
Simple Risk Index Score and Hospitalization Mortality in Patients with ST-Elevation Myocardial Infarction

Erlina Marfianti^{1,*}, Sjaiful Anwar², Achmad Bima Aryatama³

¹Internal Medicine Department, Faculty of Medicine, Islamic Indonesia of University, Yogyakarta, Indonesia

²Cardiology Department, Soedono Madiun District Hospital, Madiun, Indonesia

³Faculty of Medicine, Islamic Indonesia of University, Yogyakarta, Indonesia

*Corresponding Author. E-mail: erlina.marfianti@uii.ac.id

Phone number: +6281325135860

Received 3 March 2020; Accepted 29 March 2020; Published 4 April 2020

ABSTRACT

Introduction: Hospitalization mortality in ST-elevation Myocardial Infarction (STEMI) patients are affected by several factors, including initial identification of the risks at hospital admission. Risk score tools as a predictor of STEMI complication and death event in STEMI patients is a simple risk index score. The aim of this study was to determine the association between simple risk index score and hospitalization mortality in STEMI patients.

Methods: We retrospectively enrolled 60 consecutive patients who were admitted to our hospital diagnosed with STEMI. The simple risk index score was calculated for each patient using equation: heart rate x [age/10]²/systolic blood pressure. The patients were assigned into 2 groups according to this score, high score and low score group. Incidence of death during hospitalization in STEMI patients was recorded.

Results: The total subjects were 60 people. The subjects consisted of 30 patients with low score and 30 subjects with high score. The incidence of death during hospitalization in the group of high simple risk index score were 26 patients, and in the group of low simple risk index score were 13 patients. The association between the simple risk index score and the deaths during hospitalization in STEMI patients based on statistical analysis was significant ($p=0.00$) and value of risk relative (RR) is 2.167; 95% CI: 1.368-3.433; ($p=0.000$).

Conclusion: Simple risk index score is associated with hospitalization mortality in ST-elevation myocardial Infarction (STEMI) patients.

Keywords: Risk; hospitalization; ST elevation myocardial infarction

Introduction

Based on data from the World Health Organization (WHO), cardiovascular disease became the highest cause of death in the world in 2012. There were 17.5 million deaths (46.2%) of all deaths caused by non-communicable diseases. An estimated 7.4 million deaths are due to acute coronary syndrome and 6.7 million are caused by strokes. From these data, 80% of deaths which were caused by cardiovascular disease occur in developing countries.¹ Basic health research data in Indonesia (RISKESDAS) 2013 reported that the prevalence of cardiovascular disease in the province of East Java is the second highest after Jakarta, which is 375,127 people. Likewise, in the city of Madiun, the incidence of this disease is high.²

Acute coronary syndrome is a cardiovascular emergency disease with a high mortality rate. There are 3 types of coronary artery disease: unstable angina pectoris, myocardial infarction without ST elevation (Non STEMI) and myocardial infarction with ST elevation (STEMI). STEMI is a life-threatening disease and requires immediate initial treatment. In STEMI, the percentage of arterial closure is greater than Non STEMI or non-stable angina pectoris disease. Mortality rates in STEMI patients are also higher than other types.³

The mortality rate in STEMI patients is influenced by many things, including identification of the initial risk on hospital admission, and management or treatment at the hospital. Some guidelines and previous studies discuss about the risk stratification of STEMI to determine the severity of the disease. Some risk stratification score tools are simple, but some tools are complex and requires a complete investigation. One simple risk scores as prediction of death in STEMI patients is the simple risk index score according to TIMI 17 (Thrombolysis in Myocardial Infarction study 17), which consists of age, frequency of heart rate, and systolic blood pressure parameters.^{3,4} The use of simple risk index score (based TIMI 17) aims to quickly stratify the risk of the patient's condition in hospital triage, so that early management steps can be immediately determined to reduce the severity and mortality of STEMI during hospitalization.⁴

Thrombolysis in myocardial infarction (TIMI) study was conducted from 2008 to 2014 and the topics vary from risk stratification to management of therapy. Simple risk stratification is needed, which includes parameters that are easy to conduct, uncomplicated, and provide information in predicting the severity and mortality of STEMI patients. The difference between this study and the previous study (TIMI 17) was the dependent variable, while at TIMI 17 the dependent variable was death for 30 days of follow-up, whereas in this study the dependent variable was death during hospitalization. This study aims to determine whether the simple risk index score is related to death during hospitalization in STEMI patients.^{4,5}

Methods

The study design was a descriptive analytic study with a retrospective cohort approach using secondary data from the Soedono Madiun District Hospital medical record. The subjects for this research were STEMI patients at Soedono Madiun District Hospital. The study used medical record data in 2016. The research subjects were used according to the formula the minimum amount needed. The minimum sample calculation formula used is for cohort design with categorical data types. The formula is:

$$\left(\frac{Z\alpha\sqrt{2PQ} + Z\beta\sqrt{P_1Q_1 + P_2Q_2}}{P_1 - P_2} \right)^2$$

$Z\alpha$ = level of confidence 95% = 1,96 ; $Z\beta$ = error type 2 is 20% = 0,84; P = proportion = 0,5; $P_1 - P_2$ = minimum difference that is considered significant = 0,2. From this formula, a minimum of 30 subjects per group was obtained. Inclusion criteria were inpatients at Soedono Madiun District Hospital, who were diagnosed with STEMI, and have complete medical record data including pulse frequency, systolic blood pressure and age. Exclusion criteria are the presence of comorbidities in patients, shock conditions or incomplete medical records.

The independent variable in this study is simple risk index score and the dependent variable is death during hospitalization. A simple risk index score (we use the score based on TIMI 17) is a simple score that uses age, systolic blood pressure and heart rate frequency on hospital admission. The simple risk index score formula is :

$$\frac{\text{Heart rate frequency} \times (\text{age} / 10)^2}{\text{Systolic blood pressure (mm Hg)}}$$

The score is categorized as high when the result is ≥ 17.5 ; the score is categorized as low when the result is < 17.5 . Subjects were categorized into two groups based on the results of the simple risk index score formula, the high score group and the low score group. Each group consisted of 30 research subjects. Data were collected using purposive sampling method.

Statistical analysis using SPSS, a mean \pm standard deviation was used to express the continuous variables, while frequencies and percentages were used to express the categorical variables. For the comparison of the categorical data, the chi-square or Fisher exact test were performed. The Kolmogorov-Smirnov test was used to test the normality distribution of continuous variables. Chi Square test was used to examine the relationship between two variables; the simple risk index score with the death occurrence during hospitalization in STEMI patients at Soedono Madiun District Hospital.

The confidentiality of patient data is guaranteed in this study. This study has received a certificate of ethical review issued by the ethics committee of the Faculty of Medicine Islamic University of Indonesia with number 01/Ka.Kom.Et/70/KE/XII/2016. All hospital research procedures are undertaken including research permission from the Soedono Madiun District Hospital.

Results

The study was conducted at Soedono Madiun District Hospital with a total subjects of 60 patients. Subjects consisted of 17 female and 43 male. Age of patients ranged from 30 to 79 years. The mean age of the study population was 57.07 ± 12.07 years. The subjects consisted of 30 subjects who had a Simple index score less than 17.5 and 30 subjects who had a simple index score of more than or equal to 17.5. Total deaths in the study population were 39 people. Subjects characteristics are shown in Table 1.

Table 1. Baseline Subject Characteristics STEMI patients at Soedono Madiun District Hospital

	Total (n=60)	Simple risk score $\geq 17,5$ (High) (n=30)	Simple risk score <17,5 (Low) (n=30)	P value*
Sex				
Male (%)	42 (70%)	19 (31.7%)	23 (38.3%)	$p=0.000$
Female (%)	18 (30%)	11(18.3%)	7 (11.7 %)	
Age (years)	57.07 ± 12.07	66.50 ± 6.89	47.63 ± 8.21	$p=0.200$
Heart rate Frequency	84.57 ± 21.45	91.43 ± 26.43	77.77 ± 11.84	$p=0.000$
Blood pressure (mmHg)				
Systolic Blood Pressure	133.37 ± 34.53	123.20 ± 36.43	143.53 ± 29.74	$p=0.039$
Diastolic Blood Pressure	84.42 ± 22.67	78.13 ± 28.03	90.70 ± 13.36	$p=0.025$
Outcome				$p=0.000$
Death	38 (43.3%)	26 (43.3%)	12(20%)	
Recovery	22 (36.7%)	4 (6.7%)	18(30%)	

* P-values obtained by the Mann-Whitney test for numerical variables and by chi-square or Fisher's exact test for categorical variables.

The baseline characteristics subjects (table 1) describe that age is no significant difference between the two groups ($p > 0.05$), while for pulse frequency, systolic and diastolic blood pressure there are significant differences between the two groups ($p < 0.05$). The heart rate frequency in the high score group was higher than in the low score group. Systolic and diastolic blood pressure at high score is lower than in low score group.

To determine the relationship of simple risk index score with death during hospitalization in STEMI patients, a bivariate chi square analysis was performed. From the results of statistical analysis, there is a significant relationship with $p= 0.00$ which can be seen in table 2.

Table 2. Simple Risk Index Score And Death During Hospitalization in STEMI Patients

	Simple risk index score (High)	Simple risk index score (low)	Total	P value*
Death	26	12	38	$p=0.00$
Recovery	4	18	22	
Total	30	30	60	

* Chi Square Test

From the results of statistical analysis to determine the risk of death events, the relative risk (RR) result is 2.167; with a 95% confidence level, CI: 1.368-3.433 ($p= 0.00$).

Simple high risk index score is a predictor of death events in hospitals in STEMI patients with a probability of 2.167 times higher.

Discussion

The results of the present study demonstrate that the simple risk index score had a significant relationship with the incidence of death during hospitalization. A simple risk index score can be used to predict the incidence of death during hospitalization in STEMI patients. Patients with high simple risk index scores, the probability of death in their hospital is predicted to be higher than patients with low simple risk index scores. Statistical analysis of this study shows the relative risk (RR) 2.167; with a 95% confidence level, CI: 1,368-3,433 ($p=0,000$).^{3,4} Based on parameters in this simple risk score, the underlying mechanism is that the older the age, the degeneration process of the organ system occurs, so that the response of adaptation and compensation is also slow. Likewise, the higher heart rate frequency illustrates the existence of heart rhythm disturbance which affects the fatality of STEMI patients.

Factors that cause death in STEMI patients are influenced by many conditions, such as emergency conditions at hospital admission, disease onset, comorbidities, and management of the disease.⁵ Early risk stratification in patients with STEMI at hospital admission is very important, because it can influence clinical decisions and subsequent therapeutic management. A study by Morrow et al. showed support the results of this study, that a high simple risk score is associated with mortality in STEMI patients. Each increase in the five-point score associated with a 43% increase in mortality over 30 days of follow-up.^{5,6}

Wiviot et al. conducted a study about application a simple risk index based on the TIMI risk index (TRI) in non ST-segment elevation myocardial infarction (NSTEMI). The results showed a stratified relationship between TRI and mortality in NSTEMI patients ($p<0,0001$). Early identification of NSTEMI patients at high risk of death in the hospital can provide important information to doctors for initial triage and treatment.⁷ The results of their study are similar to our study, but in different subjects. Their study showed that simple risk index score provides important information about the prediction of death in NSTEMI patients.⁷

Roubin et al. (2012) conducted study about risk stratification in STEMI patients are TIMI, Global Registry of Acute Cardiac Events (GRACE) risk scores and ZWOLLE risk scores. Their study explained that the stratification score at 1-year follow-up, showed a statistically significant difference between mortality, revascularization of target vessels,

incidence of stroke, reinfarction, cardiovascular complications, cerebrovascular complications and the incidence of stent thrombosis. A study conducted by Chen et al. (2018) also reported that the TIMI and GRACE scores risk stratification can predict a long-term outcome (3 years) in ethnic Chinese patients with myocardial infarction (MI). The GRACE score is more accurate in predicting long-term mortality for myocardial infarction patients in China.^{8,9}

A recent study by Cinar et al. (2019) showed that the results of his research support our study. Their study aims to evaluate the use of simple risk index score with TIMI Index (TRI) score to predict stent thrombosis (ST) in STEMI patients who underwent percutaneous primary coronary intervention (PCI). The results of their study showed a statistically significant difference between TRI score and thrombosis stent with an odds ratio (OR) of 1.061; 95% CI: 1,038-1,085; P <0.00110. The TRI formula = heart rate x [age/10] ²/systolic blood pressure.¹⁰

Some previous studies have also developed simple scores for risk stratification. One of these studies shows that a simple score (proACS score) as predictor of all causes of death during hospitalization in acute coronary syndrome (ACS) patients. These parameters criteria consist of systolic blood pressure, degree of ACS Killip, increase in ST segments; age ≥ 72 years. This ProACS score as a simple risk stratification for hospital deaths in ACS patients. This score also has a very good predictive ability in ACS patients.^{11,12}

This study has some limitations. First, the study design was retrospective and observational. Second, we only included patients with STEMI not all ACS patients; therefore, our study findings may not be generalized to all acute coronary syndrome patients. Third, limited number of subjects. Fourth, this study does not consider other factors that affect patient fatality or death, caused by lack of data regarding the characteristics of a patient's clinical background such as degrees of severity disease and laboratory parameter.

In conclusion, the Simple Risk Index score at hospital admission is related to the incidence of death during hospitalization in STEMI patients. Simple Risk Index score might be an independent predictor of death during hospitalization among these patients.

Conflicts of Interest

There are no conflicts of interest with the parties involved in this research activity.

Funding sources

This research was funded by the Faculty of Medicine at the Islamic University of Indonesia through faculty grants.

Acknowledgments

We would like to thank Soedono Madiun District Hospital for facilitating this research, and also thanks to the Internal Medicine Department, Faculty of Medicine, Islamic University of Indonesia for their support.

References

1. World Health Organization. Global Status Report On Noncommunicable Diseases 2014. (2014).
2. Dasar, R. K. Badan penelitian dan pengembangan kesehatan republik indonesia. in (2013).
3. Indonesia, P. D. S. K. *Pedoman tata laksana sindroma koroner akut*. (2018).
4. Study, G. T. The TIMI Trial 30 years (1984 – 2014). in (2014).
5. Wiviott, S. D. *et al.* Performance of the thrombolysis in myocardial infarction risk index in the National Registry of Myocardial Infarction-3 and -4: A simple index that predicts mortality in ST-segment elevation myocardial infarction. *J. Am. Coll. Cardiol.* **44**, 783–789 (2004).
6. Morrow, D. A. *et al.* A simple risk index for rapid initial triage of patients with ST-elevation myocardial infarction: An InTIME II substudy. *Lancet* **358**, 1571–1575 (2001).
7. Wiviott, S. D., Morrow, D. A., Frederick, P. D., Antman, E. M. & Braunwald, E. Application of the Thrombolysis In Myocardial Infarction Risk Index in Non-ST-Segment Elevation Myocardial Infarction. Evaluation of Patients in the National Registry of Myocardial Infarction. *J. Am. Coll. Cardiol.* **47**, 1553–1558 (2006).
8. Chen, Y. H., Huang, S. S. & Lin, S. J. TIMI and GRACE risk scores predict both short-term and long-term outcomes in chinese patients with acute myocardial infarction. *Acta Cardiol. Sin.* **34**, 4–12 (2018).
9. Raposeiras-Roubín, S. *et al.* Walking beyond the GRACE (Global Registry of Acute Coronary Events) model in the death risk stratification during hospitalization in patients with acute coronary syndrome: What do the AR-G (ACTION [Acute Coronary Treatment and Intervention Outcomes Network] registry and GWTG [Get with the Guidelines] Database), NCDR (National Cardiovascular Data Registry), and EuroHeart risk scores provide? *JACC Cardiovasc. Interv.* **5**, 1117–1125 (2012).
10. Çınar, T. *et al.* A simple score for the prediction of stent thrombosis in patients with ST elevation myocardial infarction: TIMI risk index. *J. Cardiovasc. Thorac. Res.* **11**, 182–188 (2019).
11. Timóteo, A. T., Aguiar Rosa, S., Afonso Nogueira, M., Belo, A. & Cruz Ferreira, R. Score de risco ProACS: em score simples e precoce para estratificação de risco em doentes com síndromes coronárias agudas. *Rev. Port. Cardiol.* **36**, 77–83 (2017).
12. McNamara, R. L. *et al.* Predicting In-Hospital Mortality in Patients With Acute Myocardial Infarction. *J. Am. Coll. Cardiol.* **68**, 626–635 (2016).