

ST-Segment Resolution after Primary Percutaneous Coronary Intervention (PCI) in Patients with Acute ST-Segment Elevation Myocardial Infarction (STEMI)

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Original Research Article

ST-Segment Resolution after Primary Percutaneous Coronary Intervention (PCI) in Patients with Acute ST-Segment Elevation Myocardial Infarction (STEMI)

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ABSTRACT

Objective: To assess the ST segment resolution >50% in electrocardiogram taken after one hour of primary percutaneous intervention as compared to initial elevation as the predictor of successfulness of procedure.

Study Design: Observational study.

Place and duration: The study was conducted at PAF Hospital, Islamabad, Pakistan from February 2022 to January 2023 in one-year duration.

Methodology: A total of 100 patients presenting with ST-segment elevation myocardial infarction (STEMI) were planned for primary percutaneous coronary intervention and were enrolled in the study. Baseline ECG was taken, and 2nd ECG was taken after one hour of PCI. ST resolution is the main outcome variable of the study. SPSS version 23 was used for data analysis.

Results: ST-Resolution was noted in n=66 (66%) patients with (63.2-68.5%) 95% CI. Regarding the association of ST-Resolution with effect modifiers no statistically significant differences were found. The patients >40 years of age had about 2 times more risks in non-ST-resolution, (1/0.51=1.96 OR).

Conclusion: In patients with ST-elevation myocardial infarction (STEMI) undergoing primary percutaneous coronary intervention, ST-segment resolution in electrocardiograms recorded 1 hour after primary PCI is a sign of a successful procedure and good perfusion.

Keywords: ST-segment elevation, Primary PCI, Myocardial infarction, Electrocardiogram, Diabetes mellitus.

1. INTRODUCTION

The bedside assessment of electrocardiography (ECG) abnormalities in the ST segment is pivotal in evaluating and diagnosing acute myocardial infarction (1). Before determining the size and location of the infarct and predicting the effectiveness of acute reperfusion therapy, analyzing the extent of ST elevation offers valuable insights into the prognostic impact of treatment procedures (2). Moreover, prompt resolution of ST elevation or depression has demonstrated improved short and long-term outcomes, including reduced recurrence of ischemia, lower mortality rates, decreased occurrence of congestive heart failure, and re-infarction (3).

Symptom-to-balloon time (SBT) and door-to-balloon time (DBT) are both considered important metrics in patients undergoing primary percutaneous coronary intervention (PCI) for ST-segment-elevation myocardial infarction (STEMI). The correlation between ST-segment elevation and its timely resolution is strongly linked to improved outcomes. Hence, guideline recommendations suggest assessing progression after 90 minutes from the start of therapy to determine the necessity for early rescue percutaneous coronary intervention (PCI) (4,5). The concept of occluding thrombus and its subsequent resolution has been recognized since the 1950s, indicating that thrombus presence is common in around 88% of cases with infarct-related arteries when coronary angiography is performed within four hours of acute myocardial infarction (AMI) (6). It's advised to promptly identify cases with ST-segment elevation and chest pain presentation to identify those who could benefit from early reperfusion therapy (7,8).

Primary percutaneous coronary intervention (PPCI) is the preferred treatment for achieving early reperfusion, particularly in cases of ST-elevation myocardial infarction (9). Electrocardiography serves as a straightforward and valuable tool for assessing ST-segment resolution, aiding in the confirmation of epicardial reperfusion following PCI. Persistent ST elevation post-PCI signifies the failure of epicardial flow restoration strategies, indicating a larger infarct size and heightened risk of adverse cardiovascular events (10).

2. METHODOLOGY

This observational study was carried out at PAF Hospital, Islamabad, Pakistan for one year, from February 2022 to January 2023. Before participation, patients provided informed written consent after receiving comprehensive information

about the study's objectives. Confidentiality of patient information was ensured, and ethical approval was obtained from the hospital's ethical review board. Non-probability consecutive sampling was employed. The study enrolled 100 patients aged over 18, who had experienced symptoms within the preceding 6 hours and met the eligibility criteria on ECG as follows: (i) ST-segment elevation of 1mm or more in two contiguous limb leads (ii) ST-segment elevation of 2mm or more in two contiguous chest leads (iii) New left bundle branch block. Patients with certain medical conditions, such as those who underwent surgical revascularization, had pacemaker rhythm, cardiogenic shock, serious cancer, contraindications to anticoagulants, or were classified as Killip class II, III, or IV, as well as those with a life expectancy of less than six months, were excluded from the study. Baseline ECGs were taken before primary percutaneous coronary intervention, and a second ECG was taken one hour afterward. The primary outcome measure was defined as ST-segment resolution of more than 50% post-PCI compared to the baseline on the second ECG.

SPSS (Statistical Package for Social Sciences) version 23 was used for data analysis. Frequency and percentages were calculated for qualitative variables like gender, ST resolution >50%, and symptoms to balloon time (<12 hours, >12 hours). Mean and standard deviation were calculated for quantitative variables like age and BMI. Tests of significance were applied to see the association among variables. P value ± 0.05 was taken as significant.

3. RESULTS

One hundred patients were included in this study with mean age and BMI 60.82 ± 8.77 years and 26.67 ± 2.62 kg/m², respectively. Male to female ratio was 4:1, n=55 (55%) patients had diabetes mellitus. Symptom-to-balloon time (SBT) was <12 hours in n=44 (44%) patients and >12 hours in n=56 (56%) patients. (see Table 1).

Table 1: Demographic Characteristics of the Patients

Characteristic	Presence
Age (years)	60.82±8.77
BMI (kg/m ²)	26.67±2.62
Gender	
Male	n=80 (80%)
Female	n=20 (20%)

Diabetes mellitus	n=55 (55%)
Symptoms-to-Ballon time	
<12 hours	n=44 (44%)
>12 hours	n=56 (56%)

Source: Author's own.

ST-Resolution was noted in n=66 (66%) patients with (63.2-68.5%) 95% CI. The relationship between ST-resolution and effect modifiers was examined, and no statistically significant differences were found. The patients >40 years of age had about 2 times more risks in non-ST-resolution, (1/0.51=1.96 OR). (see Table 2).

Table 2: Predictors of Non-ST-Resolution with Effect Modifiers

Effect Modifier		St-Resolution		Odds ratio	P-value
		Yes	No		
Age	<40 years	9	8	0.51	0.212
	>40 years	57	26		
Diabetes mellitus	Yes	13	42	0.96	0.068
	No	11	34		
Symptoms to device time	<12 Hours	13	31	0.69	0.405
	>12 Hours	21	35		

Source: Author's own.

4. DISCUSSION

Primary PCI demonstrates the usefulness of 12 leads ECG in prediction of long-term outcomes of STEMI patients (11). The topic of patient recovery and how outcomes are measured remains a subject of ongoing debate across various studies and literature. In the present study, we observe ST resolution after one hour of PCI through ECG comparing the baseline ECG. In our study, we observe 66% ST resolution after primary PCI.

A study was conducted on 900 patients by Ndrepepa et al (12) keeping ST Resolution >70% as successful PCI and reported 31% resolution after PCI on comparison of baseline and after PCI electrocardiogram. After PCI electrocardiogram was taken at 90 minutes and 120 minutes after 1st balloon inflation. Another study was conducted by Verouden et al. (13) in 2010 and reported 56% sensitivity of electrocardiogram in evaluating the recovery of ST segment after primary PCI. A criterion for outcome measurement was ST resolution >70% at 12 lead ECG.

In our research, we identified diabetes and symptoms-to-balloon time as predictors of poor perfusion and non-ST resolution. Andrade et al. (14) conducted a study on ST-segment resolution after PCI and identified predictors of unsuccessful outcomes. They found that ST-resolution with TIMI flow grade 3 was achieved in 88.6% of patients post-PCI. Diabetes mellitus emerged as the primary predictor of unsuccessful outcomes, accounting for non-resolution of the ST segment in 52.9% of patients, with only 22.7% of diabetic patients achieving ST resolution after PCI.

Primary PCI is currently regarded as the preferred procedure for ST-segment resolution and perfusion recovery. However, conflicting literature exists, as demonstrated by the study conducted by Kumbhani et al. (15), comparing manual thrombus aspiration and primary PCI. They found that ST-resolution rates were 55.8% in the thrombus aspiration group and 44.3% in the PCI group. Additionally, the thrombus aspiration group exhibited higher rates of TIMI 3 flow and myocardial blush.

Damonte et al. (16) investigated a related topic and identified age, anterior wall myocardial infarction (MI), and the extent of the injury as primary predictors of outcomes in primary PCI. They observed complete ST-segment resolution in 48.5% of patients, with TIMI flow 3 achieved in 90% of cases. Caixeta et al. (17) performed multivariate analysis and found that anterior wall MI and advanced age were significant predictors of low-grade outcomes or non-ST resolution. Similarly, our study also noted that advanced age in patients was associated with unfavorable outcomes.

Farkouh et al. (18) conducted a study revealing that achieving ST resolution of more than 70% after primary PCI is considered a successful intervention. Complete resolution (>70%) was attained in 50.5% of patients, with symptom to balloon time identified as the primary predictor of poor ST resolution. Kushne et al. (19) reported similar results regarding the success of primary PCI and predictors of poor perfusion outcomes and ST resolution. However, in their study, ECGs were conducted at 30 and 60 minutes after PCI.

The previous evidence, as well as findings from this study, strongly support the importance of ECG in assessing the effectiveness of primary PCI, although the timing of the first electrocardiogram varies across studies. ST elevation resolution serves as a robust prognostic indicator in patients with ST-segment elevation myocardial infarction. Mortality and morbidity following PCI can be readily predicted through ECG analysis (20).

5. CONCLUSION

For individuals experiencing ST-elevation myocardial infarction and undergoing primary percutaneous coronary intervention, observing ST-segment resolution on electrocardiograms taken one-hour post-procedure indicates successful intervention and adequate perfusion. Diabetes, older age, and longer symptom-to-device time are key predictors of unfavorable outcomes.

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