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TIMI score as a predictor of death in patients with acute myocardial infarction without percutaneous coronary intervention

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ARTICLE INFORMATION

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Acronyms
ACS: acute coronary syndrome
ICU: intensive care unit
SD: standard deviation
STEMI: ST- segment elevation myocardial infarction
TIMI: Thrombolysis in Myocardial Infarction

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ABSTRACT

Introduction: Acute myocardial infarction (AMI) is a frequent disorder, associated with high morbidity and mortality; therefore the implementation of risk predictive models is required.
Objective: To determine the value of TIMI score to predict early death risk in patients with ST-elevation AMI.
Method: Patients with a diagnosis of ST-elevation AMI admitted in the intensive care unit (ICU) at Dr. Miguel Enríquez University Hospital were consecutively included. Death risk in ICU was assessed by using a logistic regression model, according to TIMI score at admission.
Results: 115 patients were analyzed. Mean TIMI score was 5.04 (standard deviation 2.7) and the mortality rate was 10.4%. Logistic regression analysis showed that the higher TIMI score was associated with increased death risk in ICU (OR 1.47 [95% CI 1.17-1.83]; p= 0.001); with adequate model calibration (Hosmer-Lemeshow test; X^2=5.82; p=0.324), and an area under the receiver-operating characteristic curve of 0.76 [(95% CI 0.60-0.93); p= 0.003].
Conclusions: TIMI score is a good tool to predict the risk of early death in patients with ST-elevation AMI assisted in centers without percutaneous coronary intervention.
Key words: Acute coronary syndrome, ST-segment elevation myocardial infarction, Risk stratification, Prognosis, TIMI score

Escala TIMI como predictor de muerte en pacientes con infarto miocárdico agudo sin intervención coronaria percutánea

RESUMEN

Introducción: El infarto agudo de miocardio (IAM) es un trastorno frecuente, asociado con una alta morbilidad y mortalidad, por lo que es necesaria la implementación de modelos de predicción de riesgo.
Objetivo: Determinar el valor de la escala TIMI para la predicción de riesgo de muerte precoz en pacientes con IAM con elevación del segmento ST.
Método: Se incluyeron consecutivamente los pacientes con IAM con elevación del segmento ST ingresados en la Unidad de Cuidados Intensivos (UCI) del Hospital Universitario Dr. Miguel Enríquez. Mediante regresión logística se evaluó el riesgo de muerte en UCI, según la puntuación en la escala TIMI al ingreso.
Resultados: Se analizaron 115 pacientes con una puntuación media en la escala

2.7) and the mortality rate was 10.4%. Logistic regression analysis showed that the higher TIMI score was associated with increased death risk in ICU (OR 1.47 [95% CI 1.17-1.83]; p= 0.001); with adequate model calibration (Hosmer-Lemeshow test; X^2=5.82; p=0.324), and an area under the receiver-operating characteristic curve of 0.76 [(95% CI 0.60-0.93); p= 0.003].

Conclusions: TIMI score is a good tool to predict the risk of early death in patients with ST-elevation AMI assisted in centers without percutaneous coronary intervention.

Key words: Acute coronary syndrome, ST-segment elevation myocardial infarction, Risk stratification, Prognosis, TIMI score

INTRODUCTION

Coronary heart diseases are one of the leading causes of death worldwide and rank second after cancer in Cuba[1]. In developed countries like the United States, only in 2009, approximately 683.000 patients were discharged from hospital with a diagnosis of acute coronary syndrome (ACS)[2]. ST-segment elevation myocardial infarction (STEMI) represents between 25 and 40% of all acute myocardial infarctions[3,4]. Epidemiological studies have shown that hospital mortality in patients suffering ACS, specifically an STEMI, ranges from 5.0 to 6.0%. On the other hand, annual mortality is 7-18%[5-7] although some decline has been observed in recent years.

Moreover, risk stratification is an important factor when assisting patients with ACS. Numerous systems have been designed in order to predict the risk of death in these individuals. Among the most widely used is the Thrombolysis In Myocardial Infarction (TIMI) score, which predicts the risk of death at 30 days[8].

After the development of percutaneous coronary intervention (PCI) techniques and a broader cardiac surgery access, the clinical outcomes picture in patients with ACS has been significantly modified, with a short and long term reduction in mortality and a better functional state in those affected[6,9]. However, not every center offers these treatment methods, in fact it is not even available in all territories of our country.

Therefore, this study was conducted with the objective of determining the TIMI score value to predict early death risk in patients with STEMI without PCI.

METHOD

Study design

A longitudinal and retrospective study was conducted in the Intensive Care Unit (ICU) at the University Hospital "Dr. Miguel Enríquez" in Havana, Cuba; which has 430 beds for hospitalization without PCI facilities. The ICU has 10 beds and assists about 700 patients a year, of which about 50% have an acute coronary syndrome; since, according to the hospital protocols, all patients with this diagnosis are admitted to the ICU for at least 48-72 hours, if no complications occur. The research was approved by the Hospital Scientific Council and the Ethics Committee, and performed according to the ethical principles of the Declaration of Helsinki.

Participants

Out of a population of 180 patients admitted to the ICU due to ACS and registered consecutively and prospectively in the database from January to December 2014, 117 who presented diagnosis of STEMI were included in the study. Two were excluded because the diagnosis was not fully elucidated; so the final sample consisted of 115 patients, in whom the incidence of death in the ICU was determined and the risk of suffering from it was evaluated according to the TIMI score record when admitted.

Variables

The following variables were taken at ICU admission: age, sex, skin color, history of comorbidities,

smoking, anatomical location of the infarction, performance of thrombolysis and score on TIMI. The measured response variable was early mortality (at the ICU).

Definitions

STEMI diagnosis was performed according to the criteria of the Third Universal Definition of Myocardial Infarction[10], which consists on the presence of chest pain with ischemic characteristics, suggestive electrocardiographic abnormalities (ST-segment elevation with defined topography), cardiac biomarkers elevation (CK-MB) and imaging alterations (echocardiography).

TIMI score for STEMI assesses three aspects[8]:

1. Medical history: age, and history of diabetes mellitus, hypertension and angina.
2. Findings on physical examination: systolic blood pressure, heart rate, Killip-Kimball class II-IV and body weight.
3. Special characteristics when admitted: ST-segment elevation in the anterior wall or complete left bundle branch block and a (more than four hours) time to reperfusion treatment.

Each variable is assigned a score and the sum represents the total points of the score, which ranges from 0 to 14.

Statistic analysis

For qualitative variables, results are displayed in percentages, whereas for quantitative it is done as mean with standard deviation (SD) or median with interquartile range (IR) according to the normality of the population.

It was determined by univariate analysis whether there were differences between the groups. Student t-test or Mann Whitney U-test were used for quantitative variables, according to the normality of the population.

Chi-square test or Fisher's exact test were used for qualitative variables when required.

The influence of the explanatory variable (record on TIMI score at ICU admission) on mortality in ICU was performed using logistic regression, the results are displayed as a probability or chance index (odds ratio [OR]) with confidence interval (CI) at 95% .The model calibration was assessed by the goodness-of-fit test of Hosmer-Lemeshow, which determines the distance between predicted death incidence in ICU and that observed; a significant result ($p < 0.05$) in this test indicates a lack of model adjustment[11]. TIMI score capacity to correctly discriminate between those cases who will die and those who will not, was assessed by the area under the receiver operating characteristic (ROC) curve also called statistical c. A statistician value $c > 0.70$ indicates an acceptable discrimination capacity[12].

Statistical tests were considered significant with a bilateral p value less than 0.05. Statistical analysis was performed using the IBM® SPSS® program, version 20 (Chicago, IL, USA).

RESULTS

Patients' characteristics

The patients studied had an average age of 64.7 years (SD 12.4 years). 66.1% were male, 38.3% were black or mixed skin and 22.6% smoked. 19.1% were diabetic, 40.0% had hypertension and 7.0% had a history of chronic kidney disease. ICU stay showed a median of 2.0 days (IR 2.0 - 3.0 days), and 12 patients died at an early stage (10.4%). The characteristics of the individuals studied are shown in **table**.

Death prediction

The average record on the TIMI score was 5.04 (SD 2.7 points). When logistic regression analysis was performed, it was noted that a higher TIMI score record was associated with an increased risk of death in ICU by 47% (dead 7.8 points [SD 3.4 points] *vs.* living 4.7 points [SD 2.4 points]; OR 1.47 [95% CI 1.17 - 1.83]; p = 0.001). Model calibration was adequate (Hosmer-Lemeshow test, χ^2=5.82; p=0.324) and discrimination was good (area under the curve 0.76 [95% CI 0.60-0.93]; p=0.003) (**Figure**).

DISCUSSION

Conducting research to evaluate the usefulness of

Table. Patients' general characteristics.

Variable	Death (n=12)	Alive (n=103)	p
Age, years (SD)	71,1 (9,8)	64,0 (12,5)	0,06
Sex			
Male	7 (58,3)	69 (67,0)	0,537
Female	5 (41,7)	34 (33,0)	
Skin color			
White	8 (66,7)	63 (61,2)	0,954
Black	4 (33,3)	40 (38,8)	
Comorbidities			
Hypertension	7 (58,3)	39 (37,9)	0,291
Diabetes mellitus	3 (25,0)	19 (18,4)	0,874
Chronic kidney disease	2 (16,7)	6 (5,8)	0,425
Smoking habit			
Yes	4 (33,3)	22 (21,4)	0,566
No	8 (66,7)	81 (78,6)	
Localization of AMI			
Anterior	8 (66,7)	49 (47,6)	0,344
Inferior	4 (33,3)	54 (52,4)	
Thrombolysis			
Yes	3 (25,0)	49 (47,6)	0,238
No	9 (75,0)	54 (52,4)	
ICU stay, days (IQR)	1,0 (1,0 - 2,75)	2,0 (2,0 - 3,0)	**0,002**

AMI, acute myocardial infarction; ICU, Intensive Care Unit; IQR, interquartile range; SD, standard deviation.
Data (except age and ICU stay) express n (%).

predictive scores in different clinical settings allows applying them more extensively. In Cuba, many patients with ACS are initially admitted to the ICU, and our study validates using the TIMI score for patients with STEMI in this context.

TIMI score capacity to predict the risk of death at such short term has never been assessed, making it difficult to compare the results with those found in other studies. In fact, the TIMI score was originally designed to predict mortality at 30 days[13]. A recent study by Mendez-Eirín *et al.*[12] indicates that the TIMI score is very good for predicting death risk at 30 days and one year in patients with ACS. Other studies have also found similar results[14].

The following investigation demonstrates that this score is also useful for predicting early mortality in patients with STEMI. As we decide to select a predictive model, we must assess complexity and mathematical accuracy as well as simplicity (clinical applicability) when performing it[15]. In this sense, compared to other predictive models like GRACE[16], TIMI score is much simpler and includes basic clinical and electrocardiographic variables.

The characteristics of the individuals analyzed are consistent with what is usually reported in literature regarding this type of patients[9,17]; however, it should be taken into account that the population of cases included was not subjected to any kind of PCI. It is well known that early coronary angiography with angioplasty has a positive impact on morbidity and mortality in individuals who have an ACS[18,19]; but not all centers where these patients are assisted have the technology and trained staff to perform them.

The study is limited by its retrospective design and since it was conducted in a single center, the sample size is not large, so the generalization of results should be done with caution; however, these results are not only extrapolated to the ICU but also to the coronary care units, where STEMI patients are admitted for a similar short time.

Other related studies, preferably prospective and multicenter are required to ensure sufficient sample size to reach an unquestionable generalization of results, conclusively determine the TIMI score capacity and predict, in advance, early mortality in patients with ACS.

CONCLUSIONS

The TIMI score is a useful tool for estimating the risk of death in patients with ACS regardless the evolution time of the disease.

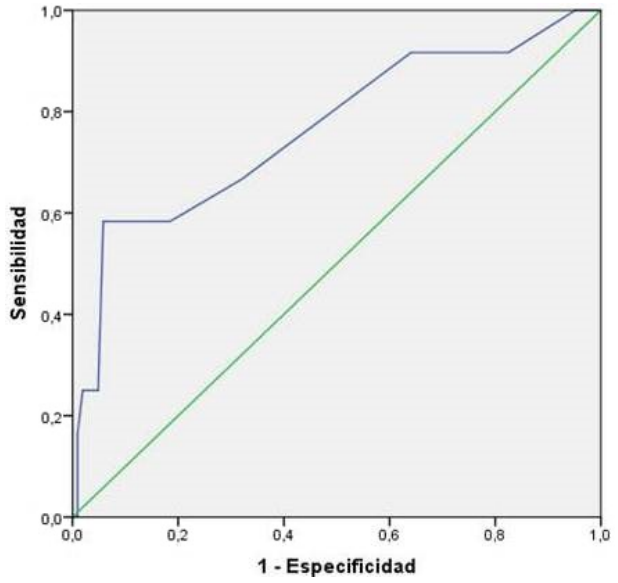

Figure. Operating characteristics curve of the TIMI Model-receiver for predicting early death in patients with ST-segment elevation acute myocardial infarction.

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