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By Hoang Anh Tien

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Predictive value of the angiographic GRACE score in patient with ST elevation myocardial infarction

Hoang Anh Tien[1], Ho Van Phuoc[2], Nguyen Hoang Khanh[2]

[1]Hue University of Medicine and Pharmacy Hospital, Hue city, Vietnam

[2]Interventional Cardiology Department, Cardiovascular Center, Da Nang Hospital, Hue city, Vietnam

Corresponding author:

Hoang Anh Tien

E-mail: hatien@hueuni.edu.vn

ABSTRACT

Objectives: Accurate risk stratification plays an important role in the management of patients with ST-elevation myocardial infarction (STEMI). However, few studies have built a prognostic model based on the GRACE score combined with the results of coronary angiography and intervention. Consequently, we performed this study to evaluate the effectiveness of the angiographic GRACE (AGRACE) score in estimating in-hospital mortality for patients with STEMI who are undergoing percutaneous coronary intervention (PCI).

Material and Methods: Cross-sectional study was conducted at Da Nang Hospital from March 2022 to September 2023 in patients receiving PCI for STEMI

Outcomes: The study included 139 patients; the mean age was 63.51 ± 13.07, and 29.5% of the patients were female. The in-hospital mortality rate was 10.1%. The AGRACE score demonstrated a strong ability to predict in-hospital mortality, with an area under the curve (AUC) of 0.921 and a p-value of 0.001. Furthermore, the AGRACE score showed a higher predictive value for in-hospital mortality than both the TIMI and GRACE scores.

Conclusions: The angiography GRACE score had a very good ability to predict in-hospital mortality (AUC = 0.921 and p = 0.001). The angiography GRACE score had a better predictive value for in-hospital mortality than GRACE and TIMI scores.

Ethical Compliance: All human participant studies were conducted in compliance with the ethical guidelines set by the institutional and/or national research committee, as well as the 1964 Helsinki Declaration and its subsequent revisions or comparable ethical principles.

Key words: STEMI, AGRACE score, GRACE score, PCI.

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OBJECTIVES

In recent years, coronary artery disease (CAD) has been the leading cause of death among cardiovascular diseases worldwide and in Vietnam. Despite many advances in diagnosis and treatment, the mortality rate in patients with STEMI remains high; therefore, risk stratification is essential to help clinicians choose appropriate treatment strategies and individualize plans for each patient (1).

Many prognostic models have been created, such as the TIMI score and the PURSUIT score, which come from clinical trials, and the GRACE score, which comes from multinational registry studies.(2). With the development of PCI, many other prognostic models have been developed that include characteristics of coronary lesions and outcomes after revascularization treatment, contributing to diversifying the risk stratification of acute myocardial infarction (AMI), such as CADILLAC and PAMI scores (3). GRACE is recommended for clinical use to stratify the risk of AMI and predict mortality events during treatment. In Japan, Mitarai, based on data from the K-ACTIVE study, built a GRACE coronary angiography score based on the GRACE score combined with the results of coronary angiography and intervention. The prognostic value of the GRACE coronary angiography score is superior to that of the GRACE score in predicting cardiovascular events for patients with STEMI undergoing PCI, as demonstrated by the results.(4). Studies conducted in Vietnam have indicated that the GRACE score can effectively predict early cardiovascular events in patients with STEMI who are undergoing PCI.(5). However, few studies have built a prognostic model based on the GRACE score combined with the results of coronary angiography and intervention. Our study aimed to assess the usefulness of the GRACE coronary angiography score in determining the likelihood of in-hospital death among individuals with AMI who received PCI.

MATERIAL AND METHODS

Participants: A total of 139 patients who met the diagnostic criteria for acute STEMI and underwent PCI between March 2022 and September 2023 were admitted to Da Nang Hospital.

Inclusion criteria: Patients with acute STEMI who underwent PCI at the Da Nang Hospital. MI was diagnosed based on the definition of the 4th MI. The patient and his family agreed to participate in this study.

Exclusion criteria: The patient was severe infection. The patient had a malignant disease.

Methods: Cross-sectional descriptive study

Procedures:

All patients who met the inclusion criteria were calculated using the GRACE coronary angiography, GRACE, and TIMI risk scores. Monitor patients during hospital stay. The TIMI risk stratification score comprises factors such as age, heart rate upon admission exceeding 100 bpm, systolic blood pressure below 100 mmHg, Killip class above I, a history of diabetes, hypertension, or angina, a weight under 67 kg, ST elevation in the anterior leads or left bundle branch block, and a treatment delay of more than 4 hours. The GRACE risk stratification score includes parameters such as age, heart rate at admission, systolic blood pressure at admission, blood creatinine levels, Killip class at admission, occurrence of cardiac arrest at admission, ST changes, and heart elevation. The AGRACE score is an enhanced version of the original GRACE score, incorporating information about the culprit coronary artery and its blood flow. If the left anterior descending artery (LAD) or the left main (LM) is the culprit artery, 30 points are added. For blood flow, TIMI grades are assigned as follows: TIMI grade 0 or 1 adds 30 points, TIMI grade 2 adds 20 points, and TIMI grade 3 adds 0 points. These adjustments are made both before and after PCI and are included in the original GRACE score. The AGRACE score is categorized into four groups: low (≤ 158), intermediate (159 - 188), high (189 - 219), and very high (≥ 220 points) (**Figure 1**).

Statistical analysis

Continuous variables were expressed as means and standard deviations, while categorical variables were represented as proportions of the total patient count. The prognostic value of the AGRACE, GRACE, and TIMI scores was evaluated using the area under the ROC curve (AUC). Model accuracy was assessed with the Hosmer-Lemeshow test, where a p-value greater than 0.05 indicated a well-fitting model. The Delong test was applied to compare the AUCs of the three scores, with statistical significance determined at $p < 0.05$. The McNemar test was utilized to compare the sensitivity and specificity between pairs of scores, with significance also set at $p < 0.05$.

RESULTS

Our study included 139 patients with STEMI who underwent PCI at Da Nang Hospital from March 2022 to September 2023, with 14 deaths (10.1%). The proportion of men and women was 70.5% and 29.5%, respectively; men were the majority, with an average age of 63.51 ± 13.07 years old, the youngest was 24 years old, and the oldest was 95 years old. Smoking accounted for 68.3% of the study participants' risk factors, followed by dyslipidemia (68.3%) and hypertension (61.2%). At admission, the study showed an average left ventricular ejection fraction (EF) was 53.87 ± 12.41 (%), with 5% experiencing cardiac arrest and 22.5% experiencing cardiogenic shock. In almost 47.5% of cases, the LAD was the most frequent

location of the culprit coronary artery, followed by RCA lesions (43.9%) and LCX lesions (5.8%) in 8 cases (**Table 2**).

Risk stratification according to the AGRACE score showed that the high-risk group (≤220 points) had the highest rate (35.3%), followed by the high-risk, intermediate-risk, and low-risk groups, accounting for 25.9%, 21.6%, and 17.3%, respectively (**Figure 2**).

The average AGRACE score was 211.64 ± 57.42. The AGRACE score, with a cutoff point of 216.5 and, sensitivity of 92.9%, and specificity of 68.8%, had a very good ability to predict in-hospital mortality (AUC = 0.921 and p = 0.001). The average GRACE score was 174.44 ± 50.83. The GRACE score, with a cutoff point of 182.5 and, sensitivity of 92.9%, and specificity of 68.0%, had a good ability to predict in-hospital mortality (AUC = 0.873 and p = 0.001). The average TIMI score was 5.38 ± 3.02. The TIMI score demonstrated a strong predictive value for in-hospital mortality (AUC = 0.848, p = 0.001), with a sensitivity of 85.7% and specificity of 83.2% at a cutoff of 7.5. (**Table 3**).

AGRACE and GRACE scores were the most sensitive predictors of in-hospital mortality, whereas TIMI score was the most specific. We evaluated the accuracy of the AGRACE, GRACE, and TIMI scores, and found that all three scores were accurate (p>0.05) (**Figure 3**).

There was a difference in the ability to predict in-hospital death of the three scores: AGRACE, GRACE, and TIMI with p = 0.0057 (Delong test). Compared to the TIMI and GRACE scores, the AGRACE score offered a higher prognostic value for in-hospital mortality.

DISCUSSION

AMI is one of the leading causes of death and disability worldwide. Treatment with reperfusion and drugs has contributed to a significant reduction in mortality after AMI in recent decades. Patients with AMI, particularly acute STEMI, are at an additional risk of death due to several clinical and paraclinical variables, comorbidities, and hospital-related events (6). Multivariable regression analysis demonstrated that age, sex, left ventricular systolic function, Killip class, renal failure, TIMI following intervention, anemia, three-vessel disease, weight < 67 kg, and time to revascularization > 4 hours were independent predictors of death (7). A better understanding of these risk factors can help doctors, researchers, and medical staff make better treatment decisions and disease management after discharge. However, in order to have a more general view and assess the condition, the clinical situation is highly variable, with each patient's approach to diagnosis and treatment as well as prognosis after discharge being very distinct, including many different risk factors. Improved risk stratification: several scores have been created to categorize the risk of acute MI in general and STEMI in particular (8). The results vary depending on the population groupings

that are scored using different scoring systems. Our study showed that the AGRACE score, with a cutoff point of 216.5 and, sensitivity of 92.9%, and specificity of 68.8%, had a very good ability to predict in-hospital mortality (AUC = 0.921 and p = 0.001). As per the research conducted by Mitarai, the AGRACE score for in-hospital death displayed a C-statistic of 0.89, which was notably higher than the conventional GRACE score. Additionally, the study showed that the AGRACE score was especially advantageous for STEMI patients when compared to the GRACE score. (4).

The AGRACE score is easily determined using the original GRACE score after PCI. Incorporating information about the artery responsible for the issue and its flow before and after PCI, the AGRACE score presents a fresh perspective on precision, thus enhancing the conventional GRACE score for individuals with AMI. The AGRACE score had the highest value for predicting in-hospital mortality in patients with MI, followed by the GRACE and TIMI scores. The De Long test revealed a statistically significant difference (p=0.001), and the sensitivity of the AGRACE and GRACE scores was equal. The specificity of the TIMI score was the highest, and the GRACE angiography score had a higher predictive value for in-hospital death.

The AGRACE score had high sensitivity and good predictive value, making it a useful tool for prognosticating patients with MI. Therefore, doctors could have a better strategy for individualized treatment plans for patients, preventing unfavorable outcomes and improving the survival rate of patients with MI.

Study limitations: Single-center trial, small number of patients, and short follow-up duration. The proportion of seriously ill patients undergoing coronary angiography was modest; therefore, they were excluded from the study.

CONCLUSIONS

The AGRACE score had a very good ability to predict in-hospital mortality (AUC = 0.921 and p = 0.001), with a cut-off point of 216.5 and a sensitivity of 92.9% and specificity of 68.8%. The AGRACE score was found to have a higher predictive value for in-hospital mortality than both the GRACE and TIMI scores.

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Table 1. Baseline characteristics of participants of the study

Characteristics	Results (x± SD) or n (%)
Age	63.51 ± 13.07
Male	98 (70.5%)
Weight (kg)	58.32 ± 9.11
Hypertension	85 (61.2%)
Dyslipidemia	94 (67.6%)
Diabetes	35 (25.2%)
Smoking	95 (68.3%)
Prior MI	5 (3.6%)
Prior PCI	5 (3.6%)
Stroke	8 (5.8%)
Heart rate (bpm)	82.35 ± 21.06
Heart rate > 100 bpm	24 (17.3%)
Systolic blood pressure (mmHg)	115.1 ± 25.38
Systolic blood pressure < 100 (mmHg)	42 (30.2)
Cardiac arrest at admission	7 (5 %)
Killip IV	31 (22,5%)
Creatinine (μmol/l)	87,33 ± 33,39
EF (%)	53,87 ± 12,41
Culprit LAD	66 (47,5%)
TIMI 0-1 pre-PCI	67 (48,2%)
TIMI 3 post-PCI	127 (91,4%)

Table 2: Risk stratification based on the AGRACE score

Risk	AGRACE score	Cases	Rate
Low	≤158	24	17.3%
Intermediate	159 - 188	30	21.6%
High	189 - 219	36	25.9%
Very high	≥ 220	49	35.3%

Table 3: Prognostic value of the AGRACE, GRACE, and TIMI score

Score	AUC	95% CI	Cut-off	Sensitivity (%)	Specificity (%)	p
AGRACE	0.921	0.84 - 1	216.5	92.9	68.8	0.001
GRACE	0.873	0.79 – 0.96	182.5	92.9	68.0	0.001
TIMI	0.848	0.73 – 0.96	7.5	85.7	83.2	0.001

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Figure 1. **Approach to calculate AGRACE score**. LAD: Left anterior descending artery, LAD: left anterior descending artery, LCX: left circumflex artery, PCI: percutaneous coronary intervention, RCA: right coronary artery, TIMI: thrombolysis in myocardial infarction.

Figure 2. **In-hospital mortality rate according to the AGRACE risk stratification.** The blue bar represented the proportion of surviving patients while the orange bar represented the proportion of in-hospital mortality.

Figure 3. **In-hospital mortality ROC curve of AGRACE, GRACE, and TIMI** . ROC: receiving operating characteristics.