMI is often followed by no-reflow or slow reflows. It is more common in those who don't take statins and have a high frequency of Q waves in their ECGs, coupled with other complex characteristics. It has been demonstrated that taking 40 mg of atorvastatin daily significantly lowers blood cholesterol.^{7,8} At the same time, atorvastatin's effects on coronary arteries are not assessed. We hypothesized that taking atorvastatin would significantly improve blood flow in individuals before undergoing primary PCI and reduce the likelihood of no-reflow.⁹

Data Collection and Method: This study was approved by the ethical board of Hayatabad Medical Complex Peshawar.

Study Design: Cross-sectional study

Study Setting: Department of Cardiology Hayatabad Medical Complex, Peshawar from 10-06-22 to 10-10-222.

Sample Size: A sample size of 149 was calculated using non-probability consecutive sampling method and the data was collected on a questionnaire designed specifically for this study.

Inclusion and exclusion Criteria: Patients aged above 20 presented with STEMI were included, however, admitted STEMI patients with history of revascularization as a result of either stenting or coronary bypass grafting were excluded. individuals with chronic muscle illnesses; patients with atorvastatin allergies; patients with peripheral vascular disease; patients with chronic heart failure; patients with thyroid disease; patients with liver and renal dysfunction; patients with cancer; patients who have had serious trauma; Patients who had a history of a myocardial infarction, a PCI, or a CABG during the previous 6 months were not included in the study.

METHODOLOGY

Patients without dissection, thrombus, spasm, or distal embolization in an infarct-related artery (IRA) and with antegrade flow 2 levels for thrombolysis in myocardial infarction (TIMI) and 1 level for myocardial blush grade (MBG) were found to have the no-reflow phenomenon following percutaneous coronary intervention (PCI). The absence of reflow was the key end point, and this was assessed by the following criteria: a) a reduction of less than 50% in the basal elevation of ST segment at 90 minutes post-reperfusion with primary PCI. b) "Angiographic no reflow," defined as a TIMI flow of 2 or less and a myocardial Blush flow of 2 or less at the conclusion of the interventional procedure in the absence of severe coronary dissection, spasm, or considerable residual stenosis. c) absence of reflow on SPECT images when the reperfused region of the offending vessel did not exhibit any capture of the radiotracer in the original or follow-up studies.

Data Analysis: We collected information on present and past medical conditions, and demographic information such as age, sex followed by the interventional procedure. The data were analyzed

with the Pearson Chi-Square test using Statistical Program for Social Sciences (SPSS v.20).

RESULTS

A total of 149 individuals were examined for the effect of high-intensity atorvastatin on the prevalence of no-reflow phenomenon including 38% identified as female and 62% identified as male (AGE: $M = 56.70 \pm 0.94$, $SD = 11.4$). The medical records of the patient revealed several comorbidities including hypertension (86%), Ischemic heart disease (84%), peripheral arterial disease (58%), diabetes (54%), hyperlipidemia (11%), and obesity (3%). 4% of the participants had a history of stroke/CVA and 36% were smokers. Over 51% of patients enrolled in this study were given high-intensity atorvastatin during their primary PCI. Ballooning and stenting were used in over 97% of the participants contrary to the 2% for whom only the ballooning procedure was utilized. The no-reflow phenomenon was observed in about 15% of participants while the blood reflow was successfully restored in 85% of the patients.

Chi-Square statistics revealed a significant association ($n = 149$, $X^2: 15.81$, $DF: 1$, $p\text{-value} < 0.001$) of high-intensity atorvastatin with no-reflow phenomenon.

Table 1: Descriptive Statistics and Frequencies of Data ($n = 149$)

Parameters	Characteristics	Values
Age	Mean (M)	56.70 \pm 0.939
	Standard Deviation (SD)	11.467
	Min-Max	27-85
Gender	Male	102 (68%)
	Female	47 (38%)

Table 2: Comorbidities observed in patients

Comorbidities	Frequency
Hypertension	128 (85.9%)
Diabetes	80 (53.6%)
Obesity	5 (3.3%)
Ischemic heart disease	124 (83.3%)
Peripheral arterial disease	86 (57.7%)
Hyperlipidemia	17 (11.4%)
Stroke/CVA	6 (4.0%)
Smoking	54 (36.2%)

Table 3: details of procedure among patients

Procedure	
Ballooning	3 (2%)
Ballooning & Stenting	146 (97.3%)
No-Reflow Phenomenon	
Observed	23 (15.4%)
Not Observed	126 (84.6%)
Atorvastatin	
Loaded	76 (51%)
Not Loaded	73 (49%)
Pearson Chi-Square (Atorvastatin * No-Reflow)	
X^2	15.87
p-value	< 0.001
df	1

DISCUSSION

The treatment of ST elevation MI is to restore blood flow. Early restoration is associated with a good outcome. Thus primary percutaneous intervention (PCI) is the treatment of choice for acute STEMI.¹⁰ The no-reflow phenomenon is defined as no flow or slow flow in a segment of the coronary artery without any angiographic evidence of mechanical vessel obstruction. It occurs in 25% of patients undergoing primary PCI.²

The suggested mechanism of no-flow is distal embolization, micro-vascular spasm, and micro-vascular obstruction due to high thrombus burden.¹¹ No-reflow phenomenon is associated with larger damage to the myocardium and lower left ventricular ejection fraction (LVEF). It is associated with a high risk of heart failure, cardiac rupture, and death.³

It affects both the short-term and long-term prognosis and has a poor prognosis due to pump failure, arrhythmias, re-infarction, and cardiac rupture.¹² Fibrinogen, highly sensitive C-reactive protein (hs-CRP), and albumin levels have been shown to correlate with the no-reflow phenomenon.¹³ Primary PCI is the recommended treatment of choice in STEMI patients because it reduces mortality.¹⁴ Different studies have shown different factors related to the no re-flow phenomenon.¹⁵ From a meta-analysis of studies done on the no-reflow phenomenon, it has been shown that high thrombus burden and TIMI flow ≤ 1 are the most impacted ones. These risk factors can be used to predict a risk score.^{16,17}

It is suggested that lesion morphology is also related to no re-flow in acute STEMI and so doing an IVUS will help in explaining lesion morphology.¹⁸ Patients aged more than 65 years, with hypertension, smoking, dyslipidemia, diabetes, renal failure, and a history of AF are at higher risk of no re-flow going for Primary PCI.¹⁹ So for every STEMI, primary PCI is necessary and no re-flow in such patients leads to an unfavorable short-term prognosis.²⁰ It is recently shown in a meta-analysis of 4829 procedures that a high dose of statin as a loading dose before PCI reduces no-reflow.²¹

CONCLUSION

Our study shows the use of high-intensity atorvastatin during primary PCI reduced the incidence of no-reflow phenomenon up to 24%. The significant effect of using high-intensity atorvastatin vastly increases the chances of blood reflow after a successful PCI preventing any possible complications as a result of the no-reflow phenomenon.

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