ORIGINAL ARTICLE
DOI: 10.55958/jcvd.v20i2.184

CORRELATION BETWEEN GRACE RISK SCORE AND CORONARY ANGIOGRAPHIC COMPLEXITY IN HIGH RISK NSTEMI PATIENTS

Muhammad Hammad Azam[a], Muhammad Abdul Wahab[b*], Naveed Danish[a], Waqar Ahmad Khan[a], Shitba Naeem[a], Shaheer Khan Muhammad[a]

[a]National Institute Of Cardiovascular Diseases (Nicvd), Karachi, MTI-Hayatabad Medical Complex, Peshawar.

Date of Submission: 14-11-2024; Date of Acceptance: 26-12-2024; Date of Publication: 15-02-2025

ABSTRACT:

BACKGROUND: *Despite advances in cardiovascular care non-ST-elevation acute coronary syndrome (ACS) spectrum including non-STEMI has come to represent a significant challenge, necessitating appropriate risk stratification techniques that could predict patient risk and tailor therapy.*

AIMS & OBJECTIVE: *To assess the association between the GRACE risk score and coronary angiographic complexity in patients with Non-ST-Elevation Myocardial Infarction (NSTEMI).*

MATERIAL & METHODS: *From January 2022 to January 2023, a prospective cross-sectional study was conducted at the Department of Cardiology, Hayatabad Medical Complex, Peshawar. GRACE and SYNTAX scores were calculated for each of the 250 NSTEMI patients. Analyzing the association between SYNTAX scores and GRACE using Pearson correlation. and logistic regression was employed to evaluate the predictive capacity of the GRACE score for obstructive coronary artery disease.*

RESULTS: *The mean GRACE score was 132.3 ± 34.7, while the mean SYNTAX score was 22.5 ± 12.8. The findings indicated a moderate positive association between the GRACE and SYNTAX scores ($r = 0.45$, $p < 0.001$). The GRACE score independently predicted the occurrence of obstructive coronary artery disease, as evidenced by logistic regression analysis (OR = 1.05, $p < 0.01$).*

CONCLUSION: *The study have recommended the GRACE score for identifying a higher number of NSTEMI patients at risk of increased mortality; and also as an additional index to infer the severity of coronary angiographic complexity in NSTEMI patients. Usage of this score, in clinical setting may lead to tailored treatment strategies.*

KEY WORDS: *GRACE risk score, coronary angiography, SYNTAX score, NSTEMI, risk stratification*

Correspondence : Muhammad Abdul Wahab, Punjab Institute of Cardiology, Lahore. Email: gmuhammad.wahab_93@yahoo.com
Author's Contribution: MHA: Principal Investigator, conducted the study and wrote the article. **MAW:** Helped in conducted the study. **ND:** Supervised the study. **WAK,SN and SKM:** Helped in manuscript writing.

INTRODUCTION

Non-ST-elevation myocardial infarction (NSTEMI) constitutes a major segment of cardiovascular diseases and is linked to significant variations in patient outcomes. In clinical practice, effective risk stratification plays a vital role in guiding treatment options and predicting patient prognosis. The score of GRACE risk is a widely recognized tool used to estimate the risk of mortality and cardiovascular events in NSTEMI patients. This approach includes multiple clinical variables such as age, heart rate, blood pressure, and kidney function, to offer a detailed risk evaluation [1,2]. The degree of coronary artery disease (CAD), assessed using the SYNTAX score, is critical in deciding whether a patient should receive percutaneous coronary intervention (PCI) or coronary artery bypass grafting (CABG) [3,4]. This score helps guide treatment decisions by assessing the complexity of coronary lesions and the severity of the disease.

NSTEMI continues to be a common reason for hospital admissions worldwide and is linked to high rates of morbidity and mortality. Recognition of high-risk patients is important for optimizing outcomes, and numerous risk stratification scores are employed to calculate the probability of death and impact clinical management. Among various scoring systems, the GRACE risk score is extensively validated and demonstrates strong predictive ability for both short-term and long-term mortality in patients with ACS. Recent societies' trials have investigated a wider understanding of high Galectin-3 levels utility in that it may be useful for predicting the coronary artery disease severity can to improve revascularization strategies. This might account as in the study by Wang et al. have identified that the GRACE score is likely to have an increasing role beyond predicting death to predict major adverse cardiovascular events and to tailor intervention strategies[2].

Additionally, the SYNTAX score originally developed for assessing complexity in coronary artery disease has become a go to tool appropriateness evaluation of different revascularization strategies including PCI versus CABG. Recent research has investigated the benefits of integrating anatomical scores, such as the SYNTAX score, with clinical risk assessments like the GRACE score, to enhance risk stratification in patients with NSTEMI. Studies, including those by Rahmani et al.[5], suggest that uniting the GRACE score with the SYNTAX score can enhance the stratification of patient risk, facilitating more thorough management of individuals at high risk. This combined approach offers enhanced insight into both the anatomical complexity and clinical risk of NSTEMI patients.[6]

Another study has reported an association between the GRACE risk score and dyslipidaemia, although data on baseline lipid levels were not available for this dataset. Patients with a higher GRACE score had shown the higher SYNTAX because stenosis in the patients were more severe [7,8]. This relationship is key for informing interventional cardiology as patients with higher SYNTAX scores are frequently routed to surgical revascularization over PCI[9,10]. Even though the GRACE score can predict cardiovascular events, this score revealed a poor accuracy for prognosticating coronary angiographic complexity, therefore underlining that it is necessary to use joint scores to better stratify patients such as the HEART or TIMI in addition to GRACE [11,12].

In Pakistan, it has already been established that GRACE risk score is a valuable tool in prediction if a patient with NSTEMI will have obstructive CAD. A single-center study in Pakistan from a large cardiac care facility reported the true GRACE score $\geq$ 84 as an independent predictor of obstructive CAD with high sensitivity and moderate specificity [13,14]. These results should be kept in mind when risk stratification of the regional

population is considered, acknowledging relevant local demographic propertiesas well as limitations of healthcare systems.

This study has shown that the GRACE risk score is well correlated with angiographic complexity in NSTEMI patients and this relation may assist in risk stratification of these patients particularly useful when advanced imaging modalities are not easily available. The aim of this study, carried out in the Department of Cardiology at Hayatabad Medical Complex in Peshawar, was to explore the association between the angiographic complexity of CAD and the score of GRACE risk. Given the increasing frequency of CAD to concerning levels and cardiovascular diseases still account for the top cause of death and morbidity in our nation. Evidencing this relationship can contribute better risks management, enable improvements in quality and clinical outcome hence rational allocation of health care resources[15,16].

The aim of the study, to assess the correlation between the coronary angiographic complexity and score of GRACE risk in NSTEMI patients treated at the Department of Cardiology, Hayatabad Medical Complex, Peshawar, from January 2022 to January 2023.

MATERIALS AND METHODS:

This study was conducted between January 2022 and January 2023 at the Department of Cardiology, Hayatabad Medical Complex, Peshawar, Pakistan. Primary coronary angiography and PCI are just some of the invasive procedures that this tertiary care center performs in their cardiology service. The association between coronary angiographic complexity and the GRACE risk score in patients with non-ST elevation myocardial infarction (NSTEMI) was examined using a prospective, cross-sectional observational approach.

The study included 250 admitted patients diagnosed as NSTEMI to the Department of Cardiology during this period. The sample size was determined taking into consideration of the 84.6% of NSTE-ACS patients having obstructive CAD proven by angiography as reported by Ishaq et al. [17] Using the WHO sample size calculator to determine a 95% confidence level with a 5% margin of error.

The study include subjects older than 18 years of age who were diagnosed as NSTEMI based on clinical presentation, elevated troponins and ECG readings. Coronary angiography was conducted within 48 hours of admission for all participants, and the GRACE risk score was calculated upon their arrival. The exclusion criteria for the study encompassed patients who were admitted with a diagnosis of ST-elevation myocardial infarction (STEMI) or those who had previously undergone CABG, comorbid illness such as end-stage renal disease or advanced cancer, refusal of coronary angiography, and incomplete clinical or angiographic data. Since the study had an observational design, no randomization and blinding was possible and all patients that matched the inclusion criteria during the study period were enrolled sequentially.

We gathered detailed information about each patient, including their demographic data, how they presented clinically, the results of their GRACE risk score, and what their coronary angiography revealed. The GRACE score, which helps assess a patient's risk, is calculated using key factors like age, heart rate, blood pressure, kidney function (creatinine levels), and whether or not the patient shows signs of heart failure. To understand how serious the coronary artery disease was, we used standard coronary angiography techniques. The complexity of the disease was measured using the SYNTAX score, which gives a numerical value based on how severe the blockages are in the arteries focusing on any narrowing greater than 50% in segments that are at least 1.5 mm in diameter. During hospitalization, the score of GRACE was used to evaluate the possibility of mortality and the likelihood of recurrence, though the SYNTAX score offered insights into the difficulty of the CAD. Obstructive CAD was identified by the presence of atleast a 50% narrowing in the left main coronary artery or 70% narrowing in any other main coronary arteries.

Data analysis was conducted using SPSS version 25. Continuous data were presented as mean ± standard deviation,

and categorical data were summarized with frequencies and percentages for descriptive purposes. The relationship between complexity of coronary artery disease and the score of GRACE risk, quantified by the score of SYNTAX, was analyzed using Pearson correlation coefficient. Additionally, logistic regression analysis was used to assess the ability of the score of GRACE to independently predict severe coronary artery disease. A p-value of less than 0.05 in all two-sided tests was considered statistically significant, establishing the threshold for significant associations and predictive accuracy.

Approved ethically by the Ethics Committee of Hayatabad Medical Complex, Peshawar (Reference No. 2242), the study followed the Helsinki guidelines, consent form was for all the participant before the study started, therefore guaranteeing their voluntary involvement and awareness of the aims of the investigation. To maintain strict anonymity and confidentiality, the authors refrained from participating in the active collection of data, thereby protecting patient privacy throughout the research process.

RESULTS:

The study included a total of 250 patients with NSTEMI, predominantly male (70%), with an average age of 63.5 years (SD = 10.2). The average heart rate recorded was 82.5 beats per minute (SD = 15.1), and the systolic blood pressure mean was 132.6 mmHg (SD = 18.5). The mean creatinine level was measured at 1.25 mg/dL. The association between the severity of CAD and GRACE score categories was analyzed using the chi-square test, revealing that 60% of the patients had obstructive CAD. Detailed descriptive statistics for these variables are presented in Table 1.

The relationship between the SYNTAX score, which quantifies the complexity of CAD, and the GRACE score, utilized for assessing patient risk, was analyzed using Pearson's correlation coefficient. A moderate +ve correlation was found between the SYNTAX score and GRACE score ($r = 0.45$, $p < 0.001$), indicating that increased coronary artery disease complexity on angiographic assessments correlates with an elevated GRACE risk score, as illustrated in Table 2. The finding shows that patients with a higher clinical risk as determined by the GRACE score, which measures in-hospital death and post-discharge cardiac death or acute MI were more likely to have multivessel disease.

Table 1 Descriptive Statistics of the Patient Population(n=250).

Variable	Mean ± SD / Frequency (%)
Age (years)	63.5 ± 10.2
Gender (Male)	175 (70%)
Heart Rate (bpm)	82.5 ± 15.1
Systolic BP (mmHg)	132.6 ± 18.5
Creatinine Level (mg/dL)	1.25 ± 0.35
GRACE Score	132.3 ± 34.7
SYNTAX Score	22.5 ± 12.8
Obstructive CAD	150 (60%)

Table 2 Correlation between GRACE and SYNTAX Scores (n=250)

Correlation Coefficient (r)	p-value
0.45	< 0.001

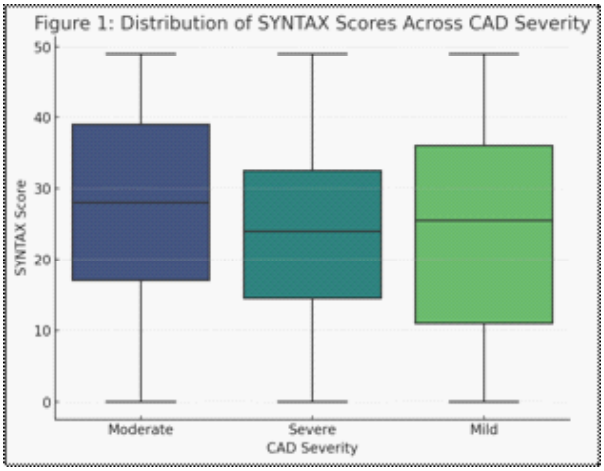

Figure 1: Distribution of SYNTAX Scores Across CAD Severity (n=250)

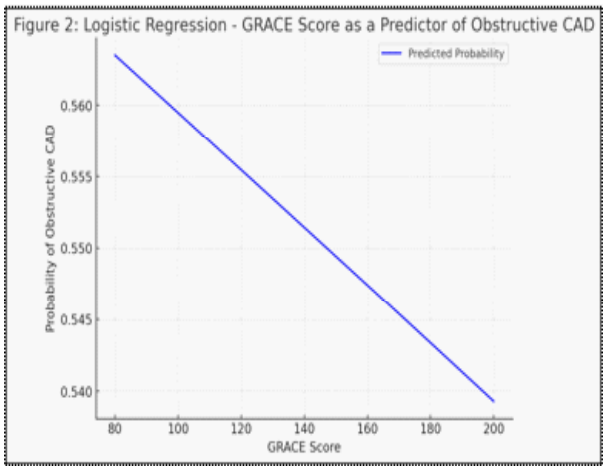

Figure 2 Logistic Regression - GRACE Score as a Predictor of Obstructive CAD (n=250)

The distribution of SYNTAX scores in each of the CAD severity categories (mild, moderate and severe) was explored to investigate the association between CAD and GRACE score further. Patients with more complex CAD, as demonstrated by higher SYNTAX scores were shown in Figure 1. Patients stratified with severe CAD had higher SYNTAX score mean compared to the mild and moderate disease. This shows the relationship between clinical risk scores against angiographic finding.

Logistic regression analysis was conducted to assess the GRACE score as an independent predictor of obstructive coronary artery disease (CAD). The findings revealed that the GRACE score significantly predicts the presence of obstructive CAD, with an odds-ratio (OR) of 1.05 (confidence95%interval:1.02–1.08; $p < 0.01$). This result highlights the prognostic value of the GRACE score in identifying patients at increased risk of obstructive CAD. These findings are visually represented in Figure 2. This demonstrates that every increase in the GRACE score by a unit, results in an additional 5% chance of having obstructive CAD This observation endorses the efficacy of GRACE score in predicting significant CAG findings in patients of NSTEMI.

The association between severity of CAD and GRACE score categories was assessed using the chi-square test. The analysis revealed a statistically significant relationship, demonstrating that patients with upper GRACE scores were extra probable to have severe CAD ($p < 0.05$). This finding highlights the utility of the GRACE score in identifying patients at greater risk for severe coronary conditions. This finding corresponds with both the correlation analysis and logistic regression outcomes, which highlights how important it is to have an objective instrument of clinical risk stratification, and eventually in guiding invasive management decisions.

DISCUSSION:

This study is one of the few in Pakistan to correlate the GRACE risk score with coronary angiographic complexity in patients with NSTEMI. To our knowledge, the relationship between the GRACE score and the severity of CAD has not been previously investigated in this local context. This research therefore provides important insights that are particularly relevant to the Pakistani population. However, the work has been previously done in other countries and helps to compare our findings with global research but also shows the lack of studies on an extensive scale within Pakistani population. In Pakistan, few studies are available on GRACE and CAD severity but no study till date has compared GRACE score with Triple vessel disease or Angiographic SYNTAX score as done in this current study.

All those studies performed at international end are supported by our finding however, no cumulatively similar data has been observed in Pakistan data

tables on cases. For example, Ishaq et al. analyzed the capability of GRACE score to forecast obstructive CAD in a Pakistani population and revealed poor predictability [17]. Nonetheless, their concern was in presence of obstructive CAD rather than its severity. Consequently, while our study is somewhat similar to local literature where GRACE score has been used before but this new side of SYNTAX score and its relationship between the two scores were not explored more in Pakistan.

Consistent with this previous study, the current finding that the GRACE and SYNTAX scores were significantly correlated in NSTEMI patients, further supports a relationship between high GRACE scores and more complex coronary lesion characteristics. This corresponds with the results from even larger international studies that have described an association between more. For instance, Sofidis et al. the GRACE score is associated with worse CAD complexity, as does collaboration with our results[18]. Indeed, research such as that by Cedro and colleagues have shown that GRACE and SYNTAX scores can be applied together to higher risk stratified patients in the NSTE-ACS[19]. These results further supported the universal utility of our study, confirming that established risk stratification scores such as the GRACE score can predict mortality on one hand but also CAD complexity on the other.

In addition, population-based studies from different parts of the world like Europe and Middle East also has shown similar results, which indicates that clinical risk scores have an overall utility trait in predicting CAD complexity. Zaridi et al. (2022) also found positive correlations between GRACE and SYNTAX scores in Moroccan NSTEMI patients which further support that these scoring systems could be applied to other populations as well[20]. These include reinforcing the quality of our findings with respect to international literature, which corroborates the rationale and applicability of GRACE as well-as SYNTAX score as complementary instruments in NSTEMI risk stratification.

However, our study had several limitations. This study was single centere and small sample size which although adequate for statistical analysis, and the findings cannot be generalized to other areas of Pakistan. Moreover, we only directly compared the GRACE with SYNTAX scores when performed in-hospital use, without taking into account other valuable information like long term clinical outcomes that would offer a more composite view of patient prognosis. Larger, multi-center studies may be useful in the future to determine whether this observation can be replicated and whether these prediction tools are also helpful in prognosticating patient outcomes. Moreover, use of other risk scores like the TIMI and HEART scores could further add to the clinical relevance of risk stratification in NSTEMI patients.

Our study adds to the literature by showing a correlation between GRACE risk score and coronary angiographic complexity among NSTEMI patients in Pakistan. Although clinical risk scores have been shown to have good predictive ability for predicting CAD complexity in general from available literature globally, however this is not the scenario with our local literature. Further research with a larger sample may help identify additional uses for the GRACE and SYNTAX scores in managing coronary artery disease. In view of our results clinical risk stratification tools like GRACE score can effectively be utilized to assess coronary complexity in NSTEMI, and help clinicians to tailor therapeutic strategies especially in resource constrained countries such as Pakistan.

CONCLUSION:

A substantial positive correlation between the score of GRACE risk and coronary angiographic complexity by measuring SYNTAX scores in NSTEMI patient. Our findings imply that although widely used for risk stratification, the GRACE score should not be interpreted as strictly 'clinical' and may also reflect coronary complexity. This study results illustrate the usefulness of using clinical risk scores as an aid in evidence based management of NSTEMI patients, especially in low and middle income countries like Pakistan. For clinical, the powerful message is that 'using it to predict mortality, creating new systems

to assess CAD severity' as concluded in this study are very well worthwhile and an important contribution.

References:

1. Rahmani R, Majidi B, Ariannejad H, Shafiee A. The Value of the GRACE Score for Predicting the SYNTAX Score in Patients with Unstable Angina/Non-ST Elevation Myocardial Infarction. Cardiovasc Revascularization Med [Internet]. 2020 Apr;21(4):514–7. Available from: https://linkinghub.elsevier.com/retrieve/pii/S155383891930435X
2. Wang XF, Zhao M, Liu F, Sun GR. Value of GRACE and SYNTAX scores for predicting the prognosis of patients with non-ST elevation acute coronary syndrome. World J Clin Cases [Internet]. 2021 Nov 26;9(33):10143–50. Available from: https://www.wjgnet.com/2307-8960/full/v9/i33/10143.htm
3. D'Ascenzo F, Biondi-Zoccai G, Moretti C, Bollati M, Omedè P, Sciuto F, et al. TIMI, GRACE and alternative risk scores in Acute Coronary Syndromes: A meta-analysis of 40 derivation studies on 216,552 patients and of 42 validation studies on 31,625 patients. Contemp Clin Trials [Internet]. 2012 May;33(3):507–14. Available from: https://linkinghub.elsevier.com/retrieve/pii/S1551714412000195
4. Abadeer MA, Sallam WM, Onsy AM. Coronary Artery Calcium Scoring by Computed Tomography and the GRACE Risk Score as Predictors of Obstructive Coronary Artery Disease in Patients with Non-ST Segment Elevation Acute Coronary Syndrome: A Comparative Study. QJM An Int J Med. 2023 Aug;116(Supplement_1).
5. Rahmani R, Majidi B, Ariannejad H, Shafiee A. The Value of the GRACE Score for Predicting the SYNTAX Score in Patients with Unstable Angina/Non-ST Elevation Myocardial Infarction. Cardiovasc Revasc Med. 2020 Apr;21(4):514-517. doi: 10.1016/j.carrev.2019.07.023. Epub 2019 Jul 23. PMID: 31495747.
6. Cid Alvarez AB, Gomez-Peña F, Redondo-Dieguez A, Avila A, López D, Sanmartin X, et al. Prognostic impact of the SYNTAX score II in patients with ST-elevation myocardial infarction undergoing primary percutaneous coronary intervention: analysis of a four-year all-comers registry. EuroIntervention. 2019 Oct;15(9):e796–803.
7. Hassan M, Kubra G, Sabeen M, Nadeem D, Murtaza A, Sikandari F. Correlation of TIMI Risk Score and GRACE Risk Score with Lesion of Coronary Artery Disease in Patients with Non-ST Segment Elevation Acute Coronary Syndrome. Pakistan J Med Heal Sci. 2023 Jul;17(6):205–7.
8. Yalcin Ocak N, Yesilaras M, Kilicaslan B, Eyler Y, Mutlu İ, Kutlu M. Comparing TIMI, HEART, and GRACE Risk Scores to Predict Angiographic Severity of Coronary Artery Disease and 30-Day Major Adverse Cardiac Events in Emergency Department Patients with NSTEACS. Prehosp Disaster Med [Internet]. 2023 Dec 13;38(6):740–8. Available from: https://www.cambridge.org/core/product/identifier/S1049023X23006490/type/journal_article
9. Namazi MH, Mazloomi SS, Aghamohammadi MK. Correlation Between TIMI Risk Score and the Number of Vessels Involved in the Angiographic Study; a Cross-sectional Study. Arch Acad Emerg Med. 2022;10.
10. Dakhil ZA, Farhan HASAN. Coronary angiographic profile in non ST elevation acute coronary syndrome: risk stratification and management strategy. Eur J Prev Cardiol. 2023 May;30(Supplement_1).
11. Elhusseini S. Credibility of Risk scores in predicting coronary artery disease severity in non-ST segment elevation acute coronary syndrome patients. Eur Heart J [Internet]. 2020 Nov 1;41(Supplement_2). Available from: https://academic.oup.com/eurheartj/article/doi/10.1093/ehjci/ehaa946.1374/6004515
12. Demandt JPA, Zelis JM, Koks A, Smits GHJM, van der Harst P, Tonino PAL, et al. Prehospital risk assessment in patients suspected of non-ST-segment elevation

acute coronary syndrome: a systematic review and meta-analysis. BMJ Open. 2022 Apr;12(4):e057305.
13. Gale CP, Stocken DD, Aktaa S, Reynolds C, Gilberts R, Brieger D, et al. Effectiveness of GRACE risk score in patients admitted to hospital with non-ST elevation acute coronary syndrome (UKGRIS): parallel group cluster randomised controlled trial. BMJ. 2023 Jun;e073843.
14. Yin G, Abdu FA, Liu L, Xu S, Xu B, Luo Y, et al. Prognostic Value of GRACE Risk Scores in Patients With Non-ST-Elevation Myocardial Infarction With Non-obstructive Coronary Arteries. Front Cardiovasc Med. 2021 Feb;8.
15. Khawaja AZ, Shahzad SK, Khalil M, Aziz Z, Ahmed M, Kiani SS, et al. Comparison of GRACE Score and SYNTAX Score in Predicting Complexity of Coronary Artery Disease in Patients with NST-ACS. Pakistan Armed Forces Med J. 2023;
16. Maltes S, Paiva MS, Madeira S, Teles RC, Almeida MS, Mendes M. Correlation between NSTE-ACS risk scores with Syntax: can we predict coronary lesion complexity before angiography? Eur Heart J. 2022 Oct;43(Supplement_2).
17. Ishaq H, Akhtar BM, Kumar M, Shar GS, Hakeem AR, Masood S, et al. THE PREDICTIVE UTILITY OF GRACE SCORE FOR OBSTRUCTIVE CORONARY ARTERY DISEASE IN PATIENTS WITH NON ST ELEVATION MYOCARDIAL INFARCTION. Pakistan Hear J. 2021;
18. Sofidis G, Otountzidis N, Stalikas N, Karagiannidis E, Papazoglou AS, Moysidis D V., et al. Association of GRACE Risk Score with Coronary Artery Disease Complexity in Patients with Acute Coronary Syndrome. J Clin Med [Internet]. 2021 May 20;10(10):2210. Available from: https://www.mdpi.com/2077-0383/10/10/2210
19. Cedro AV, Mota DM, Ohe LN, Timerman A, Costa JR, Castro L de S. Association between clinical risk score (Heart, grace and TIMI) and angiographic complexity in acute coronary syndrome without st segment elevation. Arq Bras Cardiol [Internet]. 2021 Aug 9;117(2):281–7. Available from: https://abccardiol.org/article/associacao-entre-escores-de-risco-clinico-heart-grace-e-timi-e-complexidade-angiografica-na-sindrome-coronaria-aguda-sem-elevacao-do-segmento-st/
20. Zaridi I, Qadi CA El, Essaket I, Rachid L, Jamili M El, Hattaoui M El. The Correlation between Clinical Risk Score (Heart, Grace and TIMI) and Angiographic Coronary Artery Complexity in NSTEMI. SAS J Med. 2022;