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Original Research Article

Comparative evaluation of triglyceride/high density lipoprotein cholesterol and C-reactive protein between ischemic stroke and healthy control group

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ABSTRACT

Background: Triglyceride to high-density lipoprotein cholesterol ratio (TG/HDL-C) are predictive of the start of cardiovascular disease and metabolic syndrome. Dyslipidemia is a multifactorial disorder that exacerbates the vascular pathology associated with stroke. C-reactive protein (CRP) levels are elevated in people with a higher prevalence of stroke risk factors, such as hypertension, diabetes, and dyslipidemia. This study aims to compare and analyze the values of lipid ratio such as TG/HDL-C and inflammatory marker, CRP in acute ischemic stroke (AIS).
Methods: This study was conducted at Jubilee Mission Medical College and Research Institute in Thrissur, Kerala. The duration of the research period was 2022 September to 2024 July. It was a prospective comparative cross sectional study. Data collection included physical, medical examinations and laboratory investigations. Statistical analysis was performed using statistical package for the social sciences (SPSS) version 26.
Results: The comparison of inflammatory marker, CRP and lipid profile ratio such as TG/HDL-C showed an increased level in AIS than control. No correlation was observed between CRP and TG/HDL-C in AIS group.
Conclusions: Our study observed that inflammatory markers especially CRP have strong predictive potential in diagnosing AIS. The lipid profile ratio such as TG/HDL-C have moderate predictive potential in AIS.

Keywords: Acute ischemic stroke, Lipid profile, Dyslipidemia, Triglycerides, C-reactive protein

INTRODUCTION

Stroke is a leading cause of death and disability, even in wealthier countries. In developed countries, stroke remains a leading cause of death and disability. Stroke-induced ischemic cascade leads to neuronal death and irreversible function loss. Therapeutic strategies aim to restore cerebral flow and minimize ischemic effects. Ischemic stroke, of which 80% to 85% are caused by cerebral blood flow disturbance, is the most common type of stroke.[1] Dyslipidemia and proinflammatory conditions are common pathophysiological mechanisms occurring in AIS.[2,3] Acute ischemic stroke (AIS) was connected to persistent inflammation, and understanding the relationship between inflammatory markers and lipid ratio can reveal insights into the pathophysiology and possible therapeutic targets for this conditions. Dyslipidemia, characterized by abnormal blood lipid levels, is a key risk factor for stroke. Recent studies have focused on less traditional lipid indices, such as the triglyceride to high-density lipoprotein cholesterol ratio, which has been linked to increased stroke risk. Dyslipidemia is a condition characterized by high levels of triglycerides and low levels of high-density lipoprotein cholesterol (HDL-C), and it is a significant risk factor for cardiovascular and cerebrovascular diseases. Dyslipidemia, characterized by abnormal blood lipid levels, is a key risk factor for stroke. Recent studies have focused on less traditional lipid

indices, such as the triglyceride to high-density lipoprotein cholesterol ratio, which has been linked to increased stroke risk.

METHODS

This study was conducted at Jubilee Mission Medical College and Research Institute in Thrissur, Kerala. The study was designed as prospective comparative cross sectional study. The study involved a total of 302 participants (151 healthy control and 151 AIS) in the age group between 40 and 70 years in a tertiary care hospital. Healthy control participants who were coming for checkup in the same hospital and all the AIS patients were treated in this hospital in the event of acute ischemic stroke for the first time were involved in this study. This study was approved by the institutional ethics committee. Computed tomography (CT) and magnetic resonance imaging (MRI) scans were analysed to clinically differentiate different forms of stroke.

Both males and females with comorbidities such as hypertension, smoking, neurological disorders, and vascular complications like atrial fibrillation and congestive heart failure were included in the study population. The study excluded people who had experienced a hemorrhagic stroke or were on anticoagulant or antiplatelet therapy. Extracerebral hemorrhage, transient ischemic attack, stroke with unknown etiology, subarachnoid hemorrhage, brain tumors, patients treated with intravenous thrombolytic therapy prior to onset, patients with insufficient clinical data, patients receiving antiplatelet and anticoagulation therapy, surgery, rheumatoid immune-related diseases, or malignancy were the other exclusion criteria. Before starting any antihypertensive medication, the patient's blood pressure was measured in the emergency department (ED) upon arrival. For every patient, the absolute difference between systolic blood pressure and diastolic blood pressure at admission was measured for all participants. Prior to starting anticoagulant medication, blood samples were taken from each participant upon admission.

The laboratory investigations were done in in DxC 700 AU Beckman Coulter biochemistry fully automated analyzer to analyse triglycerides and HDL. TG/HDL was determined by taking triglycerides and dividing by High density lipoprotein. CRP was done by turbidimetry in BT 1500 Biotecnica Chemistry/Turbidimetry fully automated analyzer.

IBM statistical package for the social sciences (SPSS) statistics, version 26.0, was used to statistically analyze the coded and inserted data into an excel sheet. For continuous variables, descriptive statistics were explained using means/standard deviations, medians/IQRs, and frequencies and percentages; for categorical variables, they took the form of percentages. Using the Shapiro-Wilk test was used to study the distribution of the variables. With continuously distributed data, group comparisons were performed using the relevant statistical tests. When comparing two groups, Mann-Whitney U tests were employed because the data was discovered to be non-normally distributed. Correlations were performed using bivariate Spearman's correlations. P value less than 0.05 ($p<0.05$) was considered as statistically significant.

RESULTS

Baseline characteristics of the study participants inclusive of age, sex and blood pressure were represented in Table 1. Confounding variables included smoking, diabetes mellitus, hypertension, and a history of cardiovascular disease. Upon admission, the patient's diastolic and systolic blood pressure readings were taken. Distribution of age among groups were represented in Figure 1. Distribution of sex among groups were represented in Figure 2. This study includes ages 40 to 70 years - the mean of the control group is mean±SD=47.09±6.43 and AIS group is mean±SD=53.48±7.09. The mean age of control was 47, and AIS 53. In the control group, there are 99 males and 52 females and in AIS group, there are 98 males and 53 females. The percentage wise distribution showed that both male and female population were equally distributed among the groups. The mean blood pressure of control is 120/80 and AIS 150/80.

The p value for CRP are less than 0.001, indicating statistically highly significant differences in inflammatory marker CRP between the AIS and control groups. In other words, the distributions of CRP values are significantly different between the two groups, suggesting that the markers may be useful in differentiating between AIS patients and control. The comparison of CRP between control and AIS were represented in Figure 3. The comparison of TG/HDL-C between control and AIS were represented in Figure 4. Laboratory data and outcome parameters for all patients control and AIS were represented in Table 2. Comparison of inflammatory markers and lipid ratio between healthy control and AIS were represented in Table 3. When the p value is less than 0.05, it is deemed statistically significant, signifying a substantial difference between the control and AIS groups.

The systolic and diastolic blood pressure p values were both less than 0.001, suggesting that there were substantial differences between the AIS and control groups. This means that the distributions of systolic and diastolic blood pressure values were significantly different between the two groups. Comparison of systolic BP between control and AIS were represented in Figure 5. Comparison of diastolic BP between control and AIS were represented in Figure 6. Correlation of parameters of control and AIS shown in Table 4. Correlation of parameters of control shown in Figure 7 and AIS in Figure 8. Results revealed that there was no correlation between CRP and TG/HDL-C (correlation coefficient (ρ)=0.106, p=0.194).

Table 1: Baseline characteristics, and in-hospital measures of all patients control and AIS.

Variables	Control		AIS		P value
	Mean	Median	Mean	Median	
Age (years)	47.09±6.43		53.48±7.09		
Sex					
Male (%) (n=197)	99 (65.6)		98 (64.9)		
Female (%) (n=105)	52 (34.4)		53 (35.1)		
Systolic	120	110–120	150	130–180	<0.001
Diastolic	80	80–80	80	80–100	<0.001

Table 2: Laboratory parameters of all patients control and AIS.

Parameters	Control		AIS		P value
	Mean	Median	Mean	Median	
CRP (mg%)	0.09	0.02–0.20	0.3	0.07–0.7	<0.001*
TG (mg%)	120.23	41	131.56	116	
HDL (mg%)	46.89	24	43.16	40	
TG/HDL	2.62	1.79–3.67	2.86	2.08–4.19	0.015*

*Statistically significant.

Table 3: Comparison of CRP and TG/HDL-C between healthy control and AIS.

Parameters	Control		AIS		P value
	Mean	Median	Mean	Median	
CRP	0.09	0.02–0.20	0.3	0.07–0.7	<0.001*
TG/HDL	2.62	1.79–3.67	2.86	2.08–4.19	0.015*

*Comparison of CRP and TG/HDL-C between control and AIS groups are significant

Table 4: Correlation of CRP versus TG/HDL-C of control and AIS.

Parameter	Control		AIS	
	Correlation coefficient	P value	Correlation coefficient	P value
CRP versus TG/HDL-C	0.052	0.529	0.106	0.194

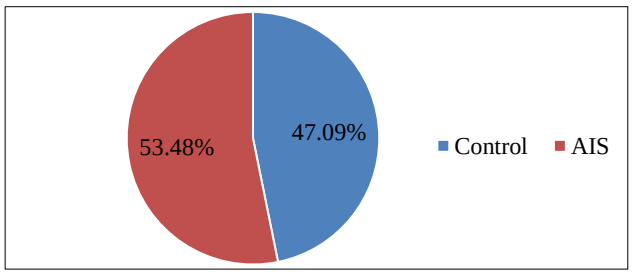

Figure 1: Distribution of age among groups.

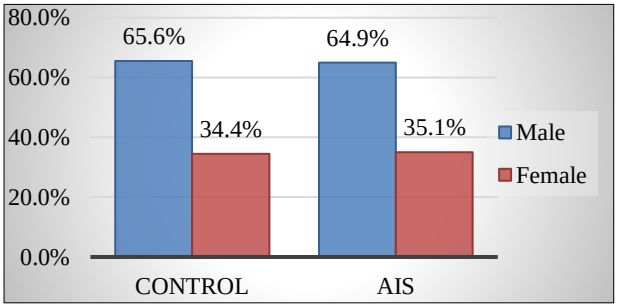

Figure 2: Distribution of sex among groups.

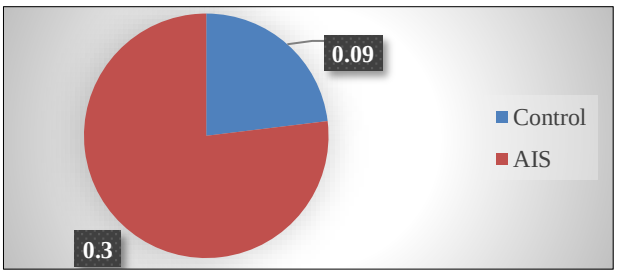

Figure 3: Comparison of CRP between control and AIS.

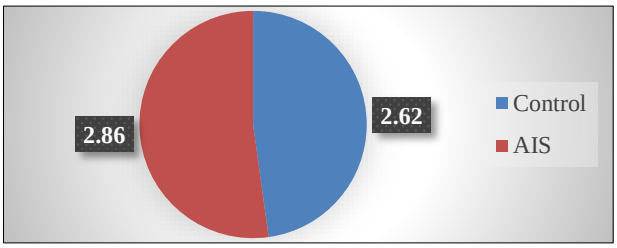

Figure 4: Comparison of TG/HDL-C between control and AIS.

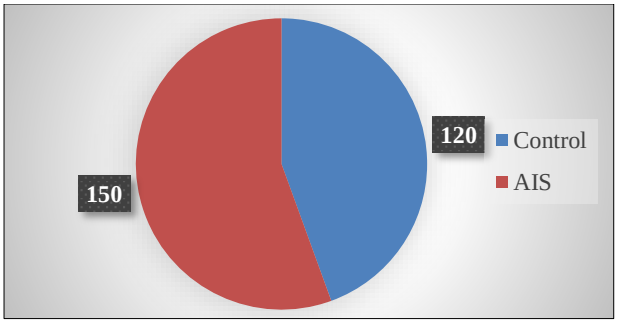

Figure 5: Comparison of systolic BP between control and AIS.

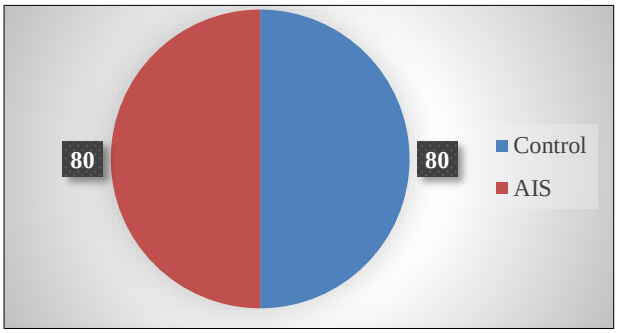

Figure 6: Comparison of diastolic BP between control and AIS.

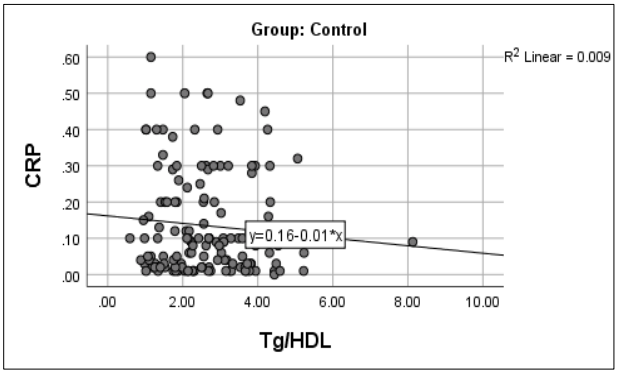

Figure 7: Correlation of CRP versus TG/HDL-C in control group.

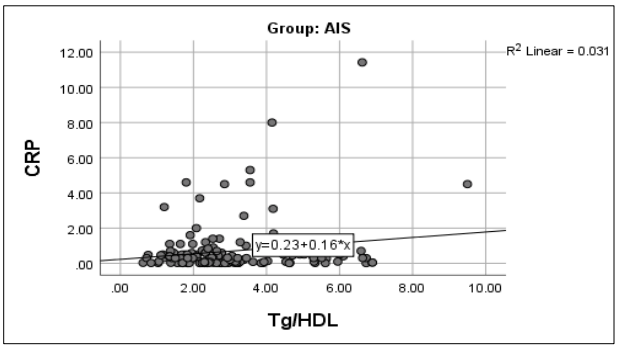

Figure 8: Correlation of CRP versus TG/HDL-C in AIS group.

DISCUSSION

Acute hypertensive response (AHR) occurs in around 75% of patients during the acute phase of acute ischemic stroke, peaking in the initial hours following stroke onset.[4,5] Poor functional outcomes are linked to low blood pressure (BP) in 5–10% of ischemic stroke patients.[6,7] The efficiency of collateral circulation is shown by blood pressure values during the acute phase of a stroke. While lower blood pressure may enhance the recruitment of pial collateral, higher blood pressure inhibits the formation of ischemic lesions. Though prolonged high blood pressure may accelerate the formation of infarcts, higher blood pressure enhances cerebral blood flow.[8-16] The result of the present study revealed that classic inflammatory marker, CRP were elevated during AIS. The findings provide the importance of inflammation in the occurrence of Ischemic stroke. Besides, the level of lipid profile ratio such as TG/HDL-C is elevated during AIS. The increased value of TG/HDL-C is an indication of the contributory role of lipid metabolites in the pathophysiology of stroke. CRP is a sensitive marker of inflammation, produced by the liver in response to inflammatory triggers. An increased risk of cardiovascular disease and stroke were linked to elevated CRP levels, highlighting the role of inflammation in the condition. Elevation of CRP levels indicates the activation of inflammatory pathways, endothelial dysfunction, blood-brain barrier disruption, and oxidative stress. CRP is a prevalent inflammatory biomarker found in the bloodstream of individuals with severe inflammation and diseases. Future ischemic cerebrovascular and cardiovascular disorders, especially transient ischemic events in the elderly, are associated with elevated CRP readings. Since biomarkers can indicate the severity of AIS, finding them is essential for early diagnosis.[17] Our study observed increased CRP levels in AIS compared to control. This indicated that CRP is a common inflammatory marker elevated in AIS.

In addition to the elevated inflammatory status in AIS, lipid profile is also a major contributor to stroke. Henceforth, in the present study, we evaluated, compared, and analyzed the lipid profile ratio such as TG/HDL-C in AIS group. Conventional lipid markers such as total cholesterol, triglycerides, LDL-C, and HDL-C are risk factors for dyslipidemia, a major contributor to stroke.[18] Our study revealed a significant increase in TG/HDL-C, in AIS compared to the control group. This observation indicated that hypertriglyceridemia with low HDL cholesterol is an indicator for the occurrence of AIS. The lipid profile ratio of TG/HDL-C is higher in the AIS group. High triglycerides and low HDL-C are predictive factors for ischemic stroke, which is frequently caused by altered lipid metabolism.[19] Elevated TG levels are linked to abnormalities in the clotting fibrinolytic cascade, potentially causing ischemic stroke, although the exact mechanisms are unknown.[18] The bivariate correlation analysis between inflammatory marker CRP and lipid profile ratio like TG/HDL-C was done in the control and AIS. From the correlation analysis, we observed the

bivariate analytes, inflammatory markers, and lipid profile ratio did not show a correlation in the control group and AIS group.

CONCLUSION

Our study observed that inflammatory markers especially CRP have strong predictive potential in diagnosing AIS. The lipid profile ratio, TG/HDL-C have moderate predictive potential in AIS. The study throws light on the importance of lipid profile and inflammatory marker in the pathophysiology of ischemic stroke. Regulating lipid metabolism and inflammatory signaling are vital in the therapeutic management of stroke.

Arriving at a solid conclusion with specific inflammatory markers and dyslipidemia conditions leading to the occurrence of AIS in T2DM conditions may not be accurate as co-morbidity associated with both T2DM and AIS are heterogeneous.

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Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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