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Original Article

Association between Triglyceride - High Density Lipoprotein Ratio with Angiographic Severity of Coronary Artery Disease in Patients with Non-ST Segment Elevated Myocardial Infarction

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Key Words : *Coronary artery disease, Triglycerides, High density lipoprotein, NSTEMI, Gensini score,*

Abstract:

Background: *Non-ST Segment Elevated Myocardial infarction (NSTEMI) is a potentially life-threatening condition. Dyslipidaemia is a major contributor of coronary artery disease (CAD) and TG/HDL-C ratio can be an important marker for the prediction of the extent of CAD. This study was aimed to find out the relation between TG/HDL-C ratio with severity of coronary artery lesion in NSTEMI patients.*

Methods: *A total of 200 NSTEMI patients were included and classified into two groups on the basis of TG/HDL-C ratio: Group-A (TG/HDL-C ratio ≤4, n=100) and Group-B (TG/HDL-C ratio >4, n=100). Angiographic severity was measured by Gensini score in all the patients during the same hospital stay period. Relation between TG/HDL-C ratio and angiographic severity was evaluated.*

Results: *Mean age of the study populations was 55.13±8.49 (years) with male predominance (75%). Hypertension, diabetes mellitus, dyslipidaemia and obesity were significantly higher in Group-B (p<0.05). Gensini score in Group-B were significantly higher than Group-A (71±23 vs 30±12, p<0.001). A strong positive linear relationship was found between TG/HDL-C ratio and Gensini score (r=+0.803). Multivariate logistic regression found TG/HDL-C ratio >4 as the powerful independent predictor of Gensini score >36 (AOR=7.98, 95% CI=4.0-15.91, p<0.001).*

Conclusion: *There is a significant positive correlation between TG/HDL-C ratio with Gensini score indicating increased severity of coronary disease in patients with NSTEMI. So early risk stratification and intensive management of NSTEMI can be done by using this cheap and easily available marker on admission.*

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Introduction:

Coronary artery disease (CAD) is an important medical and public health issue. It is a common and leading cause of death throughout the world.[1] CAD causes 1.8 million deaths annually and 20% causes of overall death in Europe while in the United States it is the main cause of death and responsible for 1 in 4.8 deaths.[2] Bangladesh has been experiencing epidemiological transition from communicable disease to non-communicable disease and death from CAD is increasing in an alarming rate. Recently published systemic review and meta-analysis shows the prevalence of CAD in Bangladeshi adult population is 5%.[3]

NSTEMI is a recognized CAD entity that has an unacceptable mortality when it goes unrecognized. It is more frequent and vulnerable to STEMI because most patients tend to be older with more co-morbidities (including DM and renal failure). Wide variation in clinical presentation, laboratory characteristics and disease severity of NSTEMI leads to greater variation in disease diagnosis, risk stratification and treatment protocol. The annual incidence of NSTEMI varies significantly between countries, with a mean global annual incidence of about 3 per1,000 adult population.[2] However, disease carries a significant morbidity, psychological effects and financial burden for

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patient and family. On diagnosis of NSTEMI, rapid decision is needed considering both ischemic and bleeding risk for patient. There is different scoring system for risk stratification for MI patients including Thrombolysis in Myocardial Infarction (TIMI) score, Global Registry for Acute Coronary Events (GRACE) score, History, ECG, age, risk factors and troponin (HEART) score etc. Risk stratification and characterization with this score system is complex.[4] So, it is high time to establish a simple non-invasive test to stratify disease risk side by side to predict extent of coronary artery lesion.

Dyslipidaemia is one of the major contributor of increased CAD risk CAD and is associated with formation and progression of atherosclerotic plaques.[5] Prevalence of dyslipidaemia in acute coronary syndrome is 60.7% in Bangladesh.[6] Elevated Triglycerides (TG) is an independent risk factor for CAD.[7] High density lipoprotein (HDL) is inversely related to CAD and are protective against CAD in both male and female.[8] TG and HDL-C considered to be highly signiûcant independent predictor of the severity of CAD.[9] TG or HDL alone does not always describe the overall cardiovascular risk. When TG and HDL level are combined in a single ratio, it will be a good predictor for severe CAD.[5]

Carbohydrate is the main diet of Bangladeshi people and high plasma concentration of TG and low plasma concentration of HDL-C is consistent with the eûects of these diets.[10] So, HDL-C and TG could be a promising marker of the atherogenicity and predictor of the severity of CAD, especially for the population of Bangladesh and other South-Asian countries. Considering the above facts, it is clear that, TG/HDL-C ratio could be a very important, easy, cheap, widely available non-invasive means of predicting the presence and extent of coronary atherosclerosis. Although association of high TG or low HDL-C and extent of CAD has been investigated in few Bangladeshi studies.[5] Probably no one has studied the association of TG/HDL-C ratio with severity of CAD in NSTEMI patients. As high TG and low HDL-C are the main lipid profile pattern in Bangladeshi population with CAD.[10] So, TG/HDL-C ratio, can be a very important marker for the prediction of the extent of CAD. Study showed that an TG/HDL-C ratio >4 is the most powerful independent predictor of CAD development.[11]

Methods:

This study was carried out in the Department of Cardiology, Dhaka Medical College Hospital, Dhaka from November 2022 to October 2023. A total number of 200 NSTEMI patients who were admitted in Department of Cardiology, DMCH and underwent CAG within the same hospital stay were included in the study by purposive sampling technique. Patient with valvular heart disease, acute and chronic heart failure, history of PCI or CABG, pregnancy, taking lipid lowering drugs and steroids, other co-morbid conditions like moderate to severe hepatic and renal impairment, COPD, stroke, active malignancy, hypothyroidism and hyperthyroidism were excluded from the study. After initial assessment treatment was given according to in hospital treatment protocol. Standard 12 lead surface ECG, Troponin I level and fasting lipid profile (within 12 hours of admission) was done in all the selected patients. TG/HDL-C ratio was calculated and patients divided into two groups. Patients with TG/HDL-C ratio ≤4 was considered as Group A (n=100) and TG/HDL-C ratio >4 was considered as Group B (n=100). Then coronary angiogram was performed in all study subjects in the same hospital period. Angiographic severity was assessed by Gensini score where 36 points was chosen as an appropriate cut-off value. Those with a Gensini score ≤36 points were considered as absent or mild coronary artery disease and those with a Gensini score >36 points were considered as moderate to severe coronary artery disease.[12] All data were recorded in preformed data collection sheet. After compiling data from all patients, statistical analysis was done by SPSS version 26.

Results:

This cross-sectional analytical study was carried out to find out association between Triglyceride/HDL-C ratio with severity of coronary artery lesion in NSTEMI patients. A total number of 200 NSTEMI patients who fulfilled inclusion and exclusion criteria, were included in the study. The patients were classified into two groups on the basis of TG/HDL-C ratio. The patients with TG/HDL-C ratio ≤4 was assigned as Group A (n = 100) and those with TG/HDL-C ratio>4 was assigned as Group B (n = 100). Angiographic severity was measured by Gensini score.

Minimum age of the respondents was 36 years and maximum were 73 years. The mean age of the total

population was 55.13±8.49 years, wherein maximum patients were between 50–59 years age group (37.5%). Age in both groups were similarly distributed (p>0.05) (Table I). 69% were male in Group A and 81% in Group B were male. Female were 31% in Group A and 19% in Group B. Both groups have similar gender distribution (p=0.050). Out of total 200 patients, proportion of male (75%) was higher than female (25%). Male: female ratio was 3:1.

Table-I

Demographic characteristics of the study subjects by age (N = 200).

	Group A (n=100)	Group B (n=100)	p- value
Age Groups (years)			
<40	6	3	0.44^{ns}
40-49	21	15	
50-59	38	37	
60-69	32	41	
≥70	3	4	
Mean± SD (years)	55.08± 9.75	55.17± 7.06	0.94^{ns}
Gender			
Male	69	81	0.050^{ns}
Female	31	19	

Data were expressed as frequency and mean ± SD

Independent sample t-test and chi square test was performed to compare between two groups. Chi-square Test was done to observe association between variables and independent sample t-test was done to compare Mean±SD. ns = not significant. Group A: patients with TG/HDL-C ratio ≤4. Group B: patients with TG/HDL-C ratio >4.

This table-II showed that hypertension, diabetes mellitus, dyslipidaemia and obesity were significantly higher in Group B (p<0.05). However, other risk factors (smoking and family history of CAD) were similarly distributed in both groups (p>0.05).

Table-II

Distribution of the study subjects according to cardiovascular risk factors (N = 200).

Risk factors	Group A (n=100)	Group B (n=100)	p value
Hypertension	43	64	0.003^{s}
Diabetes mellitus	20	46	0.001^{s}
Obesity	21	41	0.002^{s}
Smoking	42	54	0.089^{ns}
Dyslipidemia	30	52	0.002^{s}
Family History of Premature CAD	18	27	0.128^{ns}

Chi-squared Test was done to observe association. ns = not significant; s= significant. Group A: patients with TG/HDL-C ratio ≤4; Group B: patients with TG/HDL-C ratio >4

This table-III showed high level of triglycerides, Total cholesterol, HDL cholesterol, TG/HDL-C ratio in Group B (p<0.05 for all three variables) as expected but similar distribution of LDL cholesterol in both groups (p=0.29).

Table-III

Comparison of lipid variables between two groups (n = 200).

Lipid Parameters	Group A (n=100) Mean±SD	Group B (n=100) Mean±SD	Total (n=200) Mean±SD	p value
Triglycerides (mg/dl)	124±26	188±36	156±45	<0.001^{s}
HDL cholesterol (mg/dl)	42±11	36±7	39±10	<0.001^{s}
LDL cholesterol (mg/dl)	112±43	124±38	118±41	0.29^{ns}
Total Cholesterol (mg/dl)	182±41	205±53	194±49	0.001^{s}
TG/HDL-C ratio	3.09±.78	5.43±1.31	4.26±1.59	<0.001^{s}

Data were expressed as mean ± SD. Independent sample t-test was done to compare Mean±SD. ns = not significant; s= significant. Group A: patients with TG/HDL-C ratio ≤4. Group B: patients with TG/HDL-C ratio >4

Table-IV

Angiographic severity of coronary artery disease by Gensini score (n=200).

Gensini score	Group A (n=100)	Group B (n=100)	p-value
≤36	64	16	<0.001[s]
>36	36	84	
Mean+ SD	30±12	71±23	<0.001[s]

Chi-square Test was done to observe association and Independent sample t-test was done to compare Mean±SD. ns = not significant; s= significant. Group A: patients with TG/HDL-C ratio ≤4; Group B: patients with TG/HDL-C ratio >4

Table-IV showed, Angiographic severity of CAD by Gensini score. After calculation of Gensini score, 36 points were chosen as an appropriate cut-off value, those with a Gensini score ≤36 points were considered as absent or mild coronary artery disease and those with a Gensini score >36 points were considered as moderate to severe coronary artery disease. Gensini score in Group B were significantly higher than Group A (71±23 vs. 30±12, p<0.001).

Table-V

Bivariate analysis of variables with Gensini score in patients with NSTEMI (n=200).

Variables	Correlation co-efficient (r)	Significance
TG: HDL-C ratio[a]	0.803	<0.001*
Age[a]	0.214	0.002*
Sex (female)[b]	-0.11	0.012*
Diabetes mellitus[b]	0.208	0.053 ns
Hypertension[b]	0.244	0.001*
Obesity[b]	0.11	0.126 ns
Smoking[b]	0.14	0.054ns
Family history of premature CAD[b]	0.04	0.552 ns
Dyslipidemia[b]	0.203	0.54ns

*Correlation is significant at the 0.05 level (2-tailed). a= Pearson correlation; b= point biserial; ns= not significant

As data was in normal distribution, bivariate analysis was performed using Pearson correlation. Bivariate analysis was also carried out on dichotomous variables by using point biserial correlation. TG/HDL-C ratio (r=0.803, p<0.001), age (r=0.214,p=0.002), female sex (r=-0.11, p=0.012) and hypertension (r=0.244, p=0.001) were found to have significant positive correlation with Gensini score. Smoking, dyslipidemia, obesity, diabetes mellitus and family history of premature CAD, had no significant correlation with Gensini score. Correlation coefficient (r) of TG/HDL-C ratio was 0.803 which indicate a strong positive linear relationship between TG/HDL-C ratio and Gensini score. Though age had statistically significant p value (0.002) its 'r' was 0.214. That indicates, age had weakly positive correlation with Gensini score. Like this, hypertension was weakly correlated with Gensini score (r=0.244). Female sex had weakly negative significant correlation with Gensini score (r=-0.11).

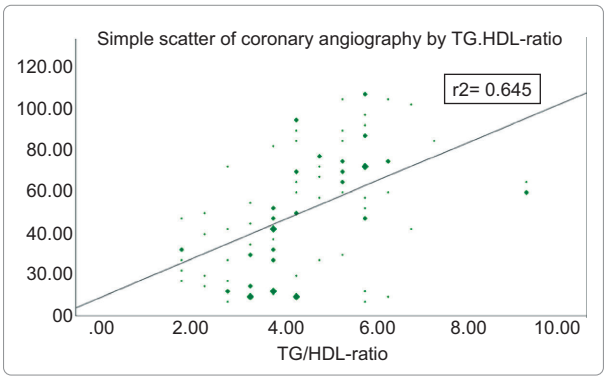

Figure-1: *Scatter plot diagram showing correlation between TG/HDL-C ratio and Gensini score (n=200).*

Scatter plot diagram in figure-1 showed a linear positive relationship between TG/HDL-C ratio and Gensini score. Coefficient of determination (r^2) was 0.645 which means 64.5% variability of Gensini score was associated with TG/HDL-C ratio and remaining 35.5% due to other factors.

Table-VI

Multivariate logistic regression of variables having significant positive correlation with Gensini score in patients with NSTEMI (n=200).

Variables of interest	AOR	95% CI of AOR	p-value
TG/HDL-C ratio >4	7.98	4.0-15.91	<0.001[s]
Age	1.47	0.70-3.08	0.306[ns]
Sex (female)	1.37	0.93-3.49	0.09[ns]
Hypertension	1.88	0.97-3.65	0.06[ns]

AOR=Adjusted odds ratio. s = significant (p<0.05); ns = not significant (p>0.05)

In table- VI multivariate logistic regression model was constructed with TG/HDL-C ratio >4, age, sex(female) and hypertension as independent variable and Gensini score >36 as dependent variable. TG/HDL-C ratio >4 was found to be significantly associated with Gensini score >36 (AOR=7.98, 95% CI=4.0-15.91, p<0.001).

Discussion:

Clinicians have focused a great deal of attention on dyslipidemia as it increases the risk of atherosclerotic CAD. There is growing evidence to indicate that TG/HDL-C ratio, is more useful in classifying CAD risk than single indices like TG, TC, LDL-C, and HDL-C. However, TG/HDL-C ratio varied greatly across populations and ethnicities.[13] Hence, this study was aimed to find out the association between TG/HDL-C ratio with severity of coronary artery lesion in NSTEMI patients in a tertiary care center of Bangladesh. A total number of 200 NSTEMI patients were included in the study and classified into two groups on the basis of TG/HDL-C ratio (TG/HDL-C ratio ≤4 vs. TG/HDL-C ratio >4).

Main findings of this study were as follows: (1) TG/HDL-C ratio was associated with severity of CAD in patients with NSTEMI, (2) Severity of CAD was higher in patient belonging to higher TG/HDL-C ratio >4 group in respect to lower TG/HDL-C ratio ≤4 group, (3) Multiple linear regression analysis revealed an independent association between serum TG/HDL-C ratio and angiographic severity of CAD in patients with NSTEMI.

In this study, the mean age of the total population was 55.13±8.49 years with male predominance (75%). This is consistent with the other studies conducted on NSTEMI in Bangladesh.[14] Kyto and his colleagues observed that men have a 2.4-fold overall risk for NSTEMI compared with women, and incidence rate of NSTEMI increases by an estimated 61% per five-year increase in age.[4]

In our study, prevalence of hypertension was significantly higher in high TG/HDL-C ratio group (64%) compared to lower TG/HDL-C ratio group (43%). Several other studies also found significant association between high TG/HDL-C ratio and increased blood pressure.[15-17] Hence, high TG/HDL-C ratio levels in NSTEMI patients may warrant closer monitoring of blood pressure since it may predict poor blood pressure control in this population.

In current study, prevalence of diabetes mellitus was also significantly higher in patients with high TG/HDL-C ratio. Wan et al. also found similar significant association between presence of DM and high TG/HDL-C ratio.[13] In a 10-years cohort study, the ratio of TG/HDL-C was found to be a stronger predictor of Type-2 diabetes mellitus development within 10 years than LDL-C, HDL-C or TG indicating that it may be useful in future medical treatment support.[18] Besides this, obesity is also significantly associated high TG/HDL-C ratio, which was also supported by several previous studies.[19,20]

Interestingly this study showed that cardiovascular risk factors such as age, sex, smoking, and family history of CAD did not have a significant effect on the TG/HDL-C ratio and Gensini score. Sudjana et al. also found no significant association of these factors with TG/HDL-C ratio and coronary angiographic severity.[21] This suggests that atherosclerosis risk factors that were previously considered as confounders in this study did not interfere with the relationship between the TG/HDL-C ratio and the degree of coronary lesion severity based on the Gensini score.

In this study, angiographic severity of CAD was measured by Gensini score. A strong positive linear relationship was found between TG/HDL-C ratio and Gensini score. Gensini score was significantly higher in high TG/HDL-C ratio >4 participants. That means, with the increase of TG/HDL-C ratio, Gensini score also increased, indicating more severe CAD. Similarly, Sudjana et al.,[21] and Wan et al.,[13] also noticed significant strong positive correlation between TG/HDL-C ratio and Gensini score.

In current study, a multivariate model that included others confounding variables, the TG/HDL-C ratio was found to be the powerful independent indicator of extensive coronary disease. These results also support the previous studies.[21-24] This indicates patients who had high TG/HDL-C ratio >4 had developed more severe CAD. In a recent Chinese study, it was shown that

the TG/HDL-C ratio was a good predictor of the CAD severity.[25] A Japanese study also demonstrated that the prevalence of plaques, and especially the high-risk, vulnerable plaques, was significantly higher in the group with the higher TG/HDL-C ratio, also supporting a prognostic value of TG/HDL-C ratio for potential future cardiovascular events.[26]

Limitations:

All samples were collected from a single center, which may not represent the general population. The sample was taken purposively. Randomization was not done. So, there may be chance of bias which can influence the results.

Conclusion:

This study assessed the association between TG/HDL-C ratio with angiographic severity of coronary artery lesion in NSTEMI patients. A strong positive linear relationship was found between TG/HDL-C ratio and angiographic severity of coronary artery lesion measured by Gensini score. Hence, it can be concluded that the TG/HDL-C ratio is an independent predictor for severe coronary artery disease. However, further large-scale multicenter research is warranted to corroborate our research findings.

Conflict of Interest - None.

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