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EVALUATION OF SERUM LIPID PROFILE IN PATIENTS WITH ISCHEMIC STROKE

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ABSTRACT

Background: Ischemic stroke is a major public health concern globally and is a leading cause of long-term disability and mortality. Among the modifiable risk factors, dyslipidemia plays a significant role in the development of atherosclerosis, which predisposes individuals to ischemic cerebrovascular events. Abnormal serum lipid profiles have been associated with an increased risk of ischemic stroke. Evaluating lipid profile abnormalities in patients with ischemic stroke can provide valuable insights into the underlying pathophysiology and contribute to better risk stratification and management strategies.

Aims and Objectives: This study aims to assess the serum lipid profile in patients diagnosed with acute ischemic stroke and to evaluate the prevalence of lipid abnormalities.

Methodology: A cross-sectional observational study was conducted in a tertiary care hospital over a period of 18 months. A total of 125 patients with clinically and radiologically confirmed acute ischemic stroke were enrolled. Serum lipid profile parameters including total cholesterol, low-density lipoprotein cholesterol (LDL-C), high-density lipoprotein cholesterol (HDL-C), triglycerides, and very low-density lipoprotein (VLDL) were measured within 24 hours of hospital admission after an overnight fast. Detailed clinical history including age, gender, comorbidities (hypertension, diabetes), and lifestyle habits (smoking, alcohol consumption) were documented. Patients with hemorrhagic stroke, chronic liver or kidney disease, or those on lipid-lowering therapy were excluded. Statistical analysis was performed using SPSS software, with significance set at $p < 0.05$.

Result: The mean age of study participants was 62.8 ± 10.4 years, with a male predominance (65.6%). Hypertension (72.8%) and diabetes mellitus (49.6%) were the most common comorbid conditions. The lipid profile revealed that 60.8% of patients had elevated LDL-C levels, 53.6% had raised total cholesterol, and 48.8% had increased triglyceride levels. Additionally, 66.4% of patients had low HDL-C levels. Dyslipidemia was significantly more prevalent among patients with hypertension and diabetes ($p < 0.05$). A strong association was found between smoking and low HDL-C levels. No statistically significant gender-based differences were observed in lipid abnormalities.

Conclusion: The study highlights a high prevalence of dyslipidemia in patients with ischemic stroke, reinforcing the role of lipid abnormalities as an important modifiable risk factor in stroke pathogenesis. Low HDL-C and elevated LDL-C were particularly common, underlining the need for routine lipid screening in high-risk populations.

Key Word: Dyslipidemia, Ischemic stroke, lipid profile, triglycerides.

INTRODUCTION

Stroke constitutes a critical neurological emergency and continues to be a leading cause of mortality and prolonged disability globally. It is primarily categorized into two types: ischemic stroke and hemorrhagic stroke.[1] Ischemic strokes, comprising roughly 80–85% of all strokes, arise from a disruption in cerebral blood flow, typically resulting from thrombotic or embolic obstruction of cerebral arteries. The ensuing deficiency of oxygen and nutrients results in swift neuronal demise, leading to considerable neurological impairments.[2] The incidence of ischemic stroke is notably elevated in low- and middle-income nations, such as India, where lifestyle modifications and the growing prevalence of non-communicable diseases have led to an increase in cases.[3]

Dyslipidemia is a significant risk factor in the pathophysiology of ischemic stroke, as it directly contributes to the creation and progression of atherosclerotic plaques. Atherosclerosis, the predominant underlying pathology in ischemic stroke, is a chronic inflammatory disorder marked by the deposition of lipids, inflammatory cells, and fibrous components within arterial walls. This process results in the constriction or blockage of cerebral arteries, ultimately causing a cerebrovascular incident.[4,5]

Dyslipidemia, characterized by elevated serum lipid levels, is a significant risk factor in the development of atherosclerosis. Increased total cholesterol (TC), low-density lipoprotein cholesterol (LDL-C), and triglycerides (TG), coupled with diminished levels of high-density lipoprotein cholesterol (HDL-C), are correlated with a heightened risk of ischemic stroke.[6]

Numerous epidemiological studies have demonstrated a definitive association between dyslipidemia and cardiovascular illnesses, including stroke. LDL-C is regarded as the most atherogenic lipoprotein, significantly contributing to plaque formation and progression. In contrast, HDL-C possesses anti-atherogenic characteristics, such as reverse cholesterol transfer, anti-inflammatory actions, and the preservation of endothelial function. Increased triglyceride levels are associated with endothelial dysfunction and prothrombotic conditions, hence exacerbating cerebrovascular risk.[7,8]

In stroke prevention and management, it is crucial to identify and regulate modifiable risk factors, including hypertension, diabetes mellitus, smoking, and dyslipidemia. Although blood pressure and glucose regulation are recognized elements of stroke preventive methods, lipid management is receiving heightened focus. The efficacy of statins and other lipid-lowering medications in secondary stroke prevention is well established, underscoring the need of early detection of dyslipidemia in stroke patients.[9]

Although a correlation between lipid abnormalities and ischemic stroke is well-documented, there is a lack of region-specific data, especially from poor nations. Differing food

habits, genetic predispositions, healthcare accessibility, and levels of knowledge lead to variations in lipid profiles among communities. Comprehending the lipid profile attributes of stroke patients in particular contexts might enhance the customization of preventative and treatment measures.

AIMS AND OBJECTIVES

- To assess the serum lipid profile in patients diagnosed with acute ischemic stroke and to evaluate the prevalence of lipid abnormalities.

MATERIALS AND METHODS

This was a hospital-based, cross-sectional observational study conducted in the Department of General Medicine at SreeMookambika Institute of Medical Sciences, Kulasekharam, a tertiary care teaching hospital over a period of 18 months. Written informed consent was obtained from all participants or their legal guardians. A total of 125 patients diagnosed with acute ischemic stroke were enrolled in the study based on predefined inclusion and exclusion criteria.

Inclusion Criteria:

- Patients aged ≥ 18 years.
- Patients presenting with acute ischemic stroke confirmed by clinical examination and neuroimaging (CT/MRI brain).
- Patients admitted within 72 hours of onset of stroke symptoms.
- Patients who provided informed consent or had consent given by a legally authorized representative.

Exclusion Criteria:

- Patients diagnosed with hemorrhagic stroke or transient ischemic attack (TIA).
- Patients on lipid-lowering therapy (e.g., statins or fibrates) prior to stroke.
- Known cases of chronic liver disease, chronic kidney disease, hypothyroidism, or nephrotic syndrome.
- Patients with malignancy, sepsis, or other acute systemic illnesses that could influence lipid levels.

Upon admission, all patients underwent a detailed clinical assessment including history taking, general and systemic examination, and documentation of neurological deficits. Demographic data (age, sex), lifestyle habits (smoking, alcohol use), and history of comorbidities such as hypertension, diabetes mellitus, and coronary artery disease were recorded. Neuroimaging (either CT or MRI brain) was performed to confirm the diagnosis of

ischemic stroke and to exclude hemorrhagic stroke. Relevant investigations including complete blood count, blood sugar levels, renal function tests, liver function tests, and electrocardiography (ECG) were also performed as part of the standard workup.

Venous blood samples were collected from each patient under strict aseptic precautions after an overnight fasting period of 10–12 hours, ensuring accurate measurement of lipid parameters unaffected by recent dietary intake. The lipid profile included the estimation of total cholesterol (TC), low-density lipoprotein cholesterol (LDL-C), high-density lipoprotein cholesterol (HDL-C), triglycerides (TG), and very low-density lipoprotein cholesterol (VLDL-C). The blood samples were centrifuged, and the serum was analyzed using a fully automated clinical chemistry analyzer based on enzymatic colorimetric methods standardized according to the guidelines of the National Cholesterol Education Program (NCEP) and the American Heart Association (AHA). The lipid profile data were then correlated with demographic and clinical parameters such as age, gender, presence of hypertension, diabetes, and lifestyle factors like smoking.

Data were entered into Microsoft Excel and analyzed using SPSS version 25.0. Continuous variables were expressed as mean ± standard deviation (SD), while categorical variables were presented as frequencies and percentages. The chi-square test was used to assess the association between dyslipidemia and categorical variables such as gender, hypertension, diabetes, and smoking status. The independent t-test and ANOVA were used for comparing means between groups. A p-value < 0.05 was considered statistically significant.

OBSERVATION AND RESULTS

The majority of ischemic stroke patients in this study were male (65.6%) and the mean age was approximately 62 years. (Table 1)

Parameter	Frequency (n=125)	Percentage (%)
Age (Mean ± SD)	61.7 ± 10.9 years	
Gender - Male	82	65.6%
Gender - Female	43	34.4%

Table 1: Demographic Profile of Patients

A high prevalence of comorbid conditions such as hypertension (72.8%), diabetes mellitus (49.6%), and smoking (37.6%) was observed, suggesting a strong vascular risk profile in this population. (Table 2)

Risk Factor	Frequency (n=125)	Percentage (%)

Hypertension	91	72.8%
Diabetes Mellitus	62	49.6%
Smoking	47	37.6%
Alcohol Consumption	34	27.2%

Table 2: Distribution of Risk Factors

Dyslipidemia was identified in 77.6% of patients, underscoring its role as a major modifiable risk factor in ischemic stroke. The most common lipid abnormality was low HDL-C (66.4%), followed by elevated LDL-C (60.8%) and high total cholesterol (53.6%). (Table 3)

Lipid Parameter	**N**	**%**	**Mean ± SD**
Total Cholesterol (> 200 mg/dL)	67	53.6%	218.6 ± 42.1 mg/dL
LDL-C (> 100 mg/dL)	76	60.8%	140.4 ± 35.2 mg/dL
HDL-C (< 40 mg/dL (M) / <50 mg/dL (F))	83	66.4%	38.2 ± 8.9 mg/dL
Triglycerides (> 150 mg/dL)	61	48.8%	186.7 ± 49.5 mg/dL
VLDL-C (> 40 mg/dL)	23	18.4%	37.3 ± 9.9 mg/dL

Table 3: Serum Lipid Profile Abnormalities

Statistical analysis revealed significant associations between dyslipidemia and comorbidities like hypertension, diabetes, and smoking, indicating that patients with these risk factors are more likely to have lipid abnormalities.

Risk factor		**With Dyslipidemia (n=97)**	**Without Dyslipidemia (n=28)**	**p-value**
Hypertension	Yes	76 (83.5%)	15 (16.5%)	0.031
	No	21 (61.8%)	13 (38.2%)	
Diabetes Mellitus	Yes	53 (85.5%)	9 (14.5%)	0.022
	No	44 (69.8%)	19 (30.2%)	
Smoking	Yes	40 (85.1%)	7 (14.9%)	0.018
	No	57 (73.1%)	21 (26.9%)	
Alcohol Consumption	Yes	28 (82.4%)	6 (17.6%)	0.36
	No	69 (75.8%)	22 (24.2%)	

Table 4: Association Between Dyslipidemia and Risk Factors

DISCUSSION

The study population predominantly consisted of males (65.6%), with a mean age of 61.7 ± 10.9 years. This demographic pattern mirrors both global and regional epidemiological trends, where ischemic stroke is more prevalent among older adults and males. Siddeswari R et al.[10] had demonstrated similar findings. In their study of 100 patients, there were 72 males and 28 females, with a mean age of 57.6 ± 12.15 years. This male predominance may be attributable to higher exposure to modifiable risk factors such as smoking and alcohol consumption, lifestyle-related stress, and differences in healthcare-seeking behavior between genders.

The higher incidence of stroke in individuals over 60 years of age reflects the age-related changes in vascular structure and function, including arterial stiffening, endothelial dysfunction, and cumulative exposure to risk factors such as hypertension, diabetes, and dyslipidemia. Age remains one of the most non-modifiable but significant risk factors for stroke.

In the present study, hypertension was the most commonly observed comorbidity, affecting 72.8% of the patients. Diabetes mellitus was present in 49.6%, and smoking was reported in 37.6%. These findings are consistent with numerous previous studies that have established hypertension as the leading modifiable risk factor for stroke. Chronic hypertension leads to structural and functional changes in cerebral blood vessels, including hypertrophy, remodeling, and compromised autoregulation, thereby increasing the risk of both ischemic and hemorrhagic strokes.

Diabetes contributes to stroke risk through several mechanisms, including accelerated atherosclerosis, increased platelet aggregation, endothelial dysfunction, and chronic inflammation. The significant proportion of diabetic patients in the current study underlines the importance of glycemic control in stroke prevention.

Smoking, another major modifiable risk factor, promotes atherogenesis, increases blood coagulability, reduces HDL levels, and induces oxidative stress. The prevalence of smoking among stroke patients in this study (37.6%) aligns with findings from Siddeswari R et al.[10] who reported that 39% of patients were smokers and an equal proportion consumed alcohol.

One of the most significant observations in this study was the high prevalence of dyslipidemia, present in 77.6% of patients. Among these, low HDL-C was the most frequent abnormality (66.4%), followed by elevated LDL-C (60.8%) and high total cholesterol (53.6%). This lipid pattern—termed atherogenic dyslipidemia—is strongly associated with the development of atherosclerosis, a major contributor to ischemic stroke.

HDL-C is known for its protective cardiovascular properties. It facilitates reverse

cholesterol transport, exerts anti-inflammatory and antioxidant effects, and maintains endothelial health. A deficiency in HDL-C, therefore, increases susceptibility to vascular injury and plaque formation. LDL-C, on the other hand, promotes plaque buildup within arterial walls, contributing to stenosis and thromboembolism. The predominance of these lipid abnormalities in the study population reflects the significant role of lipid metabolism disorders in cerebrovascular pathology.

Vakilian A et al.[11] also demonstrated significant differences in lipid profiles between ischemic stroke (IS) and intracerebral hemorrhage (ICH) groups, noting that triglyceride (TG) levels were higher in IS patients, while HDL-C levels were elevated in ICH patients. This supports the role of low HDL-C and high TG as critical contributors to ischemic events.

Further supporting evidence is provided by Shen H et al.[12] who observed that low HDL-C and high LDL-C levels were significantly associated with post-stroke depression (PSD) and worse functional outcomes. They reported that the LDL/HDL ratio was a stronger predictor than individual lipid fractions, suggesting that the balance between these lipoproteins is crucial in determining stroke prognosis.

The present findings are comparable with those of several large-scale studies. For instance, Vitturi BK et al.[13] reported a high prevalence of low HDL (44.2%) and elevated LDL (30.6%) in stroke patients. They also found that a high LDL-C/HDL-C ratio and low HDL-C levels were independently associated with poor functional recovery and increased risk of stroke recurrence. Similarly, Baral S et al.[14] observed dyslipidemia in 80% of ischemic stroke patients, with high triglycerides (58.3%) and high total cholesterol (53.3%) being predominant.

In contrast, Shah SP et al.[15] reported a lower prevalence of dyslipidemia (46.05%), with high TG in 71.43% and low HDL-C in 31.43%. Mahesar AH et al.[16] found a frequency of 32.9%, with relatively modest elevations in LDL and total cholesterol. These differences may be attributed to variations in sample size, demographic characteristics, dietary habits, healthcare access, and diagnostic criteria used for dyslipidemia.

Statistical analysis in the present study revealed that dyslipidemia was significantly more common in patients with hypertension ($p = 0.031$), diabetes mellitus ($p = 0.022$), and smoking history ($p = 0.018$). These findings suggest a strong correlation between metabolic syndrome components and lipid derangements. The coexistence of multiple vascular risk factors likely exerts a synergistic effect, markedly increasing the likelihood of ischemic events.

Interestingly, no significant association was found between dyslipidemia and alcohol consumption ($p = 0.36$). This may reflect variability in the type, quantity, and frequency of alcohol intake among patients, as well as the complex bidirectional relationship between

alcohol and lipid metabolism. While moderate alcohol use has been associated with higher HDL-C, excessive intake is known to elevate TG and contribute to liver dysfunction, thereby disrupting lipid homeostasis.

Alemayehu E et al.[17] also found dyslipidemia to be significantly associated with smoking (AOR = 6.54), alcohol consumption (AOR = 3.51), diabetes (AOR = 3.65), and higher BMI (AOR = 4.07), reinforcing the multifactorial nature of lipid abnormalities in stroke patients.

CONCLUSION

The present study highlights a significant association between dyslipidemia and ischemic stroke, with more than three-fourths of the patients (77.6%) demonstrating one or more abnormal lipid parameters. The high prevalence of dyslipidemia among patients with comorbid conditions such as hypertension, diabetes mellitus, and smoking further emphasizes the compounded risk these factors pose when present together. These findings underscore the importance of early identification, routine screening, and effective management of lipid abnormalities as an integral part of primary and secondary stroke prevention strategies. Timely interventions such as lifestyle modification, dietary regulation, and pharmacological therapy can significantly reduce the risk of ischemic events and improve long-term outcomes.

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