Journal of Population Therapeutics & Clinical Pharmacology

RESEARCH ARTICLE
DOI: 10.53555/63q86r57

PREDICTION OF SEVERITY OF CORONARY ARTERY DISEASE IN PATIENTS WITH ACUTE CORONARY SYNDROME BY TRIGLYCERIDE GLUCOSE INDEX

Dr Fouzia Goher[1]*, Dr Mudassar Iqbal[2], Dr Muhammad Irfan[3], Dr Anwaar Ul Hassan[4], Dr Muhammad Umar Iqbal[5], Dr Muhammad Sarwar Khalid[6]

[1]*,[3,4,5]Assistant Professor, Cardiology, PIC/Quaid E Azam Medical College, Bahawalpur, Pakistan
[2]Assistant Professor, Department of Cardiology, Ch Pervaiz Elahi Institute of Cardiology Multan, Pakistan
[6]Associate Professor, Department of Cardiology, PIC/Quaid E Azam Medical College Bahawalpur, Pakistan

***Corresponding Author:** Dr Fouzia Goher
*Assistant Professor, Cardiology, PIC/Quaid E Azam Medical College Bahawalpur, Pakistan,
Email: fouziagoher84@gmail.com

ABSTRACT
The study was conducted to determine the prognostic ability of triglyceride glucose index for coronary heart disease in subjects with acute coronary syndrome.This retrospective observational study was done in the Cardiology Department, Punjab Institute of Cardiology/Quaid E Azam Medical College Bahawalpur from January 2024 to June 2024. Two hundred patients with acute coronary syndrome undergoing coronary angiography were analyzed.Biochemical variables were measured after 8 hours overnight fasting and TyG index was calculated. SYNTAX score was calculated by online tool through preprocedural angiograms and divided into low score and moderate-high score. Results showed that in the multivariate analysis, TyG index was independently associated for prediction of complex CAD (OR: 2.66 (95% CI: 1.86-3.70, p<0.001). According to Spearman's correlation test revealed a weak but significantly positive relationship (r=0.019, p<0.001).Triglyceride glucose index was an independent predictor of CAD severity irrespective of diabetes status.It is concluded that TyG index and complex CAD were strongly and positively related in acute coronary syndrome patients with acute coronary syndrome.

Keywords: Acute coronary syndrome, Coronary artery disease, Percutaneous coronary intervention, SYNTAX score

INTRODUCTION
SYNTAX score is widely used scoring system for evaluation of clinical and anatomical risk factors to predict severity of coronary artery disease and mortality. It is a tool to help surgeons deicide the best surgical intervention between CABG and percutaneous coronary intervention in case of severe CAD.[1]Complexity of CAD is divided into low, intermediate or high to assess risk of cardiovascular events.[2, 3]Non-invasive assessment of complexity of CAD before coronary angiography is useful for categorization and management of acute coronary syndrome.
Literature widely agrees that insulin resistance is an important risk factor of pathology and incidence of cardiovascular disease.[4]IR increases the probability of atherosclerotic cardiovascular

disease and adverse cardiovascular events. Recent research has shown triglyceride glucose index has been suggested as the surrogate markers of IR.[5, 6]It has been revealed that TyG index independently predicts the prognosis of calcification. It is also arisk factor of atherosclerotic cardiovascular events such as heart attack and poor outcome of acute coronary syndrome.
This study was conducted to determine the prognostic ability of triglyceride glucose index for coronary heart disease in subjects with acute coronary syndrome.

METHODOLOGY

A retrospective observational study was done in the Department of Cardiology, Punjab Institute of Cardiology/Quaid E Azam Medical College Bahawalpur from January 2024 to June 2024. Two hundred patients with acute coronary syndrome undergoing coronary angiography were analyzed. Patients with missing data such as SYNTAX score or TyG index were excluded. All patients were briefed about procedure and informed consent was taken. The ethical committee of the hospital approved the study.
Sociodemographic features, medical records including history of percutaneous coronary intervention, diabetes, stroke, hypertension, atrial fibrillation & COPD, smoking status, procedural data and laboratory test findings were recorded. Biochemical variables were measured after 8 hours overnight fasting including blood sugar, creatinine, total cholesterol, high- & low-density lipoprotein, triglycerides, brain natriuretic peptide and cardiac troponin was measured. 2-D modified Simpson' method was used to calculate left ventricular ejection fraction. Fasting triglyceride levels and fasting blood glucose were multiplied to calculate TyG index. SYNTAX score was calculated by online tool through preprocedural angiograms and divided into low score and moderate-high score.
All data analysis was done by SPSS version 26 and R foundation software version 4. Frequency and percentage were employed to describe categorical parameters and Fisher's exact test or x^2 test were performed to compare them. Mean ± SD or median (IQR) were employed to describe continuous parameters and t-test or Mann-Whitney U test, respectively were performed to compare them. ANOVA test and Kruskal-Wallis test were performed for comparison of continuous data across tertiles of TyG index and categorical variables were compared by chi-square test. Association of SYNTAX score with study variables was assessed by Spearman's correlation test. Relationship between TyG index and SYNTAX score was evaluated by logistic regression analysis. Variables that were statistically significant without adjustment of other factors were analyzed in multivariable analysis and presented as OR (95% CI). In model 1 of logistic regression analysis, parameters were controlled for diabetes, age, hypertension and BMI and in model 2, BNP, heart rate and creatinine levels were also considered confounding factors in addition to the ones in model 1. The predictive ability of TyG index was determined by calculation of area under the ROC curve. Statistical significance was set at less than 0.05.

RESULTS

A total of 200 patients with acute coronary syndrome were included with an average age of 65.48 ± 10.35 years and 28.5% were females. Patients with TyG index higher than 8.67 and 9.18 were more likely to have left main lesion, diabetes, chronic total occlusion and multi-vessel disease along with elevated levels of LDL-C, fasting blood glucose, total cholesterol, triglycerides, SYNTAX score, TyG index and higher number and length of stents (Table I).
High SYNTAX score was related to older age, increased incidence of diabetes, acute myocardial infarction, high blood pressure, multi vessel disease, left main lesion, long lesion, calcified lesions, chronic total occlusion and thrombosis. In addition, these patients also had elevated cardiac troponin, heart rate, BNP, creatinine, fasting glucose, triglycerides, TyG indexand higher number and length of stents.
Significant predictors of high SYNTAX score in univariate analysis were age ($p<0.001$), BMI ($p=0.012$), history of diabetes ($p=0.022$)& hypertension ($p=0.036$), heart rate, BNP, creatinine, fasting glucose, triglycerides and TyG index. Since fasting glucose and triglycerides are parameters

of TyG index, they were excluded from multivariate analysis. In the multivariate analysis, Triglyceride glucose index was independently associated for prediction of complex CAD (OR: 2.66 (95% CI: 1.86-3.70, p<0.001)(Table II).

A significant association was found between TyG index and SYNTAX score when TyG was considered as a continuous variable (OR: 2.522 (95% CI: 1.712-3.343, p<0.001). In comparison to low SYNTAX score, the risk of higher SYNTAX score was increased by 2.1 times for 8.67 < TyG ≤ 9.18 (OR: 2.107 (95% CI: 1.257-3.165, p<0.001) and by 3.1 times for (OR: 3.109 (95% CI: 2.038-4.636, p<0.001). After adjusted of founding factors, TyG index an independent predictor as a categorical variable (OR: 2.550 (95% CI: 1.898-3.583, p<0.001) (Table III).

According to Spearman's correlation test, TyG index and SYNTAX score had a weak but significantly positive relationship (r=0.019, p<0.001).Restricted cubic spline showed a non-linear dose-response relationship (p=0.2). The AUC of TyG index was 0.528 (95% CI: 0.592-0.668) which was higher than that of fasting blood sugar (0.467, 95% CI: 0.531-0.617) and the difference was significant (p=0.095). These findings suggested that TyG index is the strongest risk factor for severity of CAD as compared to fasting glucose or triglyceride levels.

This association was also investigated with respect to diabetes status: 73 (36.5%) diabetics, 56 (28%) prediabetics and 71 (35.5%) normoglycemic patients. Triglyceride glucose index was an independent predictor of CAD severity in diabetics (Odds ratio: 2.571, 95% confidence interval: 1.490-4.578, p<0.001), prediabetics (Odds ratio: 2.217, 95% confidence interval: 1.108-4.335, p=0.008) and normoglycemic patients (Odds ratio: 2.897, 95% confidence interval: 1.348-5.688, p=0.005).

Table I: Patients data based on TyG index categorization

	TyG ≤ 8.67 (n=70)	**8.67 < TyG ≤ 9.18 (n=66)**	**TyG > 9.18 (n=68)**	**P value**
Mean age	66.81 ± 10.59	64.76 ± 10.38	65.11 ± 10.08	0.052
Female gender	14 (20%)	17 (25.8%)	26 (38.3%)	<0.001
Mean BMI	22.66 ± 2.93	23.70 ± 2.70	23.59 ± 2.78	<0.001
Smokers	38 (54.3%)	40 (60.7%)	34 (50%)	0.059
History of PCI	7 (10%)	5 (7.6%)	6 (8.9%)	0.071
COPD	5 (7.2%)	4 (6.1%)	4 (6%)	0.408
Hypertension	45 (64.3%)	44 (66.7%)	45 (66.2%)	0.710
Diabetes	11 (15.8%)	24 (36.4%)	38 (56%)	<0.001
Atrial fibrillation	5 (7.2%)	4 (6.1%)	6 (8.9%)	0.844
History of stroke	6 (8.6%)	5 (7.6%)	6 (8.9%)	0.868
Mean systolic blood pressure	130.33 ± 20.02	131.75 ± 21.29	131.67 ± 21.00	0.595
Mean heart rate	75.18 ± 13.09	77.20 ± 14.32	77.87 ± 13.83	0.061
Cardiac troponin	31.49 (10.23,900.96)	29.52 (10.45,535.47)	63.84 (12.55,1181)	0.089
BNP	110.89 (45.52,299.88)	96.2 (30.7,241.83)	119.81 (40.4,380.93)	0.032
Creatinine	78.57 (65.30,89.26)	76 (64.57,90.57)	72.85 (60.24)	0.340
Mean fasting blood glucose	5.49 ± 1.17	6.51 ± 1.80	9.01 ± 3.63	<0.001
Mean triglycerides	1.02 ± 0.34	1.57 ± 0.38	2.18 ± 0.91	<0.001
Mean total cholesterol	4.13 ± 1.12	4.64 ± 1.30	4.82 ± 1.25	<0.001
HDL-C	1.18 ± 0.29	1.08 ± 0.22	1.07 ± 0.23	<0.001
LDL-C	2.53 ± 0.85	2.91 ± 1.00	3.01 ± 0.92	<0.001

Acute myocardial infarction	35 (50%)	33 (50%)	40 (58.9%)	0.173
Diagnosis				0.141
Unstable angina	35 (50%)	31 (47%)	29 (42.7%)	
NSTEMI	14 (20%)	17 (25.8%)	17 (25%)	
STEMI	21 (30%)	18 (27.4%)	22 (32.3%)	
Multivessel disease	42 (60%)	45 (68.2%)	52 (76.5%)	<0.001
Left main disease	2 (2.9%)	5 (7.6%)	6 (8.9%)	<0.001
Calcified lesions	8 (11.5%)	8 (12.2%)	12 (17.7%)	0.151
Thrombosis	5 (7.2%)	5 (7.6%)	7 (10.3%)	0.153
Long lesion	28 (40%)	29 (44%)	36 (53%)	0.001
Chronic total occlusion	11 (15.8%)	13 (19.8%)	17 (25%)	0.039
Stents number	1.26 ± 0.73	1.38 ± 0.90	1.59 ± 1.02	<0.001
Baseline SYNTAX score	10.0 (6.0, 16.5)	12 (7, 19)	15 (11, 24.5)	<0.001
Length of stents	33.08 ± 21.69	36.00 ± 25.47	42.96 ± 30.71	<0.001
TyG index	8.28 ± 0.27	8.89 ± 1.23	9.49 ± 0.29	<0.001

Table II: Predictors of severity of coronary heart disease

	Univariate analysis	**P**	**Multivariate analysis**	**P**
Age	1.05 (1.04-1.07)	<0.001	0.99 (0.97-1.06)	0.007
Female	1.11 (0.82-1.49)	0.709		
BMI	0.88 (0.92- 1.11)	0.012	0.90 (0.85-1.04)	0.030
Smoking	0.80 (0.58-1.22)	0.314		
History of PCI	0.87 (0.49-1.59)	0.831		
Hypertension	1.37 (1.00-2.00)	0.036	1.36 (0.88-1.92)	0.096
Diabetes	1.51 (1.11-2.05)	0.022	0.92 (0.58-1.33)	0.611
Atrial fibrillation	1.71 (0.89-3.01)	0.078		
SBP	1.03 (1.00-1.04)	0.375		
Heart rate	0.98 (0.96-0.99)	0.039	1.00 (1.03-1.05)	0.410
Cardiac troponin	1.00 (1.00-1.00)	0.090		
BNP	1.00 (1.00-1.00)	<0.001	1.00 (1.00-1.00)	0.009
Creatinine	1.00 (1.00-1.00)	0.004	1.00 (0.98-1.00)	0.071
TyG index	2.39 (1.79-3.25)	<0.001	2.66 (1.86-3.70)	<0.001
Blood sugar	1.13 (1.05-1.16)	0.006		
Triglycerides	1.83 (1.51-2.18)	<0.001		
Total cholesterol	1.08 (1.00-1.31)	0.109		
HDL-C	1.12 (0.60-1.77)	0.759		
LDL-C	1.04 (1.02-1.20)	0.108		

Table III: Impact of TyG index on severity of CAD

	Non-adjusted	**P**	**Model 1**	**P**	**Model 2**	**P**
Triglyceride glucose index	2.522 (1.712-3.343)	<0.001	2.823 (1.872-3.656)	<0.001	2.550 (1.898-3.583)	<0.001
TyG ≤ 8.67	Reference					
8.67 < TyG ≤ 9.18	2.107 (1.257-3.165)	<0.001	2.376 (1.464-3.821)	<0.001	2.469 (1.507-4.106)	<0.001
TyG > 9.18	3.109 (2.038-4.636)	<0.001	3.568 (2.212-5.799)	<0.001	3.627 (2.225-5.887)	<0.001

DISCUSSION

This study was conducted to determine the predictive efficacy of TyG index for complexity of CAD in patients with acute coronary syndrome. The results found that TyG index was independently associated to high severity of CAD. This indicated that a high IR presented as triglyceride glucose index increased the risk of severe coronary lesions. This is compliant with previous studies.[7, 8]

Many studies have confirmed that patients with severe and complicated CAD have poor prognosis and outcomes. Rong et al showed that a SYNTAX score is a risk factor of major cardiovascular events as seen in 34.5 months follow-up ($p<0.01$).[9]It was also reported that patients with high SYNTAX score were more likely to have successful revascularization than outcomes of medical therapy in patients qualified for CABG. People with complex CAD also showed better outcomes after undergoing CABG in comparison to patients undergoing PCI.[10]SYNTAX score has been recommended for assessment of severity of CAD by recent guidelines for decision making regarding treatment.[11]

A major finding of the present study is that TyG index was predictor irrespective of diabetic status of patients and it is also a non-invasive assessment tool. Contrary to our study Wang et al showed that the significant impact of triglyceride glucose index on multivessel disease was not found in prediabetics.[12]Saleh et al also showed that TyG index was indicative of a high risk of coronary artery stenosis in asymptomatic diabetics.[13] In current study, severity of CAD i.e thrombosis, multi vessel disease, chronic total occlusion, left main lesion, long & calcified lesions was associated with higher TyG index in both diabetics and non-diabetics.

There is adequate evidence that insulin resistance independently predicts the prognosis in CAD patients but it has not primarily usedfor risk prediction.[14]Hence, models such as SYNTAX score include both clinical and anatomical factors that provide better risk assessment.[15] Xiong et al concluded that adjusting the residual SYNTAX score based on TyG index helps in predicting the cardiovascular prognosis of diabetic patients undergoing PCI, suggesting that TyG index should be included in risk prediction models.[16]

This study is limited in some aspects including a small study population from a single hospital. Additionally, since the study had a retrospective design, we could not assess the casual association between TyG index and SYNTAX score.

CONCLUSION

TyG index and severity of CAD were strongly and positively related in acute coronary syndrome patients.

REFERENCES

1. Askin L, Tanriverdi O. The clinical value of syntax scores in predicting coronary artery disease outcomes. Cardiovascular Innovations and Applications. 2022;6(4):197-208.
2. Park S, Park S-J, Park D-W. Percutaneous coronary intervention versus coronary artery bypass grafting for revascularization of left main coronary artery disease. Korean circulation journal. 2023;53(3):113-33.
3. Xu M, Chen H, Li H-W. The association between SYNTAX score and long-term outcomes in patients with unstable angina pectoris: a single-centre retrospective study. BMC Cardiovascular Disorders. 2022;22(1):155.
4. Hill MA, Yang Y, Zhang L, Sun Z, et al. Insulin resistance, cardiovascular stiffening and cardiovascular disease. Metabolism. 2021;119:154766.
5. Sánchez-García A, Rodríguez-Gutiérrez R, Mancillas-Adame L, González-Nava V, et al. Diagnostic accuracy of the triglyceride and glucose index for insulin resistance: a systematic review. International journal of endocrinology. 2020;2020(1):4678526.
6. Tian X, Zuo Y, Chen S, Liu Q, et al. Triglyceride–glucose index is associated with the risk of myocardial infarction: an 11-year prospective study in the Kailuan cohort. Cardiovascular diabetology. 2021;20(1):19.

7. Mohanty V, Sharma S, Goswami S, Kaushik A, et al. Association of novel hematological indices with severity of coronary artery disease using SYNTAX score in patients with acute coronary syndrome. Cardiovascular & Haematological Disorders-Drug Targetsrug Targets-Cardiovascular & Hematological Disorders). 2023;23(3):202-11.
8. Rasheed H, Abdelhamid B, Allam H, Abdallah M. Evaluation of extent and severity of coronary artery disease in patients with type II diabetes mellitus using SYNTAX score. Benha Journal of Applied Sciences. 2023;8(11):49-53.
9. Rong Y, Li T, Chen Y, Liu H, et al. The SYNTAX score and the coronary artery calcium score for the prediction of clinical outcomes in patients undergoing percutaneous coronary intervention. Food Science and Technology. 2021;42:e29621.
10. Davierwala PM, Gao C, Thuijs DJ, Wang R, et al. Single or multiple arterial bypass graft surgery vs. percutaneous coronary intervention in patients with three-vessel or left main coronary artery disease. European heart journal. 2022;43(13):1334-44.
11. Lawton JS, Tamis-Holland JE, Bangalore S, Bates ER, et al. 2021 ACC/AHA/SCAI guideline for coronary artery revascularization: executive summary: a report of the American College of Cardiology/American Heart Association Joint Committee on Clinical Practice Guidelines. Circulation. 2022;145(3):e4-e17.
12. Wang X, Xu W, Song Q, Zhao Z, et al. Association between the triglyceride–glucose index and severity of coronary artery disease. Cardiovascular diabetology. 2022;21(1):168.
13. Saleh ME, Metwally NH, Elkanawaty MZ, Elsayed DM. Triglyceride Glucose Index for Detection of Silent Coronary Artery Disease in Patients with Type 2 Diabetes Mellitus. The Egyptian Journal of Hospital Medicine (July 2025).100:3180-9.
14. Song J, Xia X, Lu Y, Wan J, et al. Relationship among insulin therapy, insulin resistance, and severe coronary artery disease in type 2 diabetes mellitus. Journal of Interventional Cardiology. 2022;2022(1):2450024.
15. Yan L, Li P, Wang Y, Han D, et al. The incremental prognostic value of the clinical residual SYNTAX score for patients with chronic renal insufficiency undergoing percutaneous coronary intervention. Frontiers in Cardiovascular Medicine. 2021;8:647720.
16. Xiong S, Chen Q, Zhang Z, Chen Y, et al. A synergistic effect of the triglyceride-glucose index and the residual SYNTAX score on the prediction of intermediate-term major adverse cardiac events in patients with type 2 diabetes mellitus undergoing percutaneous coronary intervention. Cardiovascular Diabetology. 2022;21(1):115.