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ASSOCIATION BETWEEN SEVERITY OF CLINICAL PRESENTATION AND EXTENT OF CORONARY ARTERY DISEASE IN PATIENTS WITH ST ELEVATION MYOCARDIAL INFRACTION

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ABSTRACT

Background: Acute myocardial infarction (AMI) with ST elevation (STEMI) continues to be a major cause of morbidity and mortality throughout the world. The Thrombolysis in Myocardial Infarction (TIMI) risk score is a simple clinical tool and the Gensini score is an angiographic scoring system that gives an assessment of the severity of CAD.
Objective: To assess the relationship between TIMI risk score and Gensini score in patients admitted with STEMI.
Methods: This cross-sectional descriptive study was performed during a six months period in the department of Cardiology, National Institute of Cardiovascular Diseases (NICVD) Karachi. The patients who had STEMI were selected by consecutive non-probability sampling and there were 333 patients in the age group of 18-70 years. Demographic and clinical data were collected. TIMI risk scores were computed and classified as low (0–2), intermediate (3–7) and high (≥8). The SPSS version 21 software was used for data analysis.
Results: The mean age was 57.4 ± 9.8 years with 76.0% male. Of these, 61.3% of patients had hypertension, 36.9% had diabetes mellitus and 39.9% smoked. Based on TIMI risk stratification, 24.0% were low risk, 57.7% intermediate risk, and 18.3% high risk. There was a strong correlation between TIMI risk categories and groups of Gensini score (p<0.001). There was a moderate positive correlation between the TIMI and Gensini scores (r=0.56, p<0.001) as confirmed by Pearson's analysis (r=0.53, p<0.001).
Conclusion: There was significant positive correlation between TIMI risk score and Gensini score in STEMI patients.

KEYWORDS: Coronary Angiography; Coronary Artery Disease; Myocardial Infarction; Risk Assessment; ST Elevation Myocardial Infarction.

INTRODUCTION

Despite the great progress in the field of reperfusion therapy and secondary prevention for coronary artery disease (CAD), ST-segment elevation myocardial infarction (STEMI), one of the most severe forms of CAD, is still a cause for high morbidity and mortality globally. The clinical features of STEMI are quite variable, from simple myocardial infarction to those complicated by heart failure, cardiogenic shock, haemodynamic instability and massive myocardial injury. It is important to identify patients early in order to optimize treatment strategies and improve clinical outcomes. In recent times, several angiographic assessment tools have been created and shown to correlate with adverse outcomes, including the SYNTAX Score II, which revealed a strong association between the anatomic complexity of the coronary lesion and adverse outcomes in patients undergoing primary Percutaneous Coronary Intervention (PCI) for ST-elevation Myocardial Infarction (STEMI) [1].
Multivessel coronary artery disease is seen in a significant number of STEMI patients and has been linked to higher ischemic burden, procedural complexity and prognosis. The degree of involvement of the coronary arteries also affects the short- and long-term prognosis and is one of the critical factors in treatment decisions. Recent trials comparing revascularization strategies in STEMI patients with multivessel disease have highlighted the importance of assessing the burden of coronary disease in these patients and the impact this has on their treatment

and survival [2]. Moreover, full revascularization has become a critical therapeutic goal, especially in patients with diffuse coronary disease, for the potential benefits of reduction of recurrent ischemic events and improvement of cardiovascular outcomes [3].

The correlation between the severity of the clinical presentation and the degree of CAD, has become a growing topic in the past few years. More severe clinical manifestations are seen in patients with more extensive coronary involvement as a result of larger areas of myocardium at risk and impaired ventricular function. The importance of angiographic disease burden as a determinant of clinical outcomes is further supported by the evidence from prospective studies comparing culprit-vessel-only intervention with complete revascularization in STEMI patients with multivessel disease [4]. In a similar manner, systematic reviews have shown an increased rate of adverse cardiac events in patients with diffuse coronary atherosclerosis and that these patients tend to benefit from more extensive revascularization options [5].

The relevance of extent of coronary disease is not limited to the clinical presentation, but may also affect left ventricular function and recovery following myocardial infarction. Results from the COMPLETE trial have suggested that in STEMI patients with multivessel disease, complete revascularization offers further clinical benefit, especially in patients with impaired ventricular function, highlighting the prognostic significance of extensive CAD [6]. Recent European guidelines for the treatment of acute coronary syndromes also emphasize the need for coronary angiographic assessment of the underlying coronary morphology and disease burden in the risk stratification of STEMI and treatment decision-making [7]. Similarly, current guidelines for STEMI care also focus on prompt invasive assessment and thorough evaluation of the coronary lesions in the interest of achieving better outcomes for the patient [8].

Properly estimating the severity of disease in patients with acute chest pain and suspected myocardial infarction continues to be a cornerstone of cardiovascular care. The American Heart Association/American College of Cardiology guidelines emphasize the need for risk stratification, based on clinical presentation and underlying coronary pathology, that will guide diagnostic and therapeutic interventions [9]. Moreover, the latest guidelines on coronary revascularization support the individualized approach to treatment according to the severity and complexity of the coronary artery disease, which also underlines the clinical use of angiography in patients with acute myocardial infarction [10].

Although there have been advancements in the treatment of STEMI, there is still a lack of information in terms of relationship between STEMI severity and the extent of coronary artery disease in the local STEMI patient population. An understanding of the relationship could help with early detection of high-risk individuals, better risk stratification, and timely therapeutic decisions. Thus, the objective of this study is to find the correlation between severity of clinical presentation and the severity of coronary artery disease in ST segment elevation myocardial infarction patients who underwent coronary angiography.

METHODS

This cross-sectional descriptive study was carried out in the Cardiology Department of National Institute of Cardiovascular Diseases (NICVD), Karachi for 6 months following the approval of institutional ethical review committee. All participants were required to obtain informed consent prior to entering the study, which was done verbally.

A total of 333 patients were included in the study. The Sample size was calculated through WHO sample size calculator, based on the Spearman's rank correlation coefficient of 0.552 between TIMI score and Gensini score, 95% confidence interval and 0.15 as the width of the confidence interval. A consecutive non-probability sampling method was used for patient recruitment.

All patients, male and female, between 18 and 70 years of age, with typical chest pain and ST-elevation myocardial infarction (STEMI) diagnosis, were enrolled. STEMI was diagnosed in patients whose presentation included typical ischemic chest pain that was sustained (lasting > 20 minutes) and was located retrosternal, with or without left arm or shoulder radiation, and related to exertion or emotional stress, with electrocardiographic evidence of significant ST-segment elevation. Significant ST-segment elevation was defined as newly developed or presumed new ST elevation of ≥1 mm at the J-point (except in leads V2-V3, where a ≥2 mm elevation in men 40 years of age or older and ≥2.5 mm elevation in men younger than 40 years and ≥1.5 mm elevation in women of any age was considered significant). Patients who had previously suffered a cerebrovascular disease, had a high risk of severe bleeding or did not give informed consent were excluded.

Demographic and clinical data such as smoking habit, family history of ischemic heart disease, onset time of chest pain, duration of chest pain, accompanying symptoms, age, sex, weight, height and body mass index (BMI) were collected on a predesigned data collection form. Also recorded were blood pressure and heart rate at the time of presentation. The criteria for hypertension were defined as history of hypertension documented on record or taking antihypertensive drugs for at least 6 months. diabetes mellitus was defined as history of diabetes mellitus for at least five years and was confirmed by fasting blood glucose levels ≥126 mg/dL or a random blood glucose level ≥200 mg/dL. Smokers were considered current smokers if they smoked 10 cigarettes daily or more in the month before presentation. Body mass index was categorized as underweight (<18.5 kg/m²), healthy weight (18.5–22.9 kg/m²), overweight (23.0–26.9 kg/m²), and obese (≥27 kg/m²). Family history was positive when a first-degree male relative of less than 55 years or female relative of less than 65 years had a documented ischemic heart disease.

Thrombolysis in Myocardial Infarction (TIMI) risk score was used to grade the severity of clinical presentation. Age, age ≥ 60 years, systolic blood pressure, heart rate, Killip class, history of diabetes mellitus, hypertension or angina, anterior ST-segment elevation or left bundle branch block, body weight, and ischemic time were used to calculate the TIMI score. The patients were divided into low-risk (0-2), intermediate-risk (3-7) and high-risk (≥8) groups based on the calculated score.

The coronary artery disease was assessed by the Gensini scoring system. All ECGs and coronaries were assessed by an expert cardiologist who had at least five years experience. Based on the severity and anatomical location of the coronary artery stenosis, the Gensini score was calculated. Patients were then divided into three groups according to the three tertiles of the Gensini score: first group (Gensini score <11 points), second group (Gensini score 11–38 points), and third group (Gensini score >38 points).

IBM SPSS Statistics version 21.0 was used to enter and analyze all the data. Continuous variables such as age, vital signs, TIMI score and Gensini score were tested for normality of the distribution using Shapiro–Wilk test. Quantitative variables were presented as mean ± standard deviation or median (interquartile range) where appropriate; and categorical variables were presented as frequencies and percentages. Stratification was done for potential effect modifiers such as age, gender, hypertension, diabetes mellitus, smoking status, BMI categories and family history of ischemic heart disease. The chi-square test was used for post stratification comparisons. Spearman's rank correlation coefficient and Pearson correlation analysis was used as appropriate for the relationship of TIMI risk score and Gensini score. A two-tailed p-value of ≤0.05 was considered statistically significant.

RESULTS

A total of 333 patients diagnosed with ST-elevation myocardial infarction (STEMI) were included in the study. The baseline demographic and clinical characteristics of the study population are presented in Table 1. The mean age of the participants was 57.4 ± 9.8 years (range: 29–70 years). Most patients (49.8%) were between 56 and 70 years of age, while 37.5% were aged 41–55 years and 12.6% were aged 18–40 years. Males constituted the majority of the study population (76.0%). The mean body mass index (BMI) was 25.8 ± 3.9 kg/m². Hypertension was the most prevalent cardiovascular risk factor and was observed in 61.3% of patients, followed by diabetes mellitus in 36.9% and current smoking in 39.9%. A positive family history of ischemic heart disease was reported by 24.9% of participants. The mean heart rate at presentation was 88.6 ± 17.2 beats/minute, while the mean systolic blood pressure was 121.5 ± 19.8 mmHg (**Table 1**).

The distribution of TIMI risk categories and Gensini score groups is shown in Table 2. Based on TIMI risk stratification, the majority of patients (57.7%) belonged to the intermediate-risk category, whereas 24.0% and 18.3% were classified as low-risk and high-risk, respectively. The median TIMI score was 5 (IQR: 3–7). Assessment of angiographic severity using the Gensini scoring system demonstrated that 30.0% of patients had a Gensini score below 11 points, 39.3% had scores between 11 and 38 points, and 30.6% had scores greater than 38 points. The median Gensini score was 31 (IQR: 15–54), indicating a moderate burden of coronary artery disease in the study population (**Table 2**).

The relationship between TIMI risk categories and Gensini score groups is presented in Table 3. A statistically significant association was observed between clinical risk stratification and angiographic severity of coronary artery disease (χ^2 test, $p<0.001$). Among patients categorized as low risk according to the TIMI score, 62.5% had a Gensini score below 11 points, whereas only 7.5% had severe coronary artery disease with a Gensini score greater than 38 points. In contrast, among patients in the high-risk TIMI category, 63.9% had a Gensini score greater than 38 points and only 8.2% had a Gensini score below 11 points. Patients with intermediate TIMI scores were predominantly distributed within the moderate Gensini score category (46.9%). These findings demonstrated a progressive increase in angiographic disease severity with increasing TIMI risk category, as shown in **Table 3.**

Correlation analysis further supported the observed association between clinical severity and coronary artery disease burden. As presented in **Table 4**, Spearman's rank correlation revealed a significant positive correlation between TIMI score and Gensini score ($r = 0.56$, $p < 0.001$). Similarly, Pearson correlation analysis demonstrated a moderate positive correlation between the two scoring systems ($r = 0.53$, $p < 0.001$). These findings indicated that patients with higher TIMI scores tended to have more extensive coronary artery disease as assessed by the Gensini scoring system.

Table 1. Baseline characteristics of the study population (N = 333)

Variable	Frequency (%) / Mean ± SD
Age (years)	57.4 ± 9.8
18–40 years	42 (12.6)
41–55 years	125 (37.5)
56–70 years	166 (49.8)
Male gender	253 (76.0)
Female gender	80 (24.0)
BMI (kg/m²)	25.8 ± 3.9
Hypertension	204 (61.3)

Diabetes mellitus	123 (36.9)
Current smoker	133 (39.9)
Positive family history	83 (24.9)
Heart rate (beats/min)	88.6 ± 17.2
Systolic BP (mmHg)	121.5 ± 19.8

Table 2. Distribution of TIMI risk categories and Gensini score groups (N = 333)

Variable	Frequency (%)
TIMI Risk Category	
Low risk (0–2)	80 (24.0)
Intermediate risk (3–7)	192 (57.7)
High risk (≥8)	61 (18.3)
Gensini Score Group	
<11 points	100 (30.0)
11–38 points	131 (39.3)
>38 points	102 (30.6)

Table 3. Association between TIMI risk category and Gensini score group (N = 333)

TIMI Risk Category	Gensini <11 n (%)	Gensini 11–38 n (%)	Gensini >38 n (%)	Total	p-value
Low risk (0–2)	50 (62.5)	24 (30.0)	6 (7.5)	80	
Intermediate risk (3–7)	45 (23.4)	90 (46.9)	57 (29.7)	192	
High risk (≥8)	5 (8.2)	17 (27.9)	39 (63.9)	61	
Total	100	131	102	333	<0.001

Table 4. Correlation between TIMI and Gensini Scores

Variable	Correlation Coefficient (r)	p-value
Spearman Correlation	0.56	<0.001
Pearson Correlation	0.53	<0.001

DISCUSSION

This current study assessed the relationship between severity of clinical presentation and severity of coronary artery disease in patients who presented with ST-elevation myocardial infarction (STEMI). There was a strong positive correlation between TIMI risk score and Gensini score, suggesting that more severe clinical presentation was seen in patients with more extensive angiographic coronary artery disease. In addition, there was a moderate positive correlation between the two scoring systems based on both Spearman and Pearson analyses, indicating the usefulness of clinical risk stratification to predict the angiographic burden of disease.

Demographic characteristics of the study population included a higher number of male patients with an overall mean age of about 57 years. This is similar for current STEMI cohorts, which showed higher age and male sex as risk factors for more severe coronary artery disease and worse cardiovascular outcomes [11]. It has been demonstrated that the burden of coronary atherosclerosis is related to age, leading to more complex coronary lesions and worse clinical presentations.[12].

Common cardiovascular risk factors among the STEMI patients in the present study were hypertension, diabetes mellitus and smoking. All these risk factors have been consistently linked to the more severe type of coronary artery disease and worse results after an AMI. Angiographic complexity studies have shown that patients with multiple cardiovascular risk factors have a greater coronary disease burden and more complex coronary anatomy [13]. Furthermore, there is evidence that higher angiographic severity scores are linked to adverse cardiovascular events and mortality in STEMI patients [14].

Risk stratification based on the TIMI score showed that the majority of patients were in the intermediate-risk category. Clinical severity assessment continues to play a significant role in the management of STEMI, as it can help to identify those who are more likely to have complications and die. Previous study has shown a strong correlation between clinical severity and the angiographic disease burden. In the study of Yildirim et al., the presence of more coronary artery disease was found to be significantly associated with the Killip class at presentation in patients with STEMI who underwent primary PCI [15]. These results lend credence to the idea that the clinical manifestation is related to the severity of myocardial ischemia and the coronary disease.

In the present study, the involvement of severe coronary artery disease in the Gensini scoring system was found to be around one-third of the patients. The disease burden on angiography has been identified as important predictor of prognosis in STEMI. Extensive coronary involvement is often associated with larger infarct size, lower ventricular function, and increased complications. Elbadawi et al. found that patients with cardiogenic shock complicated with STEMI had significantly more severe angiographic disease burden than patients without

cardiogenic shock, suggesting a correlation between the severity of the disease burden and the severity of the clinical presentation [16].
One of the important results of the present study is that TIMI risk categories and Gensini score groups are statistically significant. High-risk patients were significantly more likely to have more severe coronary artery disease while low-risk patients were mostly associated with lower Gensini scores. The same was noted in patients with multivessel coronary artery disease, with the extent of coronary artery involvement associated with more severe clinical presentation and outcome [17]. The conclusions indicate that at the bedside examination simple clinical evaluation can yield important data on the likely severity of coronary artery disease prior to coronary angiography.
Clinical and angiographic severity were also correlated, as evidenced by the positive association between TIMI and Gensini scores. In STEMI patients, there was a strong correlation between angiographic complexity and clinical presentation as purported by Sardella et al. [18] where a higher disease burden was directly linked to higher hemodynamic compromise and clinical instability. The correlation detected in the current study suggests that patients with higher TIMI scores could be having more serious coronary artery disease and might benefit from early investigation of coronary artery disease and more aggressive treatments. [19-20].
The strengths of this study were the employment of validated, widely accepted scoring systems to define clinical disease burden and angiographic disease burden and the evaluation of a clinically relevant patient population presenting with STEMI and a reasonably large sample size. It also gave significant local data on the relationship of the TIMI risk score as a predictor of the severity of coronary artery disease. But there are some caveats to keep in mind. The study was performed in a single tertiary care centre, with the results not necessarily applicable to other populations. The cross-sectional design did not allow for assessment of long-term cardiovascular outcomes or causal relationships. Furthermore, infarct size, left ventricular ejection fraction and long-term follow-up data were not evaluated. Future multicentre prospective studies with larger patient numbers should be encouraged to further confirm the results and to explore the effect of the burden of angiographic disease on long-term STEMI patient morbidity and mortality following primary PCI. In addition, combination of clinical and angiographic risk assessment models could help to refine risk stratification and tailor treatment strategies in acute coronary syndromes (ACS).

CONCLUSION

The present study revealed a significant correlation between the clinical presentation and severity of the CAD in patients with STEMI. There was a trend towards higher Gensini score and angiographic burden of coronary artery disease with higher TIMI risk scores. There was a strong positive correlation between both the scoring systems, indicating that more severe clinical manifestation had higher chances of having extensive coronary artery involvement. These results reinforce the value of TIMI risk stratification as a practical tool for determining severity of the coronary artery disease, and the high-risk STEMI patients who might benefit from early invasive evaluation and aggressive management.

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