ORIGINAL RESEARCH

Lipid Profile and Its Association with Ischemic Cerebrovascular Stroke Patients: An Analytical Study in a Tertiary Care Hospital of West Bengal

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Abstract

Background: Changes in the lipid profile have been reported as a risk factor for ischemic stroke in a few kinds of literature. The aim of the present study was to evaluate the lipid profile levels in ischemic stroke patients and its association with acute ischemic stroke within the first 24 hour.

Materials and methods: It was a cross-sectional analytical study, conducted among above 35 years old aged acute ischemic stroke patients. A total of 48 cases and 48 controls were taken. Computed tomography (CT) scan, clinical examination, and fasting lipid profile of the admitted patients were done. A standard questionnaire was used for data collection.

Results: History of hypertension, and diabetes mellitus was significantly higher among stroke patients (64.6 and 52.1%, respectively) than in the control group. The present study has found that the mean of total cholesterol (TC) was significantly higher (221.50 ± 42.89 mg/dL) in the stroke group than the control group (163.25 ± 18.01 mg/dL). The triglyceride level, very low-density lipoprotein (VLDL), and low-density lipoprotein (LDL) cholesterol level among the stroke patients' group were significantly higher (193.95 ± 39.23, 38.77 ± 7.83, 144.32 ± 42.15 mg/dL, respectively) compared to the control group (139.12 ± 18.28, 27.82 ± 3.65, 91.94 ± 17.62 mg/dL, respectively). High-density lipoprotein (HDL) cholesterol level was significantly lower (36.81 ± 3.35 mg/dL) than the control group (44.10 ± 3.15 mg/dL). Multivariate logistic regression found that a higher triglyceride level had 0.94 odds of having ischemic stroke (95% CI: 0.88–0.99).

Conclusion: Increased level of TC was found as a risk factor in ischemic stroke whereas high triglycerides (TG) levels had a protective role against ischemic stroke events. Reduction of cholesterol levels can reduce the incidence of ischemic stroke.

Keywords: Ischemic, Lipid, Stroke.

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Introduction

An abrupt onset of a neurological deficit caused by a focal vascular cause is described as a cerebrovascular accident (CVA) or stroke. Two major types of strokes are known which are: Ischemic and Hemorrhagic. Occlusion of blood vessels is attributed to Ischemic stroke due to diminished blood flow to the affected area whereas hemorrhagic stroke occurs due to the rupture of blood vessels leading to blood leakage in the affected area. The majority of CVA were due to ischemia (87%) also, the second leading cause of death globally. Statistics reported around 6.2 million people died from stroke in 2015, which is a rise of 830,000 since the year 2000.[1] Indian report said, that the cumulative incidence of stroke in the country varies from 105 to 152 per lakh per year.[2]

Numerous studies have shown evidence of strong correlation between coronary artery disease and dyslipidemia. Hypertension and atrial fibrillation have been identified as predictor variables of stroke occurrence. However, the relationship between serum lipid profile and stroke is less clear and is debated in the literature. Case-control studies have generally produced negative findings considering cholesterol as a risk factor in stroke, whereas longitudinal studies could not produce a direct and strong association between them. A few studies show that patients with elevated serum total cholesterol (TC) level, low-density lipoprotein cholesterol (LDL-C), and decreased high-density lipoprotein cholesterol (HDL-C) have a higher chance of atherothrombotic brain infarction formation.[3,4] High-density lipoprotein cholesterol level and stroke occurrence discussed based on the research evidence in a multiethnic, population-based case-control study in New York. Though an elevated HDL-C was found to be protective against ischemic stroke (especially so in the elderly population of 75 years. And above); uncertainties loom over the association between LDL-C and risk of stroke.[5,6]

The relationship between serum lipid profile level and stroke occurrence varies according to the types of strokes. A stronger

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association was noticed for atherosclerotic subtypes. Contrarily, a greater risk of intracerebral hemorrhage (ICH) at low serum cholesterol levels and small vessel disease with an inverse association with lipid levels is also suggested by the literatures. A specific association between the lipid components which are TC and LDL-C with stroke in young patients has also been suggested by the literature.

The present study was designed to evaluate the lipid profile levels and the vascular risk factors of patients with acute ischemic stroke during the first 24 hour.

Objective

- To assess lipid profile – TC, triglycerides (TG) high-density lipoprotein (HDL), LDL-C, and very low-density lipoprotein (VLDL) of ischemic cerebrovascular disease patients.
- To find out the association between serum lipids and ischemic stroke.

Materials and Methods

Study Type and Design

The present study was a hospital-based cross-sectional, analytical study.

Study Period and Setting

The present study was carried out in a tertiary care setup of West Bengal with 1 year duration (2020–2021).

Study Population

Patients more than 35 years of age who were admitted to the medicine in the patient department during the study period with acute rapid onset of focal neurological deficiency which persisted for more than 24 hours, gradual onset with smooth or stuttering development over few hours, computed tomography (CT) scan brain indicative of infarction/ischemia, age more than 35 years irrespective of sex were included in the study. Age-matched for selection of controls. Cases and controls were taken as 1:1 ratio.

Exclusion Criteria

- Cerebral infarction as a result of head injury, infection, dehydration, pregnancy, puerperium, primary or secondary brain tumor, or encephalopathies.
- Patients with previous neurological deficits not due to stroke and transient ischemic attacks.
- Computed tomography scan of the brain suggestive of intra-cerebral hemorrhage, subarachnoid hemorrhage, and old lacunar infarcts.
- Patients who are already on lipid-lowering drugs.

Sample Size and Sampling Technique

The estimated sample size was calculated at 47.3~48, based on the mean difference of 10 in lipid profile parameters between the two groups, with an effect size of 0.67, 90% power, and alpha level of 0.05 one-sided. Purposive sampling was done for the selection of cases and controls.

Study Variables

Independent variables were considered as follows: Age (in completed years), sex, history of hypertension, history of diabetes mellitus, body mass index (BMI), history of smoking, and serum lipid profiles levels of TC, TG, LDL, VLDL, HDL were taken as predictive variables for ischemic stroke. A patient with ischemic stroke was considered when confirmed CT scan findings were available after the acute onset of focal neurological deficits which persisted for more than 24 hours.

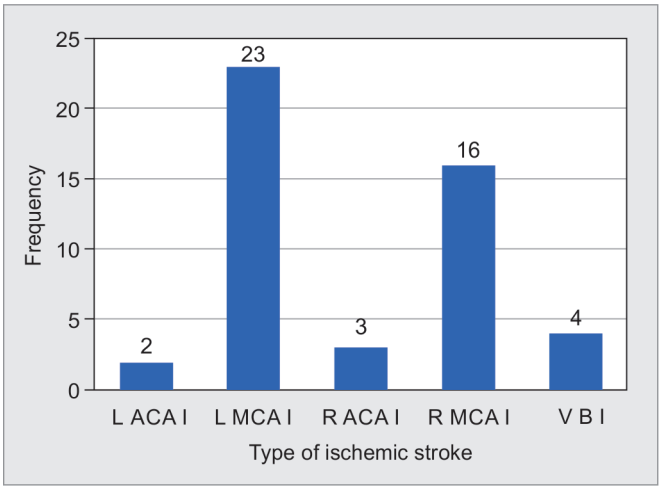

Fig. 1: Type of artery involved resulting to ischemic stroke among the patients ($n = 48$)

Study Tools and Techniques

After getting the consent, the study participants underwent a thorough clinical examination, CT scan of the brain, and lipid profile after 8 hours of fasting in all cases. Blood samples were drawn for biochemical assay of TC, TG, HDL, LDL, and VLDL.

Statistical Analysis

Statistical analysis was done with the help of Microsoft excel spreadsheet and SPSS (version 27.0; SPSS Inc., Chicago, IL, USA). Data were presented as mean and standard deviation for numerical variables and count and percentages for categorical variables. Chi-squared test (χ^2 test) for categorical variables and *t*-test for difference in mean were performed for statistical significance. Multivariate logistic regression was done and an adjusted odds ratio was calculated to find out the predictors. *p*-value ≤ 0.05 was considered for statistical significance.

Results

The study population was a compromise of 48 cases with a definite diagnosis of ischemic stroke and 48 controls. In the present study, most (47.9%) of the strokes were due to L MCA involvement followed by 33.3% with R MCA involvement, and 8.3% of patients had V B A involvement. 4.2% of patients had a stroke due to L ACA involvement and 6.3% with R ACA involvement (Fig. 1).

The mean age of stroke patients was 62.3 ± 12.8 years and for controls were 57.8 ± 9.4 years (Table 1). The difference of age in both Groups was not statistically significant. Male gender proportion was higher in both the group which is 77.1% in the stroke group and 85.4% in the control group, though the difference was not found significant. History of hypertension was higher among stroke patients (64.6%) than the control group (20.8%) and it was statistically significant. Also, a history of diabetes mellitus was significantly higher in the stroke group (52.1%) compared to the control group (18.8%). In this study, it was found that almost a similar proportion had a smoking history in both groups (37.5 vs 33.3%). About 50% of the cases in the stroke group were overweight and

Table 1: Comparison of demographic factors and clinical risk factors among patients in ischemic stroke and with controls (*n* = 96)

Variables	*Stroke patients (%)*	*Non-stroke patients (%)*	*Total*	*Value of test of significance*	*p-value*
Age (years)	62.3 ± 12.8	57.8 ± 9.4	60.1 ± 11.4	1.93	0.06
Sex					
Female	11 (22.9)	7 (14.6)	18 (18.8)	1.09	0.29
Male	37 (77.1)	41 (85.4)	78 (81.3)		
History of hypertension					
Yes	31 (64.6)	10 (20.8)	41 (42.7)	18.77	0.000*
No	17 (35.4)	38 (79.2)	55 (57.3)		
History of diabetes mellitus					
Yes	25 (52.1)	9 (18.8)	34 (35.4)	11.65	0.001*
No	23 (47.9)	39 (81.2)	62 (64.6)		
History of smoking					
Yes	18 (37.5)	16 (33.3)	34 (35.4)	0.182	0.67
No	30 (62.5)	32 (66.7)	62 (64.6)		
Overweight (BMI >25)					
Yes	24 (50.0)	22 (45.8)	46 (47.9)	32.00	0.17
No	24 (50.0)	26 (54.2)	50 (52.1)		
Total	48 (100)	48 (100)	96 (100)		

*Statistically significant

Table 2: Distribution of lipid profile among ischemic stroke and control patients (*n* = 96)

Variables	*Stroke group*	*Control group*	*t-test*	*p-value*
Total cholesterol (mg/dL)	221.50 (42.89)	163.25 (18.01)	8.67	0.000*
Triglyceride (mg/dL)	193.95 (39.23)	139.12 (18.28)	8.77	0.000*
VLDL cholesterol (mg/dL)	38.77 (7.83)	27.82 (3.65)	8.77	0.000*
LDL cholesterol (mg/dL)	144.32 (42.15)	91.94 (17.62)	7.94	0.000*
HDL cholesterol (mg/dL)	36.81 (3.35)	44.10 (3.15)	10.96	0.000*
HDL/Total cholesterol	–184.68 (43.24)	–119.14 (20.20)	–9.51	0.000*
HDL/LDL cholesterol	–107.51 (42.77)	–47.84 (20.01)	–8.75	0.000*

*Statistically significant

Table 3: Predictors of ischemic stroke by multivariate logistic regression (*n* = 96)

Variables	*Adjusted odds ratio with 95% confidence interval*	*p-value*
Age (years)	1.01 (0.93–1.08)	0.82
Sex		
Female	1.81 (0.12–26.86)	0.66
Male	Referent	–
Lipid profile		
LDL cholesterol (mmol/L)	0.87 (0.75–1.01)	0.06
HDL cholesterol (mmol/L)	1.13 (0.74–1.71)	0.56
Triglycerides (mmol/L)	0.94 (0.88–0.99)	0.03*

*Statistically significant

45.8% in the control group were overweight. These differences were not statistically significant.

The present study has found that the mean of total cholesterol was significantly higher (221.50 ± 42.89 mg/dL) in the stroke group than the control group (163.25 ± 18.01 mg/dL) as shown in Table 2. The triglyceride level among the stroke patients' group was 193.95 ± 39.23 mg/dL compared to the control groups 139.12 ± 18.28 mg/dL. The difference was statistically significant. The average VLDL cholesterol level in stroke patients was significantly higher (38.77 ± 7.83 mg/dL) than the control group (27.82 ± 3.65 mg/dL). The LDL cholesterol level in the stroke group was found as 144.32 ± 42.15 mg/dL whereas in the control group, it was 91.94 ± 17.62 mg/dL. It was significantly different. In our study, it was found the average HDL cholesterol level was significantly lower (36.81 ± 3.35 mg/dL) than the control group 44.10 ± 3.15 mg/dL (Table 2).

It was seen that in the stroke group, the mean HDL/LDL cholesterol ratio was –107.51 ± 42.77 and it was –47.84 ± 20.01 in the control group and the difference was statistically significant. It was found that in the stroke group, the average ratio of HDL/total cholesterol was higher (–184.68 ± 43.24) compared to the control group (–119.1458 ± 20.20). The difference in the mean ratio of HDL/total cholesterol between groups was statistically significant (Table 2).

A multivariate logistic regression (Table 3) was done to find out the predictors of ischemic stroke. The factors that were found significant were included in the regression along with age and sex for adjustment. LDL level, HDL level, and triglyceride level were taken among the lipid profile. VLDL was not included as multi-collinearity was found between VLDL and triglyceride levels. Keeping the other factors constant, it was found that higher triglyceride levels had 0.94 odds of having ischemic stroke (95% CI: 0.88–0.99).

Discussion

Acute CVA or stroke is among the top four causes of mortality with refer to global scenario. which can be either hemorrhagic or ischemic. In this study, the ischemic stroke and its risk factors were explored. Lipid profile variation is suggested as a risk factor for the

occurrence of stroke. Cerebral atherosclerosis along with thrombus formation was the rudimentary pathology in the development of ischemic stroke. The middle cerebral artery (MCA) is the most involved in acute stroke incident which was also seen in the current study.

The mean age of the ischemic stroke patients was more than 60 years in the present study similar to another study of West Bengal. The latter found that the hemorrhagic group had lower age (<60 years) than the ischemic group.[6] In the stroke group the male proportions were higher similar to other studies.[7] Presence of hypertension and diabetes mellitus was comparatively higher in the stroke group than the control group but smoking habit and overweight category was not significantly found associated with ischemic stroke. The male gender was seen with a higher incidence of ischemic stroke than the female gender with a substantial age-depending increase. Smoking and hypertension together had the highest risk of developing ischemic stroke with hazard ratios of 2.93 (1.26–6.83) compared with the non-hypertension/non-smokers, as found in a study in China.[8] Albucher JF et al. had found that male gender, history of smoking, and history of hypertension were elementary risk factors for intracerebral arterial occlusion.[9]

The present study has shown elevated levels of total cholesterol, LDL, VLDL, triglyceride, and lower levels of HDL in ischemic stroke patients than in the control group. A strong association was also suggested from previous research between elevated levels of serum specifically high LDL cholesterol levels.[10] Denti et al. found that LDL cholesterol levels over 100 mg/dL along with lower level of HDL cholesterol level were correlated with stroke.[11] A lower levels of HDL cholesterol was seen as the risk factor for intracerebral arterial occlusion. Also, another research has shown that a low level of HDL cholesterol is a causative factor for developing stroke.[12]

In multivariate logistic regression, higher triglyceride levels had shown a little protective effect with ischemic stroke. Triglyceride was reported as a protective factor for the development of hemorrhagic stroke in another literature.[8] Association between serum triglycerides level and the stroke occurrence is still not clear. Some literature reported negative association whereas few pointed out positive correlation for the same. Copenhagen City Heart Study brought out evidence of a linear correlation between serum triglyceride profile and ischemic stroke while no such evidence was found of high triglyceride concentration as an attributable factor for both types of strokes.[13] However in the article "Hypertriglyceridemia: A neglected risk factor for ischemic stroke", the authors hypothesized that chronic hypertriglyceridemia might create a change in metabolic status of brain-tissue by affecting mitochondrial adaptability, thus exerting protective functions during or after ischemic stroke.[14] So, it can be concluded that, further investigations are required to find out the role of hypertriglyceridemia in prognostication of ischemic stroke.

Limitation

Less sample size, and single center-based work are the limitations of the current study. The data may not represent the whole population. Also, the chances of hospital bias cannot be denied.

Conclusion

From the current study, total cholesterol was found to be a risk factor in the causation of ischemic stroke, while a high level of triglycerides was found to play a protective role against ischemic stroke events. Reduction of cholesterol level will help to reduce morbidity and mortality of ischemic stroke. Further investigation with longitudinal design can be conducted to find out the evidence of HDL and TG level's role in cerebral vascular insults.

Ethical Approval

Prior approval was taken from the Institutional Ethics Committee. A patient information sheet and consent form translated into local languages were used to obtain informed consent from the patients before collecting the serum samples. Collected data was anonymized with the removal of all identifiers.

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