Original Article

A Study of C-Reactive Protein in Acute Ischemic Stroke: A Hospital Based Cross-Sectional Study

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Abstract

Background: Ischemic stroke is a common problem faced day to day. The incidence is the most accurate indicator of the community's burden from stroke. Research has demonstrated increased levels of acute-phase reactants, including C-reactive protein and ESR. To determine the significance of C-reactive protein (CRP) levels in acute ischemic stroke patients, the current study was conducted. **Material and Methods:** This study was a Hospital Based Cross-Sectional Study conducted in the Department of General Medicine, Coimbatore Medical College, Coimbatore. The study was conducted among 100 patients with acute ischemic stroke. The investigation encompassed patients of both genders who were admitted for their first ischemic stroke within 72 hours of the onset of symptoms. **Results:** In the present study, the majority of participants were male and belonged to the 61–70 years' age group. Lacunar infarcts were the most common (24%), followed by frontal (22%) and occipital (14%) regions. Patients with elevated erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP) levels were significantly associated with increased adverse functional outcomes. **Conclusion:** This study offers a comprehensive analysis of the correlation between elevated C-reactive protein and elevated ESR and the adverse prognosis in patients with acute ischemic stroke.

Keywords: C-reactive protein, Ischemic stroke, Erythrocyte Sedimentation Rate, Modified Rankin Scale.

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Introduction

Stroke is a major public health problem worldwide. The Global Burden of Diseases (GBD) survey from 1990 found that stroke was the second largest cause of death in the world. In India, stroke is the fifth most prevalent cause of disability and the fourth most common cause of mortality. The number of people who have strokes each year ranges from 108 to 172 per 100,000, and this number is rising.[1-3]

Various studies have reported that inflammation is a substantial contributor to acute ischemic stroke (AIS), suggesting critical linkages between the neurological and immune systems. Cerebral ischemia triggers an inflammatory response encompassing various cell types. C-reactive protein (CRP) is the standard for the acute phase of inflammation; hence, it is used as a biochemical marker in research examining the relationship between inflammation and atherosclerosis across all forms.[4-7]

Increased CRP production is characteristic of both noninfectious and infectious diseases, and CRP can bind to a diverse array of endogenous products. Lipids, phospholipids, polycations, and polyanions are components of cells that may be aberrantly exposed or discharged from injured tissues. The resolution and repair of necrotic cells are facilitated by the in vivo binding of CRP to these cells. The primary function of CRP, for which it has developed and been preserved, is to identify potentially hazardous autogenous substances produced from injured tissues in the plasma, binding them to detoxify and/or promote their clearance.[8-10]

To investigate the correlation between C-reactive protein (CRP) and ESR levels in patients with acute ischemic stroke, the current study was conducted. The study also ascertained the significance of CRP in the functional prognosis of acute ischemic stroke patients.

Materials and Methods

This study was a Hospital Based Cross-Sectional Study conducted in the Department of General Medicine, Coimbatore Medical College, Coimbatore. The study was conducted among 100 patients with acute ischemic stroke. Ethical committee approval was obtained from the Institutional Ethical Committee, Coimbatore Medical College, Coimbatore. Individual informed consent was obtained from the patient or the legal guardian before the patient was recruited into the study. The investigation encompassed patients of both genders who were admitted for their first ischemic stroke within 72 hours of the onset of symptoms. The research did not include patients with acute infectious disease, stable or unstable angina, or acute myocardial

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infarction.

Additionally, patients with immunological disorders, neoplastic disorders, burns, osteoarthrosis, costochondritis, rheumatoid arthritis, and ankylosing spondylitis were precluded from the study. Routine investigations, including complete blood count, renal profile, urine routine, chest X-ray, and ECG, were conducted. The patient underwent a CT scan, and C-reactive protein levels were measured upon admission to the hospital.CRP values were determined by centrifuging 5 ml of blood in a plain vial within 4 hours of collection and separating the plasma with reagents. The VITRIOS 5600 integrated system text and VITRIOS CRP transparencies were employed to conduct the measurement. The relationship between CRP levels and adverse outcomes (modified Rankin Scale score) was investigated at 3-month intervals. The data were subsequently entered and analysed using SPSS version 16.

Results

In the present study, males constituted a higher proportion (67%) than females (33%). The 61–70-year age group comprised the majority of participants (37%), followed by the 51–60-year group (23%). Participants aged 71–80 years accounted for 16%, while both the 41–50 years and the>80 years groups comprised 12% each, indicating that most cases occurred in the elderly population.

We observed that among the regions involved, lacunar infarcts were the most common (24%), followed by frontal (22%) and occipital (14%) regions. Other regions included frontotemporal (11%), parietal (10%), temporal (9%), internal capsule (4%), temporo-parietal (4%), and watershed areas (2%), reflecting a varied distribution of lesion sites.

The functional outcome was assessed using the Modified Rankin Scale (mRS). We observed that the majority of patients had severe disability or death, with scores of 6 (28%) and 5 (20%). Moderate disability (scores 3 and 4) was observed in 19% and 17% of participants, respectively, while mild disability (scores 1 and 2) accounted for 6% and 10%, indicating that a considerable proportion of patients had poor functional outcomes.

The comparison of biochemical parameters across different Modified Rankin Scale (mRS) outcome categories was analysed among the study participants. We noted that haemoglobin levels did not exhibit a statistically significant correlation with functional outcomes among the haematological parameters (p = 0.096). Renal function parameters, including urea and creatinine, did not show statistically significant differences across mRS categories (p = 0.09 and 0.07, respectively). However, numerically higher values were observed in patients with poorer outcomes.

Table 1: Characteristics among the study participants (n=100)

Parameters	Frequency (n=100)	Percentage (%)
Sex		
Male	67	12
Female	33	23
Age		
41–50	12	12
51–60	23	23
61–70	37	37
71–80	16	16
>80	12	12
Region Involved		
Lacunar	24	24
Frontal	22	22
Occipital	14	14
Frontotemporal	11	11
Parietal	10	10
Temporal	9	9
Internal capsule	4	4
Temporo-parietal	4	4
Watershed	2	2
Modified Rankin Scale		
1	6	6
2	10	10
3	19	19
4	17	17
5	20	20
6	28	28

Table 2: Comparison of the Biochemical Parameters and outcome among the study participants (n=100)

Biochemical Parameters	MRS 1 Mean ± SD	MRS 2 Mean ± SD	MRS 3 Mean ± SD	MRS 4 Mean ± SD	MRS 5 Mean ± SD	MRS 6 Mean ± SD	p value
Hb	16.3 ± 5.2	15.6 ± 4.8	16.5 ± 4.8	15.6 ± 3.5	14.3 ± 3.6	13.6 ± 2.5	0.096
ESR	19.6 ± 5.2	29.3 ± 4.2	46.3 ± 7.5	52.7 ± 8.2	53.1 ± 8.6	56.46 ± 9.2	0.001*
C reactive Protein	7.41 ± 2.2	8.03 ± 2.4	9.31 ± 2.2	9.88 ± 2.8	9.97 ± 2.4	10.3 ± 1.4	0.001*
Urea	38.33 ± 5.1	43.7 ± 5.4	54.84 ± 7.8	37.94 ± 6.2	42.15 ± 7.4	59.46 ± 8.2	0.09
Creatinine	3.95 ± 0.5	1.33 ± 0.4	4.21 ± 0.7	1.75 ± 0.6	1.24 ± 0.5	1.78 ± 0.4	0.07
Cholesterol	211.03 ± 58.7	221.18 ± 85.5	218.93 ± 86.7	229.74 ± 75.7	231.67 ± 40.5	247.93 ± 98.7	0.004*

HDL	57.49 ± 24.1	60.3 ± 28.2	61.2 ± 27.4	59.2 ± 26.4	58.2 ± 20.4	42.8 ± 19.4	0.001*
LDL	163.17 ± 26.2	172.20 ±28.4	158.58 ± 30.1	148.12 ± 32.4	155.9 ± 34.7	189.20 ± 38.6	0.14
TGL	160.83 ± 32.9	162.1 ± 34.7	166.05 ± 40.8	169.29 ± 41.2	173.23 ± 48.8	187.93 ± 54.6	0.04*

* p value of < 0.05 was considered to be statistically significant

Among lipid profile parameters, total cholesterol and mean Triglyceride (TGL) levels showed a statistically significant association with mRS scores (p = 0.004), with higher levels corresponding to worse functional status. High-density lipoprotein (HDL) levels were significantly lower in patients with worse outcomes (p = 0.001), suggesting a protective role for HDL. However, low-density lipoprotein (LDL) did not show a statistically significant association (p = 0.14). demonstrated a statistically significant association (p = 0.04) with increasing mean values.

Discussion

Acute ischemic stroke is a major contributor to global morbidity and mortality, with inflammation playing a central role in its pathogenesis. In recent years, inflammatory biomarkers such as C-reactive protein (CRP) have attracted attention for their potential to predict stroke severity and functional outcomes. In the present study, we evaluated the association between CRP levels and functional outcomes using the Modified Rankin Scale (MRS).

Male patients comprised the majority of our study (67%), with the age group of 61–70 years being the most frequently affected (37%). This observation is consistent with the observations made by Feigin et al,[11] and Donkor et al,[12] who have reported a higher prevalence of stroke among elderly males, likely due to a higher burden of vascular risk factors such as hypertension, diabetes, and smoking. Age-related vascular changes and cumulative exposure to risk factors contribute significantly to stroke occurrence; these findings are in line with our observations.

About stroke distribution, lacunar infarcts were the most common subtype (24%), followed by involvement of the frontal (22%) and occipital (14%) regions. This finding suggests a significant contribution of small vessel disease in our study population. Similar patterns have been reported by Pantoni et al,[13] where lacunar strokes are more prevalent due to uncontrolled vascular risk factors.

Functional outcome analysis using the Modified Rankin Scale disclosed that a substantial number of patients had severe disability, with 20% in MRS 5 and 28% in MRS 6. This highlights the substantial burden of disability and mortality associated with acute ischemic stroke and emphasises the importance of early prognostic indicators.

The substantial correlation between CRP levels and stroke severity is a critical discovery of our investigation. CRP levels showed a progressive increase from patients with mild disability (MRS 1) to those with severe disability or death (MRS 6), and this association was statistically significant (p = 0.001). This finding supports the hypothesis that systemic inflammation contributes to ischemic brain injury and influences clinical outcomes. Di Napoli et al,[14] and Rost et al,[15] have documented that elevated CRP levels correspond to the acute inflammatory response preceding cerebral ischemia. This, in turn, exacerbates the neuronal damage through endothelial dysfunction, oxidative stress, and cytokine-mediated injury.

Our findings are consistent with the observations made by Di Napoli et al.[14] They have demonstrated that elevated CRP levels are independently associated with poor functional outcomes among stroke patients. Bian et al,[16] have reported that increased stroke severity was significantly associated with elevated CRP levels at the time of admission. Kaptoge et al., in their meta-analysis of various published literature, have noted that elevated CRP levels were associated with an increased risk of stroke.[17]

In addition to CRP, our study also demonstrated a statistically significant link between stroke severity and ESR (p = 0.001). This further supports the role of inflammation in stroke pathophysiology. Whiteley et al,[18] have also reported findings similar to ours. This indicates that inflammatory markers such as ESR and CRP are associated with poor outcomes following ischemic stroke.

Among lipid parameters, total cholesterol and triglyceride levels showed significant associations with worse functional outcomes. Elevated lipid levels contribute to atherosclerosis, leading to vascular occlusion and impaired cerebral perfusion. In contrast, HDL levels showed a significant inverse relationship with stroke severity, suggesting a protective role for HDL. These findings are consistent with observations reported by Amarenco et al and Tanne et al.[19,20]

Interestingly, our study did not reveal any statistically significant associations between functional outcomes and haemoglobin, urea, creatinine, and LDL levels. This suggests that inflammatory markers such as CRP and ESR may serve as more reliable predictors of stroke severity compared to routine biochemical parameters.

Conclusion

Based on our observations, we concluded that inflammatory markers (ESR and CRP) and certain lipid parameters (total cholesterol, HDL, and triglycerides) showed significant associations with stroke outcomes, indicating their potential role as predictors of disease severity and prognosis. Our study demonstrates that CRP is a significant inflammatory biomarker that correlates positively with stroke severity and functional outcome, highlighting its potential role in early prognostication of acute ischemic stroke.

Limitations: Causal inference is restricted by the cross-sectional design, and the relatively small sample size may compromise the generalisability. Furthermore, there was no evaluation of long-term results. It is advised that these findings be validated in future prospective studies with larger sample sizes and follow-up.

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Conflicts of interest

There are no conflicts of interest.

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