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Original Research Article

TRIGLYCERIDE GLUCOSE INDEX AS A SIMPLE MARKER OF CAROTID ARTERIAL THICKENING IN ACUTE ISCHEMIC STROKE

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ABSTRACT

Background: Acute ischemic stroke is commonly associated with metabolic and atherosclerotic risk factors. Triglyceride glucose index is a simple marker of insulin resistance, while carotid intima-media thickness reflects carotid atherosclerosis. Their association may be useful in routine stroke assessment.

Materials and Methods: This hospital-based cross-sectional study was conducted in the inpatient Department of General Medicine, Assam Medical College and Hospital, Dibrugarh, over one year. Fifty radiologically confirmed acute ischemic stroke patients aged ≥13 years were included by consecutive sampling. Patients with transient ischemic attack, haemorrhagic stroke, atrial fibrillation, symptom onset more than 7 days, pregnancy and lipid-lowering therapy were excluded. Fasting blood glucose and triglyceride were used to calculate TyG index. CIMT was measured by B-mode ultrasonography. Association and correlation between TyG index and CIMT were analysed.

Results: The mean age was 54.96 ± 23.3 years and 27 (54.0%) patients were male. Diabetes mellitus was present in 16 (32.0%) patients and smoking in 19 (38.0%). Mean TyG index was 8.81 ± 0.46 and mean CIMT was 1.01 ± 0.38 mm. CIMT ≥0.8 mm was seen in 35 (70.0%) patients. Higher TyG categories showed more frequent increased CIMT. The association between TyG category and CIMT category was significant (p=0.006). Mean CIMT increased from 0.73 ± 0.39 mm in the lowest TyG group to 1.41 ± 0.14 mm in the highest group (p=0.001). TyG index showed positive correlation with CIMT (r=0.631, R^2=0.399, p<0.05).

Conclusion: Higher TyG index was significantly associated with increased CIMT in acute ischemic stroke patients. TyG index may be used as a simple metabolic marker related to carotid atherosclerotic burden.

Keywords: Acute ischemic stroke; triglyceride glucose index; carotid intima-media thickness; insulin resistance.

INTRODUCTION

Acute ischemic stroke is one of the common neurological emergencies in medical practice. It remains an important cause of death and long-term disability. In India, the stroke burden is still high and it is strongly linked with vascular risk factors like diabetes mellitus, dyslipidemia, smoking, obesity and hypertension.[1] Most of these risk factors act through endothelial dysfunction, vascular inflammation and atherosclerosis.

Atherosclerosis has a major role in ischemic stroke. It may involve large arteries as well as small vessels. Carotid artery disease is clinically important because it can be assessed by a simple non-invasive ultrasound method. Common carotid artery intima-media thickness is used as a marker of early carotid atherosclerosis. Increased CIMT reflects arterial wall thickening and vascular remodelling. It also gives indirect idea about systemic atherosclerotic burden.[2] Insulin resistance is also linked with atherosclerosis and cerebrovascular disease. But direct measurement of insulin resistance is not easy in routine clinical practice. The hyperinsulinemic-euglycemic clamp is considered standard method, but it is costly and difficult to use in regular hospital work. The triglyceride glucose index is a simple surrogate marker of insulin resistance. It is calculated from fasting triglyceride and fasting blood glucose values. These tests are routinely available and do not need extra cost.[3,4]

Higher TyG index has been reported with higher risk of cardiovascular and cerebrovascular disease. Recent studies have shown association of TyG index with ischemic stroke risk, recurrent vascular events and poor outcome after stroke.[5,6] In acute ischemic stroke patients with type 2 diabetes mellitus, higher TyG index was also related with recurrent ischemic stroke and all-cause mortality at one year.[7] But all studies are not fully consistent. One recent retrospective study did not find significant association between TyG index and clinical outcomes of ischemic stroke, showing that further data is still required.[8]

The relation between TyG index and carotid atherosclerosis is clinically relevant. TyG index represents metabolic risk, while CIMT represents structural vascular change. Miao et al. reported that higher TyG index was associated with abnormal common carotid artery intima-media thickness in patients with ischemic stroke.[2] This supports the possibility that insulin resistance may be linked with carotid atherosclerosis in stroke patients. However, Indian hospital-based data on this association is still limited.

Therefore, the present study was conducted to assess the association between triglyceride glucose index and carotid intima-media thickness in patients with acute ischemic stroke. The study also describes the clinical profile, vascular risk factors, biochemical profile and stroke syndrome distribution of the study patients. The main focus was to assess whether higher TyG index is associated with increased CIMT in acute ischemic stroke.

MATERIALS AND METHODS

This hospital-based cross-sectional study was conducted in the inpatient Department of General Medicine, Assam Medical College and Hospital, Dibrugarh. The study was carried out for one year from 1 December 2024 to 30 November 2025. Radiologically confirmed acute ischemic stroke patients aged ≥13 years were included by consecutive sampling. Patients with transient ischemic attack, haemorrhagic stroke, symptom onset more than 7 days before admission, atrial fibrillation, pregnancy and those on lipid-lowering therapy were excluded. The final sample size was 50 patients, calculated using expected correlation between TyG index and CIMT, with 95% confidence level and 90% power.

After written informed consent, detailed history and clinical examination were done. Demographic details, vascular risk factors and clinical findings were recorded in a pre-designed proforma. Acute ischemic stroke was defined as sudden onset neurological deficit lasting more than 24 hours with CT or MRI evidence of cerebral infarction. Fasting blood sample was collected after 8 hours of overnight fasting. Fasting blood glucose, fasting triglycerides, HDL, LDL, total cholesterol, fasting insulin, HbA1c, renal function, liver function, electrolytes and TSH were assessed. TyG index was calculated as ln [fasting triglycerides (mg/dL) × fasting plasma glucose (mg/dL) / 2].

CIMT was measured by B-mode ultrasonography using Samsung RS 80A Prestige ultrasound scanner. Measurement was taken from the far wall of common carotid artery, 1 cm proximal to carotid bifurcation. Patients were examined in supine position with neck rotated about 45 degrees. A 10–15 MHz linear array transducer was used. Right and left carotid artery values were measured and average value was taken as mean CIMT.

The primary outcome was correlation between TyG index and CIMT. Data were entered in Microsoft Excel and analysed using SPSS version 29.0. Continuous variables were expressed as mean ± SD and categorical variables as frequency and percentage. Association between TyG and CIMT categories was tested by appropriate statistical test. Pearson correlation was used for correlation between TyG index and CIMT. A p value <0.05 was considered statistically significant. Ethical clearance was obtained from the Institutional Ethics Committee (H), Assam Medical College and Hospital. Patient confidentiality was maintained throughout the study.

RESULTS

Table 1: Baseline clinical profile of study patients

Parameter	Category / measure	Value
Age	Mean ± SD	54.96 ± 23.3 years
Age group	30–39 years	7 (14.0%)
	40–49 years	11 (22.0%)
	50–59 years	10 (20.0%)
	60–69 years	15 (30.0%)
	≥70 years	7 (14.0%)
Sex	Male	27 (54.0%)
	Female	23 (46.0%)
BMI	Mean ± SD	25.4 ± 4.5 kg/m²
BMI category	Optimal	35 (70.0%)

	Overweight	4 (8.0%)
	Obese	11 (22.0%)

Table 1 shows the baseline clinical profile of 50 patients with acute ischemic stroke. The mean age was 54.96 ± 23.3 years. Most patients were in the 60–69 years age group, followed by 40–49 years and 50–59 years. Males were slightly more common than females, 27 (54.0%) and 23 (46.0%) respectively. Mean BMI was 25.4 ± 4.5 kg/m². Most patients had optimal BMI, while 4 (8.0%) were overweight and 11 (22.0%) were obese.

Table 2: Vascular risk factors and stroke syndrome distribution

Parameter	Category	Value
Diabetes mellitus	Present	16 (32.0%)
	Absent	34 (68.0%)
Smoking	Present	19 (38.0%)
	Absent	31 (62.0%)
Alcohol use	Present	9 (18.0%)
	Absent	41 (82.0%)
Stroke syndrome	LACS	12 (24.0%)
	PACS	14 (28.0%)
	POCS	10 (20.0%)
	TACS	14 (28.0%)

Table 2 presents vascular risk factors and stroke syndrome distribution. Diabetes mellitus was present in 16 (32.0%) patients. Smoking was reported in 19 (38.0%) patients and alcohol use in 9 (18.0%). PACS and TACS were the most common stroke syndromes, each seen in 14 (28.0%) patients. LACS was seen in 12 (24.0%) and POCS in 10 (20.0%) patients.

Table 3: Biochemical and carotid artery profile of study patients

Parameter	Mean ± SD	Minimum	Maximum
Fasting blood sugar mg/dL	105.5 ± 27.21	68	220
Fasting insulin mIU/mL	7.97 ± 3.5	2.0	19.7
Fasting triglycerides mg/dL	137.3 ± 48.24	88	300
HDL cholesterol mg/dL	41.88 ± 7.52	21	54
LDL cholesterol mg/dL	106.1 ± 25.35	58.3	152.1
TyG index	8.81 ± 0.46	8.17	10.37
CIMT mm	1.01 ± 0.38	0.4	1.9

Table 3 shows the biochemical and carotid artery profile. Mean fasting blood sugar was 105.5 ± 27.21 mg/dL and mean fasting triglyceride level was 137.3 ± 48.24 mg/dL. Mean HDL cholesterol was 41.88 ± 7.52 mg/dL and LDL cholesterol was 106.1 ± 25.35 mg/dL. Mean fasting insulin was 7.97 ± 3.5 mIU/mL. The mean TyG index was 8.81 ± 0.46, while mean CIMT was 1.01 ± 0.38 mm.

Table 4: Distribution of TyG index and CIMT categories

Parameter	Category	Number	Percentage
TyG index	<8.28	4	8.0%
	8.28–8.69	17	34.0%
	8.69–9.19	22	44.0%
	≥9.19	7	14.0%
CIMT	<0.8 mm	15	30.0%
	≥0.8 mm	35	70.0%

Table 4 describes the distribution of TyG index and CIMT categories. Most patients were in the TyG index range of 8.69–9.19, accounting for 22 (44.0%) patients. Another 17 (34.0%) patients were in the 8.28–8.69 group. Only 4 (8.0%) patients had TyG index <8.28, while 7 (14.0%) had TyG index ≥9.19. Increased CIMT of ≥0.8 mm was present in 35 (70.0%) patients.

Table 5: Association and correlation between TyG index and CIMT

Analysis	Finding
CIMT <0.8 mm in TyG <8.28	3 (20.0%)
CIMT <0.8 mm in TyG 8.28–8.69	9 (60.0%)
CIMT <0.8 mm in TyG 8.69–9.19	3 (20.0%)
CIMT <0.8 mm in TyG ≥9.19	0
CIMT ≥0.8 mm in TyG <8.28	1 (2.86%)
CIMT ≥0.8 mm in TyG 8.28–8.69	8 (22.86%)
CIMT ≥0.8 mm in TyG 8.69–9.19	19 (54.29%)
CIMT ≥0.8 mm in TyG ≥9.19	7 (20.0%)
Association between TyG category and CIMT category	p=0.006

Mean CIMT across TyG categories	0.73 ± 0.39, 0.78 ± 0.28, 1.11 ± 0.33, 1.41 ± 0.14 mm
Difference in mean CIMT across TyG categories	p=0.001
Pearson correlation between TyG index and CIMT	r=0.631
Coefficient of determination	R^2=0.399
Correlation p value	p<0.05

Table 5 shows the association between TyG index and CIMT. Among patients with CIMT <0.8 mm, most were in lower TyG categories and none had TyG index ≥9.19. In contrast, among patients with CIMT ≥0.8 mm, most were in higher TyG categories, especially 8.69–9.19 and ≥9.19. This association was statistically significant with p=0.006. Mean CIMT also increased from 0.73 ± 0.39 mm in the lowest TyG group to 1.41 ± 0.14 mm in the highest TyG group, with p=0.001. Pearson correlation showed a positive correlation between TyG index and CIMT, with r=0.631 and R^2=0.399. The correlation was statistically significant with $p<0.05$.

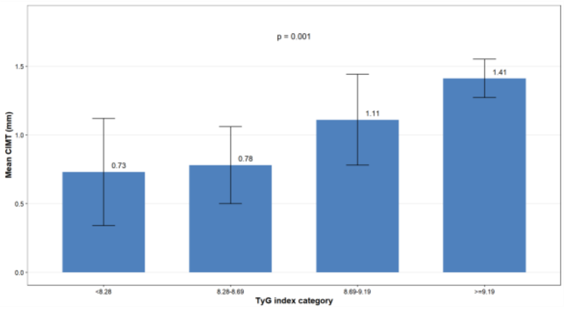

Figure 1: Mean CIMT according to TyG index category

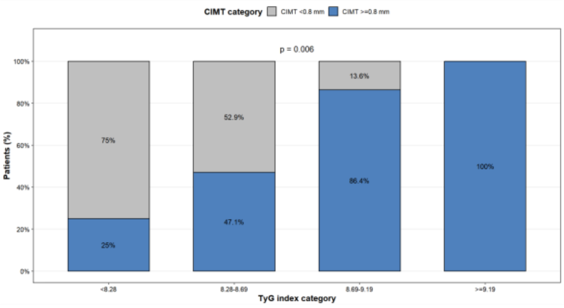

Figure 2: CIMT category distribution across TyG index categories

DISCUSSION

The present hospital-based study showed a clear association between triglyceride glucose index and carotid intima-media thickness in patients with acute ischemic stroke. The main finding was that patients with higher TyG index had higher CIMT. This supports the view that metabolic dysfunction and carotid atherosclerosis may go together in ischemic stroke patients. The study data were taken from the provided five-table result set.

In Table 1, the mean age of patients was 54.96 ± 23.3 years. Most patients were in the 60–69 years age group. Males were slightly more than females, 54.0% versus 46.0%. The mean BMI was 25.4 ± 4.5 kg/m², and 30.0% patients were either overweight or obese. This shows that the study population had a middle-aged to elderly profile with mild male predominance. This pattern is expected in acute ischemic stroke, where age, male sex and excess body weight often act along with other vascular risks. BMI alone may not explain the full risk, but it supports the presence of underlying metabolic burden.

Table 2 shows the vascular risk factor profile. Diabetes mellitus was present in 32.0% patients, smoking in 38.0% and alcohol use in 18.0%. These are clinically important because TyG index is derived from fasting glucose and triglyceride levels and therefore it reflects part of this metabolic risk load. PACS and TACS were the commonest stroke syndromes, each seen in 28.0% patients. LACS was seen in 24.0% and POCS in 20.0%. This distribution shows that both anterior circulation and lacunar type syndromes were represented. However, this study was not designed mainly to assess stroke syndrome severity. So, the stroke syndrome data should be used as descriptive background and not for strong mechanistic conclusion.

In Table 3, the mean fasting blood sugar was 105.5 ± 27.21 mg/dL and fasting triglyceride was 137.3 ± 48.24 mg/dL. Mean HDL cholesterol was 41.88 ± 7.52 mg/dL and LDL cholesterol was 106.1 ± 25.35 mg/dL. The mean TyG index was 8.81 ± 0.46. The mean CIMT was 1.01 ± 0.38 mm. These values suggest that many patients had a measurable metabolic and vascular risk profile even though the mean triglyceride level was not very high. This is important because TyG index combines triglyceride and fasting glucose and may show insulin resistance better than either value alone. Li et al. also reported that TyG index was significantly associated with carotid atherosclerosis detected by ultrasonography, including carotid intima-media thickness and plaques.[10]

The distribution in Table 4 further supports this point. Most patients were in the middle and higher TyG categories. The 8.69–9.19 group included 44.0% patients and the ≥9.19 group included 14.0% patients. CIMT ≥0.8 mm was present in 70.0% patients. This means increased carotid thickness was common in this acute ischemic stroke population. Similar observations have been reported in large population studies where higher TyG index was linked with carotid plaque and atherosclerosis incidence.[11] Wu et al. found that individuals in the highest TyG quartile had increased risk of carotid plaque compared with the lowest quartile and concluded that higher TyG increased carotid atherosclerosis incidence.[11]

Table 5 is the main table of this study. Among patients with CIMT <0.8 mm, no patient had TyG index ≥9.19. In contrast, among patients with CIMT ≥0.8 mm, 54.29% were in the TyG 8.69–9.19

category and 20.0% were in the TyG ≥9.19 category. This distribution was statistically significant with p=0.006. Mean CIMT also increased across TyG groups from 0.73 ± 0.39 mm in the lowest TyG group to 1.41 ± 0.14 mm in the highest TyG group. This graded rise is the most clinically useful observation in the study. It suggests that as insulin resistance marker increased, carotid wall thickness also increased.

The correlation analysis also supports the same finding. Pearson correlation between TyG index and CIMT was r=0.631 with R^2=0.399 and p<0.05. This indicates a moderately strong positive correlation. About 39.9% of the variation in CIMT was explained by TyG index in this study. Miao et al. also reported a positive dose-dependent association between TyG index and carotid atherosclerosis measured by common carotid artery intima-media thickness in ischemic stroke patients.[2] Cao et al. recently reported that higher TyG index was associated with carotid atherosclerosis, increased CIMT and plaque, with the risk rising when TyG was above 8.72.[12]

The present findings are therefore in agreement with earlier work. TyG index may reflect insulin resistance, lipid-glucose interaction, endothelial dysfunction and low-grade vascular inflammation. These changes may promote arterial wall thickening and atherosclerosis. It is also possible that high TyG index marks a chronic metabolic state which already existed before stroke. Since CIMT is a structural marker, it is unlikely to develop only during the acute event. So, the association seen here may represent pre-existing metabolic vascular injury rather than only acute stroke stress response.

The clinical implication is simple. TyG index is calculated from fasting glucose and triglyceride, both of which are routinely available. CIMT is also a non-invasive ultrasound marker. Their combination may help in identifying ischemic stroke patients with higher atherosclerotic burden. This does not mean that TyG index can replace standard risk assessment. It can be used as an additional low-cost marker. This is useful in Indian medical college settings where advanced vascular markers may not be available in all patients.

Studies on TyG index in acute ischemic stroke outcomes also support its wider vascular relevance. Toh et al. found that TyG index was associated with higher 90-day mortality and poorer neurological and functional outcomes in patients receiving thrombolysis.[13] Zhang et al. found that increasing TyG index was associated with early neurological deterioration and lower chance of early neurological improvement after thrombolysis.[14] Miao et al. also found higher TyG index was associated with unfavorable functional outcome and in-hospital mortality after ischemic stroke.[15] These studies are not directly same as the present study because our outcome was CIMT, but they support that TyG index has vascular and prognostic relevance in stroke.

Indian data are also emerging. Garg et al. studied acute ischemic stroke patients and found higher TyG index in patients with neurological worsening and recurrent stroke.[16] However, all studies are not uniform. Bukke et al. did not find significant association between TyG index and clinical outcomes in ischemic stroke and advised larger studies before depending on TyG index alone.[17] This difference is important. It suggests that TyG index may be more consistent as a metabolic and vascular risk marker, while its relation with clinical outcome may vary according to sample size, stroke severity, treatment received and follow-up duration.

The present study has some limitations. It was a single-centre hospital-based study with only 50 patients. The design was cross-sectional, so causal relation cannot be proved. CIMT and TyG index were measured at one point only. Serial TyG index or follow-up CIMT was not available. Stroke severity by NIHSS, infarct volume and long-term functional outcome were not included in the main analysis. Drug history, dietary factors and pre-existing metabolic control may also influence fasting glucose and triglyceride levels. Therefore, the findings should be interpreted as association, not causation.

Despite these limitations, the study adds useful local data. Higher TyG index was significantly associated with increased CIMT in acute ischemic stroke patients. The association was seen both by category-wise analysis and by correlation. This supports the role of TyG index as a simple marker related to carotid atherosclerotic burden in ischemic stroke. Larger multicentre studies with NIHSS, plaque morphology, carotid stenosis and follow-up outcome will be required to confirm the clinical usefulness.

CONCLUSION

Higher TyG index was significantly associated with increased CIMT in patients with acute ischemic stroke. Patients in higher TyG categories showed more frequent CIMT ≥0.8 mm and mean CIMT also increased progressively across TyG groups. A positive correlation was seen between TyG index and CIMT, suggesting that TyG index may reflect carotid atherosclerotic burden in these patients. As it is simple and based on routine fasting glucose and triglyceride values, TyG index can be used as an additional low-cost marker in stroke risk assessment, though larger studies are needed to confirm its clinical utility.

REFERENCES

1. Behera DK et al. Analyzing stroke burden and risk factors in India using data from the Global Burden of Disease Study. Scientific Reports. 2024.
2. Miao M et al. Triglyceride-glucose index and common carotid artery intima-media thickness in patients with ischemic stroke. Cardiovascular Diabetology. 2022;21:43. doi: 10.1186/s12933-022-01472-1.
3. Simental-Mendía LE et al. The product of fasting glucose and triglycerides as surrogate for identifying insulin resistance in apparently healthy subjects. Metabolic Syndrome and Related Disorders. 2008;6:299–304.

4. Guerrero-Romero F et al. The product of triglycerides and glucose, a simple measure of insulin sensitivity. Journal of Clinical Endocrinology and Metabolism. 2010;95:3347–3351.
5. Hoshino T et al. Triglyceride-glucose index as a prognostic marker after ischemic stroke or transient ischemic attack: a prospective observational study. Cardiovascular Diabetology. 2022;21:264. doi: 10.1186/s12933-022-01695-2.
6. Zhang B et al. Association between triglyceride-glucose index and early neurological outcomes after thrombolysis in patients with acute ischemic stroke. Journal of Clinical Medicine. 2023;12:3471.
7. Liu D et al. Predictive effect of triglyceride-glucose index on clinical events in patients with acute ischemic stroke and type 2 diabetes mellitus. Cardiovascular Diabetology. 2022;21:280. doi: 10.1186/s12933-022-01704-4.
8. Bukke SPN et al. Association of triglyceride glucose index with clinical outcomes in ischemic stroke: a retrospective study. BMC Neurology. 2024. doi: 10.1186/s12883-024-03873-z.
9. Li X et al. Triglyceride-glucose index prediction of stroke incidence risk in low-income Chinese population: a 10-year prospective cohort study. Frontiers in Endocrinology. 2024. doi: 10.3389/fendo.2024.1444030.
10. Li W et al. Association between triglyceride-glucose index and carotid atherosclerosis detected by ultrasonography. Cardiovasc Diabetol. 2022;21:137. doi: 10.1186/s12933-022-01570-0.
11. Wu Z et al. Triglyceride glucose index and carotid atherosclerosis incidence in the Chinese population: a prospective cohort study. Nutr Metab Cardiovasc Dis. 2021. doi: 10.1016/j.numecd.2021.03.027.
12. Cao H et al. Association between triglyceride-glucose index and carotid atherosclerosis in Chinese steelworkers: a cross-sectional study. Scientific Reports. 2025.
13. Toh EMS et al. Association of triglyceride-glucose index with clinical outcomes in patients with acute ischemic stroke receiving intravenous thrombolysis. Scientific Reports. 2022;12:1596. doi: 10.1038/s41598-022-05467-6.
14. Zhang B et al. Association between triglyceride-glucose index and early neurological outcomes after thrombolysis in patients with acute ischemic stroke. J Clin Med. 2023;12:3471. doi: 10.3390/jcm12103471.
15. Miao M et al. Triglyceride-glucose index and short-term functional outcome and in-hospital mortality in patients with ischemic stroke. Nutr Metab Cardiovasc Dis. 2023;33:399-407. doi: 10.1016/j.numecd.2022.11.004.
16. Garg R et al. Association of the triglyceride glucose index with outcomes in acute ischemic stroke injury. Cureus. 2024;16:e75841. doi: 10.7759/cureus.75841.
17. Bukke SPN et al. Association of triglyceride glucose index with clinical outcomes in
18. ischemic stroke: a retrospective study. BMC Neurol. 2024;24:371. doi: 10.1186/s12883-024-03873-z.