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# ASSOCIATION OF TRIGLYCERIDE-GLUCOSE INDEX WITH COMMON CAROTID ARTERY STENOSIS IN ACUTE ANTERIOR CIRCULATION STROKE

Neurology

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## ABSTRACT

**Background:** Acute anterior circulation stroke is commonly driven by large-artery atherosclerosis, and early identification of patients with a greater extracranial atherosclerotic burden may improve risk stratification. The triglyceride-glucose (TyG) index is an inexpensive surrogate marker of insulin resistance and has been linked to atherosclerotic disease and adverse cerebrovascular outcomes [1-8]. This study evaluated the association of the TyG index with common carotid artery (CCA) stenosis and stroke severity in patients with acute anterior circulation stroke. **Methodology:** This hospital-based cross-sectional study was conducted in the Department of General Medicine at Pacific Institute of Medical Sciences, Udaipur, Rajasthan. Seventy-five adults with radiologically confirmed anterior circulation stroke were enrolled over a 2-year period. Clinical details, risk factors, carotid Doppler findings, National Institutes of Health Stroke Scale (NIHSS) categories, and fasting biochemical parameters were recorded. The TyG index was calculated from fasting triglyceride and glucose values. Kruskal-Wallis test was used to compare TyG values across stenosis and NIHSS categories, and ordinal logistic regression was used to identify independent predictors of greater CCA stenosis severity. **Results:** Among 75 patients, 62.7% were male and the mean age was 54.27 ± 12.76 years. No carotid stenosis was seen in 42.6% of patients, while 22.7% had severe stenosis (>70%). Severe stroke by NIHSS was present in 45.3% of cases. Median TyG index increased across carotid stenosis categories and was highest in severe stenosis (10.04 ± 0.66; p = 0.001). Median TyG index was also higher in severe stroke (9.45 ± 0.76; p = 0.02). On ordinal logistic regression, TyG index (OR 4.92, 95% CI 1.71-15.23; p = 0.004) and hypertension (OR 3.35, 95% CI 1.19-9.81; p = 0.02) independently predicted more severe CCA stenosis. **Conclusion:** Higher TyG index values were significantly associated with both greater CCA stenosis severity and greater stroke severity in acute anterior circulation stroke. The TyG index may serve as a simple adjunctive marker for early vascular risk stratification in this setting.

## KEYWORDS

Acute Anterior Circulation Stroke, Carotid Stenosis, Insulin Resistance, TyG Index, Stroke Severity

## INTRODUCTION

Stroke remains a major cause of mortality and long-term disability worldwide, and ischemic stroke accounts for the majority of all stroke events [1]. Among the various etiological subtypes, large-artery atherosclerosis plays a particularly important role in the development of ischemic stroke through progressive luminal narrowing, plaque instability, artery-to-artery embolism, and consequent reduction in cerebral perfusion [2]. In acute anterior circulation stroke, these mechanisms are especially relevant because disease involving the carotid system may directly compromise blood flow to major cerebral territories. Early neuroimaging and vascular assessment are therefore essential not only for confirming the diagnosis and identifying the affected vascular territory, but also for estimating atherosclerotic burden, recognizing stenotic lesions, and guiding acute treatment as well as long-term secondary prevention strategies [3].

In recent years, increasing attention has been directed toward the contribution of metabolic dysfunction to cerebrovascular disease. Insulin resistance is now recognized as an important pathophysiological factor underlying endothelial dysfunction, oxidative stress, chronic vascular inflammation, dyslipidaemia, and accelerated plaque progression. These abnormalities collectively promote atherosclerosis and increase the risk of both incident and recurrent ischemic stroke. However, direct assessment of insulin resistance by clamp-based techniques is complex, costly, and impractical in routine clinical practice. For this reason, the triglyceride-glucose (TyG) index, calculated from fasting triglyceride and fasting plasma glucose levels, has emerged as a simple, inexpensive, and reproducible surrogate marker of insulin resistance [4,5].

A growing body of literature suggests that a higher TyG index is associated with adverse cerebrovascular and vascular phenotypes. Elevated TyG values have been linked with symptomatic intracranial atherosclerotic stenosis, combined intra- and extracranial arterial stenosis, carotid plaque formation, and plaque instability in both stroke populations and broader vascular cohorts [6-8]. These findings support the concept that the TyG index reflects not only metabolic derangement but also the underlying atherosclerotic milieu that contributes to cerebrovascular events.

Despite these observations, studies specifically evaluating the relationship between TyG index and common carotid artery (CCA) stenosis in patients presenting with acute anterior circulation stroke remain limited. Most available studies have focused on overall stroke risk, intracranial stenosis, or generalized carotid atherosclerotic disease rather than the severity of CCA involvement in this clinically important subgroup. In addition, the association between TyG index and stroke severity at presentation has not been adequately clarified in such patients. The present study was therefore undertaken to assess the association between TyG index and CCA stenosis severity and to explore its relationship with stroke severity in patients with acute anterior circulation stroke.

## MATERIAL & METHODS

This hospital-based cross-sectional study was carried out in the Department of General Medicine at Pacific Institute of Medical Sciences (PIMS), Udaipur, Rajasthan, after approval by the institutional ethics committee. Adults aged 18 years and above with radiologically confirmed anterior circulation stroke involving the middle cerebral artery or anterior cerebral artery territory were eligible. Patients with non-anterior circulation stroke, transient ischemic attack, metabolic encephalopathy, alternative causes of hemiparesis, or unwillingness for imaging or participation were excluded.

The calculated sample size was 75 patients, and 75 consecutive eligible cases were included. Demographic profile, vascular risk factors, addictions, clinical presentation, and laboratory data were recorded at admission. Stroke severity was assessed using the NIHSS and categorized as mild, moderate, or severe. Fasting blood samples were collected after overnight fasting, and the TyG index was calculated as ln [triglyceride (mg/dL) × fasting glucose (mg/dL)/2].

All participants underwent carotid duplex ultrasonography performed by an experienced radiologist. Carotid stenosis was categorized as no stenosis, mild (<50%), moderate (50-69%), or severe (>70%). Quantitative variables were expressed as mean ± standard deviation or median ± interquartile range, as appropriate. The Kruskal-Wallis test was used for non-parametric comparisons, and ordinal logistic regression was performed to identify independent predictors of increasing CCA stenosis severity. A p value <0.05 was considered statistically significant.

## RESULTS

A total of 75 patients with acute anterior circulation stroke were analyzed.

**Table 1. Baseline Demographic Profile, Risk Factors and Vascular Territory (n = 75)**

| Domain | Variable | Value |
|---|---|---|
| Demography | Male sex | 47 (62.7%) |
| | Female sex | 28 (37.3%) |
| | Age, years | 54.27 ± 12.76 |
| Body habitus | BMI, kg/m² | 22.25 ± 1.65 |
| | Normal BMI | 51 (68.0%) |
| | Overweight | 21 (28.0%) |
| | Obese | 3 (4.0%) |
| Comorbidity | Hypertension | 58 (77.3%) |
| | Diabetes mellitus | 51 (68.0%) |
| | Dyslipidaemia | 46 (61.3%) |
| | Coronary artery disease | 35 (46.7%) |
| Addiction | Smoking tobacco | 40 (53.3%) |
| | Alcohol use | 26 (34.7%) |
| Stroke territory | Middle cerebral artery | 44 (58.7%) |
| | Anterior cerebral artery | 31 (41.3%) |

As shown in Table 1, men accounted for 62.7% of cases, and the mean age was 54.27 ± 12.76 years. Hypertension (77.3%), diabetes mellitus (68.0%), and dyslipidemia (61.3%) were the most frequent comorbidities, while smoking tobacco (53.3%) and alcohol use (34.7%) were common addictions. Middle cerebral artery involvement was more frequent than anterior cerebral artery involvement (58.7% vs 41.3%).

**Table 2. Clinical Presentation, Laboratory Profile, Carotid Stenosis and Stroke Severity**

| Category | Variable | Value |
|---|---|---|
| Symptoms | Contralateral hemiparesis | 61 (81.3%) |
| | Contralateral hemisensory loss | 53 (70.7%) |
| | Facial weakness | 31 (41.3%) |
| | Aphasia | 23 (30.7%) |
| Laboratory Profile | Fasting blood glucose, mg/dL | 169.11 ± 68.65 |
| | Triglycerides, mg/dL | 157.31 ± 32.83 |
| | LDL, mg/dL | 141.45 ± 23.72 |
| | TyG index | 9.41 ± 0.47 |
| Carotid stenosis | No stenosis | 32 (42.6%) |
| | Mild (<50%) | 12 (16.0%) |
| | Moderate (50-69%) | 14 (18.7%) |
| | Severe (>70%) | 17 (22.7%) |
| NIHSS severity | Mild | 23 (30.7%) |
| | Moderate | 18 (24.0%) |
| | Severe | 34 (45.3%) |

The major presenting symptoms are summarized in this table; contralateral hemiparesis (81.3%) and contralateral hemisensory loss (70.7%) were the dominant clinical manifestations. Mean TyG index in the study population was 9.41 ± 0.47. With respect to vascular severity and stroke severity, Table 2 shows that 42.6% of patients had no carotid stenosis, whereas 16.0% had mild stenosis, 18.7% had moderate stenosis, and 22.7% had severe stenosis. Severe stroke by NIHSS was observed in 45.3% of the study population.

**Table 3. Association of TyG Index with Carotid Stenosis Severity and NIHSS-defined Stroke Severity**

| Comparison | Group | Median TyG ± IQR | p value* |
|---|---|---|---|
| Carotid stenosis | No stenosis | 9.15 ± 0.30 | |
| | Mild (<50%) | 9.13 ± 0.64 | |
| | Moderate (50-69%) | 9.48 ± 0.25 | |
| | Severe (>70%) | 10.04 ± 0.66 | 0.001 |
| Stroke severity | Mild NIHSS | 9.19 ± 0.54 | |
| | Moderate NIHSS | 9.23 ± 0.59 | |
| | Severe NIHSS | 9.45 ± 0.76 | 0.02 |

*Kruskal-Wallis test applied for Table 3.

The association of TyG index with carotid stenosis severity and stroke severity is presented in Table 3. The TyG index showed a significant positive association with carotid stenosis severity. Median TyG values were 9.15 ± 0.30 in patients with no stenosis, 9.13 ± 0.64 in mild stenosis, 9.48 ± 0.25 in moderate stenosis, and 10.04 ± 0.66 in severe stenosis ($p = 0.001$). TyG index also differed significantly across NIHSS categories, increasing from 9.19 ± 0.54 in mild stroke to 9.45 ± 0.76 in severe stroke ($p = 0.02$).

**Table 4. Ordinal Logistic Regression Predictors of Increasing Common Carotid Artery Stenosis Severity**

| Variable | Odds ratio | 95% confidence interval | p value |
|---|---|---|---|
| Age | 1.02 | 0.98 - 1.06 | 0.32 |
| Male sex | 0.51 | 0.16 - 1.62 | 0.26 |
| Hypertension | 3.35 | 1.19 - 9.81 | 0.02 |
| Diabetes mellitus | 2.32 | 0.89 - 6.14 | 0.09 |
| Smoking | 0.94 | 0.31 - 2.82 | 0.92 |
| TyG index | 4.92 | 1.71 - 15.23 | 0.004 |

As shown in Table 4, on ordinal logistic regression, TyG index remained an independent predictor of increasing CCA stenosis severity (OR 4.92, 95% CI 1.71–15.23; $p = 0.004$). Hypertension was also independently associated with more severe stenosis (OR 3.35, 95% CI 1.19–9.81; $p = 0.02$). Age, sex, diabetes mellitus, and smoking were not statistically significant in the adjusted model.

**Abbreviations:** BMI, body mass index; CCA, common carotid artery; LDL, low-density lipoprotein; NIHSS, National Institutes of Health Stroke Scale; TyG, triglyceride-glucose.

## DISCUSSION

This study demonstrates a significant association between TyG index and severity of common carotid artery stenosis in patients with acute anterior circulation stroke. In addition, higher TyG index values were associated with greater neurological severity as measured by NIHSS. These findings support the concept that insulin resistance-related metabolic dysfunction contributes not only to long-term atherogenesis but also to the vascular and neurological burden at stroke presentation [4-8].

The study population showed a male predominance and a high prevalence of conventional vascular risk factors, especially hypertension, diabetes mellitus, and dyslipidaemia. This general pattern is consistent with contemporary stroke cohorts in which metabolic and atherosclerotic factors cluster strongly among patients with ischemic cerebrovascular disease [10-12]. The present cohort also had substantial extracranial carotid disease, with 57.4% showing some degree of stenosis and nearly one-quarter having severe stenosis. That burden is clinically relevant because carotid atherosclerosis may increase embolic risk and worsen cerebral hypoperfusion in anterior circulation stroke [2,3].

The most important observation was the graded rise in TyG index across stenosis categories, culminating in the highest median value among those with severe stenosis. This aligns with recent evidence linking higher TyG values to symptomatic intracranial atherosclerotic stenosis, combined intra- and extracranial stenosis, carotid plaque instability, and carotid intima-media thickening [6-8,13-15,17]. Xie et al. reported that higher TyG index values were independently associated with intracranial and extracranial stenotic disease and with increasing stenosis burden [7]. Miao et al. similarly observed a relationship between TyG index and common carotid artery intima-media thickness in ischemic stroke patients [8]. The present findings extend these observations by showing that even within a hospital-based stroke cohort, TyG index remains strongly associated with higher grades of CCA stenosis.

From a pathophysiological perspective, this association is biologically plausible. Insulin resistance is linked to endothelial dysfunction, oxidative stress, pro-inflammatory cytokine activation, abnormal lipid handling, and impaired fibrinolytic balance, all of which accelerate plaque formation and destabilization [4,5,20]. The TyG index may therefore serve as a practical composite reflection of metabolic injury that is more closely connected to vascular pathology than isolated fasting glucose or triglyceride values alone. Its low cost and universal availability also make it attractive in routine stroke practice, particularly in resource-constrained settings.

A second important finding was the association between TyG index and stroke severity. Patients with severe stroke had higher median TyG values than those with mild or moderate stroke. This is in line with reports from Garg et al., who found significant positive correlations between TyG index and stroke severity parameters, and with newer studies showing that elevated TyG levels are linked to poorer early neurological and functional outcomes after acute ischemic stroke [10,18,19]. Toh et al. and Wu et al. further suggested that TyG index is associated with adverse clinical events or recurrence in selected stroke populations [11,12]. Not all studies have shown uniform prognostic value, however; Bukke et al. did not observe an independent relationship with short-term clinical outcomes in their cohort [16]. That inconsistency likely reflects differences in study design, stroke subtype, sample size, follow-up duration, and outcome definition.

The ordinal logistic regression analysis strengthens the clinical relevance of the present results. Even after adjustment for age, sex, diabetes mellitus, and smoking, TyG index remained an independent predictor of increasing carotid stenosis severity, while hypertension also retained significance. This suggests that the TyG index captures vascular risk beyond simple classification of diabetes status. In practical terms, a higher TyG index in a patient with acute anterior circulation stroke may identify those who warrant more careful carotid evaluation, stricter cardiometabolic risk control, and closer secondary prevention planning.

The study has clinical implications. Because TyG index is derived from routinely available fasting glucose and triglyceride measurements, it could be incorporated easily into early stroke assessment. Used alongside carotid Doppler and standard risk-factor evaluation, it may improve recognition of patients with a heavier extracranial atherosclerotic burden and potentially worse neurological presentation. Its value lies not as a standalone diagnostic test, but as a pragmatic adjunctive marker that may support vascular risk stratification.

The principal strengths of the study are its focused evaluation of anterior circulation stroke and its use of both carotid stenosis grading and neurological severity measures. The main limitations are the single-center design, relatively modest sample size, and cross-sectional nature, which preclude causal inference and long-term prognostic assessment. Larger prospective studies are needed to define optimal TyG thresholds, examine temporal outcomes, and determine whether adding TyG index to conventional stroke work-up improves prediction models or treatment pathways.

## CONCLUSION

Higher TyG index values were significantly associated with greater common carotid artery stenosis severity and greater NIHSS-defined stroke severity in patients with acute anterior circulation stroke. TyG index and hypertension independently predicted increasing CCA stenosis severity on multivariable analysis.

These findings support the TyG index as a simple, low-cost marker that may aid early vascular risk stratification in acute anterior circulation stroke, particularly when interpreted together with carotid imaging and standard clinical risk factors.

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### Conflict of Interest

None declared.

## REFERENCES

1. Feigin VL, Brainin M, Norrving B, Martins SO, Pandian J, Lindsay P, et al. World Stroke Organization: Global Stroke Fact Sheet 2025. Int J Stroke. 2025;20(2):132-144.
2. Banerjee C, Chimowitz MI. Stroke Caused by Atherosclerosis of the Major Intracranial Arteries. Circ Res. 2017;120(3):502-513.
3. Kim HJ, Roh HG. Imaging in Acute Anterior Circulation Ischemic Stroke: Current and Future. Neurointervention. 2022;17(1):2-17.
4. Tao LC, Xu JN, Wang TT, Hua F, Li JJ. Triglyceride-glucose index as a marker in cardiovascular diseases: landscape and limitations. Cardiovasc Diabetol. 2022;21(1):68.
5. Alizargar J, Bai CH, Hsieh NC, Wu SV. Use of the triglyceride-glucose index (TyG) in cardiovascular disease patients. Cardiovasc Diabetol. 2020;19(1):8.
6. Yang Y, Mei C, Guo X, Han B, Wang Q. Association between the triglyceride-glucose index and symptomatic intracranial atherosclerotic stenosis in nondiabetic patients: a retrospective study. BMC Neurol. 2025;25(1):325.
7. Xie Y, Cen K, Dan B, Zou L, Zhang L, Zhang R, et al. Association between triglyceride-glucose index and intracranial/extracranial atherosclerotic stenosis: findings from a retrospective study. Cardiovasc Diabetol. 2024;23(1):95.
8. Miao M, Zhou G, Bao A, Sun Y, Du H, Song L, et al. Triglyceride-glucose index and common carotid artery intima-media thickness in patients with ischemic stroke. Cardiovasc Diabetol. 2022;21(1):43.
9. Goldstein LB, Simel DL. Is this patient having a stroke? JAMA. 2005;293(19):2391-2402.
10. Garg R, Bhatnagar M, Gupta S. Association of the Triglyceride Glucose Index With Outcomes in Acute Ischemic Stroke Injury. Cureus. 2024;16(12):e75841.
11. Toh EM, Lim AY, Ming C, Yeo LL, Sia CH, Tan BW, et al. Association of triglyceride-glucose index with clinical outcomes in patients with acute ischemic stroke receiving intravenous thrombolysis. Sci Rep. 2022;12(1):1596.
12. Wu L, Zhu J, Li C, Zhu J, Dai Z, Jiang Y. Association of triglyceride-glucose index with ischemic stroke recurrence in nondiabetic patients with small vessel occlusion: a multicenter hospital-based prospective cohort study. Cardiovasc Diabetol. 2022;21(1):250.
13. Wu Z, Wang J, Li Z, Han Z, Miao X, Liu X, et al. Triglyceride glucose index and carotid atherosclerosis incidence in the Chinese population: A prospective cohort study. Nutr Metab Cardiovasc Dis. 2021;31(7):2042-2050.
14. Liao B, Meng G, Liu X. Unveiling the dual threat: combined elevated triglyceride-glucose index and intracranial arterial stenosis burden for enhanced stroke risk stratification. Front Neurol. 2025;16:1561329.
15. Huo G, Zheng J, Cao J, Zhang L, Yao Z, Zeng Y, et al. Association Between Triglyceride-Glucose Index and Carotid Plaque Stability in Different Glycemic Status: A Single-Center Retrospective Study. J Am Heart Assoc. 2025;14(3):e037970.
16. Bukke SPN, Pathange BBR, Nelluri KDD, Yadesa TM, Kamepalli S, Suvarna K, et al. Association of triglyceride glucose index with clinical outcomes in ischemic stroke: a retrospective study. BMC Neurol. 2024;24(1):371.
17. Wang A, Tian X, Zuo Y, Chen S, Zhang X, Guo J, et al. Association of triglyceride-glucose index with intra-and extra-cranial arterial stenosis: a combined cross-sectional and longitudinal analysis. Endocrine. 2021;74(2):308-317.
18. Wu Z, Shi J, Zhang Y, Zhang C, Liu Q, Wang X, et al. Triglyceride-Glucose Index and Short-Term Functional Prognosis in Patients With Acute Ischemic Stroke: A Retrospective Study. Brain Behav. 2025;15(11):e71013.
19. Hua D, Guo Z. Correlating the triglyceride glucose index with short-term neurological and functional prognosis following intravenous thrombolysis in acute ischemic stroke patients. Front Neurol. 2025;16:1670811.
20. Yan F, Yan S, Wang J, Cui Y, Chen F, Fang F, et al. Association between triglyceride glucose index and risk of cerebrovascular disease: systematic review and meta-analysis. Cardiovasc Diabetol. 2022;21(1):226.