Acta Cardiologia Indonesiana

pISSN:2460-5700
eISSN:2579-4345

Web page: jurnal.ugm.ac.id/v3/jaci

Glucose Triglycerides Index as a Predictor of Severity of Coronary Artery Assessed with Syntax Score I in Acute Coronary Syndrome Patients

Tego Sulistyono*, Triadhy Nugraha, Trisulo Wasyanto

Department of Cardiology and Vascular Medicine, Faculty of Medicine, University of Sebelas Maret, Surakarta, Central Java, Indonesia

ARTICLE INFO

*Corresponding author
email:
drtego@gmail.com

address:
Jalan Ir. Sutami No. 36A,
Kentingan, Surakarta,
Indonesia
57126

Keywords:
TyG Index; SYNTAX score I; coronary severity; acute coronary syndrome; pre-diabetes

Manuscript submitted: November 13, 2019
Revised and accepted: February 7, 2020

ABSTRACT

Background: Pre-diabetes is a golden period to prevent and delay the development of diabetes. In coronary heart disease, there are more patients with impaired glucose tolerance than the patients without impaired glucose tolerance, so screening is needed in patients who have risk factors for cardiovascular disease. Assessment of insulin resistance is a "fundamental goal" that has a large value of prevention. Triglyceride Glucose (TyG) index is a surrogate marker of insulin resistance that can be applied to the community as a practical and efficient screening method.

Aim: The purpose of this study was to assess TyG index for the severity of coronary arteries as assessed by SYNTAX score I in ACS patients.

Methods: This study was an analytic cross-sectional study with a sample of 36 ACS patients who underwent coronary angiography (CAG) examinations in the catheterization laboratory of General Hospital Dr. Moewardi. The mean value of coronary artery severity was assessed using SYNTAX Score I. Subjects were then divided into two groups and then associated TyG index with coronary artery severity assessed by SYNTAX score I. A p value <0.05 was considered statistically significant.

Results: In this study, the best TyG index value in predicting the severity of coronary arteries is a cut-off value of 8.67 (AUC 0.738) with a specificity of 70.00% and sensitivity of 69.23%. Multivariate logistic regression analysis showed that TyG index was an independent predictor of a high SYNTAX scores (OR 5.25, 95% CI 1.07 - 25.70).

Conclusion: The TyG index shows good sensitivity and specificity to classify the degree of coronary severity in ACS patients with pre-diabetes.

INTISARI

Latar Belakang: Prediabetes adalah periode emas untuk mencegah dan menunda perkembangan penyakit diabetes.Pada penyakit jantung koroner pasien dengan toleransi glukosa terganggu lebih banyak dibandingkan tanpa toleransi glukosa terganggu, sehingga skrining sangat diperlukan pada pasien yang memiliki faktor risiko penyakit kardiovaskular. Penilaian resistensi insulin merupakan “fundamental goal” yang mempunyai nilai prevensi besar. Indeks Trigliserida Glukosa (ITG) merupakan marker surrogate resistensi insulin yang dapat diaplikasikan pada komunitas sebagai metode skrining praktis dan efisien.

Tujuan: Tujuan dari penelitian ini adalah untuk menilai ITG terhadap keparahan arteri koroner yang dinilai dengan SYNTAX score I pada pasien SKA.

Metode: Penelitian ini merupakan suatu studi potong lintang analitik dengan jumlah sampel 36 pasien SKA yang menjalani pemeriksaan coronary angiografi (CAG) di laboratorium kateterisasi RSUD Dr. Moewardi. Nilai

rerata keparahan arteri koroner dinilai menggunakan Syntax score I. Subjek kemudian dibagi menjadi dua kelompok kemudian dihubungkan ITG dengan keparahan arteri koroner yang dinilai dengan SYNTAX score I. Nilai p<0.05 dianggap bermakna secara statistik.

Hasil: Pada penelitian ini didapatkan nilai ITG yang paling baik dalam memprediksi keparahan arteri koroneradalah nilai cut-off 8.67 (AUC 0.738) dengan spesifitas 70.00% dan sensitifitas 69.23%. Analisis regresi logistik multivariat menunjukkan bahwa ITG adalah prediktor independen SYNTAX score yang tinggi (OR 5.25, 95% CI1.07 - 25.70).

Kesimpulan: ITG menunjukkan sensitivitas dan spesifisitas yang baik untuk mengklasifikasikan derajat keparahan koroner pada pasien SKA dengan prediabetes.

Introduction

Pre-diabetes is the golden period to prevent and delay the development of diabetes. In Coronary Heart Disease, the number of patients with impaired glucose tolerance are greater than those without impaired glucose tolerance, thus screening is necessary in patients with cardiovascular risk factors.

Pre-diabetes is defined as a metabolic condition between normoglycemia and diabetes namely people with impaired glucose tolerance and fasting glucose disturbance.[1] World Health Organization (WHO) defined disturbed plasma glucose as fasting plasma glucose between 6.1 to 6.9 mmol/L.[2]

Fasting glucose and TG within high-normal range are able to predict cardiovascular disease (CVD).[3] Thus, evaluating the combination of TG level and fasting glucose in patients with Acute Coronary Syndrome (ACS) by observing the coronary artery severity become interesting to apprehend.

Triglyceride Glucose (TyG) Index is a new marker which has been proven to have high sensitivity and specificity in identifying metabolic syndromes.[4] The superiority of Tyg index compared to another indexes come from the fact that glucotoxicity and lipotoxicity are the main key of insulin receptor modulation. A recent study showed that measurements with 20 / (fasting glucose fasting glucose P-peptides) that used to measure the RI index were superior to homeostasis assessment-insulin resistance (HOMA-IR) models measured by hyperinsulinemic-euglycemic clamp.[5] Previous studies have shown that ITG is associated with carotid atherosclerosis, coronary artery calcification and a high risk of CVD.

However, currently there is no data available that links ITG to the severity of coronary arteries in patients with ACS. Therefore the main objective of this study is to investigate the prognostic role of ITG in assessing the severity of coronary arteries in the SKA group.

Methods

Clinical Data

This was an observational analytical study with cross sectional design. This study was conducted in intensive cardiovascular care unit (ICVCU), Moewardi General Hospital, Surakarta, Central Java, Indonesia. This study took 2 months to complete from September to October 2019.

The sample was collected consecutively from patients with ACS based on ESC 2017 criteria in Intensive Cardiovascular Care Unit, Cardiac High Care Unit, and ward care who underwent intervention.

The exclusion criteria in this study include patients with significant heart valve disease, cardiomyopathy, severe liver disease, infection, thyroid disease and adrenal cortex dysfunction, autoimmune disease, hematology disorders, malignancy, history of surgery or trauma for the past 3 months, and has ever received statin/triglyceride- and glucose-lowering medicine.[6,7] Thirty six subjects with ACS agreed to take part in the study was included.

Laboratory Data Collection

After fasting for 8 hours, blood vein samples were collected and sent to the laboratory. Fasting glucose concentration, triglyceride, and HDL-C were measured according to standard procedure using Advia 1800, chemistry Architect (Siemens). Before the blood samples were taken, the subjects were identified and the height and weight were measured.

After the blood samples were taken, coronary angiography was conducted and SYNTAX score I was calculated.

Coronary Artery Severity

In order to acquire coronary artery severity, catheterization using fluoroscopy C-arm (Phillips) was carried out. Coronary artery severity was measured using SYNTAX score I using calculator scoring (high version).[8]

Insulin Resistance

Patients with impaired plasma fasting glucose, i.e. 5.6 – 6.9 mmol/L or 100 – 125 mg/dL). Patients with impaired fasting glucose and glucose tolerance are considered to have pre-diabetes.[9] Optimal triglyceride: < 150 mg/dL, borderline: 150-199 mg/dL, at risk: ≥ 200 mg/dL.[10]

TyG Index

TyG index is a product of fasting blood glucose (FBG) and TG. Lee et al. reported that TyG index can serve as a useful marker to identified individual with a high risk in

developing diabetes.[11] In this study, to assess RI, we calculated it using TyG index formula.

Statistical Analysis

After the data were collected, we proceed with data processing and analyzing using SPSS version 21.0 program. Normality test Shapiro Wilk was done to determine whether the distributions of the data were normal. After that, a comparative test was done to know whether there is significant difference between TyG index score and SYNTAX score I using Chi-square.

Curve analysis receiver operating characteristics (ROC) was done to predict the diagnostic ability of TyG index in determining the severity of coronary artery in ACS patients. In order to analyze the correlation between TyG index and coronary artery severity parameters, factors correlating with TyG index regression analysis was done. Significant statistical value was defined as p value < 0.05.

Results

Subjects' Characteristics

The study was conducted in 36 acute coronary syndrome (ACS) patients in Intensive Cardiovascular Care Unit (ICVCU), Moewardi General Hospital Surakarta, Central Java. After randomly selected, those patients were measured for coronary artery severity using SYNTAX score I, where according to this SYNTAX score I variable the patients were then distinguished into 2 (two) sample groups that is normal sample group with SYNTAX score I < 23 and severe group with SYNTAX score I ≥ 23.

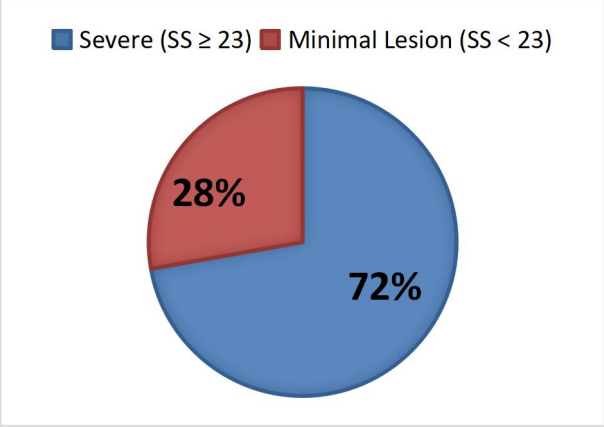

Figure 1. The composition of the subject based on Coronary Artery Severity with SYNTAX score I (percent).

This study was done towards 92 patients in whom 56 of them were excluded for not fulfilling the inclusion criteria, and the rest 36 were included. From 36 patients, 26 of them had severe coronary artery (SYNTAX score I ≥ 23) or account for 77.22 percent and the rest 100 patients had coronary artery with minimal lesion (SYNTAX score I < 23) or account for 27.78 percent (figure 1).

Study descriptive characteristics in the form of qualitative variable were described each categorical proportion and homogeneity test in two sample groups using Chi square test.

Sex category in severe coronary artery group consists of 22 male or account for 84.6 percent and the rest were 4 female or account for 15.4 percent. The sex composition and proportion in minimal lesion coronary artery group was slightly different, where 7 of them were male or account for 70.0 percent and the rest 3 people were female or account for 30.0 percent.

The value of Chi square test of variable homogeneity was $\chi 2 = 0.985$ with probability of 0.321 ($p > 0.05$) which mean that there is no differences in the proportion male and female sex between the severe coronary artery group and the minimal lesion coronary artery group. In other words, the sex proportion of the severe coronary artery group and the minimal lesion coronary artery group is the same or homogenous. Accordingly, for other variables such as diagnosis, Killip, smoking status, hypertension status, diabetes mellitus status, stroke status, dyslipidemia and history of heart disease, the proportion between the severe coronary artery and the minimal lesion coronary artery group was the same or homogenous (Table 1).

Table 1.
Comparison of Primary Qualitative Characteristics Variables between Severe Coronary Artery Group and Minimal Lesion Coronary Artery Group

Variables	Severe Coronary Artery (SYNTAX ≥ 23)		Minimal Lesion Coronary Artery (SYNTAX < 23)		Chi Square Test	
	n	%	n	%	X2	P value
Sex						
Male	22	84.6	7	70.0	0.985	0.321
Female	4	15.4	3	30.0		
Diagnosis						
STEMI	13	50.0	6	60.0		
NonSTEMI + UAP	13	50.0	4	40.0	0.290	0.590
Killip						
1	18	69.2	9	90.0	1.662	0.197
>1	8	30.8	1	10.0		
Smoking Status						
Yes	12	46.2	2	20.0	2.079	0.149
No	14	53.8	8	80.0		
Hypertension Status						
Yes	12	46.2	6	60.0	0.554	0.457
No	14	53.8	4	40.0		
Diabetes Mellitus Status						
Yes	4	15.4	2	20.0	0.111	0.739
No	22	84.6	8	80.0		
Stroke Status						
Yes	2	7.7	1	10.0	0.050	0.822
No	24	92.3	9	90.0		
Dyslipidemia Status						
Yes	2	7.7	0	0.0	0.814	0.367
No	24	92.3	10	100.0		
History of Heart Disease						
Yes	1	3.8	2	20.0	2.467	0.116
No	25	96.2	8	80.0		

Source: Primary Data, 2019, processed.

The normality test result showed that demographical and clinical characteristic variable that had normal data distribution both in the severe coronary artery group and

the minimal lesion coronary artery group were age, GRACE, and HDL-C. Other variables such as BMI, TIMI, LDL-C, and uric acid in the severe coronary artery group had abnormal distribution where in the minimal lesion coronary artery had normal distribution. After we conducted a test for the whole data it was concluded that BMI, TIMI, LDL-C, and uric acid had normal distribution whereas HbA1c and creatinine had abnormal distribution.

The homogeneity test result of quantitative characteristic variable showed that every variable were homogenous ($p > 0.05$). Thus, characteristics variable such as age, BMI, GRACE, TIMI, LDL-C, HDL-C, HbA1c, uric acid, and creatinine were homogenous.

The description and the homogeneity test result of quantitative demographical and clinical characteristic variables were shown as follows in table 2.

Table 2.
Homogeneity Test of Quantitative Demographical and Clinical Characteristic Variable of the Severe Coronary Artery and Minimal Lesion Coronary Artery Groups

Variables	Severe Coronary Artery (SYNTAX ≥ 23)		Minimal Lesion Coronary Artery (SYNTAX < 23)		2 Mean Differences Test	
	Mean	SD	Mean	SD	Statistical value	P value
Age	59.42	9.16	63.10	12.29	t = -0.980	0.334
BMI	23.64	4.81	22.81	2.27	t = 0.516	0.609
GRACE	104.00	29.66	110.20	28.90	t = -0.566	0.575
TIMI	3.38	1.81	3.80	1.69	t = -0.627	0.535
LDL-C	127.96	45.97	110.60	26.69	t = 1.118	0.271
HDL-C	38.04	10.71	37.00	3.77	t = 0.297	0.768
HbA1c	6.63	1.55	7.09	2.04	Z = -0.789	0.454
Uric acid	6.74	2.08	6.50	2.15	t = 0.296	0.769
Creatinine	1.20	0.56	1.27	0.46	Z = -1.017	0.320

*) Significant in significant degree of 5 percent ($p < 0.05$)
**) Significant in significant degree of 1 percent ($p < 0.01$)

Thus every demographical or clinical characteristic variables, whether it is qualitative or quantitative were homogenous, so that for the next analysis we can proceed to measure the main variable that was testing Triglyceride Glucose Index (TyG index) advisability as the predictor of coronary artery severity that was measured using SYNTAX score I.

Evaluation of Correlation between Triglyceride Glucose Index (TyG Index) and SYNTAX Score I

Evaluation of correlation between TyG Index and SYNTAX score I that represent coronary artery severity was done using correlation analysis. The Scatter plot was made before the measurement of correlation coefficient between variables was done

The scattered dots accumulate near the horizontal line shows that the correlation between TyG index and SYNTAX score I is relatively strong (figure 2). The result of correlation analysis between TyG index and SYNTAX score I is presented in the table 3.

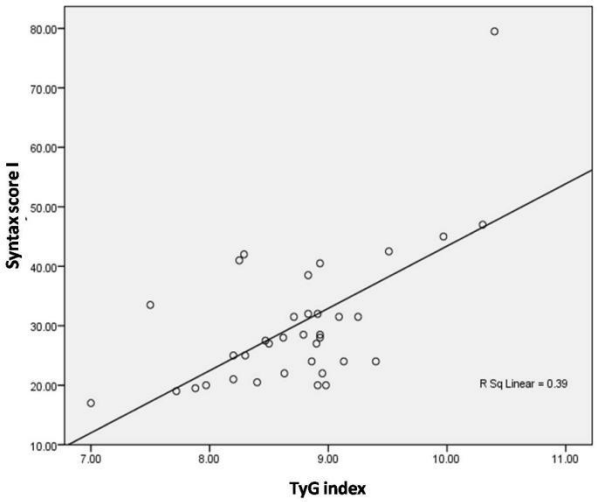

Figure 2. Scatter plot of Correlation between TyG Index and SYNTAX score I (n = 36)

Table 3.
The Result of Correlation Analysis between Triglyceride Glucose Index and SYNTAX Score I

Correlation between Variables	Correlation Analysis Result		
	Correlation	P Value	Annotation
TyG Index –SYNTAX score I	r = 0.624	0.001**	significant

The result of correlation analysis suggested that TyG index variable has a positive correlation with SYNTAX score I variable confidently (significant) with significant degree of 5 percent ($p < 0.05$) and with correlation value of r = 0.624.

The evaluation of TyG index and SYNTAX score I correlation can also be proven by measuring the mean differences of the severe coronary artery and minimal lesion coronary artery groups. The result of mean differences analysis of the severe coronary artery group and minimal lesion coronary artery group suggested that TyG index variable is different confidently with significant degree of 5 percent ($p < 0.05$). The result of mean differences analysis is shown in table 4.

Table 4.
Two Mean Differences Analysis of Triglyceride Glucose Index (TyG Index) in Severe Coronary Artery Group and Minimal Lesion Coronary Artery Group

Variable	Severe Coronary Artery (SYNTAX ≥ 23)		Minimal Lesion Coronary Artery (SYNTAX < 23)		Two Mean Differences Analysis	
	Mean	SD	Mean	SD	Statistical Value	P value
TyG Index	8.92	0.64	8.26	0.64	t = 2.732	0.010*

The two differences mean test results reinforce the correlation analysis result that the TyG index variable has a significant relationship at the 5 percent significance level ($p < 0.05$). Thus the research hypothesis which states that: "Triglyceride Glucose Index can be used as a predictor of

the coronary artery severity using SYNTAX score I in ACS patients" is truly proven conclusively (significantly).

Determining the Glucose Triglyceride Index (TyG index) Cut-off Point as Coronary Artery Severity Detector in ACS Patients Using The ROC Curve

The ROC curve generated from TyG index to identify the severity of the coronary arteries resulted in an area under curve (AUC) of 0.738. It can be interpreted that TyG index variable can be used as a predictor of coronary arteries severity in ACS patients. Based on the ROC curve, the TyG index variable Cut-off Point value is 8.67 (figure 3).

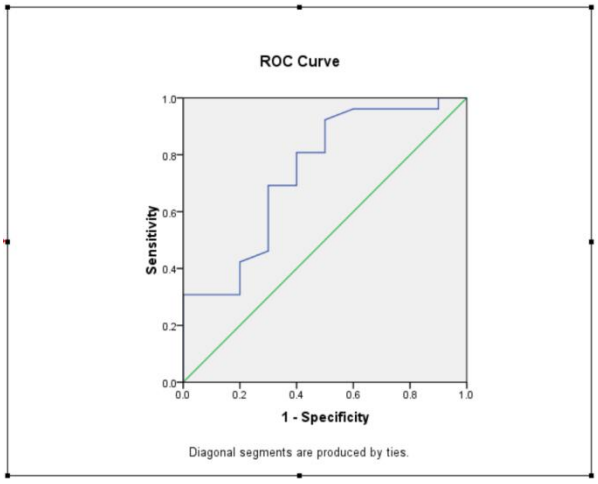

Figure 3. The ROC Curve (cut-off point = 8.67).

With the cut-off point of the Glucose Triglyceride Index variable of 8.67, the severity of the coronary arteries with ACS can be detected from the TyG index variable with a sensitivity level of 69.23% and a specificity level of 70.00% and a diagnostic accuracy rate of 69.44%.

Using Chi-square analysis, sensitivity, specificity, and diagnostic accuracy can be considered in the following table 5.

Table 5.
Sensitivity and Specificity and Diagnostic Accuracy of the Glucose Triglyceride Variable Index (TyG index) on the Severity of Coronary Artery in ACS Patients (Cut-off Point = 8.67)

Variable		Severe Coronary Artery (SYNTAX ≥ 23)		Minimal Lesion Coronary Artery (SYNTAX < 23)		X2	p	Odd Ratio
		n	%	n	%			
TyG index	< 8.67	18	69.2	3	30.0	4.57	0.03	5.25 (1.07-25.70)
	> 8.67	8	30.8	7	70.0			
Sum		26	100.0	10	100.0			

χ2value shows the relationship between TyG index and the severity of coronary arteries is 4,573 with a probability of p = 0.032, which means that the relationship between the two variables is significant at a significance level of 5 percent (p <0.05). The odd ratio value is 5.25 (1.07 - 25.70) so it can be concluded that the relationship between TyG index and the severity of the coronary arteries is significant (convincing). The sensitivity, specificity and diagnostic accuracy of TyG index variables as predictors of the severity of coronary arteries in ACS are depicted in table 6.

Table 6.
Sensitivity, Specificity and Diagnosis Accuracy of Triglyceride Glucose Index (TyG index) as Predictors of Coronary Artery Severity in ACS Patients Based on SYNTAX score I ≥ 23 and SYNTAX score I <23

Parameters	Triglyceride Glucose Index (TyG index)
Sensitivity (%)	69.23
Specificity (%)	70.00
Diagnosis Accuracy (%)	69.44
Area Under Curve (AUC)	0.738
Odd Ratio (95% CI)	5.25 (1.07 - 25.70)
Chi Square value (χ2)	4.573*

Annotation: ** Significance at 1% Degree of Significance.
* Significance at 5% Degree of Significance.

Relationship of Demographic and Clinical Variable with TyG index

The relationship between demographic and clinical variables that are quantitative with TyG index variables were analyzed using Pearson and Spearman correlation. The results of the correlation analysis is as shown in table 7.

Table 7.
Results of Correlation Analysis of Quantitative Description Variables with TyG index

Quantitative Variables	TyG index Correlation Value	Prob.
Age	r = -0.084	0.626
BMI	r = -0.008	0.963
GRACE	r = -0.121	0.484
TIMI	r = -0.278	0.101
LDL-C	r = 0.044	0.797
HDL-C	r =-0.072	0.676
HbA1c	r = -0.170	0.321
UricAcid	r = -0.027	0.875
Creatinine	r = 0.208	0.223

Annotation: ** Significance at 1% Degree of Significance.
* Significance at 5% Degree of Significance.

There is no quantitative variable that has a significant relationship with a significance level of 5 percent (p> 0.05).Furthermore, we used Chi Square test (χ2) to analyze the relationship between the qualitative variables with TyG index. The test results are as shown in table 8.

Table 8.
Chi square analysis on the relationship between the qualitative variables with TyG index

Qualitative Variables	Glucose Triglyceride Index (TyG index) Statistic Value	Prob.
Sex	$\chi2 = 0.005$	0.943
Diagnostic	$\chi2 = 0.538$	0.463
Killip	$\chi2 = 2.781$	0.427
Smoking	$\chi2 = 1.616$	0.204
Hypertension	$\chi2 = 0.114$	0.735
Diabetes mellitus	$\chi2 = 1.851$	0.174
Stroke	$\chi2 = 0.094$	0.760
Disiplidemia	$\chi2 = 1.513$	0.219
History of Heart Disease	$\chi2 = 0.094$	0.760

Annotation: ** Significance at 1% Degree of Significance.
* Significance at 5% Degree of Significance.

Based on the chi square analysis it is concluded that there is no qualitative variable that has a convincing relationship with the TyG index variables. Thus overall none of the description variables has a significant relationship with the TyG index variable at a significance level of 5 percent.

Difference between TyG index and SYNTAX score I Based on ACS Diagnosis

The TyG index variable data are grouped into two based on the 8.67 cut-off point, namely the TyG index group < 8.67 and the TyG index group > 8.67. While the SYNTAX score I variable is grouped into two based on a new measure, namely the SYNTAX score I < 23 and the SYNTAX score I ≥ 23. The relationship between the two variables is the TyG index group and the SYNTAX group I score with the diagnosis variable STEMI and NSTEMI / UAP was analyzed by chi square test and shown in table 9.

Table 9.
Proportion Difference in TyG index Groups and SYNTAX Group I

Variabel	STEMI n	%	NSTEMI + UAP N	%	Chi Square X2	P value
TyG index Group						
TyG index < 8.67	10	52.6	11	64.7	0.538	0.463
TyG index > 8.67	9	47.4	6	35.3		
SYNTAX score I Group (Coronary Artery Severity)						
Severe Coronary Artery	13	68.4	13	76.5	0.290	0.590
Minimal Lesion Coronary Artery	6	31.6	4	23.5		

in the STEMI Group and the NSTEMI + UAP Group
Annotation: ** Significance at 1% Degree of Significance.
* Significance at 5% Degree of Significance.

Differences in Demographic and Clinical Characteristic Variables with ACS Diagnosis

Analysis of the difference between demographic and clinical characteristic variables that are quantitative with the ACS diagnosis variable was done by analyzing the difference of the two mean variables of the quantitative characteristics in the STEMI group and the NSTEMI + UAP group. Normality test data for quantitative characteristic variables found that the age, BMI, GRACE, TIMI, LDL-C, HDL-C, and Uric Acid variables were normally distributed and the HbA1c and creatinine variables were not normally distributed. The results of the analysis of the differences in the average of the quantitative characteristic variables between the STEMI and NSTEMI + UAP groups are as shown in table 10.

Tabel 10.
Analysis of Differences in the Two Mean Quantitative Characteristic Variables of the STEMI Group and the NSTEMI + UAP Group

Quantitative Characteristic Variables	ACS Diagnosis Statistic Value	Prob.
Age	t = -0.980	0.334
BMI	t = 0.516	0.609
GRACE	t = -0.566	0.575
TIMI	t = -0.627	0.535
LDL-C	t = 1.118	0.271
HDL-C	t = 0.297	0.768
HbA1c	Z = -0.370	0.731
Uric Acid	t = 0.296	0.769
Creatinine	Z = -1.025	0.315

Annotation: ** Significance at 1% Degree of Significance.
* Significance at 5% Degree of Significance.

Based on the test results of the differences in the two mean quantitative characteristic variables between the STEMI and NSTEMI + UAP groups above, it can be concluded that none of the quantitative characteristics variables have a significant difference (p> 0.05).

Furthermore, we analyze the difference in the proportions of the qualitative characteristic variables for the STEMI group and the NSTEMI + UAP group using the Chi Squared Test ($\chi2$) between the qualitative characteristic variables with the STEMI and NSTEMI + UAP groups. The test results are as shown in table 11.

Table 11.
Analysis of the Difference in the Proportion of Qualitative Characteristic Variables between the STEMI Group and the NSTEMI + UAP Group

Qualitative Characteristi Variable	ACS Diagnosis Statistic Value	Prob.
Sex	$\chi2 = 0.343$	0.558
Killip	$\chi2 = 1.226$	0.747
Smoking	$\chi2 = 0.071$	0.790
Hypertension	$\chi2 = 0.111$	0.739
Diabetes mellitus	$\chi2 = 1.092$	0.296
Stroke	$\chi2 = 2.928$	0.087
Disiplidemia	$\chi2 = 0.007$	0.935
History of Heart Disease	$\chi2 = 0.496$	0.481

Annotation: ** Significance at 1% Degree of Significance.
* Significance at 5% Degree of Significance.

It can be concluded that none of the qualitative characteristic variables has a convincing (significant) difference between the STEMI group and the NSTEMI + UAP group.

Discussion

The two different mean test and the correlation analysis test showed that the TyG index variable and coronary severity had a significant relationship at the 5 percent

significance level ($p < 0.05$). This result is in line with research conducted by Qi Mao and colleagues where TyG index was a high predictor of independent SYNTAX scores ($p < 0.05$).[12]

This study analyzes the basic characteristic variables based on gender, age, BMI, GRACE, diagnosis, killip, TIMI, smoking status, hypertension status, diabetes mellitus status, stroke status, dyslipidemia status, heart disease history status and laboratory results namely, LDL-C , HDL-C, HbA1c, uric acid, creatinine. The study subjects were divided into 2 groups, namely group 1 with severe arteries and group 2 with normal arteries. The results showed no significant difference between the characteristic variables in group 1 compared to group 2 with $p > 0.05$.

In this study the best TyG index values in predicting the severity of coronary arteries with a cut-off value of 8.94 (AUC 0.742), a specificity of 84.62% and a sensitivity of 60.00%. This is consistent with research conducted by Qi Mao and colleagues, where TyG index is proven to be a diagnostic indicator for MACE events with a cut-off value of 8,556 (AUC 0.639).[12]

Multivariate logistic regression analysis showed that TyG index was an independent predictor of a high SYNTAX score (OR 8.25, 95% CI 1.58 ± 43.13). This is in accordance with research conducted by Qi Mao and colleagues, where TyG index is proven to be a risk factor for high SYNTAX scores (OR 6,055, 95% CI 2,915-12,579).[12]

This study also analyzed the basic characteristic variables based on gender, age, BMI, GRACE, diagnosis, killip, TIMI, smoking status, hypertension status, diabetes mellitus status, stroke status, dyslipidemia status, heart disease history status and laboratory results namely, LDL- C, HDL-C, HbA1c, uric acid, creatinine with TyG index variables found that none of the characteristic variables had a significant relationship with $p > 0.05$. Studies analyzing TyG index variables in patients with STEMI (group 1) compared to NSTEMI/UAP (group 2) showed no significant difference ($p > 0.05$).

The fasting glucose component of TyG index is potential to predict diabetes. Triglycerides correlate with insulin secretion in normoglycemic and prediabetes subjects.13 Lee and colleagues reported that TyG index can be a useful marker for identifying individuals at high risk for developing diabetes.[11]

Hypertriglyceridemia is caused by visceral fat associated with an increase in free fatty acids to the liver, which can be caused by a decrease in liver insulin sensitivity and an increase in liver glucose output. Hypertriglyceridemia is associated with RI and causes impaired glucose tolerance and diabetes.[14]

Limitation

There are several limitations in this study. First, the study was conducted at a single center. Second, there were probabilities of hyperglycaemia reactive of ACS patient, and some patient has been consume statin before admited.

Conclusion

Triglyceride Glucose Index can be used as a predictor of the severity of coronary arteries assessed by SYNTAX score I in ACS patients. TyG index provides a good diagnostic value in determining the severity of coronary arteries in ACS patients.

Acknowledgements

We are grateful to Moewardi hospital for the support and permission to take the patient data

Funding Sources

Nil.

Disclosures and Ethics

None of the authors of this paper had any potential conflict of interest that needs to be disclosed in relation to this manuscript.

References

1. DeFronzo RA, Abdul-Ghani M. 2011. Assessment and treatment of cardiovascular risk in prediabetes: impaired glucose tolerance and impaired fasting glucose. Am J Cardiol, 108:3B-24B.
2. Definition WHO diagnosis of diabetes mellitus and intermediate hyperglycemia: report of a WHO/IDF consultation. Geneva: World Health Organization. 2006;3.
3. Shaye K, Amir T, Shlomo S, Yechezkel S. 2012. Fasting glucose levels within the high normal range predict cardiovascular outcome. Am Heart J, 164:111-116.
4. Angoorani P, Heshmat R, Ejtahed HS, Motlagh ME, Ziaodini H, Taheri M, et al. 2018. Validity of triglyceride–glucose index as an indicator for metabolic syndrome in children and adolescents: the CASPIAN-V study. Eat Weight Disord, 23:877-883.
5. Ohkura T, Shiochi H, Fujioka Y, Sumi K, Yamamoto N, Matsuzawa K, et al. 2013. 20/(fasting C-peptide× fasting plasma glucose) is a simple and effective index of insulin resistance in patients with type 2 diabetes mellitus: a preliminary report. Cardiovasc Diabetol, 12:21.
6. Kolman L, Hu YC, Montgomery DG, Gordon K, Eagle KA, Jackson EA. 2009. Prognostic value of admission fasting glucose levels in patients with acute coronary syndrome. Am J Cardiol, 104:470-474.
7. Tada H, Kawashiri MA, Nomura A, Yoshimura K, Itoh H, Komuro I, et al. 2018. Serum triglycerides predict first cardiovascular events in diabetic patients with hypercholesterolemia and retinopathy. Eur J Prevent Cardiol, 25:1852-1860.
8. Palmerini T, Genereux P, Caixeta A, Cristea E, Lansky A, Mehran R, et al. 2011. Prognostic value of the SYNTAX score in patients with acute coronary syndromes undergoing percutaneous coronary

intervention: analysis from the ACUITY (Acute Catheterization and Urgent Intervention Triage StrategY) trial. J Am Coll Cardiol, 57:2389-2397.

9. Goldfine AB, Phua EJ, Abrahamson MJ. 2014. Glycemic management in patients with coronary artery disease and prediabetes or type 2 diabetes mellitus. Circulation, 129:2567-2573.

10. Jellinger P, Smith D, Mehta A, Ganda O, Handelsman Y, Rodbard H, et al. 2012. American Association of Clinical Endocrinologists' guidelines for management of dyslipidemia and prevention of atherosclerosis. Endocrine Pract, 18 (Supplement 1):1-78.

11. Lee SH, Kwon HS, Park YM, Ha HS, Jeong SH, Yang HK, et al. 2014. Predicting the development of diabetes using the product of triglycerides and glucose: the Chungju Metabolic Disease Cohort (CMC) study. PLoS One, 9:e90430.

12. Mao Q, Zhou D, Li Y, Wang Y, Xu SC, Zhao XH. 2019. The triglyceride-glucose index predicts coronary artery disease severity and cardiovascular outcomes in patients with non-st-segment elevation acute coronary syndrome. Dis Markers, 2019:6891537.

13. Shimodaira M, Niwa T, Nakajima K, Kobayashi M, Hanyu N, Nakayama T. 2014. Serum triglyceride levels correlated with the rate of change in insulin secretion over two years in prediabetic subjects. Ann Nut Metab, 64:38-43.

14. Bickerton AS, Roberts R, Fielding BA, Hodson L, Blaak EE, Wagenmakers AJ, et al. 2007. Preferential uptake of dietary fatty acids in adipose tissue and muscle in the postprandial period. Diabetes, 56:168-176.