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Angiographic Severity of Coronary Artery Disease in Patients with STEMI in Bangladesh

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Abstract **Original Research Article**

Background: ST-elevation myocardial infarction (STEMI) is a major manifestation of coronary artery disease (CAD), and the extent of coronary involvement is an important indicator of disease severity. The triglyceride-to-high-density lipoprotein cholesterol (TG/HDL-C) ratio may reflect an atherogenic lipid profile associated with greater coronary disease burden. ***Objective:*** To assess the angiographic severity of CAD using vessel and Gensini scores and determine its relationship with the TG/HDL-C ratio among patients with STEMI. ***Method:*** This cross-sectional observational study was conducted among 73 patients with STEMI at the Department of Cardiology, Sylhet MAG Osmani Medical College Hospital, Bangladesh, from July 2019 to June 2021. Patients were categorized into high (≥4) and low (<4) TG/HDL-C groups. Coronary angiography was performed during hospitalization, and CAD severity was assessed using vessel and Gensini scores. Severe CAD was defined as a Gensini score >20. Data were analyzed using SPSS version 25.0. ***Results:*** The mean age was 51.03±10.47 years, and 84.9% were male. Chest pain was the predominant presenting symptom (98.6%). Hypertension was significantly more common in the high TG/HDL-C group than in the low-ratio group (66.0% vs. 34.8%, p=0.013). Mean Gensini score was significantly higher among patients with TG/HDL-C ≥4 than among those with <4 (39.4±24.29 vs. 11.34±7.37, p=0.0001). Severe CAD was present in 86.0% of patients with TG/HDL-C ≥4 compared with 8.7% of those with <4 (p=0.0001). Vessel involvement also differed significantly between groups (p=0.022). ***Conclusion:*** A higher TG/HDL-C ratio was strongly associated with greater angiographic severity and extent of CAD among patients with STEMI. The TG/HDL-C ratio may serve as a simple, readily available marker of severe coronary involvement.

Keywords: ST-elevation myocardial infarction (STEMI); coronary artery disease; TG/HDL-C ratio; Gensini score; vessel score; angiographic severity.

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INTRODUCTION

ST-elevation myocardial infarction (STEMI) represents one of the most serious clinical manifestations of coronary artery disease (CAD) and occurs when an acute coronary occlusion results in myocardial ischaemia and necrosis. Despite advances in reperfusion therapy, STEMI continues to be associated with substantial morbidity and mortality, particularly when diagnosis and treatment are delayed. The clinical presentation of STEMI may vary considerably among patients, and the extent of underlying coronary atherosclerosis is an important determinant of the overall disease burden. In addition to the culprit lesion responsible for the acute event, patients may have significant disease in other coronary vessels, reflecting a more extensive atherosclerotic process. [1-2]

The burden of CAD has become increasingly important in Bangladesh, where conventional cardiovascular risk factors such as diabetes mellitus, hypertension, smoking, dyslipidaemia and obesity are common. Evidence from South Asian populations has demonstrated a strong association between these risk factors and myocardial infarction, while Bangladesh has been reported to have a particularly high prevalence of several major cardiovascular risk factors. [3-4] In Bangladeshi patients undergoing coronary angiography, diabetes, hypertension, dyslipidaemia and smoking have

frequently been observed among individuals with significant coronary disease. A study involving patients with myocardial infarction reported diabetes in 34%, dyslipidaemia in 32.5%, hypertension in 41.3%, and current or previous smoking in 61.7% of patients. [5] These findings indicate the substantial contribution of modifiable risk factors to the development and progression of CAD in the local population.

Coronary angiography remains an important investigation for defining the anatomical extent of coronary artery involvement in patients with acute myocardial infarction. It allows assessment of the number of diseased vessels, location and degree of stenosis, and the overall distribution of atherosclerotic lesions. In Bangladesh, angiographic studies have demonstrated differences in the pattern of coronary involvement among patients presenting with different forms of acute coronary syndrome. In one Bangladeshi study comparing STEMI and NSTEMI patients, 80% of patients with STEMI had single-vessel disease, while multivessel disease was more frequent among patients with NSTEMI. [6] However, the angiographic pattern of STEMI can vary according to the characteristics of the studied population, and assessment of disease severity rather than simply the presence or absence of stenosis provides a more detailed understanding of coronary involvement.

Several angiographic scoring systems have therefore been developed to quantify the severity and extent of CAD. The Gensini score is one of the commonly used methods and takes into account both the degree of luminal narrowing and the anatomical importance of the affected coronary segment. A higher Gensini score reflects a greater overall angiographic burden of atherosclerotic disease. [7] The vessel score, on the other hand, provides a relatively simple assessment based on the number of major coronary vessels with significant stenosis. The use of both approaches can provide complementary information, as vessel scoring describes the distribution of disease whereas the Gensini score provides a more quantitative estimate of its overall severity. Previous Bangladeshi research has used both vessel score and Gensini score to assess angiographic severity in patients undergoing coronary angiography. [8]

The relationship between conventional cardiovascular risk factors and angiographic severity has also received considerable attention. Diabetes, hypertension, obesity, dyslipidaemia and smoking may contribute not only to the development of CAD but also to more extensive coronary involvement. In a Bangladeshi study of patients with myocardial infarction, waist-to-height ratio and waist-to-hip ratio showed significant positive relationships with Gensini score, whereas BMI did not show a significant correlation. [9] Similarly, another study of Bangladeshi patients undergoing coronary angiography reported an association between lower vitamin D levels and greater vessel and Gensini scores. [10]

Objective

The present study was undertaken to assess the angiographic severity of coronary artery disease in Bangladesh.

METHODOLOGY

Study Design and Study Period

This was a cross-sectional observational study conducted over a two-year period from 1st July 2019 to 30th June 2021. The study was carried out in the Department of Cardiology, Sylhet MAG Osmani Medical College Hospital, Sylhet.

Study Population

The target population consisted of all patients diagnosed with ST-elevation myocardial infarction (STEMI) who were admitted to the Department of Cardiology during the study period. The study population included patients who fulfilled the predetermined eligibility criteria. A purposive sampling technique was employed, and a total of 73 eligible patients were enrolled.

Inclusion Criteria

Patients were included if they were aged more than 18 years, of either sex, had a diagnosis of STEMI, and provided informed written consent to participate in the study.

Exclusion Criteria

Patients were excluded if they had a previous history of percutaneous coronary intervention (PCI) or coronary artery bypass grafting (CABG), were receiving lipid-lowering medication, or had a documented history of old myocardial infarction, valvular heart disease, cardiomyopathy, or congenital heart disease.

Variables Studied

The principal variables of interest were the triglyceride-to-high-density lipoprotein cholesterol (TG/HDL-C) ratio, coronary vessel score, and Gensini score. Demographic and clinical variables included age, sex, obesity, diabetes mellitus, hypertension, cigarette smoking, and family history of coronary artery disease (CAD).

Data Collection

Data were obtained using a pre-designed structured questionnaire incorporating both qualitative and quantitative information. At admission, patients presenting with chest pain suggestive of STEMI underwent detailed history taking and physical examination. Information regarding major cardiovascular risk factors, including hypertension, diabetes mellitus, cigarette smoking, dyslipidaemia,

obesity, and family history of CAD, was recorded. Relevant previous medical records were also reviewed where necessary to confirm the history of these risk factors.

Diagnosis of STEMI

A standard 12-lead resting electrocardiogram was performed immediately after admission, with proper positioning of the leads, at a paper speed of 25 mm/s and a standardization of 10 mm/mV. Blood samples for cardiac troponin I (cTnI) were collected under aseptic conditions at the initial assessment (0 hour) and sent to the Department of Biochemistry, Sylhet MAG Osmani Medical College Hospital, or an appropriate standard laboratory. A repeat cTnI sample was obtained 3–6 hours after the first sample.

The diagnosis of STEMI was established based on clinical evidence of acute myocardial ischaemia, characteristic ST-segment elevation on ECG, and a rise and/or fall in cTnI concentration with at least one value exceeding the 99th percentile of the upper reference limit. ST-segment elevation was considered significant when elevation at the J point was ≥1 mm in two contiguous leads other than V2–V3. For V2–V3, the cut-off values were ≥2 mm in men aged ≥40 years, ≥2.5 mm in men aged <40 years, and ≥1.5 mm in women irrespective of age.

Laboratory Investigations

A fasting lipid profile was obtained within 24 hours of hospital admission, including total cholesterol, LDL cholesterol, HDL cholesterol, and serum triglycerides. The TG/HDL-C ratio was calculated using the measured triglyceride and HDL-C concentrations. Patients were subsequently classified into two groups according to a TG/HDL-C ratio of <4 and ≥4. Other routine investigations, including complete blood count, random plasma glucose, and serum creatinine, were also performed. Echocardiography was carried out to evaluate cardiac structure and function and to exclude or identify cardiomyopathy, valvular heart disease, and congenital heart disease.

Coronary Angiographic Assessment

Coronary angiography was performed during the index hospital admission. Each angiogram was assessed by an experienced cardiologist who was blinded to the patient's TG/HDL-C ratio. The angiographic severity of CAD was evaluated using the coronary vessel score and Gensini score. Significant CAD was defined as ≥70% stenosis in any of the three major epicardial coronary arteries or ≥50% stenosis of the left main coronary artery. According to the vessel score, significant disease was categorized as single-vessel, two-vessel, or three-vessel disease. Significant left main coronary artery stenosis was considered equivalent to single-vessel disease for the purpose of vessel scoring.

Gensini Score

The Gensini score was determined by assessing the degree of stenosis in individual coronary artery segments and assigning a weighting factor according to the anatomical importance of each segment. Anatomical weighting scores ranged from 0.5 to 5, while the degree of coronary luminal obstruction was scored according to the maximum percentage of stenosis, ranging from 1 to 100%. The score assigned for the degree of stenosis was multiplied by the corresponding anatomical weighting factor for each affected segment. The scores for all coronary segments were then summed to obtain the total Gensini score. The association between the TG/HDL-C ratio and the angiographic severity of CAD was subsequently assessed. All patients received treatment according to the standard management protocol for STEMI.

Statistical Analysis

After collection, the data were checked for completeness, coded, tabulated, and analyzed using Statistical Package for the Social Sciences (SPSS) version 25.0. Continuous quantitative variables were expressed as mean ± standard deviation, whereas categorical variables were presented as frequencies and percentages. Appropriate statistical tests were applied according to the nature and distribution of the data. A p-value of <0.05 was considered statistically significant.

Ethical Considerations

Ethical approval for the study was obtained from the Institutional Ethical Review Committee of Sylhet MAG Osmani Medical College, Sylhet. Before enrollment, each participant was informed in detail about the purpose, procedures, and voluntary nature of the study. Participants were also informed of their right to withdraw from the study at any point without any adverse consequences. Written informed consent was obtained from each participant after adequate explanation and confirmation of their willingness to participate.

RESULTS

Among the studied sample (n=73) highest frequency, 26 (35.6%) was observed in 50-59 years age group, followed by 60 years or more group (n=19, 26%) (Table I) Mean age ± SD was 51.03 ± 10.47 years.

Table I: Distribution of sample by age group (n=73)

Age groups (years)	Frequency	Percent
30-39	10	13.7
40-49	18	24.7

50-59	26	35.6
60 or more	19	26.0
Total	73	100.0

Among the studied sample (n=73), 62 were male and 11 were female.

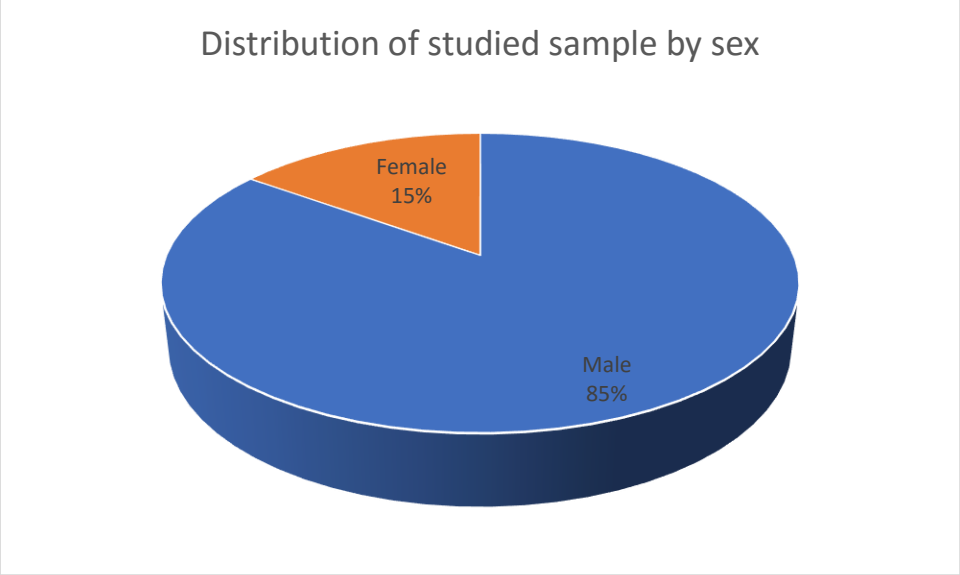


Fig 1: Distribution of studied sample by sex

Most (72, 98.6%) of the studied sample had chest pain. Second common clinical feature was chest tightness, present in 43 (58.9%) individuals. Dyspnoea was present in 28 patients, followed by sweating.

Table II: Distribution of studied sample by clinical features

Symptoms	Frequency	Percent
Chest pain	72	98.6
Chest tightness	43	58.9
Dyspnoea	28	38.4
Sweating	17	23.3
Palpitation	17	23.3
Vomiting	7	9.6

In studied samples, 31 (42.5%) patients had DM. Statistically non-significant difference (p=0.055) was noted among high TG/HDL group and low TG/HDL group, 50 % and 26.1% respectively. Among the High TG/HDL cohort 33 (66%) had HTN and in low TG/HDL group the number was lower (n=8, 34.8%). This difference was statistically significant (p=0.013). Obesity was present in 32% (n=16) of high TG/HDL group as opposed to 17.4% (n=7) in counterpart, and difference statistically non-significant (p=0.194). Smoking history was present 46% and 26.1% individuals in high TG/HDL group and low TG/HDL group respectively, this difference failed to achieve significance (p=0.128). 16% in former group and 30.4 % in later group had family history of CVD. This difference was statistically non-significant (p=0.213).

Table III: Distribution of studied sample by risk factors

Risk factor	Total (n=73) (%)	High TG/HDL (≥4) (n=50) (%)	Low TG/HDL (<4) (n=23) (%)	p-value
DM	31 (42.5%)	25 (50%)	6 (26.1%)	0.055^{ns}
HTN	41 (56.2%)	33(66.0%)	8 (34.8%)	0.013^{s}
Obesity	20(27.4%)	16 (32.0%)	4 (17.4%)	0.194 ^{ns}
Smoking	29 (39.7%)	23(46.0%)	6 (26.1%)	0.128 ^{ns}
Family H/O CVD	15(20.5%)	8 (16%)	7 (30.4%)	0.213 ^{ns}
Chi-square test, s- significant ns – non-significant				

Mean ± SD of pulse in high TG/HDL group and low TG/HDL group was 80.22±15.24 bpm and 80.35 ±11.24 bpm, respectively (p=0.971) There was non-significant difference (p=0.733) was noted in mean SBP in former (136.44± 22.76 mmHg) and later group (134.57 ± 19.30 mmHg). Although difference in mean diastolic BP exist between these two groups but these was statistically non-significant (p= 0.548).

Table IV: Distribution of physical examination in studied samples

Physical Examination	High TG/HDL (≥4) (n=50)	Low TG/HDL (<4) (n=23)	p-value
Pulse (bpm)	80.22±15.24	80.35 ±11.24	0.971[ns]
SBP(mm Hg)	136.44± 22.76	134.57 ± 19.30	0.733 [ns]
DBP(mmHg)	82.9 ±14.57	85.00 ± 11.87	0.548 [ns]
JVP (cm)	7.36 ± 0.63	7.17± 0.39	0.197 [ns]
Independent sample t test ns – non-significant			

Table showed Gensini score was significantly different (p=0.0001) in low TG/HDL group (11.34 ± 7.37) and high TG/HDL group (39.4 ± 24.29).

Table V: Comparison of Gensini score among high TG/HDL group and low TG/HDL group

	High TG/HDL (≥4) (n=50)	Low TG/HDL (<4) (n=23)	p-value
Gensini score	39.4 ± 24.29	11.34 ± 7.37	0.0001 [s]
Independent sample t test s-significant			

Among the studied sample, in high TG/HDL group (n=50), 19 (38 %) patients had vessel score 1 and 16 (32%) patients had vessel score 3. On the contrary, out of 23 patients in low TG/HDL group, 12 (52.2%) patients had score 1 and 7 (30.4%) had score 2. This difference was statistically significant (p=0.022).

Table VI: Distribution of vessel score among high TG/HDL group and low TG/HDL group

Vessel score	High TG/HDL (≥4) (n=50) (%)	Low TG/HDL (<4) (n=23) (%)	Total (n=73) (%)	p-value
0	1 (2%)	2(8.7%)	3 (4.1%)	
1	19(38%)	12 (52.2%)	31(42.5%)	
2	14(28.0%)	7 (30.4%)	21(28.7%)	
3	16(32%)	2(8.7%)	18(24.7%)	0.022[s]
Total	50 (68.5%)	23 (31.5%)	73 (100%)	
Chi-square test s-significant				

Among the 50 high TG/HDL sample, 43 (86%) patients had severe CAD whereas in low TG/HDL group, only 2 (88.7%) patients had severe CAD (p=0.0001).

Table VII: Distribution of studied sample according to the severity of CAD

TG/HDL ratio	Severe CAD (Gensini score >20)	Non-Severe CAD (Gensini score <20)	Total	p-value
High (≥4)	43 (86%)	7 (14%)	50(100%)	0.0001[s]
Low (<4)	2 (8.7%)	21 (91.3%)	23 (100%)	
Total	45 (61.6%)	28 (38.4%)	73(100%)	
Chi-square test s-significant				

DISCUSSION

The present study included 73 patients with STEMI, with a mean age of 51.03±10.47 years. The largest proportion of patients belonged to the 50–59-year age group (35.6%), followed by those aged ≥60 years (26.0%), while only 13.7% were aged 30–39 years. There was a marked male predominance, with males accounting for 84.9% of the study population. These findings are broadly consistent with observations. [10] A large STEMI cohort reported a mean age of 51.6±10.3 years and 93% male participants, which is very similar to the age distribution observed in the present study. [11]

Similarly, another study reported a median age of 53 years among myocardial infarction cases, with men comprising 88% of cases. [12] The predominance of middle-aged and older men in the present study therefore reflects the demographic pattern commonly reported among patients presenting with acute myocardial infarction in Bangladesh.

Chest pain was the predominant presenting symptom in the present study, occurring in 98.6% of patients, followed by chest tightness (58.9%), dyspnoea (38.4%), sweating (23.3%), palpitation (23.3%) and vomiting (9.6%). The very high frequency of chest pain is consistent with the typical clinical presentation of STEMI and indicates that classical ischemic symptoms remained prominent in this cohort. The presence of dyspnoea and autonomic symptoms such as sweating and vomiting in a substantial proportion of patients also indicates the variable clinical expression of acute myocardial infarction. In particular, the coexistence of these symptoms with chest pain may reflect the acute physiological stress associated with myocardial ischemia and infarction.

Several conventional cardiovascular risk factors were common in this study. Hypertension was the most frequent risk factor (56.2%), followed by diabetes mellitus (42.5%), smoking (39.7%), obesity (27.4%) and family history of cardiovascular disease (20.5%). These findings are compatible with the established risk profile of myocardial infarction in Bangladesh. In the large study, myocardial infarction cases had higher frequencies of diabetes, hypertension, family history of MI and tobacco use than controls. [13] In the present study, hypertension was significantly more frequent among patients with a high TG/HDL-C ratio than among those with a low ratio (66.0% vs. 34.8%, p=0.013). Diabetes, obesity and smoking were also more common in the high-ratio group, although these differences did not reach statistical significance. The lack of significance for some risk factors may partly reflect the relatively small sample size, particularly the smaller low TG/HDL-C group of 23 patients. Physical examination findings, including pulse rate, systolic and diastolic blood pressure and JVP, did not differ significantly between the two TG/HDL-C groups, suggesting that the major differences between the groups were more evident in their metabolic and angiographic characteristics than in routine bedside measurements.

The principal finding of this study was the marked difference in angiographic disease severity according to the TG/HDL-C ratio. Patients with a high TG/HDL-C ratio (≥4) had a mean Gensini score of 39.4±24.29, compared with only 11.34±7.37 among those with a ratio <4 (p=0.0001). Furthermore, vessel involvement differed significantly between the groups (p=0.022). Three-vessel disease was present in 32.0% of patients with a high TG/HDL-C ratio but only 8.7% of those with a low ratio, whereas single-vessel disease was more frequent in the low-ratio group. These findings indicate that a higher TG/HDL-C ratio was associated not merely with the presence of CAD but with a greater anatomical extent of coronary involvement. This observation is consistent with previous angiographic research. One study reported that a TG/HDL-C ratio above 4 was independently associated with extensive coronary disease and proposed the ratio as a simple surrogate marker of atherogenic lipid abnormalities. [14] Another angiographic study found that TG/HDL-C increased with the number of stenotic coronary branches and was positively associated with the number of diseased vessels. [15]

The association became even more evident when CAD was classified according to Gensini-defined severity. Severe CAD, defined as a Gensini score >20, was present in 86.0% of patients with TG/HDL-C ≥4, compared with only 8.7% of patients with TG/HDL-C <4 (p=0.0001). Thus, patients with a high TG/HDL-C ratio demonstrated a substantially greater burden of angiographically severe disease. This finding is supported by previous studies using Gensini scoring. In a study of patients undergoing coronary angiography, the TG/HDL-C ratio was significantly higher among patients with CAD and showed a positive correlation with the Gensini score; patients with more extensive branch involvement also had higher ratios. [16]

The strong difference in Gensini scores observed in the present study may be explained by the metabolic characteristics represented by the TG/HDL-C ratio. A high ratio combines elevated triglyceride concentrations with relatively low HDL-C and may reflect an atherogenic lipid profile associated with insulin resistance, small dense LDL particles and increased atherogenic lipoprotein metabolism. Previous research has described the relationship between high TG/HDL-C and extensive coronary disease and has suggested that the ratio provides a readily available surrogate measure of atherogenicity. [17]

CONCLUSION

The present study demonstrated a strong association between the triglyceride-to-HDL cholesterol (TG/HDL-C) ratio and angiographic severity of coronary artery disease among patients with STEMI. Patients with a TG/HDL-C ratio ≥4 had a substantially higher frequency of severe CAD compared with those with a ratio <4 (86.0% vs. 8.7%, p=0.0001), along with significantly higher mean Gensini scores (39.4±24.29 vs. 11.34±7.37, p=0.0001) and greater vessel involvement (p=0.022). These findings indicate that a higher TG/HDL-C ratio is associated with greater extent and severity of coronary atherosclerotic disease in patients presenting with STEMI. Therefore, the TG/HDL-C ratio may serve as a simple and readily available marker for

identifying patients with a greater burden of angiographic CAD.

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