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Review Article

Value of Triglyceride Glucose Index in Prediction of Cardiac Outcomes in Patients with Acute Coronary Syndrome

Mohammed A Taha , Hassan A Hassanain , Ali H Mohammad , Sharaf Eldeen S Abdallah

*Internal medicine department, Faculty of medicine, Sohag university, Sohag, Egypt

Abstract

Background: Predictors of mortality in acute coronary syndrome are crucial in clinical practice since coronary artery disease is the leading cause of death worldwide.

Materials and methods: We conducted a prospective study on 104 acute coronary syndrome patients admitted at Sohag university hospital coronary care unit and followed up those patients for 6months for recording of major adverse cardiac events after measuring triglyceride glucose index on admission.

Results: Following up patients for major adverse cardiac events, the results showed that heart failure was reported in 9 (8.7%) cases, myocardial infarction was reported in 4 (3.8%) cases while stroke was found in one case. The most frequent comorbidity found among the studied patients was DM that was found in 76.9% cases followed by hypertension in 41.3% cases. The age of studied patients had a mean age of 58.81 years. triglyceride and glucose index (TyG index) mean (±SD) was 8.30± 0.60. There was significant elevation in TyG index in cases with major adverse cardiac effects with mean index of 9.23 in patients with heart failure, 10.03 in patients with myocardial infarction and 10.30 in the patient with stroke.

Conclusion: According to the study's findings, patients with recent ACS who had higher TyG index values are at an elevated risk of MACEs.

Keywords: IHD, TyG index and MACE.

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*Correspondence : medoalitahasmsa2711@gmail.com

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Introduction

The study aims to assess the value of triglyceride glucose index (TyG) in prediction of major adverse cardiac events (MACE) in patients with acute coronary syndrome.

Ischemic heart disease (IHD) or coronary artery disease (CAD), which is a broad term that includes acute coronary syndrome (ACS), which still accounts for most deaths internationally (16% of all fatalities and almost one-third of all deaths globally). [(1)] IHD is the most common and prevalent cardiovascular disease. [(2)]

The primary cause of morbidity and mortality from cardiovascular (CV) illness worldwide is acute coronary syndrome (ACS). [(3)]

Historically, coronary artery disease (CAD) was thought of as a male-specific condition; but, as time went on, a growing prevalence of CAD in women was observed. [(4)]

Numerous risk factors, including diabetes mellitus, hypertension, a family history of coronary artery disease, obesity, dyslipidemia, and smoking, are related to the occurrence of coronary artery disease.

The presenting complaints also differ, with unusual symptoms occurring more frequently in women, making it challenging to diagnose women. [5,6]
Recent research indicates that the pathologically connected conditions of metabolic syndrome (MetS) and insulin resistance (IR) both raise the risk of developing cardiovascular disease (CVD) and the frequency of major adverse cardiac events (MACE). [7]

TyG index is easily applicable by measuring the fasting triglyceride and fasting blood sugar level and then apply a special equation: **ln [fasting triglycerides (mg/dL) × fasting plasma glucose (mg/dL)/2]**.[8]
Different CAD & ACS outcomes, such as MACE prediction, which is the main target of this study, Coronary artery calcium score, in stent restenosis, new onset of atrial fibrillation, and severity of CAD by coronary angiography, have been linked to the TyG index.

Pateints and methods

Patient's selection

A prospective study on 104 acute coronary syndrome patients admitted at Sohag university hospital coronary care unit.

Inclusion criteria

More than 18-year-old ACS patients were hospitalized to the coronary care unit at Sohag University hospital.

Exclusion criteria

Patients younger than 18 years old, with acute infectious diseases, history of rheumatic disease, hematological disease or neoplastic disease, Familial hereditary dyslipidemia, Pregnancy, chronic kidney disease patients, Chronic liver disease patients and lacking clinical or follow up data.

Methods

All patients were subjected to full history including age, sex, smoking history, family history of coronary artery disease and history of diabetes and hypertension, detailed examination, investigations including serum fasting triglyceride level, serum fasting glucose level, electrocardiogram, troponin, lipogram, CBC, liver function and kidney function, HbA1c & body mass index measurement, Measurement of TYG index by formula mentioned before.
following up the patients and correlating the index with incidence of MACE after 6 months of admission including rehospitalization due to heart failure or reinfarction or coronary revascularization or incidence of cerebrovascular stroke and death due to cardiac cause.

Clinical outcomes

This study aims to assess TyG index accuracy in detecting MACE in ACS patients in short term follow up over 6 months after admission.

Statistical analysis of data

Using SPSS program (Statistical Package for Social Sciences) software version 26.0, Microsoft Excel 2016 and MedCalC program software version 19.1, the gathered data will be tabulated and statistically evaluated.
Descriptive statistics were calculated using the mean, SD (standard deviation), minimum and maximum of the range for numerical parametric data, the median, first and third interquartile ranges, and number and percentage for categorical data, and they were estimated for numerical nonparametric data as well. When there were two independent groups and parametric data, the independent t-test was used for inferential studies on quantitative variables. When there were two independent groups and nonparametric data, the Mann Whitney U was used.

Analytical statistics

For inferential analysis of qualitative data, the Chi square test for independent groups was applied. A valuable tool for assessing the sensitivity and specificity of quantitative diagnostic tests that divide cases into two categories is the receiver operating characteristic (ROC) curve. To determine significance, P values under 0.05 were employed; values beyond this cutoff are non-significant. A statistical indicator of the possibility that a study's results could have been the result of chance is the p-value.

Results

Demographic characteristics of the study population:

In total, 104 cases were examined in our study. Patients were aged between 35 and 78 years, with a mean age of 58.81± 9.82 years. The most common age group found was the age group >60 years in 42.3% cases, followed by age group 51-60 years in 38.5% cases then age group 41-50 years in 14.4% cases and age group 30-40 years in 4.8% cases. There was 72 (69.2%) males and 32 (30.8%) females with male to female ratio was 2.25:1.

Table (1): Distribution of studied cases as per demographic characteristics.

Parameters		Studied cases. (n= 104)	
		N	%
Gender	**Male**	72	69.2%
	Female	32	30.8%
Age group	**30- 40 years**	5	4.8%
	41- 50 years	15	14.4%
	51- 60 years	40	38.5%
	> 60 years	44	42.3%
Age (years)	**Mean± SD**	58.81± 9.82	

Table (2): shows chronic disease among the studied cases. The most frequent comorbidity found among the studied patients was DM that was found in 76.9% cases followed by hypertension in 41.3% cases.

Table (2): Distribution of studied cases as per chronic disease.

Parameters	Studied cases. (n= 100)	
	N	%
HTN	43	41.3%
DM	80	76.9%
DM & HTN	33	31.73%

Table (3) shows sugar profile performed in the studied cases. The mean fasting blood sugar was 112.41± 56.78 mg/dl while the mean HbA1c was 6.40± 2.0.

Table (3): Distribution of studied cases as per clinical history.

Parameters		Studied cases. (n= 104)	
		N	%
Smoking		49	47.1%
BMI (Kg/m^2)	**Mean± SD**	24.95± 2.03	

Regarding clinical data, unstable angina was found in 3 (2.9%) cases, NSTEMI was found in 51 (49%) cases while STEMI was found in 49 (47.1%) cases.

Table (4) shows that the total Triglyceride and glucose index (TyG index) ranged from 7.4 to 10.4 with mean (±SD) was 8.30± 0.60.

Table (4): Distribution of studied cases as per total Triglyceride and glucose index (TyG index).

Parameters		Studied cases. (n= 104)
TyG index	**Mean± SD**	8.30± 0.60

SD= standard deviation

By following up our patients for major adverse cardiac events and their assessment, the results showed that heart failure was reported in 9 (8.7%) cases, myocardial infarction was reported in 4 (3.8%) cases while stroke was found in one case as shown table (5)

Table (5): Distribution of studied cases as per major adverse cardiac events.

Parameters	Studied cases. (n= 104)	
	N	%
Heart failure	9	8.7%
MI	4	3.8%
Stroke	1	1.0%

Higher TyG index mean was found in patients with incidence of MACE as shown in **table:(6)**

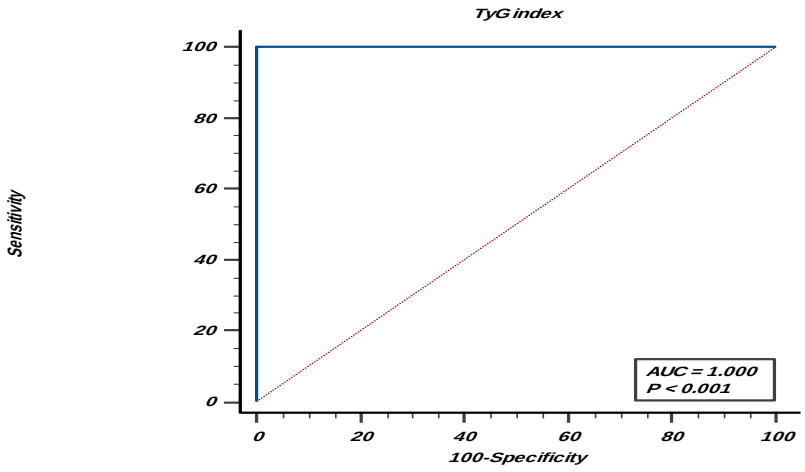
Table (6): Relation between TYG index and major adverse cardiac events**.**

Parameters		TYG index	
		Mean	± SD
Heart Failure	**Yes**	9.23	0.49
MI	**Yes**	10.03	0.30
Stroke	Yes	10.30	0.0

ROC curve analysis and table (7) shows that TYG index are excellent predictor for major adverse cardiac events with area under the curve 1.00. TYG index can predict major adverse cardiac events with sensitivity and specificity was 98% and 98% respectively (p< 0.001).

Table (7): ROC curve analysis to predict the diagnostic performance of TYG index.

Variable	Area	P-value	Cutoff	Sensitivity	Specificity
RRI	1.00	**<0.001***	>8.7	98%	98%



ROC curve of TYG index in prediction of major adverse cardiac events.

Outcomes:

Of 104 studied patients of ACS 9 patients (8.7%) showed heart failure within 6 months in whom TyG index mean (± SD) was 9.23± 0.49 which was higher than those who didn't develop heart failure who had a mean of 8.21.

4 patients (3.8%) showed a new onset of myocardial infarction within 6 months in whom the TyG index mean (± SD) was 10.03± 0.3 which is much higher than those who didn't in whom the index mean was 8.23. This result showed that patients who had a

higher value of TyG index on admission had a possible higher risk of developing MACE within 6 months of following those patients.

Discussion

Insulin resistance (IR), a characteristic of the metabolic syndrome (MetS), is strongly associated with a higher risk of cardiovascular disease (CV disease) as well as a higher risk of MACE. [9]

One of the main metabolic disease mediators, insulin resistance (IR), not only contributes to the etiology of cardiovascular diseases but also negatively correlates with their outcomes. [10]

The hyperinsulinemia-euglycemic clamp is the optimum test for IR evaluation, however due to the challenging testing process, it is rarely used in clinical settings and large population studies.[11] Researchers came up with the theory that TGs might predict IR since IR and persistently elevated plasma glucose and triglycerides (TGs) are closely related. [12]

The hyperinsulinaemic-euglycaemic clamp test [13] used to measure IR has demonstrated a substantial correlation with the triglyceride glucose (TyG) index, which incorporates fasting plasma glucose (FPG) and TGs levels.[14] As an acceptable, and alternative IR marker, the TyG index has gained acceptance.

This study includes 104 patients admitted to coronary care unit with ACS. The age of studied patients ranged from 35 to 78 years with a mean age was 58.81± 9.82 years.

The cut off level of TYG index at which MACE occurred in our study was 9.5 ± 0.5. So, patients with a TYG index above 9 showed incidence of MACE as follows, 9 patients (8.7%) had rehospitalization due to heart failure with mean index of 9.1,

4 patients (3.8%) admitted with re-infarction with mean index of 10.03, one patient had a CVS with an index of 10.3 and no death cases recorded.

2030 individuals were enrolled in the trial, by Qianyun Guo, In the 2.5-year follow-up period, 233 of the 2030 patients had MACCEs, including 11 cardiac deaths, 29 MIs without fatalities, 180 ischemia-driven revascularizations, and 41 strokes.

Comparing the MACCEs group to the non-MACCEs group, the TyG index levels were noticeably higher in the MACCEs group. The TyG index has a sensitivity of 64.4% and a specificity of 71.7% for predicting MACCEs.[15]

Another study, High Triglyceride-Glucose Index is Associated with Poor Prognosis in Patients with Acute Coronary Syndrome in Long-Term Follow-Up by Fatma Özpamuk, between January 2017 and January 2022, 1694, patients with acute myocardial infarction were included. Patients with a TyG of 8.65 experienced MACEs more frequently than those with a TyG of 8.65. In STEMI patients, the cut-off value for the TyG index was found to be >9.3, but in NSTEMI patients, it was found to be >9.2.[16]

High triglyceride-glucose index is linked to poor cardiovascular outcomes in individuals with acute myocardial infarction, according to a study by Xiaosong Ding, out of 3181 eligible patients, 1601 had a TyG index of <8.88, and 1580 had a TyG index of≥ 8.88. During the 33-month follow-up, 449 patients (28.1%) in the TyG index ≥8.88 group developed composite MACEs.[17]

Limitations of this study:

In this one-center trial, participants from a single hospital were randomly chosen during a predetermined time span. Generalizing the results should be done with caution since all the studies listed were completed with a longer time of follow-up, the sample size may not be acceptable, and the follow-up duration may not be sufficient. This is because all the studies stated were conducted on a bigger sample population. Finally, because most ACS patients who often have stress hyperglycemia and have poor prognoses were included in these trials, it may be difficult to determine the true impact of the index on prognosis. After being admitted to the hospital, laboratory parameters were only measured once, which could have resulted in measurement bias. Another fault in this study is that it did not examine the predictive ability of the index for different age groups or between men and women. The study's small sample size could be the source of this. This study has the additional flaw that many patients might not have taken their

medications exactly as directed, which may have contributed to some occurrences of cardiac decompensation or MACE.

Conclusion

Higher TyG index values are a strong independent predictor, and the current study's findings demonstrate a positive relationship between higher TyG index values and an increased risk of MACEs in ACS patients within six months after the onset of the illness.

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