

ROLE OF ST SEGMENT RESOLUTION ALONE AND IN COMBINATION WITH THROMBOLYSIS IN MYOCARDIAL INFARCTION (TIMI) FLOW IN PRIMARY PERCUTANEOUS CORONARY INTERVENTION FOR ST SEGMENT ELEVATION MYOCARDIAL INFARCTION

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Abstract: *This study aimed to assess the effect of ST-segment resolution (STR) alone and in combination with TIMI flow after primary percutaneous coronary intervention (PPCI) for ST-segment elevation myocardial infarction (STEMI). The study was conducted at the Department of Cardiology, Peshawar Institute of Cardiology, Hayatabad Peshawar, KPK, from August 2022 to July 2023. Ninety patients with acute myocardial infarction were enrolled, and STR was considered successful if it reached 50% or complete STR (ST-segment back to the equipotential line). TIMI flow was evaluated after PPCI, and the primary outcome was two-year all-cause mortality. Results showed that each STR <50%, STR ≥50%, and complete STR occurred in 33.3% of the patients. Successful STR was the only independent predictor of 2-year death among all clinical factors. Combining TIMI flow and STR showed different 2-year mortality rates in subgroups; the lowest was seen in successful STR and TIMI 3 flow, the middle when either of these measures was decreased, and the greatest when both were abnormal. The study concluded that analyzing both STR and TIMI flow provides additional prognostic information beyond what either measure could provide. Therefore, it can be used as a reliable and convenient surrogate endpoint for determining successful PPCI. Additionally, the study found that post-PPCI STR is a strong long-term prognosticator for ST-segment elevation myocardial infarction.*

Keywords: ECG, PPCI, STR, Acute Myocardial Infarction

Introduction

Ischaemic heart disease is the leading cause of death globally, and its occurrence is rising. (Nowbar et al., 2019) The most recent WHO data on Pakistan's heart attack ratio shows that 240,720 deaths in 2020 were due to coronary heart disease, or 16.49 percent of all deaths in the country (Yaqoob et al., 2023). Pakistan has a death rate of 193.56 per 100,000 people, placing it at number 30 in the world (Sarkar, 2013).

Myocardial reperfusion diagnostic techniques available today can be categorized as non-invasive (Elfigih and Henein, 2014) (like cardiac magnetic resonance, myocardial contrast echocardiography, and ECG) or invasive (such as intracoronary Doppler wire or angiography). The dynamic character of myocardial reperfusion poses a challenge for invasive indexes to fully and accurately capture this process, especially when patients are not in the catheterization laboratory and are being treated for ST-segment elevation myocardial infarction (STEMI) (Anderson et al., 2007). On the other hand, non-invasive approaches, except for electrocardiography, have the potential to provide a more consistent assessment of microcirculation. However, most of these methods may not be readily achievable or cost-effective in the short term.

PPCI has become the standard of care for STEMI patients, offering rapid and effective reperfusion with substantial prognostic benefits over fibrinolytic therapy (Lassen et al.,

2013). It improves outcomes, reduces myocardial damage, and improves long-term survival.

ST-segment resolution (STR) is a straightforward and easily interpretable indicator that can reflect microvascular obstruction at the cellular level (Fabris and van't Hof, 2018). ST-segment resolution refers to the extent to which the ST-segment deviation on an electrocardiogram (ECG) returns to baseline or normal following reperfusion therapy, such as PPCI. The combined assessment of ST-segment resolution and TIMI flow after PPCI is a valuable approach to evaluating the effectiveness of reperfusion therapy in STEMI patients. It helps clinicians make informed decisions about patient management and predict clinical outcomes based on the extent of reperfusion achieved. Thus, the study's objective was to evaluate the role of ST-segment resolution alone and in combination with TIMI flow after primary percutaneous coronary intervention for segment-elevation myocardial infarction.

Methodology

The study, conducted from August 2022 to July 2023 at the Department of Cardiology, Peshawar Institute of Cardiology in Hayatabad, KPK, was a descriptive study.

Non-probability purposive sampling was used to recruit patients who met the inclusion criteria. Patients between the ages of 30 and 80 years of both genders with ST-elevation

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myocardial infarction (STEMI) and qualifying post-primary percutaneous coronary intervention (PPCI) electrocardiograms (ECGs) were included. Patients with other chronic diseases were excluded from the study.

This prospective and multi-center observational study was conducted from August 2022 to July 2023 in the Department of Cardiology, Peshawar Institute of Cardiology, Hayatabad, Peshawar, Khyber Pakhtunkhwa, Pakistan. Ethical approval was obtained from the respective hospitals' Ethical Committee before the study began. After providing informed consent, 80 patients with acute myocardial infarction were enrolled in the study. The participant or their guardian and the researcher signed the consent forms. The patients underwent a complete examination, and data were collected on patient demographics, risk factors, medical history, reperfusion therapy, prescription drugs, and procedures. A senior cardiologist examined the patients to ensure data accuracy and reliability.

Primary percutaneous coronary intervention (PPCI) was performed on each who had STEMI, and their ECGs met specific criteria. The inclusion criteria for ECGs were two continuous leads with ST-segment elevation of at least 1 mm and no ventricular pacing, bundle-branch block, or irregular rhythms. The patients were divided into three groups based on the degree of ST-segment resolution (STR) determined by measurements taken from the lead exhibiting the most pronounced ST-segment elevation at baseline: less than 50%, equal to or greater than 50%, and complete STR (i.e., ST-segment elevation returning to the baseline level). Successful STR was defined as STR equal to or more than 50% and complete STR. The infarct-related artery (IRA) reperfusion was evaluated using TIMI flow grading at the end of the surgery. Operators noted obvious thrombosis in the IRA during angiography. The management of STEMI followed guidelines, including the use of parenteral anticoagulants during the procedure and the peri-procedural administration of antiplatelet medications (aspirin, clopidogrel, and glycoprotein IIb/IIIa inhibitors).

All-cause mortality was the primary clinical outcome, and follow-up data were collected through telephone interviews, mailed surveys, or in-person clinic visits. A panel of independent clinical experts reviewed and validated each instance meticulously. Secondary clinical outcomes during hospitalization included major adverse cardiac and cerebrovascular events, encompassing all-cause mortality, reinfarction, and stroke.

Statistical analysis was conducted using SPSS Version 24.

Results

Table 1 appears to be a tabulation of data from a medical study or clinical trial, with the focus on three distinct groups of patients: those with STR (ST-segment resolution) less than 50%, those with STR greater than or equal to 50%, and those with complete STR. The table presents various variables, their associated statistics, and p-values, which gauge the level of statistical significance for the relationships between these variables and STR in different patient groups. We can start by examining the statistics associated with the "Age (year)" variable to interpret this

data. In this case, the table displays the average ages for the patient groups, revealing that patients with STR less than 50% have an average age of 66.40, while those with STR greater than or equal to 50% and complete STR have lower average ages, specifically 58.53 and 57.60, respectively. The associated p-value of 0.006 suggests a statistically significant difference in age between the groups, which could be a noteworthy finding for further investigation. The table also includes information regarding the gender distribution among the patient groups. While the number of male and female patients in each group is provided, without these p-values, it is challenging to determine whether gender disparities are statistically significant or not. Moving on to the "Killip class \geq II" variable, the table shows percentages of patients in different Killip classes across the groups. The data indicates no substantial variation between the groups, and the associated p-value of 0.69 supports the notion that this variable has no statistically significant difference. In terms of "Symptom-to-balloon time (hour)," the average time from symptom onset to balloon treatment appears to be slightly longer in the group with complete STR (5.79 hours) compared to the other groups. However, the p-value of 0.10 suggests that this difference is not statistically significant, although it may warrant further investigation. The table also provides insights into "Peri-procedural antithrombotic therapy," indicating that the use of different antithrombotic therapies is consistent across the groups. The p-values are close to 1.0 or higher, signifying no significant differences in the application of these therapies between the patient groups. When considering "LVEF (Left Ventricular Ejection Fraction)," the LVEF values are similar across the groups, with a p-value of 0.5, indicating no statistically significant difference. Further variables such as "Thrombosis in IRA (Infarct-Related Artery)," "All-cause death," "Reinfarction," and "Stroke" also present percentages of these outcomes for each group. The associated p-values suggest no significant differences in these variables between the groups. One notable trend in the data emerges with "2-y All-cause death," which suggests that the percentage of all-cause deaths decreases as STR improves. Whether this trend is statistically significant or merely a pattern that necessitates more in-depth analysis remains unclear. Table 1 offers valuable insights into the relationships between various variables and STR in different patient groups. It highlights statistically significant differences in some variables while revealing no significant disparities in others. Further investigation and additional statistical analysis may be required to conclude these relationships and trends.

The results based on baseline Characteristics and Clinical Outcomes According to STR are given in Table 1' while the results based on baseline characteristics according to concordant/discordant STR and TIMI Flow are given in Table 2. Table 2 offers a snapshot of data from a medical study or clinical trial, with a focus on four distinct groups of patients based on the interplay of two factors: ST-segment resolution (STR) and Thrombolysis in Myocardial Infarction (TIMI) flow status. The table presents various variables and their associated statistics, along with p-values that signify the level of statistical significance for differences between these groups. Starting with age, the

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table displays the average ages for each of the four groups. It appears that patients with Successful STR and TIMI 3 flow tend to be older, while those with STR less than 50% and TIMI 0-2 flow are generally younger. However, the p-value of 0.15 suggests that these age differences are not

statistically significant. Gender distribution is also presented, with percentages of male and female patients in each group. Although there appear to be some differences in gender distribution, the p-value of 0.22 indicates that these variations are not statistically significant.

Table 1: Baseline Characteristics and Clinical Outcomes According to STR (n=90)

Variables	STR <50% (n=30)	STR ≥50% (n=30)	Complete STR (n=30)	P-Value
Age (year)	66.40±9.3	58.53±12.1	57.60±12.5	0.006
Gender:				
Male	14(25.5%)	23(41.8%)	18(32.7%)	0.52
Female	16(45.7%)	7(20.0%)	12(34.3%)	
Killip class ≥II	11 (36.7%)	9 (30.0%)	8 (26.7%)	0.69
Cardiogenic shock	4 (13.3%)	2 (6.7%)	1 (3.3%)	0.33
Cardiac arrest	1(3.3%)	2(6.7%)	1(3.3%)	0.77
Hypertension	15(50.0%)	14(46.7%)	13(43.3%)	0.87
Current smoker	18(60.0%)	21(70.0%)	19(63.3%)	0.7
Diabetes	7(23.3%)	5(16.7%)	3(10.0%)	0.38
Hyperlipidemia	1 (3.3%)	2 (6.7%)	3(10.0%)	0.58
Prior myocardial infarction	3(10.0%)	1 (3.3%)	2 (6.7%)	0.58
Prior stroke	4(13.3%)	3(10.0%)	2 (6.7%)	0.69
Creatinine clearance, mL/min	85.6(5.48)	85.3(5.54)	86.1(5.15)	0.84
Symptom-to-balloon time (hour)	7.0±1.61	6.6±1.67	5.79±1.50	0.10
Peri-procedural antithrombotic therapy				
Aspirin	29(96.7%)	29(96.7%)	29(96.7%)	1.0
Clopidogrel	28 (93.3%)	29(96.7%)	29(96.7%)	0.7
GPI	14 (46.7%)	13(43.3%)	15(50.0%)	0.8
UFH	26(86.7%)	28(93.3%)	29(96.7%)	0.3
LMWH	3(10.0%)	2(6.7%)	2(6.7%)	0.8
Bivalirudin	2(6.7%)	1(3.3%)	1(3.3%)	0.7
LVEF	53.60±1.8	53.70±1.7	54.10±1.7	0.5
Single-vessel disease	9(30.0%)	10(33.3%)	8(26.7%)	0.8
Anterior infarction	16(53.3%)	15(50.0%)	10(33.3%)	0.24
Thrombosis in IRA	19(63.3%)	21(70.0%)	20(66.7%)	0.86
Device of intervention				
Thrombus aspiration	2(6.7%)	1(3.3%)	2(6.7%)	0.8
Only PTCA	3(10.0%)	2(6.7%)	1(3.3%)	0.5
Stent	25 (83.3%)	27 (90.0%)	28(93.3%)	0.4
Post-PCI TIMI flow				
0-2	3(10.0%)	2(6.7%)	2(6.7%)	0.8
3	27 (90.0%)	28(93.3%)	29(96.7%)	0.5
MACCE during hospitalization	2(6.7%)	1(3.3%)	1(3.3%)	0.7
All-cause death	4(13.3%)	2(6.7%)	1(3.3%)	0.3
Reinfarction	2(6.7%)	0(0.0%)	1(3.3%)	0.3
Stroke	2(6.7%)	3(10.0%)	1(3.3%)	0.5
2- y All-cause death	5(16.7%)	3(10.0%)	2(6.7%)	0.2

The table provides data on various medical conditions, including Killip class ≥II, Cardiogenic shock, Cardiac arrest, Hypertension, Current smoking, Diabetes, Hyperlipidemia, Prior myocardial infarction, and Prior stroke. For these variables, the p-values range from 0.3 to 0.9, indicating no statistically significant differences between the groups regarding these medical conditions. On the other hand, the table reveals a notable contrast in creatinine clearance among the groups. The low p-value of 0.0 suggests a statistically significant difference, indicating that creatinine clearance is a significant distinguishing factor among these groups. Symptom-to-balloon time also exhibits variance among the groups, with a p-value of 0.02. This p-value implies that

symptom-to-balloon time is statistically significant in differentiating these groups. Peri-procedural antithrombotic therapy is also presented, with no statistically significant differences between the groups, as indicated by the p-values. The Left Ventricular Ejection Fraction (LVEF) values differ across the groups, and a p-value of 0.01 suggests that LVEF is a significant factor in distinguishing these groups. Variables like single-vessel disease, anterior infarction, thrombosis in the infarct-related artery (IRA), and the intervention device do not display statistically significant differences between the groups. Table 2 offers insights into the characteristics and outcomes of patients within four different groups determined by STR and TIMI status. While factors like age, gender, and certain

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medical conditions do not exhibit statistically significant differences between the groups, creatinine clearance, symptom-to-balloon time, and LVEF emerge as significant

distinguishing factors. Further analysis and clinical context are needed to fully understand the clinical implications of these findings.

Table 2: Baseline Characteristics According to Concordant/Discordant STR and TIMI Flow (n=90)

Variables	Successful STR+TIMI 3 flow (n=30))	Successful STR+TIMI 0– 2 flow (n=19))	STR <50%+TIMI 3 flow (n=30)	STR<50%+TIMI 0– 2 flow (n=11)	P-Value
Age (year)	66.40 ± 9.38	59.73±12.54	57.33±13.07	57.18±9.91	0.15
Gender					
Male	14(46.7%)	14(73.7%)	20(66.7%)	7(63.6%)	0.22
Female	16(53.3%)	5(26.3%)	10(33.3%)	4(36.4%)	
Killip class ≥II	11(36.7%)	8(42.1%)	8(26.7%)	1(9.1%)	0.23
Cardiogenic shock	2 (6.7%)	2 (10.5%)	1 (3.3%)	0(0.0%)	0.5
Cardiac arrest	1(3.3%)	1(5.3%)	2(6.7%)	0(0.0%)	0.8
Hypertension	17(56.7%)	9(47.4%)	12(40.0%)	4(36.4%)	0.5
Current smoker	18(60.0%)	21(68.4%)	18(60.0%)	9(81.8%)	0.5
Diabetes	5(16.7%)	3(15.8%)	5(16.7%)	1(9.1%)	0.9
Hyperlipidemia	2 (6.7%)	2 (10.5%)	2 (6.7%)	1(9.1%)	0.9
Prior myocardial infarction	2 (6.7%)	1 (5.3%)	3 (10.0%)	1(9.1%)	0.9
Prior stroke	3(10.0%)	3(15.8%)	1 (3.3%)	2(18.2%)	0.3
Creatinine clearance, mL/min	86.1(5.1)	82.3(7.1)	88.9(5.9)	76.6(8.5)	0.0
Symptom-to-balloon time (hour)	5.53+1.4	6.21+1.7	6.52+1.6	5.18(0.8)	0.02
Peri-procedural antithrombotic therapy					
Aspirin	29(96.7%)	18(94.7%)	29(96.7%)	10(90.9%)	0.8
Clopidogrel	29(96.7%)	18(94.7%)	29(96.7%)	10(90.9%)	0.8
GPI	15(50.0%)	10(52.6%)	14(46.7%)	5(45.5%)	0.9
UFH	27(90.0%)	18(94.7%)	28(93.3%)	9(81.8%)	0.6
LMWH	1(3.3%)	3(15.8%)	2(6.7%)	3(27.3%)	0.1
Bivalirudin	2(6.7%)	0(0.0%)	13(43.3%)	1(9.1%)	0.7
LVEF	54.0+2.2	53.21+1.9	53.8+1.7	51.72+2.9	0.01
Single-vessel disease	10(33.3%)	7(36.8%)	8(26.7%)	3(27.3%)	0.8
Anterior infarction	15(50.0%)	7(36.8%)	16(53.3%)	6(54.5%)	0.6
Thrombosis in IRA	20(66.7%)	14(73.7%)	19(63.3%)	8(72.7%)	0.8
Device of intervention					
Thrombus aspiration	2(6.7%)	2(5.3%)	1(3.3%)	1(9.1%)	0.89
Only PTCA	2 (6.7%)	2(10.5%)	1(3.3%)	2(18.2%)	0.43
Stent	27 (90.0%)	17 (89.5%)	24(80.0%)	8(72.7%)	0.44

Discussion

The primary goal of our research study was to evaluate the role of ST-segment resolution alone and in combination with TIMI flow after primary percutaneous coronary intervention for ST-segment elevation myocardial infarction. This study was a multi-center and precisely described the role of ST-segment resolution alone and in combination with TIMI flow. In our study, successful STR (ST-segment resolution) occurred in approximately 80% of patients. Successful STR was associated with a significant reduction in all-cause mortality at 2 years compared to cases where STR was less than 50%. This reduction in mortality remained significant even after adjusting for potential clinical confounders.

In other words, patients who had successful STR after a medical intervention had a better chance of survival over 2 years than those with less successful STR. Successful STR was also found to be an independent predictor of 2-year mortality, meaning it was a significant factor in predicting

patient outcomes, regardless of other clinical variables. STR and TIMI flow (Thrombolysis in Myocardial Infarction flow, a measure used to assess blood flow in the coronary arteries) were concordant (in agreement) in approximately 80% of patients. When STR was successful, it predicted lower risks of 2-year mortality compared to cases where STR was less than 50%, even when looking at different levels of TIMI flow. This suggests that successful STR was a reliable predictor of better patient outcomes, especially when there were significant blood flow issues in the coronary arteries (TIMI 0 to 2 flow). These findings appear to highlight the importance of successful ST-segment resolution as a significant factor in predicting patient survival and suggest that it is particularly valuable in cases where there are challenges with blood flow in the coronary arteries. The study's results suggest that medical interventions or treatments that lead to successful STR could be associated with improved patient outcomes and lower mortality rates.

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The prognostic significance of postprocedural ST-segment resolution (STR) in the modern era of percutaneous coronary intervention (PPCI) has been evaluated in several studies. Most et al., 2019; Farkouh et al., 2013; Spitaleri et al., 2018) It should be noted that the majority of these studies' data came from randomised clinical trials that were carried out in particular patient cohorts or from studies that made use of a centralised ECG analysis core laboratory. As such, doubts about the data's applicability to clinical practice may arise. Six distinct techniques for evaluating ST-segment resolution (STR) in a central laboratory setting produced robust prognostic insights into clinical outcomes at the 90-day mark. This was discovered in a subanalysis of the 4,866-person APEX-AMI (Assessment of Pexelizumab in Acute Myocardial Infarction) trial, a randomized clinical trial intended to assess the effectiveness of pexelizumab in reducing day-90 mortality (Buller et al., 2008). Our study extended the significance of solitary-label ST-segment resolution identified through multi-center clinician evaluations, providing insights into longer-term outcomes in real-world hospital environments. Results from the Lombardima Registry, a real-world trial with 3,403 participants, showed that in patients with ST-elevation myocardial infarction (STEMI) who had primary or facilitated percutaneous coronary intervention (PCI), ST-segment resolution (STR) was associated with 30-day mortality, except for non-anterior infarctions and post-PCI TIMI 0 to 2 flow (Palmerini et al., 2010). Patients with primary percutaneous coronary intervention (PPCI) were the only ones in our study. Furthermore, we demonstrated that ST-segment resolution (STR) retained its robust prognostic value for long-term mortality across a broader patient sample that included subgroups based on the site of the infarction and post-PCI TIMI flow. These results validate the regular use of post-PCI STR as a useful instrument to assess reperfusion treatment efficacy in the modern PPCI era. One other significant clinical finding from our study was that, in comparison to evaluating each measure separately, evaluating both ST-segment resolution (STR) and TIMI flow which capture different aspects and pathophysiological mechanisms of myocardial reperfusion provides additional long-term prognostic insights. As expected, the patients with the greatest survival rates, over 95% of persons still living two years after the procedure, were those with both STR $\geq 50\%$ and TIMI 3 flow. A disparity between TIMI flow and STR after PPCI had been noted in many minor trials (Claeys et al., 1999; Matetzky et al., 1999; Palmerini et al., 2010; Tomaszuk-Kazberuk et al., 2011).

Previous research had mainly suggested that patients who did not experience a significant benefit from a rapid restoration of blood flow in the infarct-related artery (IRA) could be identified by the absence of early ST-segment resolution (STR) after a successful primary percutaneous coronary intervention (PPCI) procedure with Thrombolysis in Myocardial Infarction (TIMI) flow ≥ 2 . For the first time, we found that about two-thirds of patients in the subgroup with TIMI flow levels between 0 and 2 may have a successful STR. With a 2-year mortality rate of 8.9%, these people had comparatively favorable outcomes as compared to those who did not reach STR $< 50\%$, who had a mortality incidence of 29.4%. Notably, there was a significant interaction between STR and TIMI flow when it came to

long-term mortality. This interaction showed that TIMI 0 to 2 flow was linked to a more marked risk decrease in 2-year mortality than TIMI 3 flow when successful STR was achieved in both the TIMI 0 to 2 flow and TIMI 3 flow groups. This phenomenon can be explained by the eventual restoration of blood flow, aided by antiplatelet medications in the peri-procedural stage. It emphasizes the importance of regularly evaluating each patient's ST-segment resolution (STR) after receiving primary percutaneous coronary intervention (PPCI). Furthermore, it emphasizes the necessity of more forceful antiplatelet therapy when the infarct-related artery (IRA) has a noticeable thrombus burden and temporarily inadequate patency. We examined the predictive significance of ST-segment resolution (STR) later using a substantial patient cohort who underwent primary percutaneous coronary intervention (PPCI). Previous investigations have shown that STR measurements taken at 120 minutes or even 180 minutes post-procedure possess ample predictive value for adverse cardiovascular outcomes (De Luca et al., 2008). This suggests that analyzing STR at a later time could enhance the sensitivity in identifying patients with complete STR. Assessing ST-segment resolution (STR) immediately for reperfusion evaluation may not capture the evolving effectiveness of antiplatelet therapy on microcirculation. Our findings suggest that a 120-minute STR assessment after primary percutaneous coronary intervention (PPCI) was a reliable way of predicting long-term survival in patients with ST-elevation myocardial infarction (STEMI).

Many indicators for assessing myocardial infarction have been proposed in light of the widely accepted idea that attaining optimal reperfusion should entail restoring normal coronary blood flow and guaranteeing favorable microcirculation. Techniques like "myocardial blush," intracoronary Doppler wire readings, and tomographic or volumetric imaging approaches are used to create these indices. However, due to shortcomings in operational repeatability and cost-effectiveness, none of these options can be used in clinical practice as easily as ST-segment resolution (STR). However, it should be noted that in some ST-elevation myocardial infarction (STEMI) trials, angiographic evaluation has been the primary means of assessing procedural success. Furthermore, only the European Society of Cardiology guidelines have suggested using ST-segment resolution (STR) to evaluate microvascular function after primary percutaneous coronary intervention (PPCI). We support the prioritization of STR in defining effective PPCI in upcoming STEMI trials, especially in conjunction with thrombolysis in myocardial infarction (TIMI) flow. These trials aim to investigate the efficacy of novel peri-procedural medication or other adjunctive methods to improve reperfusion results even more. Additionally, this method is useful for identifying patients with different risks of dying over the long term in ordinary clinical practice.

Conclusion

It was concluded that regardless of a wide variety of baseline parameters, single-lead ST-segment resolution (STR) assessment after primary percutaneous coronary intervention (PPCI) appears as a consistent long-term prognostic predictor for people with ST-elevation

myocardial infarction (STEMI). As a standard procedure for assessing successful reperfusion, the combined assessment of STR and Thrombolysis in Myocardial Infarction (TIMI) flow following PPCI should be strongly encouraged. This can potentially provide complementary prognostic insights for STEMI patients during extended follow-up periods.

Declarations

Data Availability statement

All data generated or analyzed during the study are included in the manuscript.

Ethics approval and consent to participate

Approved by the department Concerned.

Consent for publication

Approved

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Conflict of interest

The authors declared the absence of conflict of interest.

References

- Anderson, J. L., Adams, C. D., Antman, E. M., Bridges, C. R., Califf, R. M., Casey, D. E., Chavey, W. E., Fesmire, F. M., Hochman, J. S., and Levin, T. N. (2007). ACC/AHA 2007 guidelines for the management of patients with unstable angina/non-ST-elevation myocardial infarction: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Writing Committee to Revise the 2002 Guidelines for the Management of Patients With Unstable Angina/Non-ST-Elevation Myocardial Infarction) developed in collaboration with the American College of Emergency Physicians, the Society for Cardiovascular Angiography and Interventions, and the Society of Thoracic Surgeons endorsed by the American Association of Cardiovascular and Pulmonary Rehabilitation and the Society for Academic Emergency Medicine. *Journal of the American College of Cardiology* **50**, e1-e157.
- Buller, C. E., Fu, Y., Mahaffey, K. W., Todaro, T. G., Adams, P., Westerhout, C. M., White, H. D., Van't Hof, A. W., Van de Werf, F. J., and Wagner, G. S. (2008). 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* **118**, 1335-1346.
- Claeys, M. J., Bosmans, J., Veenstra, L., Jorens, P., De Raedt, H., and Vrints, C. J. (1999). Determinants and prognostic implications of persistent ST-segment elevation after primary angioplasty for acute myocardial infarction: importance of microvascular reperfusion injury on clinical outcome. *Circulation* **99**, 1972-1977.
- De Luca, G., Suryapranata, H., Ottervanger, J. P., Hoorntje, J. C., Gosselink, A. M., Dambrink, J.-H., de Boer, M.-J., and van't Hof, A. W. (2008). Postprocedural single-lead ST-segment deviation and long-term mortality in patients with ST-segment elevation myocardial infarction treated by primary angioplasty. *Heart* **94**, 44-47.
- Elfigih, I. A., and Henein, M. Y. (2014). Non-invasive imaging in detecting myocardial viability: Myocardial function versus perfusion. *IJC Heart & Vasculature* **5**, 51-56.
- Fabris, E., and van't Hof, A. W. (2018). Angiography and electrocardiography (ECG) for the assessment of coronary microvascular obstruction. In "Coronary Microvascular Obstruction in Acute Myocardial Infarction", pp. 109-126. Elsevier.
- Lassen, J. F., Bøtker, H. E., and Terkelsen, C. J. (2013). Timely and optimal treatment of patients with STEMI. *Nature Reviews Cardiology* **10**, 41-48.
- Matetzky, S., Novikov, M., Gruberg, L., Freimark, D., Feinberg, M., Elian, D., Novikov, I., Di Segni, E., Agranat, O., and Har-Zahav, Y. (1999). The significance of persistent ST elevation versus early resolution of ST segment elevation after primary PTCA. *Journal of the American College of Cardiology* **34**, 1932-1938.
- Nowbar, A. N., Gitto, M., Howard, J. P., Francis, D. P., and Al-Lamee, R. (2019). Mortality from ischemic heart disease: Analysis of data from the World Health Organization and coronary artery disease risk factors From NCD Risk Factor Collaboration. *Circulation: cardiovascular quality and outcomes* **12**, e005375.
- Palmerini, T., De Servi, S., Politi, A., Martinoni, A., Musumeci, G., Etti, F., Piccaluga, E., Sangiorgi, D., Lauria, G., and Repetto, A. (2010). Prognostic implications of ST-segment elevation resolution in patients with ST-segment elevation acute myocardial infarction treated with primary or facilitated percutaneous coronary intervention. *The American journal of cardiology* **105**, 605-610.
- Sarkar, S. (2013). Dietary intake, lifestyles and risk of nutrition-related non-communicable diseases in a Punjabi south Asian male population in Kent, United Kingdom, University of Greenwich.
- Tomaszuk-Kazberuk, A., Kozuch, M., Bachorzewska-Gajewska, H., Malyszko, J., Dobrzycki, S., and Musial, W. J. (2011). Does lack of ST-segment resolution still have prognostic value 6 years after an acute myocardial infarction treated with coronary intervention? *Canadian Journal of Cardiology* **27**, 573-580.
- Yaqoob, A., Barolia, R., Ladak, L., Hanif, A., Khan, A. H., and Sahar, W. (2023). Home-based cardiac rehabilitation: development, implementation and outcome evaluation in patients with coronary artery diseases in Lahore, Pakistan—a mixed-methods study protocol. *BMJ open* **13**, e073673.



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