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Frequency of Hyperlipidemia among Patients of Hemorrhagic Stroke

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ABSTRACT

Background: Increased risk for stroke is associated with hyperlipidemia for many years, particularly for ischemic stroke. However, its prevalence and association with hemorrhagic stroke are not so well known. It is important to establish the prevalence of hyperlipidemia among hemorrhagic stroke patients and its associations with clinical and demographic factors to aid stroke prevention. **Objective:** To determine the frequency of hyperlipidemia among patients of hemorrhagic stroke presenting at Ayub Teaching Hospital Abbottabad. **Study Design:** Cross-sectional study. **Duration and Place of Study:** The study was conducted from April 2024 to October 2024 at the Department of General Medicine, Ayub Teaching Hospital, Abbottabad. **Methodology:** A total of 95 patients aged 30–70 years with hemorrhagic stroke were enrolled. Hyperlipidemia was defined based on a serum cholesterol level ≥ 150 mg/dl. Data including age, gender, BMI, residential status, socioeconomic status, diabetes, and hypertension were recorded. Lipid profiles were obtained after an overnight fast. **Results:** The mean age of participants was 57.45 ± 8.15 years, with 68.4% male representation. Hyperlipidemia was found in 18.9% of patients. Significant associations were observed between hyperlipidemia and factors such as age (>50 years), male gender, rural residency, poor socioeconomic status, diabetes, and hypertension. **Conclusion:** This study highlights that while hyperlipidemia is more common in hemorrhagic stroke patients over 50 years of age.

INTRODUCTION

A stroke occurs when there is a blockage in the brain's supply of blood, leading to a deficiency of oxygen and nutrients essential to ensure brain function.[1] This leads to death of brain cells and results in irreversible disability or death.[2] Strokes are categorized under two, namely, ischemic and hemorrhagic.[3] The ischemic strokes, accounting for the majority of cases, are caused by a blockage in the blood vessels that supply blood to the brain.[4] Hemorrhagic strokes result from bleeding of the blood vessels leading to bleeding within the brain.[4]

Hemorrhagic stroke occurs when a brain vessel ruptures, leading to bleeding within the brain tissue or within the spaces surrounding the brain.[5] It is less common than ischemic stroke but tends to be more lethal. Hemorrhagic strokes are generally categorized under two headings: intracerebral hemorrhage (ICH) within the brain tissue and subarachnoid hemorrhage (SAH) within the space between the brain and the thin covering tissues over the brain.[6] Hypertension, aneurysms, arteriovenous malformations, and trauma are the common causes.

Lipid profiles, or tests of the levels of various fats (lipids) in the blood, are an integral part of assessing cardiovascular risk.[7] In stroke, and especially in ischemic stroke, lipid abnormalities such as increased levels of cholesterol or triglycerides are generally found with increased risk.[8] Elevated levels of low-density lipoprotein (LDL) or "bad cholesterol" can lead to fatty deposits to accumulate in the arteries, causing atherosclerosis and resulting increased risk of ischemic stroke.[9]

Hyperlipidemia, or the elevated levels of lipids, particularly cholesterol, in the blood, has a long-standing association with ischemic stroke but a more complex role with hemorrhagic stroke.[10] Some have suggested that elevated levels of lipid, and both total and LDL cholesterol, have a role in the pathogenesis of hemorrhagic stroke.[11] Hyperlipidemia in part leads to atherosclerosis, a disease that weakens arteries and predisposes them to tearing and hemorrhage.[12] The relationship between lipid levels and hemorrhagic stroke is also subject to the coexistence of additional risk factors, hypertension and anticoagulant treatment.[13]

A study conducted by Almuklass AM et al. demonstrated that the prevalence of hyperlipidemia among patients with hemorrhagic stroke was 14%.[14]

There is a lack of regional data related to the prevalence of hyperlipidemia in patients with hemorrhagic stroke within this region. Investigating this correlation could help the study provide useful information regarding regional health patterns, guide targeted preventive programs, and help develop efficient treatment procedures to be followed by patients at risk. In addition, insight into the lipid profile's influence in hemorrhagic stroke within the regional perspective could enhance healthcare and direct policy recommendations in KPK.

METHODOLOGY

This study was conducted from April 2024 to October 2024 at the Department of General Medicine, Ayub Teaching Hospital, Abbottabad. It involved 95 patients diagnosed with hemorrhagic stroke. The sample size was determined using the World Health Organization's sample size formula, applying a 95% confidence interval, a 7% margin of error, and an anticipated frequency of hyperlipidemia of 14% among hemorrhagic stroke patients.[14]

The inclusion criteria for the study were patients aged between 30 to 70 years, both genders, and those who with hemorrhagic stroke. Exclusion criteria consisted of individuals with a history of transient ischemic attack, secondary dyslipidemia, a record of lipid-lowering therapy, or recurrent cerebrovascular accidents.

Patients meeting the inclusion criteria were enrolled after approval from the ethics committee. Demographic data, including age, gender, BMI, residential and socioeconomic status, profession, education level, and history of diabetes and hypertension, as well as the duration of stroke symptoms, were recorded. Blood samples for lipid profiling were collected after a 10-hour overnight fast. Brachial venous blood was drawn into EDTA tubes and sent directly to the hospital's laboratory for analysis.

Hyperlipidemia was defined as serum total cholesterol and triacylglycerol levels of ≥ 150 mg/dl, as measured by a fasting lipid profile. The collected data was recorded on a specially designed proforma for hyperlipidemia detection. Data analysis was performed using IBM SPSS version 26. Descriptive statistics, including mean ± standard deviation or median and interquartile range, were used for continuous variables such as age, stroke duration, and lipid levels. Normality of data was assessed using the Shapiro-Wilk test. Categorical variables, including gender and hyperlipidemia, were analyzed by calculating frequencies and percentages. Stratification of hyperlipidemia by age, gender, diabetes, hypertension and stroke symptom duration was performed. Post-stratification analysis was conducted using the chi-square test or Fisher's exact test, with a p-value ≤0.05 considered statistically significant.

RESULTS

As shown in Table-I, the mean age of patients is 57.45 ± 8.15 years, with a mean BMI of 28.14 ± 1.96 kg/m². The mean total cholesterol and triglycerides levels are 146.99 ± 12.77 mg/dl and 138.48 ± 16.81 mg/dl, respectively. Gender distribution shows 68.4% male and 31.6% female patients. A majority, 62.1%, reside in rural areas, while 37.9% are urban residents. Regarding socioeconomic status, 53.7% of patients belong to the poor category, 38.9% to the middle class, and 7.4% to the rich category. As for employment, 38.9% have jobs, 29.5% are jobless, and 31.6% are housewives. Education levels are varied, with 38.9% being uneducated, 31.6% having primary education, 25.3% with secondary education, and 4.2% with higher education. Regarding health conditions, 60% have diabetes and 77.9% have hypertension.

Table I

Patient Demographics

Demographics		Mean ± SD
Age (years)		57.452±8.15
BMI (Kg/m^2)		28.137±1.96
Total Cholesterol (mg/dl)		146.989±12.77
Triglycerides (mg/dl)		138.484±16.81
Gender	Male n (%)	65 (68.4%)
	Female n (%)	30 (31.6%)
Residential Status	Rural n (%)	59 (62.1%)
	Urban n (%)	36 (37.9%)
Socioeconomic Status	Poor n (%)	51 (53.7%)
	Middle n (%)	37 (38.9%)
	Rich n (%)	7 (7.4%)
Profession	Job n (%)	37 (38.9%)
	Jobless n (%)	28 (29.5%)
	Housewife n (%)	30 (31.6%)
Education	Uneducated n (%)	37 (38.9%)
	Primary n (%)	30 (31.6%)
	Secondary n (%)	24 (25.3%)
	Higher n (%)	4 (4.2%)
Diabetes	Yes n (%)	57 (60%)
	No n (%)	38 (40%)
Hypertension	Yes n (%)	74 (77.9%)
	No n (%)	21 (22.1%)

In Table-II, it is reported that 18.9% of patients have hyperlipidemia, while 81.1% do not.

Table II

Hyperlipidemia in patients of hemorrhagic stroke

Hyperlipidemia	Frequency	% age
Yes	18	18.9%
No	77	81.1%
Total	95	100%

Table-III explores the association of hyperlipidemia with demographic factors. The data shows significant differences in hyperlipidemia prevalence based on age, gender, residential status, socioeconomic status, diabetes, and hypertension. Hyperlipidemia is significantly more common in patients aged >50 years

(25.7% vs. 0.0% in those ≤50 years, p = 0.005). In terms of gender, males are more likely to have hyperlipidemia (24.6% vs. 6.7% in females, p = 0.049). No significant association was found for BMI. Rural residents are significantly more likely to have hyperlipidemia compared to urban residents (30.5% vs. 0.0%, p < 0.001). Patients in the poor socioeconomic status group exhibit a higher prevalence of hyperlipidemia (35.3% vs. 0.0% in middle and rich categories, p < 0.001). Diabetes is also strongly associated with hyperlipidemia (31.6% in diabetic patients vs. 0.0% in non-diabetic patients, p < 0.001). Lastly, hypertension shows a significant association with hyperlipidemia (24.3% vs. 0.0% in hypertensive and non-hypertensive patients, p = 0.023).

Table III

Association of Hyperlipidemia with Demographic Factors

Demographic Factors		Hyperlipidemia		p-value
		Yes n(%)	No n(%)	
Age (years)	≤50	0 (0.0%)	25 (100.0%)	0.005*
	>50	18 (25.7%)	52 (74.3%)	
Gender	Male	16 (24.6%)	49 (75.4%)	0.049*
	Female	2 (6.7%)	28 (93.3%)	
BMI (Kg/m²)	≤25	0 (0.0%)	2 (100.0%)	1.000*
	>25	18 (19.4%)	75 (80.6%)	
Residential Status	Rural	18 (30.5%)	41 (69.5%)	<0.001*
	Urban	0 (0.0%)	36 (100.0%)	
Socioeconomic Status	Poor	18 (35.3%)	33 (64.7%)	<0.001*
	Middle	0 (0.0%)	37 (100.0%)	
	Rich	0 (0.0%)	7 (100.0%)	
Diabetes	Yes	18 (31.6%)	39 (68.4%)	<0.001*
	No	0 (0.0%)	38 (100.0%)	
Hypertension	Yes	18 (24.3%)	56 (75.7%)	0.023*
	No	0 (0.0%)	21 (100.0%)	

*Fischer Exact Test

DISCUSSION

The study reveals that 18.9% of the patients were diagnosed with hyperlipidemia, which is an important proportion of individuals who are afflicted by this condition among hemorrhagic stroke patients. This conclusion is endorsed by literature that reveals an association between abnormalities in lipid levels and stroke risk, particularly among those with compromised control of cholesterol and triglyceride.

The study also revealed several demographic factors that influence the prevalence of hyperlipidemia. For instance, elderly patients (>50 years) were more prone to the prevalence of hyperlipidemia. This is coherent with scientific evidence that shows that aging goes hand-in-hand with an alteration of lipid metabolism that promotes increased cholesterol levels. Male gender was also an influencing factor to the prevalence of hyperlipidemia courtesy of hormonal factors that influence lipid metabolism differently for both men and women. The high correlation between rural residence and hyperlipidemia can also be attributed to lifestyle determinants including limited access to healthcare services and unhealthy eating habits that are characteristic among the rural people.

Low socioeconomic status did play a significant role, and poorer patients had a higher incidence of hyperlipidemia. This is also consistent with documented evidence of low socioeconomic status being associated with unhealthy dietary practices, low activity levels, and limited access to healthcare, all of which are consequences of or lead to dyslipidemia. The association between hyperlipidemia and diabetes and hypertension is also consistent with documented clinical evidence that these conditions are frequently comorbid and have a reciprocal effect on one another to impair cardiovascular function, such as lipid imbalance.

Our study result mirrors a relatively lesser prevalence of hyperlipidemia among hemorrhagic stroke patients than among ischemic stroke patients, also evident from the studies of Ammad B et al. [14], where hyperlipidemia was identified among 79% of ischemic stroke patients but not among hemorrhagic stroke patients. This was similar to what was observed from our study, where prevalence of hyperlipidemia among hemorrhagic stroke patients was significantly lesser.

Our research also correlated hyperlipidemia and clinical and demographic characteristics and found that hyperlipidemia was more common among patients >50 years (25.7% compared to 0.0% among ≤50-year-old patients, p = 0.005). This agrees with Gul MM et al. [15] findings, which showed that lipid derangement, particularly hypercholesterolemia, was more common among elderly patients with ischemic stroke. However, our hemorrhagic stroke research provides a different perspective, that while hyperlipidemia is a major stroke risk factor for ischemic stroke, its correlation to hemorrhagic stroke is possibly lesser due to the varying pathophysiological processes involved between these two types of stroke.

Gender differences among our study (24.6% of men compared to 6.7% of women diagnosed with hyperlipidemia, p = 0.049) are comparable to Aslam MS et al. [16] who also documented that males are more susceptible to hyperlipidemia, perhaps because there are gender differences in lipid metabolism. This trend of greater hyperlipidemia among men was comparable among studies but appears to be of lesser impact on hemorrhagic stroke since Bhatti KA et al. [17] and Batool SN et al. [18] also documented that dyslipidemia impacts more on ischemic stroke than on hemorrhagic stroke.

Our evidence for rural residence (30.5% of rural versus 0.0% of those from an urban residence for hyperlipidemia, p < 0.001) is supplemented by Nasim H

et al. [19] who also reported similar trends linking rural residence to stroke risk. This may be due to differences in lifestyle and access to healthcare that may lead to more lipid abnormalities among rural areas. Nasim H et al. [19] however, reported that the rural-urban divide contributed more to ischemic stroke, which suggests that while hyperlipidemia is a significant predictor of ischemic stroke, its predictive ability for hemorrhagic stroke may not be so.

In relation to the association between diabetes and hyperlipidemia, 31.6% of diabetic patients were diagnosed to have hyperlipidemia while no non-diabetic patients were diagnosed to have hyperlipidemia ($p < 0.001$). This is consistent with the findings of Ammad B et al. [14] and Batool SN et al. [18] which revealed that diabetes was significantly associated with hyperlipidemia, perhaps due to metabolic dysregulation and insulin resistance that may result in lipid imbalance. However, the fact that no non-diabetic hemorrhagic stroke patients were diagnosed to have hyperlipidemia supports that while diabetes is a significant risk factor for ischemic stroke, its effect among hemorrhagic stroke patients who are diagnosed to have hyperlipidemia may be otherwise.

Equivalently, hypertension and hyperlipidemia were highly correlated according to our study (24.3% among patients suffering from hypertension compared to 0.0% among non-hypertensive patients, $p = 0.023$), similar to Ammad B et al. [14] and Nasim H et al. [19] who also reported that hypertension tends to occur together with hyperlipidemia among stroke patients. Among ischemic stroke patients, this correlation is well-established because both hypertension and hyperlipidemia act synergistically to facilitate the genesis of atherosclerosis and stroke risk. For hemorrhagic stroke, however, the contribution of hyperlipidemia is presumably minimal, while hypertension is more central to hemorrhagic stroke pathophysiology.

It suggests the need for more research to better understand the different pathophysiological processes resulting in such strokes. It also reflects the need to target modifiable risk factors like dyslipidemia, particularly among those at significant risk of ischemic stroke, in stroke prevention.

Nevertheless, one must also take into account that the observations must be interpreted cautiously due to a variety of limitations. First, this study was done within a single center so it would limit the power to generalize these observations to more universal groups. The sample itself, though adequate to the extent of this investigation, might not account for the variability that exists within a large and heterogenous cohort. The effect of genetic predisposition and also the risk of selection bias within the sample population can also influence the observations. Replication and further elaboration upon these observations are necessary using follow-up studies incorporating multi-center data and more extensive collections of samples, along with more subtle measures of both genetic and lifestyle variables.

CONCLUSION

Our study has revealed that hyperlipidemia is relatively low among hemorrhagic stroke compared to ischemic stroke patients. The study reveals a high association between hyperlipidemia and factors that lead to stroke such as age, sex, diabetes, and hypertension particularly for ischemic stroke. While hyperlipidemia is highly important for ischemic stroke, its association for hemorrhagic stroke is low. This reveals an imperative for specific prevention to address those risk factors that are amenable to change, particularly among those who are at high risk for ischemic stroke.

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Author's Contribution

The authors have played key roles in the creation of this manuscript, as outlined below.
Dr. Tayyaba Mumtaz was responsible for the overall design of the study, drafting the manuscript, and collecting data from the hospital.
Dr. Haidar Zaman made significant contributions to the development of the article, as well as to the study's design, analysis, and interpretation of data

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