

The Value of the GRACE Score for Predicting the SYNTAX Score in Patients with Unstable Angina/Non-ST Elevation Myocardial Infarction

Ahmed Y Nammour, Mohamed Abdelshafi Tabl, Mohamed Ahmed Hamouda, and Elsaheed Hussien Eltabakh *

Cardiology Department, Faculty of Medicine, Benha University, Benha, Egypt

* Corresponding author: Elsaheed Hussien Eltabakh, Email: dr.elsaheed@gmail.com, Phone: +2010939937

ABSTRACT

Background: Coronary artery disease (CAD) severity in acute coronary syndrome (ACS) can be evaluated using various scoring systems. The Global Registry of Acute Coronary Events (GRACE) score and the SYnergy between percutaneous coronary intervention with TAXus and cardiac surgery (SYNTAX) score are essential tools for risk stratification and determining CAD complexity.

Objective: To evaluate the correlation between the GRACE score and the severity of CAD assessed by the SYNTAX score in patients with unstable angina/non-ST elevation myocardial infarction (UA/NSTEMI).

Patients and Methods: This cross-sectional observational study included 109 adult patients with ACS who underwent coronary angiography (CA) at 6th October Insurance Hospital and Benha University Hospital between October 2022 and October 2023. The GRACE score was calculated using clinical parameters and the SYNTAX score assessed coronary lesion complexity.

Results: A significant correlation was found between the GRACE and SYNTAX scores ($r=0.603$, $p<0.05$). Patients with a SYNTAX score ≥ 23 had significantly higher GRACE scores (median \pm Interquartile range (IR) 119 ± 18) compared to those with a SYNTAX score < 23 (median \pm IR 96 ± 31) ($p<0.001$). ROC analysis revealed an AUC of 0.844 (95% CI, 0.768–0.919) for the GRACE score predicting a SYNTAX score ≥ 23 , with a sensitivity of 80.3% and specificity of 75% at a cut-off value of 109.

Conclusion: The GRACE score is a reliable predictor of CAD severity as assessed by the SYNTAX score in patients with UA/NSTEMI. This correlation supports using the GRACE score for initial risk stratification and management planning in this patient population.

Keywords: GRACE score; SYNTAX score; Unstable angina; Non-ST elevation myocardial infarction; Coronary artery disease.

INTRODUCTION

Coronary artery disease (CAD) remains one of the leading causes of morbidity and mortality worldwide. Acute coronary syndrome (ACS), including unstable angina (UA) and non-ST elevation myocardial infarction (NSTEMI), represents a critical manifestation of CAD that requires prompt and accurate risk stratification to guide therapeutic decisions [1]. The complexity of CAD can significantly impact patient outcomes, necessitating the use of reliable and comprehensive scoring systems to assess both the immediate risk and the anatomical severity of the disease [2].

The Global Registry of Acute Coronary Events (GRACE) score is widely used in clinical practice to predict the risk of mortality and adverse cardiovascular events in patients with ACS. It incorporates various clinical parameters such as age, heart rate, blood pressure, and biomarkers, providing a robust tool for early risk stratification [3]. On the other hand, the SYnergy between percutaneous coronary intervention with TAXus and cardiac surgery (SYNTAX) score is designed to evaluate the anatomical complexity of coronary lesions, helping to determine the most appropriate revascularization strategy [4]. Understanding the relationship between these two scoring systems can enhance clinical decision-making by offering a more integrated assessment of patient risk.

Previous studies have highlighted the individual prognostic value of the GRACE and SYNTAX scores, but the extent to which they correlate in predicting CAD severity has not been fully elucidated. Identifying a reliable correlation between these scores could improve the accuracy of risk stratification and potentially influence management strategies for patients with UA/NSTEMI [5,6].

The primary aim of this study was to evaluate the correlation between the GRACE score and the severity of CAD assessed by the SYNTAX score in patients with UA/NSTEMI.

PATIENTS AND METHODS

Study design and Population:

This single-center cross-sectional observational study enrolled 109 adult patients presenting to 6th October Insurance Hospital and Benha University Hospital with ACS and were undergoing CA between October 2022 and October 2023.

ACS was diagnosed according to the fourth universal definition of acute myocardial infarction [7]. Patients that previously had a coronary revascularization procedure were excluded from the study. For each patient, demographics and baseline clinical characteristics, as well as the determinants of the GRACE risk score 2.0

(i.e., age, heart rate, systolic blood pressure, serum creatinine concentration, the presence of ST-segment deviation, cardiac arrest during admission, elevated serum cardiac biomarkers, and Killip class) were documented on admission and assessed by two experienced cardiologists based on the patients' medical records.

The GRACE 2.0 ACS risk calculator is available online (https://qxmd.com/calculate/calculator_262/grace (accessed on 01-10-2022 to 01-10-2023).

Coronary Angiography and Scores Calculation

Patients underwent CA in our catheterization laboratory and all CAs were visually assessed by two well-experienced interventional cardiologists, blinded to all other clinical data. The SYNTAX score algorithm was used to assess the complexity of coronary anatomy in the patients with NSTEMI, or UA, according to standardized practices [8,9]. A SYNTAX score cut-off level of 23 was used to distinguish the patients presenting with intermediate-high complex lesion (high-risk coronary anatomy) and to determine the therapeutic approach and timing of revascularization.

Ethical considerations:

The study was done after being accepted by the Research Ethics Committee, Benha University. All patients provided written informed consents prior to their enrolment. The consent form explicitly outlined their agreement to participate in the study and for the publication of data, ensuring protection of their confidentiality and privacy. This work has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

Statistical Analysis

After data were collected, they were analyzed by Statistical Package for the Social Sciences (SPSS) version 25. Categorical data were described as count and percentages and continuous data were described as means \pm standard deviation (SD) or median \pm interquartile range (IR). A student's t test (for quantitative data that were normally distributed) or a Mann-Whitney test (for quantitative data that were not normally distributed) and Pearson Chi-square test (for data that were categorical variables) were used for comparison. Correlation between GRACE score, SYNTAX score was determined using

Spearman's correlation. Two-tailed p value <0.05 was considered significant.

RESULTS

Population Characteristics

A total of 109 patients (80.7% men) with confirmed ACS (NSTEMI, and UA) who underwent a coronary angiography were enrolled in the present analysis. The mean age of participants was (59.2 ± 8.46) years and 60.6% were smokers (**Table 1**). Of these patients, 49.5% suffered from dyslipidemia and almost one in two from diabetes mellitus (DM). In addition, according to the calculated GRACE score on admission, 47 (43.12%) patients were considered as low-risk (GRACE score < 109), 54 (46.88%) were identified as intermediate-high (GRACE score >109). Finally, the mean GRACE score was equal to 109.7 ± 22.92 .

Table 1: Clinical characteristics and laboratory results of patients

Variable	Count (%)
Male Gender	88 (80.7)
DM	65 (59.6)
HTN	70 (64.2)
Dyslipidemia	54 (49.5)
Obesity	48 (44.9)
Smoking	66 (60.6)
Mean \pm SD	
Age (year)	59.2 ± 8.46
SBP	127 ± 23
HR	83 ± 23
Creatinine (mg/dl)	1.05 ± 0.28
Platelets	261 ± 66
Hb (g/dl)	13.3 ± 1.5
TG (mg/dl)	134 ± 9
LDL (mg/dl)	106 ± 3
HDL (mg/dl)	46 ± 7
Cholesterol (mg/dl)	206 ± 48

Data were presented as mean \pm Standard deviation (SD), Number (%), DM: Diabetes Mellitus, HTN: Hypertension, SBP: Systolic Blood Pressure, HR: Heart Rate, Hb: Hemoglobin, TG: Triglycerides, LDL: Low-Density Lipoprotein, HDL: High-Density Lipoprotein.

Cross tabulation revealed insignificant association of demographics and traditional risk factors of CAD except obesity with GRACE score while with SYNTAX, only gender was significantly associated with SYNTAX score (**Table-2**).

Table 2: Basal clinical and demographic characteristics of participants according to SYNTAX score and GRACE score.

variable	SYNTAX Score <23 (n=48)	SYNTAX Score ≥23 (n=61)	P value	Low score (n=47)	GRACE (1-108) (n=62)	Intermediate-High GRACE score (>109)	P value
	Count (%)			Count (%)			
Male	34 (70.8)	54 (88.5)	0.020	35 (74.5)	53 (85.5)		0.149
Diabetic	30 (62.5)	35 (57.4)	0.588	26 (55.3)	39 (62.9)		0.424
Hypertensive	31 (64.6)	39 (63.9)	0.944	29 (61.7)	41 (66.1)		0.633
Dyslipidemia	23 (47.9)	31 (50.8)	0.763	18 (38.3)	36 (58.1)		0.041
Obesity	19 (41.3)	29 (47.5)	0.521	20 (42.6)	28 (46.7)		0.671
Smoking	26 (54.2)	40 (65.6)	0.226	27 (57.4)	39 (62.9)		0.564

Data were presented as Number (%), SYNTAX: SYnergy between percutaneous coronary intervention with TAXus and cardiac surgery, GRACE: Global Registry of Acute Coronary Events.

The relationship between SYNTAX score and GRACE score was calculated and has shown that patients with SYNTAX score ≥23 had significantly higher GRACE score, as illustrated in **table 3**.

Table 3: The relationship between median GRACE score and SYNTAX score categories.

Variable	SYNTAX Score <23 (n=48)	SYNTAX Score ≥23 (n=61)	P value
	Median ± IR		
GRACE score	96 ± 31	119 ± 18	<0.001

Data were presented as Median ± Interquartile Range (IR), GRACE: Global Registry of Acute Coronary Events, SYNTAX: SYnergy between percutaneous coronary intervention with TAXus and cardiac surgery.

Cross-tabulation was done to find the association of GRACE score and SYNTAX score with the extent of CAD as depicted in **table 4**. It was evaluated that both the aforementioned tools were significantly predicting CAD severity. The greater the GRACE score, the more severe is the CAD.

Table 4: The relationship between GRACE score categories and SYNTAX score categories.

GRACE Score category	SYNTAX Score category		P value
	SYNTAX Score <23 (n=48)	SYNTAX Score ≥23 (n=61)	
	Count (%)		
Low (1-108)	35 (72.9)	12 (19.7)	<0.001
Intermediate-High ≥=109	13 (27.1)	49 (80.3)	

Data were presented as Number (%), GRACE: Global Registry of Acute Coronary Events, SYNTAX: SYnergy between percutaneous coronary intervention with TAXus and cardiac surgery.

To investigate the character of GRACE score as a potential predictor of coronary artery disease extent and severity as determined by SYNTAX score. ROC analysis was performed on data from 109 NSTEMI patients as shown in table (4) and figure (1). The ROC curves of GRACE score reflected separation between SYNTAX score <23 and SYNTAX score ≥23, with an area under curve (AUC) of 0.844 (95% CI, 768 – 919) with a sensitivity and specificity of 80.33% and 75% respectively, which suggests reliance on it would produce a number of false negatives (19.7%). The cut-off value of GRACE score at which diagnosis of SYNTAX score ≥23 can be made was 109.

After determination of the cut-off value of GRACE score, Cross tabulation was carried out to show sensitivity and specificity of GRACE score value in SYNTAX score category prediction and also to detect the positive predictive value (PPV) and negative predictive value (NPV) of GRACE score in SYNTAX score category prediction. The test showed that SYNTAX score prediction had a sensitivity of 80.3%, specificity of 75.0%, (PPV) 79.0%, (NPV) 74.5%. **Table 5**

Table 5: Performance metrics of the GRACE Score in predicting high SYNTAX scores (≥23)

Variable	AUC	p	95% C.I	Cut-off	Sensitivity	Specificity	PPV	NPV
Total GRACE	0.844	<0.001	0.768 – 0.919	>109	80.3%	75.0%	81%	74.0%

Data were presented as Area Under the Curve (AUC), 95% Confidence Interval (95% C.I), Cut-off value (Cut-off), Sensitivity, Specificity, Positive Predictive Value (PPV), Negative Predictive Value (NPV), GRACE: Global Registry of Acute Coronary Events, SYNTAX: SYnergy between percutaneous coronary intervention with TAXus and cardiac surgery.

Bivariate correlation of GRACE score with SYNTAX score showed that GRACE score was positively and significantly correlated with SYNTAX score among NSTEMI patients, ($r= 0.603$). **Figure 1** has showed a positive and linear relationship between increasing numeric of median SYNTAX score with increase in GRACE score.

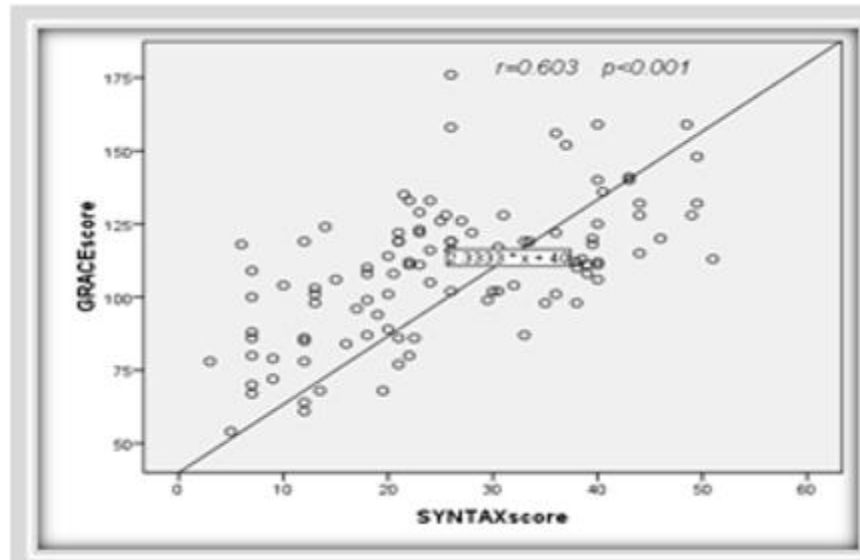


Figure 1: Bivariate correlation between GRACE and SYNTAX score.

DISCUSSION

The Global Registry of Acute Coronary Events (GRACE) score and the SYNERgy between percutaneous coronary intervention with TAXus and cardiac surgery (SYNTAX) score are critical tools used in the management of acute coronary syndrome (ACS) [10]. The GRACE score is utilized for risk stratification, predicting mortality and adverse cardiovascular events, while the SYNTAX score assesses the anatomical complexity of coronary artery disease (CAD) to guide revascularization strategies. Understanding the correlation between these two scores can provide a more comprehensive risk assessment and improve clinical decision-making in patients with unstable angina/non-ST elevation myocardial infarction (UA/NSTEMI) [11].

The primary aim of this study was to evaluate the correlation between the GRACE score and the severity of CAD assessed by the SYNTAX score in patients with UA/NSTEMI. Establishing this relationship could enhance the predictive power of these tools, aiding in better risk stratification and therapeutic planning.

This single-center, cross-sectional observational study included 109 adult patients presenting with ACS at 6th October Insurance Hospital and Benha University Hospital from October 2022 to October 2023. Patients with previous coronary revascularization procedures were excluded. Each patient's GRACE score was calculated using clinical parameters such as age, heart rate, systolic blood pressure, and serum creatinine. Coronary angiography was performed to determine the SYNTAX score, which assessed the complexity of coronary lesions. Statistical analyses, including cross-tabulation and ROC

analysis, were used to examine the correlation between the GRACE and SYNTAX scores.

In the present study, a positive correlation was observed between GRACE score and angiographic SYNTAX score ($r=0.603$ $p < 0.001$). By ROC analysis, the ability of GRACE score to predict SYNTAX score ≥ 23 was modest, with a high negative predictive value that could independently predict patients with normal coronary arteries or mild CAD.

Based on the current evidence, CABG is favored to PCI in patients with three-vessel disease and SYNTAX score ≥ 23 ; in patients with lower SYNTAX score, PCI is considered a reasonable alternative [12]. Therefore, early recognition of the severity of CAD in the patients could help to plan for the revascularization method. In this regard, the use of GRACE score may help to stratify the patients before coronary angiography.

There have been only a limited number of studies investigating the relationship between the severity of coronary artery disease (CAD) and the GRACE score. **Avci et al.**, demonstrated that the patients with HRCA had higher GRACE score. A positive correlation was observed between GRACE score and angiographic SYNTAX score ($r = 0.338$, $p < 0.001$). By ROC analysis, GRACE score predicted HRCA with an area under the receiver operator curve (AUC) of 0.71 (95% CI 0.60–0.81, $p < 0.001$). A GRACE score of 123 was identified as the optimal cut-off to predict HRCA with sensitivity 71% and specificity 60%. However, the ability of GRACE score to predict HRCA was modest [13].

In a study to identify predictors of HRCA in patients with UA/NSTEMI undergoing early angiography, GRACE score of N140 was the strongest

predictors of HRCA [14]. The GRACE score could be successfully added to the SYNTAX score to improve its risk stratification ability and aid in predicting the clinical outcome of the patients after revascularization, including in-hospital mortality [15].

Our study demonstrated that only dyslipidemia exhibited a significant difference among participants according to GRACE score category (low or intermediate-high). Dyslipidemia patients were significantly clustered in intermediate-high group, $p = 0.041$. No significant differences in another traditional risk factors among different groups, all p values > 0.05 .

We found that a GRACE score of 109 is the optimal cut-off level to predict SYNTAX score ≥ 23 with a sensitivity of 73.5% and a specificity of 60%. Our study found that patients with SYNTAX scores ≥ 23 had significantly higher GRACE scores (p value < 0.001).

The primary limitations of this study include its single-center design, which may limit the generalizability of the findings to other populations and settings. Additionally, the relatively small sample size of 109 patients might not fully capture the variability in GRACE and SYNTAX scores across a broader patient cohort. The study's cross-sectional nature precludes establishing causality, and the exclusion of patients with prior coronary revascularization might have introduced selection bias. Finally, reliance on visual assessment for coronary angiography, despite being performed by experienced cardiologists, may introduce inter-observer variability. Future studies with larger, multi-center cohorts and standardized angiographic assessments are needed to validate these findings.

CONCLUSION

Our findings revealed a positive correlation between the GRACE score and the angiographic SYNTAX score. GRACE score exhibited a considerable but modest ability to predict CAD severity, and its high negative predictive value could lead to speculation that a patient had normal or mild CAD before coronary angiography. It may also help the cardiologist stratify patients' risks and decide on a revascularization approach. Nonetheless, our findings must be validated by larger studies in the future.

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