

TIMI Score Modification for Predicting 30-Day Mortality Following Primary Percutaneous Coronary Intervention among STEMI Patients at Cipto Mangunkusumo National Hospital

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ABSTRACT

Background: This study to validate the TIMI (Thrombolysis in Myocardial Infarction) core and also assess the validity of a modified TIMI score that includes three additional variables from primary percutaneous coronary intervention (PPCI) findings: left ventricular ejection fraction based on echocardiography post-PPCI, TIMI flow, and the number of lesions in a population of STEMI (ST-elevation myocardial infarction) patients who underwent PPCI at Cipto Mangunkusumo National Hospital with a focus on predicting 30-day mortality. This is the first study to validate the TIMI score among STEMI patients who underwent PPCI at Cipto Mangunkusumo National Hospital. This study aimed to develop a modified TIMI score with enhanced ability to predict 30-day mortality among STEMI patients at Cipto Mangunkusumo National Hospital following PPCI. **Results:** Among 230 study subjects, the 30-day mortality rate for the patients post-PPCI was 10%. There was no significant association between ejection fraction based on echocardiography after PPCI, TIMI flow, or the number of lesions and 30-day mortality post-PPCI in the STEMI patients. The discrimination performance of the TIMI score in predicting 30-day mortality post-PPCI was AUC (Area Under the Curve) 0.901, with good calibration. **Conclusion:** The performance of the TIMI score in terms of predicting 30-day mortality after PPCI in STEMI patients at Cipto Mangunkusumo National Hospital was excellent (AUC 0.901, 95% CI 0.849–0.952), with good calibration. TIMI score can predict the 30-day mortality rate among STEMI patients undergoing PPCI.

Keywords: ST-elevation myocardial infarction, percutaneous coronary intervention, hospital mortality, risk assessment, prognosis, Indonesia.

INTRODUCTION

Thirty-day mortality is a critically important outcome to observe among patients post-PPCI.^{1–3} More than 60% of PPCI mortality occurs within 30 days following the procedure.⁴ A study by Thrane et al.⁵ reported an even higher figure,

stating that over 75% of mortality occurs within 30 days post-PPCI. Thirty-day mortality serves as a determinant for future prognosis because patients who survive beyond 30 days post-PPCI have a mortality risk of less than 1.5% in the following year.⁶

Being able to predict the potential mortality rate of patients would assist clinicians in designing patient management strategies and making the right clinical decisions, including when to discharge patients from the hospital and determining the appropriate duration of intensive monitoring.^{2,3}

The thrombolysis in myocardial infarction (TIMI) score is a mortality prognostic scoring system for STEMI patients that was initially developed for STEMI populations undergoing thrombolytic revascularization and consists of several variables (**Table 1**).^{7,8} Currently, TIMI score evaluation is the standard clinical practice for all STEMI patients entering the emergency department, including those who are planned to undergo PPCI as their revascularization therapy option instead of thrombolysis.^{9–14} In Indonesia, a few studies validated the TIMI score in the past. A study in 2011 yielded an AUC value of 0.801 (95% CI, 0.759–0.844) with good calibration.¹³ However, that study included a broad subject group, encompassing all STEMI patients, both those who underwent reperfusion therapy and those who did not, while only 10.9% of the subjects actually received reperfusion therapy.¹³ The latest study at Cipto Mangunkusumo National Hospital conducted by Mansur et al. validated the TIMI score among all STEMI patients in a young population aged ≤ 50 years old, showing an AUC of 0.836. Nonetheless, similar to the previous study in 2011, this study also included all STEMI patients regardless of whether they underwent revascularization or not.¹⁵

To date, no study has validated the TIMI score in terms of its ability to predict 30-day mortality specifically among STEMI patients

who underwent PPCI. In STEMI patients who eventually undergo PPCI, there are some potential clinical variables that can only be assessed after the revascularization procedure is completed, such as post-PPCI ejection fraction (EF), TIMI flow, and the number of lesions. This study aimed to validate the TIMI score and also add three more variables to achieve a more accurate and improved 30-day mortality outcome prediction.

METHODS

This was a retrospective cohort study that utilized medical record data from STEMI patients who underwent PPCI at Cipto Mangunkusumo National Hospital from January 2018 to November 2024. The mortality status within 30 days post-PPCI in the subjects was obtained by retrieving data from the medical record or contacting the subjects via telephone. The inclusion criteria were patients with a complete medical record, a report of a complete ECG post-PPCI, and a complete PPCI procedure report. The exclusion criteria were patients with malignancy. The dropout criterion was unknown 30-day mortality status. The final sample size was 230 subjects. Univariate analysis was performed to determine the 30-day mortality rate of the STEMI patients post-PPCI. Bivariate analysis was conducted to examine the relationship between 30-day mortality and other variables, including the post-PPCI left ventricular ejection fraction, TIMI flow, and mkl the number of lesions. Variables with a p-value under 0.2 were included in the multivariate analysis to derive a new predictive model. Validation testing of the TIMI score alone in this study population was also performed using the Hosmer-Lemeshow test and AUC curve.

This study passed the ethical review of the Health Research Ethics Committee, Faculty of Medicine, Universitas Indonesia–RSUPN Dr. Cipto Mangunkusumo with the number KET-1573/UN2.F1/ETIK/PPM.00. 02/2024.

RESULTS

Among the 230 STEMI patients who were the subjects of this study, the 30-day mortality rate post-PPCI was 10% (23 subjects), of which 86.9% were cardiac-related deaths. In this study,

Table 1. The variables and point values of TIMI score.⁸

Variables	Points
Age ^a 75 years old	3
Age 65–74 years old	2
Diabetes, angina, or hypertension	1
Systolic blood pressure < 100 mmHg	3
Heart rate > 100 bpm	2
Killip II to IV	2
Body weight < 67 kg	1
Anterior ST segment elevation or LBBB (Left bundle branch block)	1
Time to reperfusion > 4 hours	1

the mean age of the subjects was 56 years, with the majority of subjects being under 65 years old (80.8%). The male gender was predominant in this study (82.6%). **Table 2** shows the demographic characteristics of the subjects.

In the bivariate analysis, two variables showed a p-value < 0.25: the TIMI score and EF

post-PPCI (**Table 3**). These two variables were then further analyzed using multivariate logistic regression. The final results indicated that only the TIMI score was statistically significant ($p < 0.05$), while the other variables did not impact the 30-day mortality of the STEMI patients following PPCI (**Table 4**).

Table 2. The demographic characteristics of the study subjects.

Variable	Number of subjects (N = 230)
Gender, n (%)	
Female	40 (17.39)
Male	190 (82.61)
Age (years), n (%)	
≥ 75	12 (5.22)
65-74	32 (13.91)
< 65	186 (80.8)
Systolic blood pressure (mmHg), n (%)	
< 100	28 (12.17)
≥ 100	202 (87.83)
Heart rate (beats per minute), n (%)	
> 100	15 (6.52)
≤ 100	215 (93.48)
Body weight (kg), n (%)	
< 67	118 (51.30)
≥ 67	112 (48.70)
Diabetes mellitus, n (%)	
Yes	95 (41.30)
No	135 (58.70)
Hypertension, n (%)	
Yes	140 (60.87)
No	90 (39.13)
Killip class, n (%)	
II/III/IV/VI	48 (20.87)
I	182 (79.13)
Anterior ST segment elevation or LBBB, n (%)	
Yes	181 (78.70)
No	49 (21.30)
Time to treatment (hours), n (%)	
≤ 4	20 (8.70)
> 4	210 (91.30)
TIMI score, n (%)	
≥ 5	70 (30.43)
< 5	160 (69.57)
Number of lesions, n (%)	
Multi vessel	178 (77.39)
Single vessel	52 (22.61)
TIMI flow, n (%)	
0/1/2 flow	40 (17.39)
3 flow	190 (82.61)
Post-PPCI ejection fraction(%), n (%)	
≥ 50	110 (47.83)
< 50	120 (52.17)

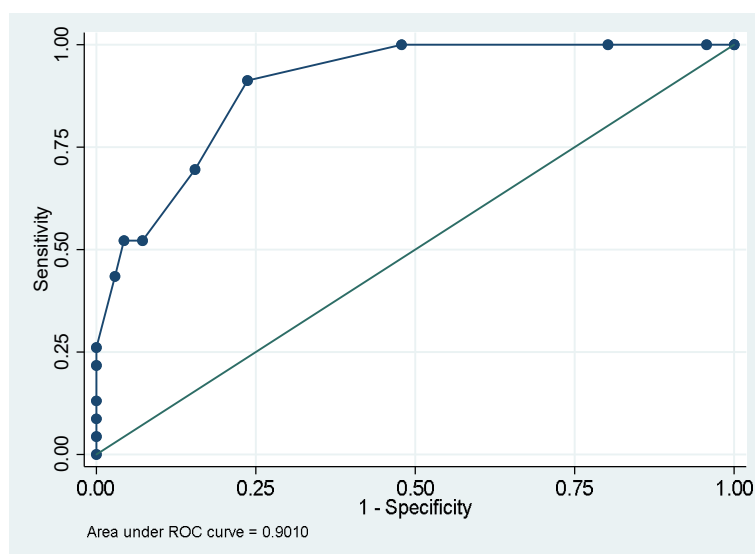
Table 3. Bivariate analysis of the TIMI score, post-PPCI ejection fraction, TIMI flow, and number of lesions with 30-day mortality.

Variables	30-Day Mortality		RR (95% CI)	P value
	Yes (n = 23)	No (n = 207)		
TIMI score, n (%)				
≥ 5	21 (30.0)	49 (70.0)	24.00 (5.784–99.579)	< 0.0001
< 5	2 (1.25)	158 (98.75)		
Post-PPCI ejection fraction (%)				
< 50	17 (14.17)	103 (85.83)	2.579 (1.062–6.349)	0.036
≥ 50	6 (5.45)	104 (94.55)		
TIMI flow, n (%)				
0/1/2 flow	4 (10.0)	36 (90.0)	1.000 (0.359–2.781)	1.000
3 flow	19 (10.0)	171 (90.0)		
Number of vessels, n (%)				
Multivessel	20 (11.24)	158 (88.76)	1.947 (0.602–6.296)	0.266
Single vessel	3 (5.77)	49 (94.23)		

Table 4. Multivariate logistic regression analysis of post-PPCI ejection fraction and TIMI score.

Variables	RR (95% CI)	P value
Early Model		
TIMI score	22.223 (5.337–92.528)	< 0.0001
Post-PPCI ejection fraction	1.901 (0.831–4.348)	0.128
Final Model		
TIMI score	24.000 (5.784–99.579)	< 0.0001

RR = risk ratio

**Figure 1.** The performance of TIMI score discrimination in predicting 30-day mortality following PPCI in STEMI patients

The discrimination performance of the TIMI score showed an AUC of 0.901 (95% CI, 0.849–0.952) with a p value < 0.0001 (Figure 1), thereby indicating excellent predictive ability for 30-day mortality. Calibration using the Hosmer-Lemeshow test yielded a p value of 0.356, which suggested good calibration (p

> 0.05). Because the proposed additional variables (TIMI flow, EF post-PPCI, and the number of lesions) were not found to influence the prediction of 30-day mortality among the study subjects in the multivariate analysis, no further discrimination performance or calibration assessments were conducted for these variables.

There was no significant association between the ejection fraction based on the ECG after PPCI, TIMI flow, or the number of lesions and 30-day mortality post-PPCI in the STEMI patients. The discrimination performance of the TIMI score in predicting 30-day mortality post-PPCI in the patients was very good (AUC 0.901), with good calibration.

DISCUSSION

Left ventricular ejection fraction can assess the degree of change in left ventricular volume from the diastolic to the systolic phase.^{16–18} The ejection fraction is closely associated with clinical outcomes, including mortality, in STEMI patients. A decrease in the ejection fraction below 60% has already been associated with an increased risk of mortality.^{19–21} In an episode of acute myocardial infarction, a significant and acute reduction in ejection fraction can occur. This phenomenon has been extensively discussed in previous studies, which suggested that a decrease in ejection fraction following a STEMI event may serve as an important prognostic factor in determining the future mortality and morbidity risks for patients.^{20,22} In this study, post-PPCI EF did not have an effect on 30-day mortality in STEMI patients post-PPCI. A study found that improvement in ejection fraction post-PPCI was associated with a reduced long-term mortality risk in patients with reduced ejection fraction but not in those with an ejection fraction > 50% before the procedure.²³ However, this study did not assess the pre-PPCI ejection fraction.

TIMI flow, which is a measure of coronary blood flow in acute myocardial infarction, has been identified as having prognostic value in STEMI patients undergoing reperfusion. In more than 60% of STEMI patients post-reperfusion with TIMI flow grades 0 to 2, the in-hospital mortality rate was 2.3 times higher (63%) compared to those with a TIMI flow grade of 3 (27%) ($p < 0.001$).^{24–26} In this study, TIMI flow did not affect 30-day mortality post-PPCI in STEMI patients. The distribution of subjects was not uniform across the TIMI flow groups. The majority of subjects (82.61%) had TIMI 3 flow, while only 40 subjects had TIMI 0, 1, or 2 flow, making the distribution unrepresentative due

to the small number of subjects in these latter groups, due to a significant discrepancy.

Data from previous studies have shown a strong correlation between the number of lesions and mortality risk in STEMI patients. Multivessel coronary artery disease (MVD) accounts for more than 40% of STEMI cases and is associated with a poorer prognosis compared to single-vessel disease (SVD).¹⁴ The overall mortality rate in patients with MVD, as reported in a 2012 study in South Korea, was 10.2% higher than the 5.9% observed in SVD patients.^{27,28} However, this study found that the number of lesions in the STEMI patients who underwent PPCI did not influence 30-day mortality ($p=0.266$). This finding was consistent with the previous study by Mandal et al.,²⁵ in which the number of lesions was found to be an independent, nonsignificant predictor of 30-day mortality after PPCI ($p>0.05$). Instead, the location and size of the infarction lesions had a more significant impact on mortality.^{4,25,29} Single-vessel lesions in large and major arteries, such as the left main artery or proximal left anterior descending (LAD) artery, pose higher risks and greater mortality compared to lesions in distal smaller vessels, even if the lesion is single-vessel.³⁰ Conversely, multivessel disease in noncritical vessels may offer a better prognosis. Secondly, the presence of collateral circulation and microcirculation also plays a crucial role in reducing the damage caused by ischemic tissue due to blocked circulation in a major artery, thus reducing mortality.³¹ The importance of location and size of the infarction has been articulated in the Gensini score and SYNTAX score, previously established scores used to assess the severity of coronary artery disease based on angiogram images.^{32,33}

One of the limitations of this study was the unavoidable difference in interobserver analysis because this was a retrospective study. This study therefore leaves room for opportunities for future research to evaluate mortality over a longer observation period, such as one year or five years. It is suggested to perform a study with a larger sample size in the form of a prospective cohort study so that established protocols and standardization can be tailored in the recording and collection of objective patient data, thereby

improving the process and minimizing errors.

CONCLUSION

The performance of the TIMI score in predicting 30-day mortality after PPCI in STEMI patients at Cipto Mangunkusumo National Hospital was excellent (AUC 0.901, 95% CI 0.849–0.952), with good calibration. Ejection fraction based on ECG post-PPCI, TIMI flow, and the number of lesions was not associated with 30-day mortality in STEMI patients after PPCI.

CONFLICT OF INTERESTS

All the authors declare that there are no conflicts of interest.

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