

## ORIGINAL ARTICLE

# Correlation between the GRACE Risk Score and the SYNTAX Score in Patients with Non-ST-Segment Elevation Myocardial Infarction

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### Abstract

**Background:** The GRACE risk score is a valid clinical tool to risk stratify patients with non-ST-segment elevation myocardial infarction (NSTEMI). The SYNTAX score is a comprehensive angiographic grading tool to determine the anatomic complexity of coronary artery disease. Predicting the SYNTAX score before a coronary angiogram (CAG) can help with patient counseling, optimization of planning, and preparation for possible complex percutaneous procedures or CABG in patients with NSTEMI.

**Objective:** The objective of this study is to determine the correlation between the GRACE risk score and the SYNTAX score in patients with NSTEMI.

**Materials and Methods:** A total of 52 patients with NSTEMI undergoing coronary angiography were enrolled in this study. According to the calculated GRACE score on admission, patients were divided into a low-risk group (GRACE score  $\leq 108$ ), an intermediate-risk group (GRACE score = 109–140), and a high-risk group (GRACE score > 140). After coronary angiography, the SYNTAX score was calculated. The correlation between the scores was determined by Pearson's correlation test.

**Results:** The mean SYNTAX score in the low GRACE risk group was  $9.5 \pm 5.1$ , in the intermediate GRACE risk group it was  $12.5 \pm 7.6$ , and in the high GRACE risk group it was  $18.5 \pm 8.9$ , and the differences were significant ( $P$  value = 0.005). There was a significant positive correlation ( $r = 0.515$ ,  $p = <0.001$ ) between the GRACE risk score and the SYNTAX score in patients with NSTEMI.

**Conclusion:** Our study demonstrates that in NSTEMI patients, the GRACE risk score has a significant positive correlation with the SYNTAX score.

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### Introduction:

According to the World Health Organization, cardiovascular diseases (CVDs) are the leading cause of death globally.<sup>1</sup> Acute coronary syndrome (ACS) is one of the leading causes of morbidity and mortality worldwide.<sup>2,3</sup> The term acute coronary syndrome (ACS) refers to any group of clinical symptoms compatible with acute myocardial ischemia and includes unstable angina (UA), non-ST-segment elevation myocardial infarction (NSTEMI), and ST-segment elevation myocardial infarction (STEMI).<sup>4</sup>

Among the spectrum of patients with ACS, including unstable angina (UA), non-ST-segment elevation myocardial infarction (NSTEMI) and ST-segment elevation myocardial infarction (STEMI) have different mortality and morbidity risks, thus different treatment strategies are applied. Where primary percutaneous coronary intervention (PCI) is a class I recommendation for STEMI patients, a risk-based treatment approach is recommended for NSTEMI patients.<sup>5</sup> According to current clinical guidelines risk assessment for optimizing treatment strategy and estimating prognosis is recommended in all

patients with NSTEMI.<sup>6</sup> Guidelines also recommend the GRACE score as a tool for the identification of high-risk patients with NSTEMI who will benefit from an early invasive strategy.<sup>5,7</sup>

The Synergy Between Percutaneous Coronary Intervention with Taxus and Cardiac Surgery (SYNTAX) score, a comprehensive angiographic grading tool that takes into account anatomic risk factors, is the best-known scoring system to assess the complexity of CAD.<sup>8</sup> Based on the complexity of CAD, this score is capable of objectively guiding decision-making between coronary artery bypass grafting (CABG) surgery and percutaneous coronary intervention (PCI).<sup>9</sup>

About 40–80% of patients with NSTEMI have multivessel CAD with multiple complex plaques.<sup>6,10</sup> In NSTEMI patients with multivessel disease, the choice of revascularization modality will be influenced by the overall anatomical disease complexity and the presence of comorbidities, including diabetes. In very high-risk NSTEMI patients where immediate revascularization is desired, PCI is usually preferred for reasons of timeliness, unless concomitant mechanical complications dictate a preference for surgical intervention. For NSTEMI patients without very high risk finding the choice of revascularization modality should be made according to the general principles of myocardial revascularization using the SYNTAX score.<sup>5</sup>

Predicting the SYNTAX score before a coronary angiogram can help the physician regarding pre-procedure patient counseling, optimization of planning, timing, intensity of intervention, and adequate preparation for a possible challenging percutaneous procedure or CABG in patients with NSTEMI.<sup>11</sup> The relationship between risk-stratification scoring methods and the complexity of CAD has been the subject of various research studies to date.<sup>12–15</sup> Only a few studies, as far as we are aware, evaluate the correlation between the GRACE risk score and the anatomic complexity of coronary artery disease assessed by the SYNTAX score.<sup>11,16–19</sup> As there are a limited number of studies, we aimed to assess the correlation between the GRACE risk and the SYNTAX score in patients with NSTEMI.

### Materials and Methods:

This cross-sectional type of observational study was conducted in the Department of Cardiology, BSMMU, from January 2021 to December 2022, after approval of the protocol by the Institutional Review Board (IRB). A total of 52 patients admitted with NSTEMI undergoing

coronary angiogram were enrolled in the study. Sample size was calculated for correlation study.<sup>20</sup>

NSTEMI was diagnosed according to fourth universal definition of myocardial infarction.<sup>21</sup> After enrollment, a meticulous history was taken, and relevant clinical examinations and investigation findings were recorded. For each patient, the GRACE risk score was determined.<sup>22</sup> According to the calculated GRACE score on admission, patients were divided into a low-risk group (GRACE score  $\leq 108$ ), an intermediate-risk group (GRACE score = 109–140), and a high-risk group (GRACE score  $> 140$ ). Coronary angiography was performed by expert interventional cardiologist according to current practice guidelines. The SYNTAX score of each patient was calculated by a validated online calculator.<sup>23</sup> All data were registered, documented, and analyzed in the statistical software, IBM Statistical Package for Social Science (SPSS) version 29.0.1.0 for Windows. Continuous variables were expressed as mean  $\pm$  SD and categorical variables as frequency and percentage. Quantitative variables were analyzed by one-way ANOVA test. Categorical variables were analyzed by the chi-square test. The correlation of the GRACE risk score with the SYNTAX score was done by Pearson's correlation coefficient test. ROC curve analysis was done to see the sensitivity and specificity of the GRACE risk score to predict the SYNTAX score. From the ROC curve, a cut-off value of the GRACE score was determined to predict an intermediate to high SYNTAX score (SYNTAX score  $> 22$ ).

### Result:

A total of 52 patients admitted with NSTEMI undergoing coronary angiogram were enrolled in the study.

The mean age of the study population was  $55.3 \pm 12$  years. The mean age was  $46.3 \pm 6.3$  years in the low-risk group,  $55.2 \pm 8.8$  years in the intermediate-risk group, and  $61.3 \pm 13.7$  years in the high-risk group. Male patients were 44 (85%) while females were 8 (15%), with a male-to-female ratio of 5.5:1. The overall frequency of hypertension was 71% (37), diabetes mellitus was 60% (31), smoking was 52% (27), dyslipidemia was 52% (27) and family history of premature CAD was 17% (9) in the study population.

The age difference between the low, intermediate, and high-risk groups was significant ( $P = 0.001$ ). There was also a significant difference in the frequency of dyslipidemia among the above three risk groups ( $P = 0.008$ ).

**Table-I**  
*Demographic and cardiovascular risk factor characteristics of the study population*

Variables	Total study population (N=52)	Low-risk group (GRACE Score ≤108) (n=13)	Intermediate risk group (GRACE Score 109-140) (n=19)	High-risk group (GRACE Score >140) (n=20)	P Value
Age(yrs), mean±SD	55.3 ± 12	46.3 ± 6.3	55.2±8.8	61.3±13.7	0.001 <sup>s</sup>
Male sex, % (n)	85% (44)	85% (11)	79% (15)	90% (18)	0.537
Hypertension, %(n)	71% (37)	69% (9)	68% (13)	75% (15)	0.676
Diabetes mellitus, %(n)	60% (31)	38% (5)	63% (12)	70% (14)	0.084
Smoking, % (n)	52% (27)	69% (9)	37% (7)	55% (11)	0.638
Dyslipidemia, % (n)	52% (27)	31% (4)	58% (8)	75% (15)	0.008 <sup>s</sup>
Family history of premature CAD, % (n)	17% (9)	23% (3)	16% (3)	15% (3)	0.596
BMI, mean±SD	24.8 ± 3.3	25.8 ± 3.4	24.8 ± 2.9	24.1 ± 3.3	0.369

P value reached for different risk group, BMI= body mass index, s =significant

**Table-II**  
*SYNTAX score in study population (N=52)*

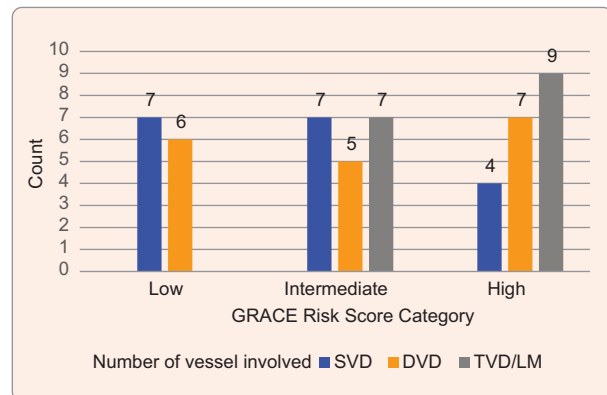
Variables	Total study population (N=52)	Low-risk group (GRACE Score ≤108) (n=13)	Intermediate risk group (GRACE Score 109-140) (n=19)	High-risk group (GRACE Score >140) (n=20)	P Value
SYNTAX Score, mean±SD	14.0 ± 8.5	9.4 ± 5.1	12.5 ± 7.6	18.5 ± 8.9	0.005 <sup>s</sup>
SYNTAX Score, range	03-44	03 – 23.4	04 – 31.5	08 - 44	

SYNTAX = Synergy Between PCI with TAXUS and Cardiac Surgery, s =significant, P value reached for different risk group

The minimum SYNTAX score was 3.0 and the maximum was 44.0. The mean SYNTAX score was 14.0 ± 8.5. The mean SYNTAX score in the low-risk group was 9.4 ± 5.1, in the intermediate GRACE risk group it was 12.5 ± 7.6, and in the high GRACE risk group it was 18.5 ± 8.9, and the differences were significant (P value = 0.005). Here mean SYNTAX score increased from low to high GRACE risk category.

The above figure showed that triple vessel/left main diseases (TVD/LM) were more common in the intermediate and high GRACE score groups. None of the TVD/LM patients were in the low-risk group.

Pearson's correlation test was performed to measure the correlation between the GRACE risk score and the SYNTAX score. A significant positive correlation was found between the GRACE risk score and the SYNTAX

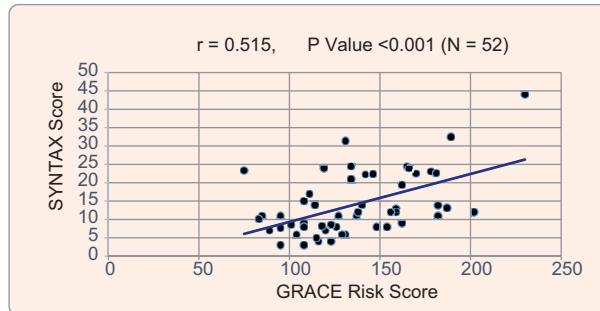


SVD = single vessel disease, DVD = double vessel disease, TVD = triple vessel disease, LM = left main disease

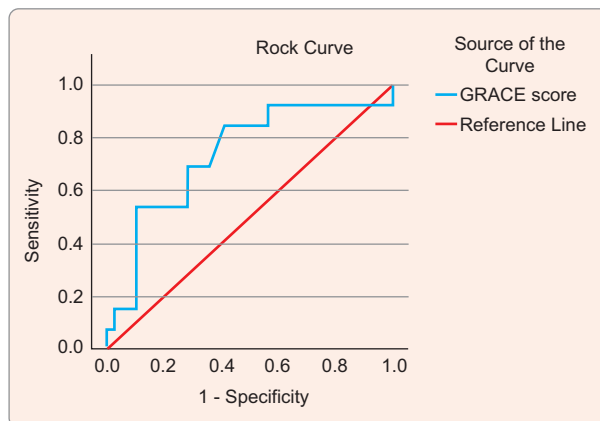
**Figure 1:** Bar diagram showing the number of vessel involvement in the study population (N = 52).

score, meaning that a high GRACE score goes with a high SYNTAX score and vice versa. The correlation coefficient  $r$  was 0.515,  $R^2$  was 0.265, and the  $p$  value was  $<0.001$ .

In ROC curve analysis, the area under curve (AUC) of the GRACE score for predicting intermediate to high SYNTAX score was 0.736 with a  $p$  value  $<0.001$ , 95% CI (0.570–0.901). A cut-off value of GRACE score 132 or more was determined to predict an intermediate to high SYNTAX ( $> 22$ ) score with 77% sensitivity and 62% specificity.



**Figure 2:** Scatter diagram showing correlation between the GRACE risk score and the SYNTAX score ( $N=52$ ).



**Figure 3:** The receiver-operating characteristics curve (ROC) analysis of the GRACE score for predicting intermediate to high SYNTAX score (SYNTAX score  $> 22$ ).

### Discussion:

The main objective of this study was to find out the correlation between the GRACE risk score and the SYNTAX score in patients with non-ST-segment elevation myocardial infarction (NSTEMI). The GRACE risk score is a well-known validated tool to predict the prognosis and risk stratify patients with NSTEMI, while the SYNTAX score is an established angiographic grading tool to determine the complexity of CAD. According to

the calculated GRACE score on admission, patients were divided into a low-risk group (GRACE score  $\leq 108$ ), an intermediate-risk group (GRACE score = 109–140), and a high-risk group (GRACE score  $> 140$ ). The older patients were more in the high-risk group. The difference in age among GRACE risk groups was statistically significant which is consistent with a previous study.<sup>14</sup> As age is an important determining parameter of the GRACE score, it can be predicted that the higher the age, the higher the GRACE score. There was no statistically significant difference in gender distribution among the different risk groups which is in line with previous study.<sup>12</sup> Here, we found that the mean BMI is decreasing from a low to a high-risk group but their difference was not statistically significant ( $P = 0.369$ ). In an epidemiological study, it was found that the prevalence of overweight and obesity peaks in the age group 40–50 years, and the prevalence decreases thereafter.<sup>24</sup> As the elderly patients in our study population are more in the high-risk group, this may be an explanation for our finding.

The GRACE risk groups did not significantly differ in terms of cardiovascular risk factors, including hypertension, diabetes mellitus, smoking, and family history of premature CAD. But dyslipidemia had a significant difference among the GRACE risk group ( $P$  value = 0.008) which consistent with a previous study.<sup>14</sup> The frequency of dyslipidemia had significantly increased from low to high-risk group. Analysis of individual components of the lipid profile showed that total cholesterol and LDL cholesterol had statistically significant differences among the risk groups ( $P = 0.009$  for total cholesterol,  $P = 0.012$  for LDL cholesterol). So, it is evident that, though dyslipidemia is not a determining parameter in the GRACE scoring system, it has a significant impact on it.

Mean SYNTAX score increased from low to high GRACE risk group and the differences were significant ( $P$  value = 0.005). A positive correlation between the GRACE risk score and the SYNTAX score was found in our study. The correlation coefficient between the GRACE risk score and the SYNTAX was 0.515 ( $p < 0.001$ ), and this was statistically significant. That means a high GRACE score goes with a high SYNTAX score and vice versa. With the increase in the GRACE score, the SYNTAX score increased, indicating more complex CAD. These positive correlations were in agreement with other similar studies.<sup>11,14,16-18</sup> In ROC curve analysis a cut-off value of GRACE score 132 or more was determined to predict an intermediate to high SYNTAX score ( $> 22$ ) with 77%

sensitivity and 62% specificity. A previous study found that a GRACE score of 109 is the optimal cut-off to predict an intermediate to high SYNTAX score with a sensitivity of 73.5% and a specificity of 60% in patients with unstable angina/non-ST-elevation myocardial infarction.<sup>16</sup> In our study we found a relatively higher cut off value of the GRACE score (132) for predicting an intermediate to high SYNTAX score.

### Conclusion:

Our study demonstrates that the GRACE risk score has a significant positive correlation with the SYNTAX score in patients with non-ST segment elevation myocardial infarction (NSTEMI). So, the GRACE risk score might be useful for predicting the SYNTAX score and, thereby, the anatomic complexity of coronary artery disease (CAD) in patients with NSTEMI. Thus, a higher GRACE score warrants more alertness by the cardiologist, with the possibility of challenging complex percutaneous procedures or CABG in patients with NSTEMI

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### Conflict of Interest:

The authors declare no conflicts of interest.

### Ethical approval:

Ethical approval for this study was granted by the Institutional Review Board of BSMMU (memo number: BSMMU/2022/4867)

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