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RESEARCH PAPER

Association of Triglyceride-Glucose Index with the Severity (Assessed by SYNTAX Score) of Coronary Artery Disease in Patients with Acute Coronary Syndrome

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Abstract

Background: Acute Coronary Syndrome (ACS) is a significant manifestation of coronary artery disease (CAD). Severity of CAD is determined by SYNTAX score based on coronary angiogram which is an invasive procedure. A noninvasive evaluation of CAD severity by Triglyceride-Glucose (TyG) index before coronary angiogram might help with risk assessment and selection of treatment strategy.

Objective: To evaluate the association of Triglyceride-Glucose (TyG) index with severity of CAD determined by SYNTAX score in patients with ACS.

Methods: This cross-sectional study was done in the department of Biochemistry of Sir Salimullah Medical College from March 2024 to February 2025. A total 224 patients with ACS undergoing coronary angiography were enrolled as study subjects by purposive sampling. TyG index was calculated from fasting plasma glucose and fasting serum triglycerides level. Subjects were grouped according to the tertile of TyG index into tertile 1 (T1), tertile 2 (T2) & tertile 3 (T3). A SYNTAX score of ≤22 was considered as not severe and a SYNTAX score of > 22 was considered as severe CAD. Severity of CAD was compared among different tertile groups by chi-square test. Association of high TyG Index with severity of CAD was determined by odds ratio (OR). The correlation of TyG Index with severity of CAD was determined by Pearson's correlation coefficient test. The cut-off point of TyG index was determined by Youden's Index. The diagnostic role of TyG index for detection of severe CAD was determined by Receiver operator characteristic (ROC) curve, the area under (AUC) curve, sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and accuracy. P-value ≤0.05 was considered statistically significant.

Results: Among 224 subjects divided into TyG index tertiles, the highest tertile (T3) was strongly associated with a high SYNTAX score (>22), and subjects with high TyG index (>8.47) found to have 37.83 times more risk to have severe CAD (OR= 37.83, CI:17.06-84.0). The TyG index showed a significant positive correlation with the SYNTAX score (r=0.880, p< 0.001). Receiver operating characteristics (ROC) curve analysis of TyG index (cut-off point 8.47) for predicting severe CAD showed the area under curve (AUC) to be 0.99, sensitivity 76.5%, specificity 92.0%, PPV 88.0%, NPV 83.5% and accuracy 85.0%.

Conclusion: High TyG index was associated with increased severity of coronary artery disease in ACS patients. High TyG index was a good predictor of severe CAD with high sensitivity , specificity, diagnostic accuracy and AUC.

Key words: Coronary Artery Disease, Acute Coronary Syndrome, Triglyceride-Glucose Index, SYNTAX score.

Introduction

Coronary artery disease (CAD) is a major contributor to disability and the world's leading cause of mortality.[1] Globally, the primary cause of premature mortality and disability is cardiovascular disease (CVD).[2] Racial differences in CAD prevalence are significant.[3] Individuals from South Asia including Bangladesh, Sri Lanka, Pakistan, India & Nepal have a higher prevalence of CAD and related risk factors.[4] In Bangladesh, the prevalence ranges from 0.33% to 19.6% as reported in many studies. Despite marked

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disparity in values, there seems to be a rising prevalence & mortality from CAD.[4]

Coronary artery disease is an inflammatory disease of the cardiac blood vessels. An inflammatory response is triggered when the innermost lining of blood vessels is damaged by a variety of metabolic processes. A thrombus may form and then embolize as a result of a destabilized fibroma rupturing together. Alternatively, the fibroma enlarges to the point where it obstructs the artery to a considerable degree, which results in tissue ischemia.[3]

Coronary artery disease irrespective of gender has been linked to these well known risk factors, which include tobacco use, unhealthy diet, obesity, physical inactivity, hypertension, diabetes, hyperlipidemia, and excessive alcohol consumption. However certain risk factors are unique to women, such as menopause, polycystic ovary syndrome, preterm birth, pre-eclampsia, gestational diabetes mellitus, primary ovarian insufficiency, and pregnancy-induced hypertension.[5]

Acute coronary syndrome (ACS) is the symptomatic manifestation of coronary artery disease. The impact and burden of ACS are remarkable.[6] ACS includes unstable angina, acute non-ST-segment elevation myocardial infarction (NSTEMI), and acute ST-segment elevation myocardial infarction (STEMI) (7).Acute coronary syndrome is the leading cause of death and morbidity, contributing to almost 2.5 million hospitalizations annually and 50% of all fatalities from CVD.[7]

Significance of Insulin resistance (IR) in the manifestation of ACS has been revealed in different studies. The interaction between IR with the traditional risk factors adds more complexity to the clinical scenario.[8] In IR, body tissues show less sensitivity to the physiological action of Insulin. IR raises the risk of dyslipidemia, hypertension & hyperglycemia. These metabolic abnormalities have strong association with acceleration of atherosclerosis by producing inflammation, vasoconstriction and thrombosis.[9]

A recent study conducted on Brazilian population revealed that TyG index has better ability to identify patients with IR when compared to HOMA score.[10] Triglyceride-glucose (TyG) index indirectly assess IR via a mathematical model which uses laboratory data of fasting plasma glucose level & fasting triglycerides.[11] Previous study showed an association between TyG index & progression of coronary artery calcification.[12] Therefore, TyG index through insulin resistance and accelerated atherosclerosis is linked with severity of CAD.

The Synergy between Percutaneous Coronary Intervention with Taxus and Cardiac Surgery (SYNTAX) score is a comprehensive angiographic tool. It is well known scoring system practiced widely that considers anatomic risk factors to assess CAD complexity.[13] Individuals who score higher on SYNTAX are more likely to have complex medical conditions and to experience significant adverse cardiovascular events.[14] Angiography is done in a well- equipped tertiary hospital where cath Lab & Coronary Care Unit (CCU) support are available. To address this limitation, noninvasive assessment of the severity of coronary artery disease is highly demanded which can be beneficial for early risk stratification & choice of therapeutic approach in such patients. In this perspective, TyG index as noninvasive marker can be the focus of interest.

To date, very few studies have explored the link between the TyG index & the CAD severity as assessed by the SYNTAX Score in patients with Acute Coronary Syndrome (ACS). This study aimed to investigate this relationship between TyG index and CAD severity in ACS patients.

Materials and Methods

This cross-sectional analytical study was conducted in the department of Biochemistry of Sir Salimullah Medical College, Dhaka, from March 2024 to February 2025. A total of 224 diagnosed patients of ACS undergoing coronary angiography were selected by purposive sampling using set selection criteria from the department of cardiology, sir salimullah medical college mitford hospital (SSMCMH) and national institute of cardiovascular diseases (NICVD), Dhaka. Exclusion criteria included individuals with history of cardiomyopathy or heart valve disease, cardio-vascular disease other than coronary artery disease, infection, hepatic disease / renal disease, thyroid disease, autoimmune disease, malignancy, pregnant & lactating women. The study analyzed both independent and dependent variables. Independent

variables are FPG, Fasting TG, TyG Index, and dependent variable was SYNTAX score.

Fasting blood samples were collected after an overnight fast of 10-12 hours. A total of 5 mL of venous blood was drawn, with 2 mL collected in sodium fluoride tubes for fasting plasma glucose measurement and 3 mL in plain tubes for fasting serum triglycerides assessment. Samples were processed in the Biochemistry laboratory of Sir Salimullah Medical College using standard biochemical methods. Fasting plasma glucose was estimated using the glucose oxidase method, fasting serum triglycerides using the enzymatic GPO-PAP method. The TyG index was calculated using the formula: Ln [fasting triglycerides (mg/dL) × fasting glucose (mg/dL)/2]. Participants were divided into three groups on the basis of the tertiles of TyG Index as tertile 1 (T1), tertile 2 (T2) and tertile 3 (T3). All patients underwent coronary angiogram. During procedure by using a web-based online calculation tool, the SYNTAX score was calculated from Coronary angiogram by cardiologists who were blinded to the study protocol and baseline clinical characteristics. SYNTAX score > 22 was considered as severe CAD.[13]

Ethical clearance was obtained from the Institutional Ethics Committee of sir salimullah medical college. Participants were informed about the study's purpose, risks, and procedures, and only those who provided written consent were included. Socio-demographic and clinical data were collected using a structured questionnaire.

Data were checked, and processed systematically. Statistical analysis was performed using SPSS version 27. Continuous variables were expressed as mean ± standard deviation, while categorical variables were presented as percentages. Severity of CAD as determined by SYNTAX score is compared among different tertile groups by chi-square test. Association of high TyG Index with severity of CAD was determined by odds ratio (OR) and Pearson's correlation coefficient test. To assess the diagnostic performance of TyG index for detection of severe CAD, cut-off point of TyG index was determined by Youden's Index. Subsequently depending on that cut-off point, performance of TyG index for detection of severe CAD was determined by Receiver operating characteristics (ROC) curve, the area under (AUC) curve, sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and accuracy. A p-value of ≤ 0.05 was considered statistically significant.

Results

A total 224 patients with acute coronary syndrome (ACS) undergoing coronary angiography were included in this study purposively and were divided into three groups according to the tertile of TyG Index; tertile 1 (T1), tertile 2 (T2) and tertile 3 (T3). The mean age was 54.28 ± 6.43 years with a higher proportion of males (61.6.%) compared to females (38.4%)(table-I).

Table I: Age and Gender distribution of the study subjects (N=224)

Variables	
Age (m ± SD)	54.28 ± 6.43
Gender	
Male	138 (61.6%)
Female	86 (38.4%)

The comparison of CAD severity (SYNTAX score) among the three groups based on TyG index tertile showed a significant association between higher TyG index levels and the presence of severe CAD (p=0.00), as determined by the Chi-square test(table-II). The patient with high TyG index (> 8.47) showed significantly increased risk of developing severe coronary artery disease(OR 37.83, CI-17.06-84.0, p-value<0.000001) (table-III).

The scattered diagram showing the strong positive correlation ($r = 0.880$; $p < 0.001$) between TyG index and SYNTAX score in all study subjects and Coefficient of determination ($R^2 = 0.77$) indicates that approximately 77% of the variability in CAD severity can be explained by high TyG index (figure-1).

The receiver operating characteristics (ROC) Curve analysis of TyG index for predicting severe CAD (SYNTAX score >22), showing an excellent diagnostic performance with an AUC of 0.99 (figure-2).

The optimal cut-off value of TyG index was 8.47, determined by Youden's index . By using this cut off value TyG index had a sensitivity 76.5%, specificity 92.0%, positive predictive value (PPV) 88.0%, negative predictive value (NPV) 83.5%, and accuracy 85.0%, indicating good diagnostic performance for detection of severe CAD (table-IV).

Table II: Comparison of CAD severity (SYNTAX score > 22) among the three groups based on TyG index tertile (N=224)

Variables	Tertile 1(T_1) No. (%)	Tertile 2(T_2) No. (%)	Tertile 3(T3) No. (%)	*p*-value
SYNTAX score >22	0 (0.0%)	23 (10.27%)	75 (33.5%)	0.000
SYNTAX score ≤22	74 (33%)	52 (23.23%)	0 (0.0%)	0.000

p-value was determined by Chi-square test

Table III: Risk of severe CAD among the individuals with high TyG index (N= 224)

TyG index	Severe CAD (SYNTAX score > 22)	Not severe CAD (SYNTAX score ≤22)	Total	(OR) Odds Ratio	95% CI (Confidence Interval)	*p*- value
TyG index > 8.47	75	10	85			
TyG index ≤8.47	23	116	139	37.83	(17.06-84.0)	<0.000001
Total	98	126	224			

p-value was determined by Chi-Square test.

Table IV: Performance of TyG index for predicting severe CAD (SYNTAX score > 22)

Cut-off value	Sensitivity	Specificity	PPV	NPV	Accuracy	AUC
8.47	76.5%	92.0%	88.0%	83.5%	85.0%	0.99

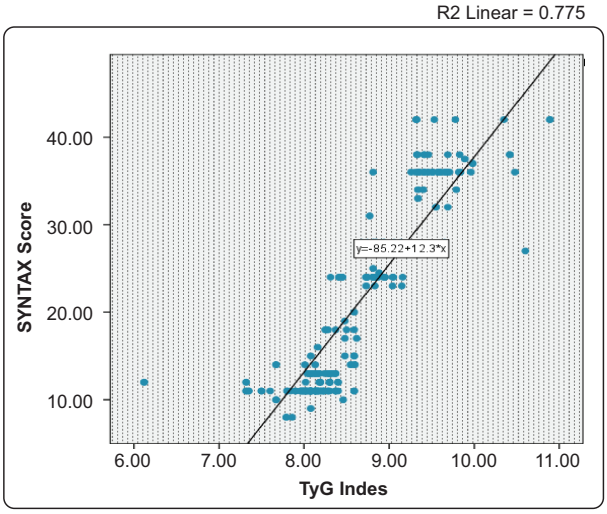

Figure 1: Pearson's Correlation coefficient of TyG index with SYNTAX score in all study subjects (r = 0.880)

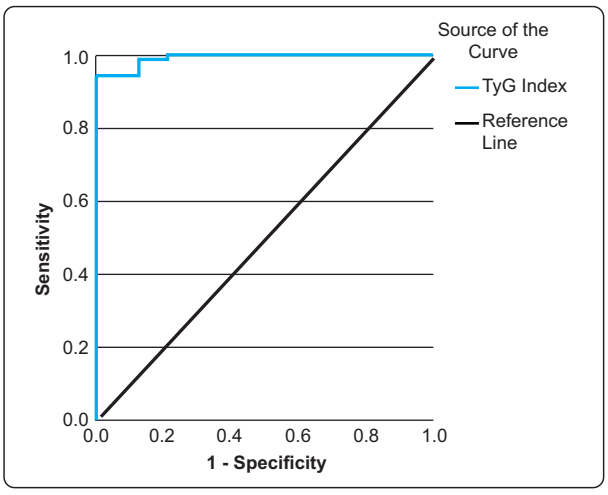

Figure 2: Receiver Operator Characteristic (ROC) Curve analysis of TyG index for predicting severe CAD (SYNTAX score > 22) with an AUC 0.99.

Discussion

This cross-sectional study was conducted in the Department of Biochemistry, Sir Salimullah Medical College, Dhaka. According to the tertile of TyG index 224 subjects were divided into three tertiles as T1, T2 and T3 respectively.

The mean age of the study participants was 54.28 ± 6.43 years, which reflects a predominantly middle-aged population. This is consistent with previous evidence showing that the incidence of coronary artery disease (CAD) increases with advancing age.[15] Similarly, a study examining the TyG index among patients with severe CAD reported a mean age of 61.8 ± 10.5 years, further supporting the relationship between age and CAD burden.[16] Although the mean age in that study was slightly higher, both findings reinforce the notion that middle age groups are at greater risk for atherosclerotic progression.

In this study, male participants constituted 61.6% of the total sample. This predominance of males is consistent with previous findings, which reported that 78.5% of patients presenting with acute coronary syndrome (ACS) were male.[15] Similarly, another study demonstrated that 74.6% of males had severe CAD associated with a high TyG index.[16] These observations reinforce the well-established evidence that men are more likely to develop CAD and exhibit more severe disease profiles, possibly due to differences in hormonal protection, risk-factor exposure, and lifestyle patterns.

A major findings of this study was the strong and significant correlation between the TyG index and the SYNTAX score ($r = 0.880$; $p < 0.001$), indicating that higher TyG index is associated with higher CAD severity. This result is consistent with previous research, which also demonstrated a significant positive association between the TyG index and the SYNTAX score ($r = 0.347$; $p < 0.001$).[17] Although the correlation reported in earlier studies was more moderate compared to the present findings, both results support the growing evidence that the TyG index is a useful marker for predicting the severity of coronary artery disease.

To evaluate the predictive ability of the TyG index for assessing CAD severity, a Receiver operating characteristics (ROC) curve analysis was performed. The analysis demonstrated excellent diagnostic performance, with an AUC of 0.993 ($p < 0.001$). Using Youden's index, a cut-off value of 8.47 was identified, providing high sensitivity (76.5%) and specificity (92.0%), resulting in an overall diagnostic accuracy of 85.0%. These findings indicate that the TyG index is a good and reliable marker for identifying patients with severe CAD. In comparison, another study reported a higher optimal TyG cut-off (> 9.68), but with lower sensitivity (65%) and specificity (63%).[18] The superior diagnostic parameters observed in the present study may be attributed to differences in population characteristics, disease severity, or methodological variations.

This study demonstrated a significant association between the TyG index and the SYNTAX score in patients who underwent coronary angiography diagnosed with acute coronary syndrome (ACS). This finding indicates that higher TyG values, which reflect increased insulin resistance, are closely linked to greater coronary lesion complexity. These results underscore the potential utility of the TyG index as a simple, cost-effective biomarker for identifying high-risk ACS patients and for guiding clinical decision-making.

Conclusion

High Triglyceride-Glucose (TyG) index was significantly associated with the severe CAD. TyG index is found to be a good predictor of severe CAD with very high sensitivity, specificity ,PPV ,NPV ,accuracy. These findings might reinforce the potential of the TyG index as a noninvasive and cost-effective biomarker for early detection of severity of CAD and risk stratification in patients with ACS.

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Conflict of Interest: There are no conflicts of interest.

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