ORIGINAL ARTICLE DOI: https://doi.org/10.18502/fem.v7i3.13821

The relation between ST-segment resolution and in-hospital mortality after primary percutaneous coronary interventions

Firas R. AL-Obaidi[1,2]*, Mohammed H. Al-Ali[3,4], Tahsin Al-Kinani[3,4], Youna Hamid Faeel[4], Suzy Hameed Nassir[4]

1. AL-Zahraa College of Medicine, University of Basrah, Basrah, Iraq.

2. Basra Cardiac Centre, Basrah, Iraq.

3. College of Medicine, University of Thi Qar, Nasiriyah, Iraq.

4. Nasiriya Heart Centre, Nasiriyah, Iraq.

***Corresponding author:** Firas R. AL-Obaidi; **Email:** firas.alobaidi@uobasrah.edu.iq

Published online: 2023-09-02

Abstract: **Objective:** The resolution of ST-segment elevation (>50%) indicates successful reperfusion with thrombolytic therapy. The aim of this study is to evaluate the relation of ST-segment resolution post-primary percutaneous cardiac intervention (PCI) with in-hospital mortality and coronary thrombolysis in myocardial infarction (TIMI) blood flow.

Methods: This study is a single-centred retrospective study. The study enrolled 100 patients who were referred to the Nasiriya Heart Centre for primary PCI. We measured the ST segment amplitude in the lead with the highest elevation prior to primary PCI and assessed the ST-segment elevation post-primary PCI. The ratio of ST-segment resolution was calculated and considered complete if reaches ≥70% from the initial ST-segment elevation. We assessed the association of ST-segment resolution with in-hospital mortality.

Results: Analysis of the electrocardiogram (ECG) showed that 21 patients (21%) had complete ST-segment (≥ 70%) resolution. No significant association was shown between ST-segment resolution and in-hospital mortality. Two out of 21 patients with complete ST-segment resolution died in the hospital and 6 out of 79 patients with incomplete ST-segment resolution died (P=0.77). There is no significant association between ST-segment resolution and coronary TIMI flow g rades. In patients with complete ST-segment resolution, 19 patients had TIMI III flow and 2 patients had TIMI II fl ow. In patients with incomplete ST-segment resolution, 72 patients had TIMI III flow, 6 patients had TIMI II flow; and 1 patient had no-reflow (P=0.84).

Conclusion: Complete ST-segment resolution in post-primary PCI settings has no significant association with in-hospital mortality. Absent or incomplete ST-segment resolution is not necessarily an indicator of coronary artery re-occlusion after primary PCI.

Keywords: Complete ST-segment Resolution; ECG; Primary PCI; Prognosis; ST-segment Elevation Myocardial Infarction

Cite this article as: R. AL-Obaidi F, H. Al-Ali M, Al-Kinani T, Faeel YH, Nassir SH. The relation between ST-segment resolution and in-hospital mortality after primary percutaneous coronary interventions. Front Emerg Med. In Press.

1. Introduction

Reperfusion strategies are the cornerstone treatment of ST-segment elevation myocardial infarction (STEMI). Successful reperfusion leads to patent coronary arteries and prevents microvascular dysfunction (1). The assessment of coronary flow after reperfusion can be assessed using electrocardiogram (ECG) to detect the resolution of ST-segment elevation. The resolution of ST-segment elevation (>50%) indicates successful reperfusion with thrombolytic therapy (2). However, the absence of ST-segment resolution may not indicate occluded coronary arteries. Only 35%-40% of patients have complete ST-segment resolution after thrombolytic therapy (3,4). Furthermore, complete ST-segment resolution to predict thrombolysis in myocardial infarction (TIMI) III flow post-thrombolytic therapy has 80% accuracy (5).

The aim of this study is to evaluate the association of ST-segment resolution in post-primary percutaneous cardiac intervention (PCI) with the in-hospital mortality and coronary TIMI blood flow. Also, we aim to identify any possible clinical predictors of ST-segment resolution.

2. Methods

2.1. Study population and data collection

This study is a single-centred retrospective study. The study included reviewing the medical records of all patients admitted to our centre with the diagnosis of STEMI. The diagnosis of STEMI was based mainly on symptoms and the ECG crite-

ria with (ST-segment elevation of ≥1 millimetres (mm) in at least 2 contiguous leads). Cardiac biomarkers were also measured (6). The patients were referred to the Nasiriya Heart Centre for primary PCI. We extracted the demographic data of the patients, analysed ECG findings with measurement of ST segment amplitude in the lead with the highest elevation prior to primary PCI and assessed the ST-segment elevation post-primary PCI (7). The ratio of ST-segment resolution was calculated and considered ST-segment resolution as complete, if reaches ≥70% from the initial ST-segment elevation (8). The ECG prior to referral was done within 10 minutes of presentation and repeated 60 minutes post-primary PCI.

We analysed the in-hospital mortality and the coronary TIMI blood flow grading for all patients. We assessed the association between ST-segment resolution and in-hospital mortality and TIMI coronary blood flow.

2.2. Statistical analysis

The analysis was done using the SPSS software (IBM SPSS Statistics for Windows, Version 21.0. Armonk, NY: IBM Corp). The analysis included descriptive data and frequencies, the use of the Chi-squared test for categorical variables, the t-test for continuous variables, and linear regression analysis. The P-value was considered significant if less than 0.05.

2.3. Ethical consideration

the study had been conducted based on the principles outlined in the Declaration of Helsinki.

3. Results

The study enrolled 100 patients who were admitted to Nasiriya Heart Centre with the diagnosis of acute STEMI. The patients' age ranged between 23 to 84 years (mean=58 years), with 72 patients being male (72%). All patients were treated with primary PCI. History of diabetes mellitus (DM) was reported in 40 patients (40%), hypertension in 54 patients (54%), smoking in 59 patients (59%); and a history of ischemic heart disease in 23 patients (23%).

The main presenting symptom is chest pain in 95 patients (95%), epigastric pain in 2 patients (2%); and dyspnoea in 3 patients (3%). Arrhythmias prior to primary PCI were reported as ventricular fibrillation (VF) in 2 patients and ventricular tachycardia (VT) in 3 patients. Complete heart block occurred in 3 patients that needed a temporary pacemaker.

During angiography, the number of diseased vessels was single-vessel disease in 50 patients (50%) involving only the culprit lesion. Two-vessel disease was found in 18 patients (18%) and multi-vessel disease in 32 patients (32%).

The infarct-related artery was the left main stem (LMS) in 1 patient (1%), left anterior descending (LAD) artery in 48 patients (47%), left circumflex (LCX) artery in 14 patients; and right coronary artery (RCA) in 37 patients (37%).

Primary PCI successfully restored coronary blood flow with TIMI III flow in 91 patients (91%). In 8 patients (8%), the TIMI flow was II, and only 1 patient (1%) with no-reflow. In-hospital mortality was reported in 8 patients (8%).

Analysis of the ECG before and after primary PCI showed that 21 patients (21%) had complete ST-segment (≥70%) resolution and 79 patients (79%) had incomplete (<70%) resolution of ST-segment.

Our study showed no significant association between ST-segment resolution and in-hospital mortality. Out of 21 patients with complete ST-segment resolution, 2 patients died in the hospital. Out of 79 patients with incomplete ST-segment resolution, 6 patients died (P=0.77) (Figure1).

There is no significant association between ST-segment resolution and coronary TIMI flow grades. In patients with complete ST-segment resolution, 19 patients had TIMI III flow and 2 patients had TIMI II flow. In patients with incomplete ST-segment resolution, 72 patients had TIMI III flow, 6 patients had TIMI II flow; and 1 patient had no-reflow (P=0.84) (Figure 2).

Multi-regression analysis shows no significant association between ST-segment resolution and age (P=0.42), gender (P=0.92), history of DM (P=0.82), history of hypertension (P=0.08), smoking (P=0.75); and history of ischaemic heart disease (P=0.98).

4. Discussion

Complete coronary perfusion after STEMI is the goal of any intervention to improve the short and long-term outcomes of the patients. Studies evaluated the resolution of ST-segment elevation after thrombolytic therapy and primary PCI as a predictor of complete coronary perfusion. Our study showed that complete ST-segment resolution occurred in 21% of patients admitted for primary PCI.

There was no significant association between complete ST-segment resolution and short-term mortality or TIMI grade of coronary artery flow. However, the follow-up was limited to the duration of the index hospitalization. There are differences in the results of previous studies which could be related to different methodologies. A sub-analysis of the ATLANTIC trial found that complete ST-segment resolution (≥70%), measured one-hour post-primary PCI, occurred in only 54.9% of patients. Patients with complete ST-segment resolution had lower 30-day mortality [OR=0.43, (95% CI: 0.19,0.97), P=0.04] and major composite cardiovascular adverse outcomes [OR=0.35, (95% CI: 0.19,0.65), P<0.01] (9). Another study showed the use of aspiration thrombectomy results in 51.4% complete ST-segment resolution vs 35.6% with conventional primary PCI. However, the 3-year follow-up showed no difference in outcomes between the two groups (10).

A large study with a 5-year follow-up reported a 31% rate of complete ST-segment resolution with a 6.8% mortality rate vs 8.3% mortality rate in patients with no ST-segment resolution [adjusted hazard ratio (HR)=0.91, (95% CI: 0.61,1.33), P=0.607] (11).

In the HORIZONS-AMI ECG sub study, complete ST-segment

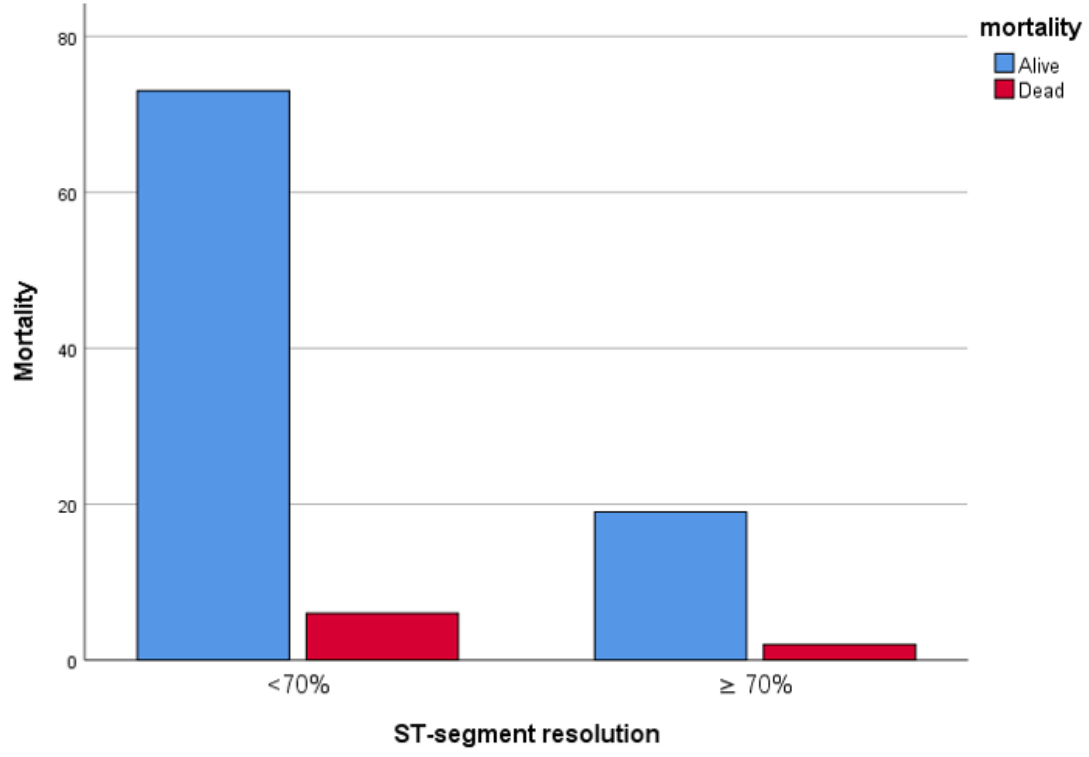

Figure 1 Association between ST-segment resolution and in-hospital mortality post-primary PCI

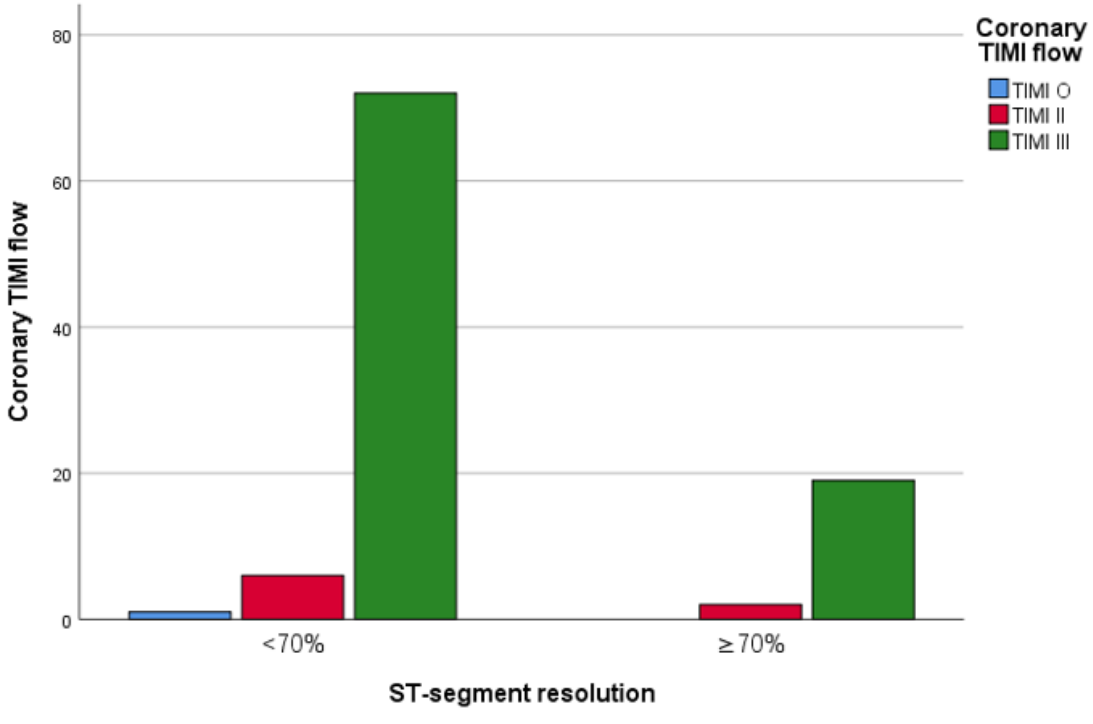

Figure 2 Association between ST-segment resolution and coronary TIMI flow grade post-primary PCI

resolution was detected in 50.1% of patients. The 3-year outcomes were favourable with complete ST-segment resolution in comparison with no resolution; mortality was 5.6% vs 8.9% (P=0.03). The major cardiovascular events rate was 19.6% with complete resolution vs 29.9% with no resolution (P=0.0001) (12).

In the ECG analysis of the patients enrolled in the (APEX-AMI) Trial, 90-day outcomes were lower with complete ST-segment resolution. The mortality was 2.9% with complete resolution vs 8% with no resolution (P=0.001). The rate of death, congestive heart failure, and shock composite outcomes was 5.6% with complete resolution vs 14.9% with no resolution (P=0.001) (13).

Many studies indicated the prognostic significance of complete ST-segment resolution post-primary PCI (14,15). However, our study showed no prognostic significance during the index hospitalization. Our results were consistent with another study that reported no significant effects of complete ST-segment resolution on mortality (16). No changes in the standard management are required in patients with no complete ST-segment resolution.

5. Limitations

The results of the study are limited by the small sample size, no identification of the total ischaemic time (onset of chest pain to time of reperfusion), the short duration of follow-up; and no imaging studies included in the assessment.

6. Conclusion

Complete ST-segment resolution in post-primary PCI settings has no significant association with in-hospital mortality nor with coronary TIMI III flow. Absent or incomplete ST-segment resolution is not necessarily an indicator of coronary artery re-occlusion after primary PCI.

7. Declarations

7.1. Acknowledgement

None.

7.2. Authors' contribution

all authors contributed equally to the study.

7.3. Conflict of interest

None.

7.4. Funding

None.

References

1. Konijnenberg LSF, Damman P, Duncker DJ, et al. Pathophysiology and diagnosis of coronary microvascular dysfunction in ST-elevation myocardial infarction. Cardiovasc Res. 2020;116(4):787-805.
2. de Lemos J, Braunwald E, et al. ST segment resolution as a tool for assessing the efficacy of reperfusion therapy. J Am Coll Cardiol. 2001;38(5):1283-94.
3. McKendall GR, Forman S, Sopko G, Braunwald E, Williams DO. Value of rescue percutaneous transluminal coronary angioplasty following unsuccessful thrombolytic therapy in patients with acute myocardial infarction. Thrombolysis in myocardial infarction investigators. Am J Cardiol. 1995;76(16):1108-11.
4. Gibson CM, Cannon CP, Greene RM, et al. Rescue angioplasty in the thrombolysis in myocardial infarction (TIMI) 4 trial. Am J Cardiol. 1997;80(1):21-6.
5. de Lemos JA, Antman EM, Giugliano RP, et al. ST-segment resolution and infarct-related artery patency and flow after thrombolytic therapy. Thrombolysis in myocardial infarction (TIMI) 14 investigators. Am J Cardiol. 2000;85(3):299-304.
6. Thygesen K, Alpert JS, Jaffe AS, et al. Fourth universal definition of myocardial infarction (2018). J Am Coll Cardiol. 2018;72(18):2231-64.
7. Schröder R. Prognostic impact of early ST-segment resolution in acute ST-elevation myocardial infarction. Circulation. 2004;110(21):e506-e10.
8. Farkouh ME, Reiffel J, Dressler O, Nikolsky E, Parise H, Cristea E, et al. Relationship between ST-Segment recovery and clinical outcomes after primary percutaneous coronary intervention. Circ Cardiovasc Interv. 2013;6(3):216–23.
9. Fabris E, van 't Hof A, Hamm CW, et al. Clinical impact and predictors of complete ST segment resolution after primary percutaneous coronary intervention: a subanalysis of the ATLANTIC trial. Eur Heart J Acute Cardiovasc Care. 2019;8(3):208-17.
10. Messas N, Hess S, El Adraa A, et al. Impact of manual thrombectomy on myocardial reperfusion as assessed by ST-segment resolution in STEMI patients treated by primary PCI. Arch Cardiovasc Dis. 2014;107(12):672-80.
11. Ndrepepa G, Alger P, Kufner S, Mehilli J, Schömig A, Kastrati A. ST-segment resolution after primary percutaneous coronary intervention in patients with acute ST-segment elevation myocardial infarction. Cardiol J. 2012;19(1):61-9.
12. Farkouh ME, Reiffel J, Dressler O, et al. Relationship between ST-segment recovery and clinical outcomes after primary percutaneous coronary intervention: the HORIZONS-AMI ECG substudy report. Circ Cardiovasc Interv. 2013;6(3):216-23.
13. Buller CE, Fu Y, Mahaffey KW, et al. ST-segment recovery and outcome after primary percutaneous coronary intervention for ST-elevation myocardial infarction: insights from the assessment of Pexelizumab in acute myocardial infarction (APEX-AMI) trial. Circulation. 2008;118(13):1335-46.

14. Brodie BR, Stuckey TD, Hansen C, et al. Relation between electrocardiographic ST-segment resolution and early and late outcomes after primary percutaneous coronary intervention for acute myocardial infarction. Am J Cardiol. 2005;95(3):343-8.
15. Spitaleri G, Brugaletta S, Scalone G, et al. Role of ST-segment resolution in patients with ST-segment elevation myocardial infarction treated with primary percutaneous coronary intervention (from the 5-year outcomes of the EXAMINATION [evaluation of the Xience-V stent in acute myocardial infarction] trial). Am J Cardiol. 2018;121(9):1039-45.
16. Masoumkhani F, Gohari S, Reshadmanesh T, Ahangar H, Faghihzadeh S. Association between ST-segment resolution after primary angioplasty and short-term outcomes in patients with acute myocardial infarction. Minerva Cardiol Angiol. 2021;69(2):133-40.