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Research Article

Can TG/HDL Ratio be an Accurate Predictor in the Determination of the Risk of Cerebrovascular Events in Youngsters?

Eda Kılıç Çoban

Department of Neurology, Bakırköy Mental and Neurological Diseases Training and Research Hospital, Istanbul, Turkey

Abstract

Objectives: There is good evidence that shows that modification of modifiable risk factor will reduce the risk of stroke. Hyperlipidemia is one of these risk factors. Studies have shown that nontraditional serum lipid variables may be better predictors of vascular risk rather than others.

The objective of the present study was to assess the relationships of traditional and nontraditional serum lipid measurements between young and elder patients with stroke and healthy young adults.

Methods: One hundred twelve young patients with ischemic stroke, 113 healthy adults, and 110 patients with ischemic stroke aged >45 years were included in the study. Laboratory tests for total cholesterol (TC), its fractions, and triglycerides (TGs) were performed using standard techniques, and we computed four nontraditional lipid variables.

Statistical analyses were performed using chi-square test, Student's t-test, and SPSS version 16.0 software. A p value of <0.05 was considered statistically significant.

Results: The mean age of 112 young patients with stroke was 38.46±5.96 years. There were 63 male and 49 female patients. Measurements of lipid parameters were as follows: low-density lipoprotein (LDL) 121.42±36.56 mg/dl, high-density lipoprotein (HDL) 38.84±12.47 mg/dl, TG 186.10±176.14 mg/dl, TC 194.76±45.35 mg/dl, LDL/HDL 3.39±1.46, TG/HDL 5.44±6.36, and TC/HDL 5.40±6.36. All lipid measurements were significantly higher in young patients with stroke than in healthy adults.

The mean age of 110 patients with stroke aged >45 years was 69.53±12.34 years. There were 63 male and 47 female patients. Measurements of lipid parameters were as follows: LDL 125.18±35.97 mg/dl, HDL 41.47±14.16 mg/dl, TG 117.53±59.03 mg/dl, TC 190.16±42.96 mg/dl, LDL/HDL 3.32±1.55, TG/HDL 3.46±3.43, and TC/HDL 5.01±2.08. TG level and TG/HDL ratio were significantly higher in young patients with stroke than in older cases.

Conclusion: All lipid measurements were significantly higher in young patients with ischemic stroke than in young healthy adults. TG level and TG/HDL ratio were significantly higher in male than in female patients. In addition, TG level and TG/HDL ratio were significantly higher in young patients with stroke than in older cases. As the TG/HDL ratio has proven to be a highly significant independent prognostic predictor of stroke, it should be calculated in young patients with ischemic stroke.

Keywords: Stroke; TG/HDL ratio; young stroke.

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Address for correspondence: Eda Kılıç Çoban, MD. Department of Neurology, Bakırköy Mental and Neurological Diseases Training and Research Hospital, Istanbul, Turkey
Phone: +90 212 409 15 15 **E-mail:** eda_coban@yahoo.com

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Stroke is the most common cause of death in developed countries after cancer and ischemic heart disease. It is the most common physical disability. Its incidence in developing countries is steadily increasing due to unhealthy living conditions.[1] The treatment of stroke is difficult and still not effective. Therefore, the original target is protection from stroke. It has been proven that stroke can be prevented by correction of modifiable risk factors.[2]

For many years, it has been suspected that lipid abnormalities may cause atherosclerosis. Many epidemiological and cohort studies have detected a strong correlation between the incidence of ischemic heart disease, stroke, and peripheral vascular disease that develops on the background of atherosclerosis and total cholesterol (TC), low-density lipoprotein (LDL), and high-density lipoprotein (HDL). Recent studies have shown that aside from these conventional serum lipid markers, TC/HDL, LDL/HDL, and triglyceride (TG)/HDL ratios may have higher predictive values in the determination of vascular risk.[3, 4]

The aim of the present study was to determine if any correlation exists between conventional and nonconventional (TG/HDL, LDL/HDL, and TC/HDL) measurements when young patients with ischemic stroke were compared with age-matched healthy populations and elderly patients with ischemic stroke.

Methods

A total of 335 patients with 112 patients between the ages of 16 and 45 years who were admitted to our neurology clinic and hospitalized with a diagnosis of ischemic cerebrovascular disease, 113 age-matched healthy adult neurology polyclinic outpatients as the control group, and 110 patients aged >45 years who were hospitalized in the neurology clinic with a diagnosis of ischemic cerebrovascular disease between 2014 and 2015 were included in the study. Since the study was a retrospective study, patient consent was not necessary. Ethics Committee approval was not obtained for the study, but it was conducted in accordance with the principles of the Declaration of Helsinki.

The natural characteristics of the lesion were determined by brain tomography and/or brain magnetic resonance imaging of the patients who were hospitalized with a diagnosis of ischemic cerebrovascular disease.

Patients with head trauma and/or intracerebral hematoma, a history of cerebral venous thrombosis, and using lipid-lowering drugs were excluded from the study.

Serum lipid levels (TC, LDL, HDL, and TG) were measured by a standard laboratory method after a 12-hour fasting within the first 48 h of the patients' admission, and TC/HDL, LDL/HDL, and TG/HDL ratios were calculated.

Statistical Analysis

The SPSS version 16.0 (Chicago, IL, USA) software and the chi-square test and Student's t-test were used for statistical analyses. A p value <0.05 was accepted as statistically significant.

Results

Of 112 young patients with stroke, there were 65 (56.2%) male and 49 (43.8%) female patients with an overall mean age of 38.46±5.96 years. The mean cholesterol levels of the patients were as follows: LDL 121.42±36.56 mg/dl, HDL 38.84±12.47 mg/dl, TG 186.10±176.14 mg/dl, TC 194.76±45.35, LDL/HDL 3.39±1.46, TG/HDL 5.44±6.36, and TC/HDL 5.40±6.36.

Of 113 young healthy control groups, 54 (47.8%) were males, and 59 (52.2%) were females with an overall mean age of 31.70±7.83 years. The mean cholesterol levels of the healthy control subjects were as follows: LDL 105.04±32.45 mg/dl, HDL 47.37±16.20 mg/dl, TG 132.73±75.50 mg/dl, TC 178±41.45 mg/dl, LDL/HDL 2.45±1.07, TG/HDL 3.38±2.77, and TC/HDL 4.10±1.53.

There was no significant gender difference in the young population who had stroke or not (p=0.231). However, the mean age of young patients with stroke was still significantly higher than that of young population without stroke (p=0.00).

All cholesterol levels (LDL, HDL, TG, TC, LDL/HDL, TG/HDL, and TC/HDL) were significantly higher in young patients with stroke than in young population without stroke (p=0.01, p=0.00, p=0.005, p=0.005, p=0.00, p=0.003, and p=0.00, respectively) (Table 1).

TG level and TG/HDL ratio were higher in young male patients with stroke than in women (p=0.01 and p=0.01, respectively) (Table 2).

Of 110 patients with ischemic stroke aged >45 years, 63 (57.3%) were males, and 47 (42.7%) were females with

Table 1. Comparison of serum cholesterol levels in young ischemic stroke, and control groups

	Young stroke Mean±SD	Control Mean±SD	p
Total cholesterol (TC)	194.76±45.35	178.00±41.45	0.005
LDL	121.42±36.56	105.04±32.45	0.001
HDL	38.84±12.47	47.37±16.20	0.000
Triglyceride (TG)	186.10±176.14	132.73±75.50	0.005
TK/HDL	5.40±1.82	4.10±1.53	0.000
LDL/HDL	3.39±1.46	2.45±1.07	0.000
TG/HDL	5.44±6.36	3.38±2.77	0.003

LDL: Low–density lipoprotein; HDL: High-density lipoprotein; SD: Standard deviation.

Table 2. Comparison of serum cholesterol levels in young male, and female ischemic stroke patients

	Female Mean±SD	Male Mean±SD	p
Total cholesterol (TC)	193.04±44.92	196.10±46.01	0.72
LDL	124.38±38.38	119.10±35.21	0.45
HDL	41.08±14.79	37.10±10.11	0.09
Triglyceride (TG)	138.10±60.51	223.26±222.26	0.01
TC/HDL	5.15±1.93	5.59±1.73	0.21
LDL/HDL	3.43±1.60	3.36±1.36	0.79
TG/HDL	3.80±2.12	6.71±8.06	0.01

LDL: Low–density lipoprotein; HDL: High-density lipoprotein; SD: Standard deviation.

Table 3. Comparison of serum cholesterol levels in young, and elderly ischemic stroke patients

	Young Mean±SD	Elderly Mean±SD	p
Total cholesterol (TC)	194.76±45.35	190.16±42.96	0.44
LDL	121.42±36.56	125.18±35.97	0.44
HDL	38.84±12.47	41.47±14.16	0.14
Triglyceride (TG)	186.10±176.40	117.53±59.03	0.000
TC/HDL	5.40±1.82	5.01±2.08	0.14
LDL/HDL	3.39±1.46	3.32±1.55	0.72
TG/HDL	5.44±6.36	3.46±3.43	0.004

LDL: Low–density lipoprotein; HDL: High-density lipoprotein; SD: Standard deviation.

a mean age of 69.53±12.34 years. The mean cholesterol levels of the patients were as follows: LDL 125.18±35.97 mg/dl, HDL 41.47±14.16 mg/dl, TG 117.53±59.03 mg/dl, TC 190.16±42.96 mg/dl, LDL/HDL 3.32±1.55, TG/HDL 3.46±3.43, and TC/HDL 5.01±2.08. In elderly patients with stroke, LDL/HDL ratio and HDL value were lower in males than in females (p=0.04 and p=0.01, respectively). TG level and TG/HDL ratio were significantly higher in young patients with stroke than in elderly patients when young and old patients with stroke were compared in terms of cholesterol values (p=0.00 and p=0.004, respectively) (Table 3).

Discussion

Most of the epidemiologic studies have found a correlation between high levels of cholesterol and increased risk of ischemic stroke. In general, epidemiological studies have indicated that high TC levels may be associated with an increased risk of ischemic stroke. There is also a relationship between cholesterol levels and carotid artery atherosclerosis.[5] In 16% of patients with stroke, hyperlipidemia was found, and in the study by Khan and Tanvier et al.,[6, 7] hyperlipidemia was the most frequent third risk factor for stroke. In the study by Mahmood et al.,[8] in 21% of 200 patients with stroke, hyperlipidemia was determined as a risk factor. Of the many cardiovascular risk factors, elevated cholesterol levels are one of the important factors that play a role in the development of atherosclerosis despite the absence of other known risk factors.[9]

Large vessel atherosclerosis and small vascular disease are etiological factors of stroke in <10% of young patients with stroke (11.2% in our patients). However, modifiable stroke risk factors, such as dyslipidemia, diabetes, and hypertension, which cause recurrent vascular events, are at a higher incidence rate in the healthy young population.[10] In our study, all cholesterol subgroups in young patients with stroke were detected at significantly higher rates than those in controls. Similarly, in the study by Nirmala et al.,[11] TC, TG, LDL, very low-density lipoprotein, TC/HDL, and LDL/HDL rates were found to be significantly higher in young patients with stroke than in controls, and a positive correlation was found with risk of stroke and these parameters.

Recently, many new parameters related to lipid and lipoprotein metabolism have been identified. Some of these parameters are LDL/HDL, TC/HDL, and TG/HDL ratios. HDL subgroups play different roles in the development of atherogenesis. While large and lower density HDL2 particles are considered as preservatives, low density HDL3 particles are atherogenic.[12] TG/HDL ratio was first proposed by Gaziano et al.[13] as the atherogenic index that was considered as the most important predictor of coronary artery disease. The Copenhagen Male Study identified TG as the single most powerful risk factor but found that the TG/HDL ratio yielded more precise results in determining the risk.[14]

In our study, all cholesterol levels were higher in young patients with stroke than in controls, and TG level and TG/HDL ratio in young male group with stroke were found to be significantly higher than those in women. Furthermore, when young and elder patients with stroke were compared in terms of cholesterol levels, TG level and TG/HDL ratio were significantly higher in young patients with stroke than in elderly patients.

TG/HDL ratio is indicative of harmful LDL particles. Elevated LDL with high TG and HDL levels causes a greater risk of developing coronary artery disease than LDL alone.[15, 16] TG/HDL ratio is a strong independent predictor of all-cause mortality and cardiovascular events.[17] In the study by Park et al.,[18] a 2-year follow-up of patients with high TG/HDL ratio showed a significant increase in the risk of major vascular events and recurrent strokes, thus suggesting a prognostic value in detecting high-risk patients for recurrent stroke. The elevated TG level and TG/HDL ratio we detected in our young patients with stroke may be a predictor of atherosclerosis, which may herald recurrent strokes.

Since our study had a retrospective design, as a limitation of our study, the patients' body mass indexes were not known, so they were not investigated in terms of metabolic syndrome. High TG and low HDL values may be part of the metabolic syndrome in these patients.

LDL is considered as the most atherogenic lipoprotein and accounts for the majority of cholesterol in the plasma. In the study by Nirmala et al.,[11] serum levels were significantly higher in patients with stroke. In our study, LDL/HDL ratio was high, and HDL level was low in elderly male patients with stroke. Lipoprotein metabolism shows some changes with age. In men, after puberty, TC levels increase up to 50 years, plateau at age 70, and then slowly decrease. The most important factor affecting the level of cholesterol is changes in body weight. Cholesterol levels gradually increase in women between the ages of 25 and 55 years, but this increase is slower than men. Age-related changes in cholesterol metabolism manifest themselves mainly as LDL elevation, whereas age-related HDL levels are unchanged and are generally higher in women than in men by 10 mg/dl.[19, 20] Therefore, the results in our study are owing to the fact that in men, the value of LDL increases with age faster than that in women, but their age-related HDL values are lower in women.

The retrospective design of our study has created a limitation in our study because the body mass indexes were not investigated, and therefore, the TG/HDL ratio was not assessed as a parameter of the metabolic syndrome. However, it can be emphasized that by only knowing the TG/HDL ratio may be a stimulant in determining the risk in young patients with stroke.

In conclusion, dyslipidemia is one of the modifiable risk factors in the etiology of ischemic stroke and plays an important role in the development of atherosclerosis. In young patients with ischemic stroke, regardless of the underlying etiology, all cholesterol levels are significantly elevated relative to the young healthy population. Especially in young male patients with ischemic stroke, TG/HDL ratio is higher than in the healthy population in the same age group and older patients with ischemic stroke. TG/HDL ratio should be determined independently from the etiology detected in young patients with stroke since studies have shown that elevation of TG/HDL ratio has a prognostic value in terms of recurrent stroke.

Disclosures

Ethics Committee Approval: Ethics Committee approval was not obtained for the study, but it was conducted in accordance with the principles of the Declaration of Helsinki.

Peer-review: Externally peer-reviewed.

Conflict of Interest: None declared.

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