https://doi.org/10.48047/AFJBS.6.16.2024.674-692

African Journal of Biological Sciences

Journal homepage: http://www.afjbs.com

Research Paper Open Access

CORRELATION BETWEEN HIGH GRACE RISK SCORE AND MULTIVESSEL CORONARY ARTERY DISEASE IN ACUTE CORONARY SYNDROME PATIENTS

Hamza Azhar Ghauri[1], Shafiq ur Rehman[2], Muhammad Abair Ul Haq[3], Muhammad Husnain Yousaf[4], Kashif Khan[5], Hesham Naeem[6]

[1 2] Assistant Professor of Cardiology, Rawalpindi Institute of Cardiology, Rawalpindi, Pakistan.
[3] Fellow interventional cardiology, Rawalpindi Institute of Cardiology, Rawalpindi, Pakistan.
[4 5 6] Senior Registrar Cardiology, Rawalpindi Institute of Cardiology, Rawalpindi, Pakistan.
Corresponding author
Dr. Hamza Azhar Ghauri, Assistant Professor of Cardiology, Rawalpindi Institute of Cardiology, Rawalpindi, Pakistan.
Email: hamzaghauri9@gmail.com

Volume 6, Issue 16, Nov 2024

Received: 27 Oct 2024

Accepted: 23 Nov 2024

Published: 06 Dec 2024

doi:10.48047/AFJBS.6.16.2024.674-692

ABSTRACT

Introduction: Ischemic heart disease is the leading cause of death all over the world & acute chest pain is one of the most common presentations in the Emergency Departments all over the world with ACS being the major life threatening culprit. Therefore, it needs to be diagnosed immediately with early risk stratification in the ED to identify those patients who might benefit from early aggressive & invasive treatment strategy. But it is an established fact that ACS presents a difficult challenge for the physicians first in terms of prompt diagnosis and then planning the management strategy accordingly. For this reason, the ability of GRACE Risk Score has been tested in determining the presence MVCAD in patients with ACS to help speed up the decision making in this life threatening situation. ***Methodology:*** This study was conducted at the Cardiology Department of Shifa International Hospital, Islamabad. Study design was cross-sectional and the duration of the study was 6 months in which a total of 200 patients were observed by using WHO formula for sample size calculation. Keeping confidence level 95%, prevalence = 42%, margin of error = 7%, sample size was calculated to be at least 195 patients. More over non-probability consecutive sampling technique was used for sample collection. ***Findings:*** In this study mean age was 59 years with SD ± 10. 66% patients were male whereas 34% were female. Moreover, amongst these 200 patients (who had a GRACE score of >140), 3.5% patients had normal coronary arteries, 35% patients had single vessel coronary artery disease (SVCAD) and importantly 61.5% patients had multivessel coronary artery disease (MVCAD). ***Conclusion:*** GRACE Risk score has significant value for assessing the severity and extent of coronary artery stenosis in patients with acute coronary syndrome. It is not limited to any type of ACS instead covers the whole spectrum as it predicts the presence of multi vessel coronary artery disease in patients with ACS & a high GRACE Risk Score (>140) quite consistently.

Key Words: Acute coronary syndrome, coronary angiography, GRACE risk score, multivessel coronary artery disease.

Conflict of Interest: Authors show no conflict of interest

INTRODUCTION:

Ischemic heart disease (IHD) is a major global health concern, consistently ranked as the leading cause of mortality worldwide, accounting for millions of deaths annually. This burden is equally significant in Pakistan, where the prevalence of coronary artery disease (CAD) is particularly high among South Asian populations. Individuals of Indo-Pak origin have one of the highest susceptibilities to CAD due to a combination of genetic, lifestyle, and socio-economic factors [1,2]. Acute coronary syndrome (ACS), a critical manifestation of IHD, represents a spectrum of conditions ranging from unstable angina (UA) to non-ST elevation myocardial infarction (NSTEMI) and ST elevation myocardial infarction (STEMI) [3]. These conditions are life-threatening and often present as acute chest pain, which remains one of the most common reasons for emergency department visits globally [4]. Despite advances in diagnostic tools and management strategies, ACS continues to pose significant challenges for clinicians. The rapid and accurate diagnosis of ACS is often hindered by its complex and varied presentation, making early identification of high-risk patients crucial for effective management. Once diagnosed, determining the severity and extent of CAD—particularly multivessel coronary artery disease (MVCAD)—is essential for guiding the choice of invasive versus conservative treatment strategies [5]. This stratification not only impacts clinical outcomes but also informs discussions with patients and families about the disease's technical, psychological, and financial implications.

To address these challenges, early risk stratification tools have been developed to identify patients at higher risk of adverse outcomes. Various scoring systems, including TIMI, GRACE, GUSTO, PURSUIT, EMMACE, and the Simple Risk Index, are used to predict mortality, recurrent events, and CAD severity [6]. Among these, the Global Registry of Acute Coronary Events (GRACE) risk score stands out due to its consistent accuracy and reliability across different ACS subtypes [7]. The GRACE risk score incorporates clinical, biochemical, and electrocardiographic parameters to calculate a composite risk estimate, which has been validated in multiple international studies. This tool not only predicts in-hospital and six-month mortality but also has shown superior predictive power compared to other scores, particularly in assessing the severity of CAD and guiding invasive management decisions [8,9].

Despite the widespread use of the GRACE risk score, its specific correlation with angiographic findings, especially the presence and extent of MVCAD, has been insufficiently studied.

International research highlights its potential, with an Indian study demonstrating significantly higher chances of detecting MVCAD in patients with elevated GRACE scores [10]. Similarly, a local study published in the *Journal of Pakistan Medical Association* reinforced these findings by comparing TIMI and GRACE scores, concluding that the GRACE score was more reliable in predicting the extent of CAD in patients with NSTEMI [11]. This study further stratified patients into low (<133) and high-risk (>133) GRACE categories, finding that high GRACE scores were associated with a substantially higher prevalence of three-vessel CAD (46% vs. 23%) [12]. Another notable study conducted in Turkey established a clear relationship between GRACE risk score categories (low, intermediate, and high) and the prevalence of MVCAD, reported as 28%, 30%, and 42%, respectively [13]. These findings emphasize the importance of GRACE scoring in the emergency setting, where timely and accurate stratification is critical to optimizing outcomes. The ability of the GRACE risk score to consistently predict the presence of MVCAD offers significant clinical advantages. This tool allows clinicians to efficiently stratify patients presenting with ACS, enabling faster decisions about invasive interventions, resource allocation, and tailored management plans [14]. Moreover, by correlating GRACE scores with disease severity, it aids in providing patients and their families with clear insights into the disease's progression and expected outcomes. Given the lack of localized data and the growing burden of CAD in Pakistan, this study aims to evaluate the GRACE risk score's predictive ability for MVCAD in the Pakistani population. By focusing on its application in emergency settings, the study seeks to bridge critical gaps in the literature, ensuring that high-risk patients with ACS are promptly identified and managed to improve outcomes and reduce mortality [15].

METHODOLOGY

This cross-sectional study aimed to determine the frequency of multivessel coronary artery disease (MVCAD) in patients presenting with acute coronary syndrome (ACS) and a GRACE score >140 at Shifa International Hospital, Islamabad, a 500-bed tertiary care facility. The study was conducted over six months, from July 1, 2014, to December 31, 2014. Using a prevalence of 42%, a margin of error of 7%, and a confidence level of 95%, a sample size of at least 195 patients was calculated. Non-probability consecutive sampling was employed for participant selection.

Patients aged 35–75 years, presenting with symptoms suggestive of ACS (e.g., chest pain) and undergoing coronary angiography, were included if their GRACE score was >140. Those with a

history of gastrointestinal bleeding, stroke, malignancies, severe sepsis, prior coronary artery bypass grafting (CABG) or percutaneous coronary intervention (PCI), or chronic hemodialysis were excluded to minimize confounding effects on results.

Permission for the study was obtained from the hospital's ethical committee, and written informed consent was secured from participants. Data were collected systematically using patient records and a standardized pro forma. Vital signs, clinical assessments, and diagnostic tests were documented, including electrocardiograms (ECG) to evaluate ST-segment and T-wave changes, cardiac biomarkers (CK-MB and Troponin-I), and serum creatinine levels. Clinical classification using the Killip class system was performed based on signs of heart failure. The GRACE score was calculated during the initial patient evaluation in either the emergency department or outpatient department using the GRACE calculator. Scores incorporated patient age, heart rate, systolic blood pressure, serum creatinine, Killip class, ECG changes, and cardiac enzyme levels.

Coronary angiography was performed within 3–48 hours of hospital presentation by a trained cardiology team. Using non-ionic contrast and via either the right femoral or radial artery, angiographic procedures assessed the number of diseased coronary arteries. Significant stenosis was defined as ≥70% narrowing in major coronary arteries or ≥50% stenosis of the left main artery. Multi-vessel disease was defined as significant stenosis in at least two coronary arteries, including the culprit vessel. Quantitative coronary angiography (QCA) was performed using a Siemens Megalix Cat Plus 126/40/90-121 GW system to confirm the extent of disease.

Data were analyzed using SPSS version 16. Quantitative variables, including age, GRACE score, and systolic blood pressure, were presented as means and standard deviations, while categorical variables like gender, diabetes, hypertension, smoking, dyslipidemia, Killip class, and primary diagnosis were reported as frequencies and percentages. The frequency of MVCAD was calculated, and potential effect modifiers such as age, gender, and comorbidities were controlled through stratification. Post-stratification, the chi-square test was applied, with a p-value ≤ 0.05 considered statistically significant. This comprehensive methodology ensured accurate identification and stratification of ACS patients while minimizing confounding variables, thereby allowing for robust analysis of the relationship between GRACE scores and the prevalence of MVCAD.

FINDINGS

This study was conducted at the Cardiology Department in which a total of 200 patients were observed to determine the frequency of multivessel coronary artery disease in patients with acute coronary syndrome (ACS) undergoing coronary angiography having GRACE score >140 at presentation and results were analyzed as:

Age distribution among 200 patients was analyzed as 24(12%) patients were in age range 35-45 years, 51(25.5%) patients were in age range 46-55 years, 73(36.5%) patients were in age range 56-65 years and 52(26%) patients were in the age range 66-75 years. Mean age was 59 years with SD ± 10.

Table 1: Age Distribution

(n= 200) Mean age was 59 Years with SD ± 10

AGE	FREQUENCY	PERCENTAGE
35-45 year	24	12
46-55 years	51	25.5
56-65 years	73	36.5
66-75 years	52	26
Total	**200**	**100%**

Mean weight of patients was 74kg with SD ± 10, mean GRACE score was 160 with SD ± 18, mean systolic B.P was 100 with SD ± 9, mean serum creatinine level was 1.11 with SD ± 0.4 & mean LVEF was 36 with SD ± 7.

Gender distribution among 200 patients was analyzed as 132(66%) patients were male and 68(34%) patients were female.

Table 2: Gender Distribution
(n= 200)

In terms of type of ACS, 200 patients were analyzed as 7(3.5%) patients had unstable angina, 134(67%) patients had NSTEMI, 59(29.5%) patients had STEMI.

Table 3: Frequency Of Type Of ACS
(n = 200)

INDICATION	FREQUENCY	PERCENT
UNSTABLE ANGINA	07	3.5 %
NSTEMI	134	67 %
STEMI	59	29.5 %
Total	**200**	**100%**

GENDER	FREQUENCY	PERCENT
FEMALE	68	34%
MALE	132	66%
Total	**200**	**100%**

Baseline characteristics among 200 patients were analyzed as 125(62.5%) patients were diabetic, 121(61.5%) patients had hypertension, 71(35.5%) patients were smokers, 89(44.5%) patients had Dyslipidemias.

Table 4: Frequency of Baseline Characteristics

(n = 200)

BASELINE VALUES	FREQUENCY	PERCENT
Diabetes:	**125**	**62.5 %**
Hypertension:	**121**	**61.5 %**
Smoking:	**71**	**35.5 %**
Dyslipidemias:	**89**	**44.5 %**

Distribution of 200 patients as per Killip Class was as follow, 125(62.5%) had Killip Class I, 62(31%) had Killip Class II, 10(5%) had Killip Class III and 3(1.5%) had Killip Class IV.

Table 5: Frequency of Killip Class

(n = 200)

KILLIP CLASS	FREQUENCY	PERCENT
Class I	125	62.5 %
Class II	62	31 %
Class III	10	05 %
Class IV	03	1.5 %
TOTAL	**200**	**100%**

Frequency of no. of coronary arteries involved in 200 patients was assessed as follows, 7(3.5%) patients had normal coronary arteries, 70(35%) patients had single vessel coronary

artery disease (SVCAD), 123(61.5%) patients had multivessel coronary artery disease (MVCAD).

Table 6: Frequency of No. Of Coronary Arteries Involved

(n = 200)

NO. OF CORONARY VESSELS DISEASED	FREQUENCY	PERCENTAGE
NORMAL	07	3.5 %
SVCAD	70	35 %
MVCAD	**123**	**61.5 %**
Total	200	100 %

Stratification of MVCAD with age, gender, baseline characteristics (Diabetes, Hypertension, Smoking, Dyslipidemias) & Killip Class is given in table no 7,8,9 & 10. The stratification of multivessel coronary artery disease (MVCAD) by age reveals a significant association between age groups and the presence of coronary artery disease (CAD) severity, as evidenced by a chi-square test result with a p-value of 0.041. Among the 200 patients included in the study, the distribution of coronary artery findings varied across four age groups: 35–45 years, 46–55 years, 56–65 years, and 66–75 years. In the youngest age group (35–45 years), a majority of patients exhibited single-vessel CAD (SVCAD) (12 cases), followed by MVCAD in 11 patients, with only 1 patient having normal coronary arteries. In the 46–55year group, 31 patients had MVCAD, representing the majority in this cohort, while 15 had SVCAD, and 5 had normal coronary arteries. The 56–65 year group, which included the highest number of participants (73), showed a predominant presence of MVCAD in 44 patients, followed by SVCAD in 28 patients, and only 1 case of normal coronary arteries. In the oldest age group (66–75 years), 37 patients had MVCAD, while 15 presented with SVCAD, and no cases of normal coronary arteries were observed. Overall, MVCAD was most frequently observed across all age groups, with 123 cases (61.5%), followed by SVCAD with 70 cases (35%), and normal coronary arteries in only 7 cases (3.5%). The data highlight an age-related trend where

the prevalence of MVCAD increases significantly in older age groups, reflecting the progressive nature of atherosclerosis and CAD severity with advancing age.

Table 7: Stratification of MVCAD by Age
(n = 200) Chi square test was applied in which P value was 0.041

CAD	35-45 years	46-55 years	56-65 years	66-75 years	Total
NORMAL	01	05	01	00	**07**
SVCAD	12	15	28	15	**70**
MVCAD	11	31	44	37	**123**
Total	**24**	**51**	**73**	**52**	**200**

The stratification of multivessel coronary artery disease (MVCAD) by gender highlights a statistically significant association between gender and the distribution of coronary artery disease (CAD) severity, as indicated by a chi-square test result with a p-value of 0.05. Among the 200 patients studied, there was a noticeable difference in the prevalence of CAD types between male and female participants. Of the total 132 male patients, MVCAD was the most frequently observed condition, affecting 79 patients (59.8%). Single-vessel CAD (SVCAD) was present in 51 males (38.6%), while only 2 males (1.5%) had normal coronary arteries. In contrast, among the 68 female patients, MVCAD was also the predominant condition, seen in 44 cases (64.7%). However, females had a higher proportion of normal coronary arteries compared to males, with 5 cases (7.4%), while 19 females (27.9%) were diagnosed with SVCAD. Overall, MVCAD was the most common finding in both genders, accounting for 123 cases (61.5%), followed by SVCAD in 70 cases (35%), and normal coronary arteries in only 7 cases (3.5%). The data suggest that although males outnumber females in this cohort, the severity of CAD, as represented by MVCAD, is similarly high in both genders, with females showing a slightly higher relative frequency of MVCAD and normal arteries. These findings underscore the importance of considering gender-specific factors in the assessment and management of CAD.

Table 8: Stratification of MVCAD by Gender

(n= 200) Chi square test was applied in which P value was 0.05

	Male	**Female**	**Total**
Normal	02	05	**07**
SVCAD	51	19	**70**
MVCAD	79	44	**123**
Total	**132**	**68**	**200**

The stratification of multivessel coronary artery disease (MVCAD) by baseline characteristics, including diabetes mellitus (D.M.), hypertension (HTN), smoking, and dyslipidemias, provides insights into the association of these risk factors with coronary artery disease (CAD) severity. Although the analysis shows varying distributions of CAD severity across these characteristics, none of the associations reached statistical significance, as indicated by p-values > 0.05 for all factors. Among the 125 patients with diabetes mellitus, MVCAD was the most common finding, affecting 84 patients (67.2%). Single-vessel CAD (SVCAD) was present in 38 patients (30.4%), while only 3 patients (2.4%) had normal coronary arteries. Similarly, among the 121 patients with hypertension, MVCAD was seen in 75 patients (62%), SVCAD in 41 patients (33.9%), and normal coronary arteries in 5 patients (4.1%). The p-values for diabetes (0.085) and hypertension (0.79) indicate no statistically significant relationship with MVCAD in this study. In the 71 patients with a history of smoking, MVCAD was again the predominant condition, observed in 42 patients (59.2%), followed by SVCAD in 28 patients (39.4%) and normal coronary arteries in just 1 patient (1.4%). Dyslipidemias, present in 89 patients, showed a similar pattern, with 54 patients (60.7%) having MVCAD, 30 patients (33.7%) diagnosed with SVCAD, and 5 patients (5.6%) having normal coronary arteries. The p-values for smoking (0.351) and dyslipidemias (0.341) suggest no significant associations with MVCAD prevalence.

Overall, MVCAD was the most frequently observed condition across all baseline characteristics, underscoring the cumulative impact of these risk factors on CAD severity. However, the lack of

statistically significant p-values suggests that while these factors are clinically relevant, their specific influence on the stratification of CAD in this cohort requires further investigation.

Table 9: Stratification of MVCAD by Baseline Characteristics
(n = 200)

	Normal	SCVAD	MVCAD	Total	p Value
D.M	03	38	84	**125**	0.085
HTN	05	41	75	**121**	0.79
Smoking	01	28	42	**71**	0.351
Dyslipidemias	05	30	54	**89**	0.341

The stratification of multivessel coronary artery disease (MVCAD) by Killip class demonstrates the distribution of coronary artery disease severity across different levels of heart failure classification, though no statistically significant association was found, as indicated by the chi-square test with a p-value of 0.70.

In Killip Class I, which represents patients with no signs of heart failure, 75 patients had MVCAD (60%), 44 had single-vessel CAD (SVCAD) (35.2%), and 6 had normal coronary arteries (4.8%). In Killip Class II, which includes patients with mild heart failure (e.g., jugular venous distension or rales), 38 patients had MVCAD (61.3%), 23 had SVCAD (37.1%), and 1 patient had normal coronary arteries (1.6%). Killip Class III, representing patients with severe heart failure (marked pulmonary edema), included 7 patients with MVCAD (70%), 3 with SVCAD (30%), and no patients with normal coronary arteries. In Killip Class IV, which involves patients with cardiogenic shock, 3 patients had MVCAD (100%), while none had SVCAD or normal coronary arteries. Overall, MVCAD was the most common finding across all Killip classes, with a total of 123 patients (61.5%) diagnosed with MVCAD, followed by SVCAD in 70 patients (35%), and normal coronary arteries in just 7 patients (3.5%). Despite the clear trend of MVCAD being more frequent in higher Killip classes, the p-value of 0.70 suggests that Killip class does not significantly

influence the prevalence of MVCAD in this study. The findings indicate that while heart failure severity, as classified by Killip class, may be associated with more severe CAD, the relationship was not statistically significant in this cohort.

Table 10: Stratification of MVCAD by Killip Class
(n = 200) *Chi square test was applied in which P value was 0.70*

	KILLIP I	**KILLIP II**	**KILLIP III**	**KILLIP IV**	Total
Normal	06	01	00	0	**07**
SVCAD	44	23	03	0	**70**
MVCAD	75	38	07	03	**123**
Total	**125**	**62**	**10**	**03**	**200**

DISCUSSION

This study, conducted in the Cardiology Department of Shifa International Hospital, Islamabad, aimed to determine the frequency of multivessel coronary artery disease (MVCAD) in patients with acute coronary syndrome (ACS) and a GRACE score >140 at presentation. A total of 200 patients were observed, and the findings were consistent with both local and international trends. The study revealed that 62% of patients with ACS were over the age of 55, with the mean age being 59 years (SD ± 10), highlighting the prevalence of CAD in older age groups. These findings align with recent international studies, which have similarly shown an increased incidence of ACS in the older population [16]. The gender distribution in our study also reflects trends seen globally, with a higher number of male patients (66%) compared to females (34%). This is consistent with current epidemiological data, which report a higher prevalence of CAD in males, particularly in younger age groups, but a rising incidence in females as they age [4]. Furthermore, the study

identified a high prevalence of cardiovascular risk factors in our cohort. Diabetes mellitus (62.5%), hypertension (61.5%), smoking (35.5%), and dyslipidemia (44.5%) were all prevalent, consistent with findings from the *Diabetic Care Report 2004* and other studies indicating that these risk factors are significantly more prevalent in South Asian populations, contributing to the high burden of CAD [5,6]. While these risk factors were common in our study, their association with MVCAD did not reach statistical significance, suggesting that other factors may influence the severity of CAD in this cohort.

Our study found that the majority of ACS patients were diagnosed with non-ST elevation myocardial infarction (NSTEMI) (67%), followed by STEMI (29.5%) and unstable angina (3.5%). The higher incidence of NSTEMI underscores the significant burden of disease in this patient group, which is often under-managed despite the potential for worse outcomes due to delayed diagnosis or intervention. This finding is in line with global trends where NSTEMI accounts for a substantial proportion of ACS cases, yet it often receives less aggressive treatment compared to STEMI [17] [18]. Risk stratification is a crucial component in managing ACS, as it helps identify patients at high risk for adverse outcomes such as death or recurrent ischemic events. Various prognostic models, including the GRACE risk score, have been developed to predict the likelihood of adverse events in ACS patients. These models incorporate data from clinical history, physical examination, electrocardiography, and biomarkers of myocardial necrosis. Risk stratification is especially important in the emergency department setting, where decisions must be made rapidly about whether to discharge patients safely or admit those requiring immediate intervention [19]. However, while these models are effective in predicting mortality, they are limited in their ability to assess the severity of coronary artery disease [20]. The pathophysiology of ACS is heterogeneous, and patients with similar clinical presentations may have different underlying

coronary anatomy and prognosis. For example, elderly patients typically have more severe CAD and are at a higher risk of complications [21]. Diabetes mellitus, which is a known high-risk factor for CAD, significantly increases the likelihood of severe coronary lesions and worse outcomes [22]. Furthermore, prior coronary interventions, such as PCI, are associated with less severe disease but may still present challenges in patients with multivessel disease or left ventricular dysfunction [23].

In our study, we found that 61.5% of patients with a high GRACE score (>140) had MVCAD, which supports the utility of the GRACE score in identifying patients with more severe coronary lesions. This result is consistent with other studies that have evaluated the predictive value of the GRACE score in relation to CAD severity. For instance, Garcia et al. demonstrated that higher GRACE scores were associated with an increased likelihood of multiarterial disease and left main coronary artery involvement in ACS patients undergoing coronary angiography [24]. Similarly, studies by Mega et al. and Abu-Assi et al. have shown that elevated risk scores correlate with more severe coronary stenosis and a higher incidence of multivessel disease [25] [26]. In a study conducted by Prabhudesai et al., the GRACE score was found to be a strong predictor of multivessel disease, with higher scores (>217) indicating a significantly greater likelihood of having double or triple vessel disease [27]. Likewise, a Turkish study by Cakar et al. demonstrated that the prevalence of multivessel disease was 42% in the high-risk group based on the GRACE score, compared to 28% and 30% in the low- and intermediate-risk groups, respectively [28]. These findings are consistent with our study, which also demonstrated a high sensitivity for detecting multivessel disease in patients with a high GRACE score. In addition to confirming the predictive value of the GRACE score in assessing CAD severity, our study contributes to the growing body of literature emphasizing its role in guiding clinical decision-making in ACS

management. A local study by Mahmood et al. further validated the GRACE score as an effective tool in determining the extent of CAD in patients with NSTEMI, with a particular focus on multivessel disease [29]. Our study expands on these findings by demonstrating the applicability of the GRACE score not only in NSTEMI but also in STEMI patients, highlighting its versatility in risk stratification across different ACS subtypes.

Limitations of the Study

One limitation of this study is the relatively small sample size, which may impact the generalizability of the findings. While the results are consistent with those from similar studies, the limited number of participants reduces the power to detect significant associations between baseline characteristics and coronary artery disease (CAD) severity. A larger sample size could have potentially revealed more robust statistical relationships and further validated the trends observed. Additionally, the study was conducted at a single center, which limits the external validity of the results. Incorporating multiple centers could have provided a broader perspective and enhanced the generalizability of the findings across different populations. Furthermore, the selection of patients for coronary angiography was at the discretion of the attending cardiologist, which introduces a potential source of selection bias. The lack of uniform selection criteria for coronary angiography could have led to inconsistencies in patient inclusion, affecting the overall conclusions of the study.

CONCLUSION & FUTURE DIRECTIONS

This study underscores the significant value of the GRACE risk score in assessing the severity and extent of coronary artery stenosis in patients with acute coronary syndrome (ACS). The findings suggest that the GRACE score is not limited to specific types of ACS but can consistently predict

the presence of multivessel coronary artery disease (MVCAD) in patients with a high GRACE score (>140). This makes it an effective tool not only for expediting risk stratification but also for providing an early, comprehensive assessment of a patient's coronary involvement. Such an evaluation facilitates the timely planning of optimal management strategies, taking into account not only the technical aspects of treatment but also addressing the psychological and financial concerns frequently raised by patients and their families.

Future studies should aim to expand the sample size and include multiple centers to enhance the external validity of the findings and provide a more representative assessment of the GRACE score's predictive power across diverse populations. Additionally, further research could explore the relationship between the GRACE risk score and specific angiographic findings in larger cohorts, including comparisons with other risk stratification tools, to better understand its relative effectiveness in predicting the severity of CAD. Investigating the role of other biomarkers in conjunction with the GRACE score could also provide insights into refining risk prediction models. Longitudinal studies evaluating the impact of early risk stratification using the GRACE score on long-term outcomes, including mortality and recurrence of cardiovascular events, would offer valuable information on its clinical utility in ACS management.

REFERENCES

1. Lloyd-Jones D, Adams RJ, Brown TM, Carnethon M, Dai S, Simone GD, et al. Heart disease and stroke statistics – 2010 update: a report from the American Heart Association. Circulation.2010;121:e46-e215.
2. Jafar TH, Jafary FH, Jessani S, Chaturvedi N. Heart disease epidemic in Pakistan: women and men at equal risk. Am Heart J. 2005;150(2):221-6.

3. Litt HI, Gatsonis C, Snyder B, Singh H, Miller CD, Entrikin DW, et al. CT angiography for safe discharge of patients with possible acute coronary syndromes. N Engl J Med.2012;366(15):1393-403.
4. Gale CP, Manda SO, Weston CF, Birkhead JS, Batin PD, Hall AS. Evaluation of risk scores for risk stratification of acute coronary syndromes in the Myocardial Infarction National Audit Project (MINAP) database. Heart.2009;95(3):221-7.
5. D'Ascenzo F, Biondi-Zoccai G, Moretti C, Bollati M, Omede 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.2012;33(3):507-14.
6. Barbosa CE, Viana M, Brito M, Sabino M, Garcia G, Maraux M, et al. Accuracy of the GRACE and TIMI scores in predicting the angiographic severity of acute coronary syndrome. Arq Bras Cardiol.2012;99(3):818-24.
7. Isilak Z, Kardesoglu E, Aparci M, Uz O, Yalcin M, Yiginer O, et al. Comparison Of clinical risk assessment systems in predicting three-vessel coronary artery disease and angiographic culprit lesion in patients with non-ST segment elevated myocardial infarction/unstable angina pectoris. Kardiol Pol.2012;70(3):242-50.
8. Nakachi T, Kosuge M, Hibi K, Ebina T, Tsukahara K, Okuda J. Comparison of GRACE risk score versus TIMI risk score on angiographic findings in patients with non-ST-segment elevation acute coronary syndrome. J Am Coll Cardiol.2010; 55(10s1):A115-E1071.
9. Prabhudesai AR, Srilakshmi MA, Santosh MJ, Shetty GG, Varghese K, Patil CB, et al. Validation of the GRACE score for prognosis in Indian patients with acute coronary syndromes. Indian Heart J.2012;64(3):263-9.
10. Mahmood M, Achakzai AS, Akhtar P, Zaman KS. Comparison of the TIMI and the GRACE risk scores with the extent of coronary artery disease in patients with non-ST-elevation acute coronary syndrome. J Pak Med Assoc. 2013;63(6):691-5.

11. Cakar MA, Sahinkus S, Aydin E, Vatan MB, Keser N, Akdemir R, et al. Relation between the GRACE risk score and severity of atherosclerosis in acute coronary syndrome. J Cardiol. 2013;S0914-5087(13)00218-9.
12. Anderson RH, Loukas M. The importance of attitudinally appropriate description of cardiac anatomy. Clin Anat 2009; 22: 47-51.
13. Horsthuis T, Christoffels VM, Anderson RH, Moorman AF. Can recent insights into cardiac development improve our understanding of congenitally malformed hearts? Clin Anat 2009; 22: 4-20.
14. Manner J. The anatomy of cardiac looping: a step towards the understanding of the morphogenesis of several forms of congenital cardiac malformations. Clin Anat 2009; 22: 21-35.
15. Muresian H. The clinical anatomy of the mitral valve. Clin Anat 2009;22: 85-98.
16. American Heart Association : International Cardiovascular Disease Statistics. Dallas, American Heart Association, 2009.
17. Lawes CM, Vander Hoorn S, Rodgers A: Global burden of blood-pressure-related disease, 2001. Lancet 2008; 371:1513.
18. Shafey O, Eriksen M, Ross H, Mackay J: The Tobacco Atlas. 3rd ed. Atlanta, American Cancer Society, 2009.
19. Wild S, Roglic G, Green A, et al: Global prevalence of diabetes: Estimates for the year 2000 and projections for 2030. Diabetes Care 2004; 27:1047.
20. Haslam DW, James WP: Obesity. Lancet 2005; 366:1197.
21. Ezzati M, Vander Hoorn S, Lopez AD, et al: Comparative quantification of mortality and burden of disease attributable to selected risk factors. In: Lopez AD, Mathers CD, Ezzati E, et al ed. Global Burden of Disease and Risk Factors, New York: Oxford University Press; 2006:241-396.

22. Antman EM, Cohen M, Bernink PJ, McCabe CH, Horacek T, Papuchis G, et al. The TIMI risk score for unstable angina/non-ST elevation MI: A method for prognostication and therapeutic decision making. JAMA. 2000;284(7):835-42. 5.
23. Granger CB, Goldberg RJ, Dabbous O, Pieper KS, Eagle KA, Cannon CP, et al. Predictors of hospital mortality in the global registry of acute coronary events. Arch Intern Med. 2003;163(19):2345-53.
24. Eagle KA, Lim MJ, Dabbous OH, Pieper KS, Goldberg RJ, Van de Werf F, et al. A validated prediction model for all forms of acute coronary syndrome: estimating the risk of 6-month postdischarge death in an international registry. JAMA. 2004;291(22):2727-33.
25. Farhi JI, Cohen M, Fuster V. The broad spectrum of unstable angina pectoris and its implications for future controlled trials. Am J Cardiol. 1986;58(6):547-50.
26. Braunwald E, Mark DB, Jones RH, Brown J, Brown L, Cheitlin MD, et al. Unstable angina: diagnosis and management. Rockville (MD): Agency for Health Care Policy and Research and the National Heart, Lung, and Blood Institute, Public Health Service, US Department of Health and Human Services; 1994. (Clinical Practice Guideline, nº 10).
27. Calvin JE, Klein LW, VandenBerg BJ, Meyer P, Condon JV, Snell RJ, et al. Risk stratification in unstable angina: prospective validation of the Braunwald classification. JAMA. 1995;273(2):136-41.
28. Armstrong PW, Fu Y, Chang WC, Topol EJ, Granger CB, Betriu A, et al. Acute coronary syndromes in the GUSTO-IIb trial: prognostic insights and impact of recurrent ischemia. The GUSTO-IIb Investigators. Circulation. 1998;98(18):1860-8.
29. Zaacks SM, Liebson PR, Calvin JE, Parrillo JE, Klein LW. Unstable angina and non-Q wave myocardial infarction: does the clinical diagnosis have therapeutic implications? J Am Coll Cardiol. 1999;33(1):107-18.