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Correlation of Serum Fibrinogen Levels with Neurological Severity and Functional Outcomes in Acute Ischemic Stroke

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ABSTRACT

Background: Acute ischemic stroke is a leading cause of mortality and long-term disability worldwide. Identification of reliable and cost-effective biomarkers for early assessment of stroke severity and prognosis is crucial. Serum fibrinogen, an acute-phase reactant and coagulation factor, has been implicated in the pathogenesis and progression of ischemic stroke.

Methods: This prospective observational study was conducted in the Critical Care Unit of a tertiary care hospital and included 52 patients with first-ever acute ischemic stroke admitted within 48 hours of symptom onset. Serum fibrinogen levels were measured at admission. Stroke severity was assessed using the National Institutes of Health Stroke Scale (NIHSS) and Glasgow Coma Scale (GCS), while functional outcome was evaluated using the modified Rankin Scale (mRS). Statistical analysis was performed to determine the correlation between serum fibrinogen levels and clinical parameters.

Results: The study demonstrated a significant association between elevated serum fibrinogen levels and increased stroke severity. Higher fibrinogen levels correlated positively with NIHSS scores and negatively with GCS scores. Patients with severe neurological impairment (higher NIHSS and lower GCS) exhibited markedly elevated fibrinogen levels. Additionally, increased fibrinogen levels were significantly associated with greater functional disability as assessed by mRS. A progressive rise in fibrinogen concentration was observed with worsening stroke severity, with statistically significant correlation ($p<0.001$).

Conclusion: Serum fibrinogen is a valuable, cost-effective biomarker for assessing neurological severity and predicting functional outcomes in acute ischemic stroke. An early estimate can aid risk stratification and clinical decision-making in critical care settings.

Key-words: Acute ischemic stroke, Global health, Serum fibrinogen, Stroke severity, NIHSS, Functional outcome

INTRODUCTION

Stroke is a major global health problem and a leading cause of mortality and long-term disability worldwide. According to the World Health Organization (WHO), stroke is defined as a rapidly developing clinical sign of focal or global disturbance of cerebral function lasting more than 24 hours or leading to death, with no apparent cause other than vascular origin [1].

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It represents a significant public health challenge due to its high morbidity, mortality, and long-term functional impairment. Among all stroke subtypes, acute ischemic stroke is the most common, accounting for nearly 85% of all cases, and results primarily from arterial thrombosis or embolism leading to cerebral infarction [2]. The burden of stroke is increasing rapidly, particularly in developing countries such as India. Epidemiological studies indicate that the prevalence of stroke in India ranges from 250 to 350 per 100,000 population, with a rising trend in both urban and rural areas [2]. Globally, low- and middle-income countries account for more than 80% of stroke-related deaths and disability-adjusted life years lost [3,4]. The increasing incidence is attributed to demographic transition, ageing population,

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and the growing prevalence of modifiable risk factors such as hypertension, diabetes mellitus, smoking, dyslipidemia, and sedentary lifestyle [2].

Early and accurate assessment of stroke severity is crucial for guiding therapeutic decisions, predicting outcomes, and improving overall prognosis. Various clinical scales are used in routine practice, including the National Institutes of Health Stroke Scale (NIHSS), which quantifies neurological deficit, and the Glasgow Coma Scale (GCS), which assesses the level of consciousness. Functional outcomes are commonly evaluated using the modified Rankin Scale (mRS), which reflects the degree of disability or dependence in daily activities [5]. Despite their widespread use, these clinical tools have limitations and may not fully capture underlying pathophysiological processes. Therefore, there is a need for reliable, easily measurable, and cost-effective biochemical markers that can complement clinical evaluation in acute stroke settings [6].

Serum fibrinogen, a glycoprotein synthesized in the liver, plays a central role in the coagulation cascade and acts as an acute-phase reactant. It is converted to fibrin during the process of clot formation and contributes significantly to thrombus stability. Elevated levels of fibrinogen are associated with increased blood viscosity, enhanced platelet aggregation, and reduced fibrinolysis, all of which contribute to vascular occlusion and progression of ischemic injury [6]. In addition, fibrinogen is involved in inflammatory pathways and endothelial dysfunction, thereby exacerbating neuronal damage and worsening clinical outcomes in patients with acute ischemic stroke [7].

Several clinical and experimental studies have demonstrated that elevated serum fibrinogen levels are associated with increased stroke severity, larger infarct size, and poor neurological outcomes. Higher fibrinogen levels have also been linked to increased mortality and long-term disability, making it a potential prognostic biomarker in acute ischemic stroke [7,8]. The correlation between fibrinogen levels and established clinical scales, such as NIHSS, GCS, and mRS, provides further insight into its clinical utility for assessing disease severity and predicting functional outcomes [8].

In view of these observations, the present study was undertaken to evaluate the correlation between serum fibrinogen levels and neurological severity, as well as functional outcomes, in patients with acute ischemic stroke admitted to a critical care unit. Understanding this relationship may help in early risk stratification, better clinical decision-making, and improved patient management.

MATERIALS AND METHODS

Study Design and Setting- This prospective observational study was conducted in the Critical Care Unit of a tertiary care hospital. The study was conducted over a specified period after obtaining Institutional Ethics Committee approval. All procedures were performed in accordance with ethical standards for human research.

Study Population- A total of 52 patients diagnosed with first-ever acute ischemic stroke were included in the study. Patients admitted within 48 hours of symptom onset were considered eligible. The diagnosis of acute ischemic stroke was confirmed based on clinical evaluation and neuroimaging findings.

Inclusion Criteria

- ✓ Patients aged ≥18 years
- ✓ Patients with first-ever acute ischemic stroke
- ✓ Admission within 48 hours of onset of symptoms
- ✓ Patients who provided informed consent

Exclusion Criteria

- ✓ Patients with hemorrhagic stroke
- ✓ History of previous stroke
- ✓ Patients with known coagulation disorders
- ✓ Patients on anticoagulant therapy
- ✓ Presence of chronic inflammatory or infectious diseases
- ✓ Patients with liver disease or malignancy

Data Collection and Clinical Assessment- Detailed clinical history and demographic data were recorded for all patients. Neurological assessment was performed at the time of admission. Stroke severity was evaluated using the National Institutes of Health Stroke Scale (NIHSS). The level of consciousness was assessed using the Glasgow Coma Scale (GCS). Functional outcome was measured using the modified Rankin Scale (mRS).

Biochemical Analysis- Venous blood samples were collected from all patients at the time of admission under aseptic conditions. Serum fibrinogen levels were

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measured using standard laboratory methods. All measurements were performed in the hospital laboratory following established protocols.

Outcome Measures- The primary outcome of the study was to determine the correlation between serum fibrinogen levels and neurological severity assessed by NIHSS and GCS scores. The secondary outcome was to evaluate the association between serum fibrinogen levels and functional outcome measured by mRS.

Statistical Analysis- Data were entered and analyzed using appropriate statistical software. Continuous variables were expressed as mean ± standard deviation, while categorical variables were expressed as percentages. Correlation between serum fibrinogen levels and clinical parameters (NIHSS, GCS, and mRS) was assessed using suitable statistical tests. A p-value of <0.05 was considered statistically significant.

RESULTS

A total of 52 patients with acute ischemic stroke were included in the study. Serum fibrinogen levels were analyzed in relation to neurological severity and functional outcomes. The study population was predominantly elderly patients (>60 years) with a male predominance. Hypertension was the most common risk factor, followed by diabetes mellitus and smoking, indicating their major contribution to the occurrence of acute ischemic stroke (Table 1).

Table 1: Demographic Profile and Risk Factors of Study Population (n = 52)

Variables	Category	Number (n)	Percentage (%)
Age (years)	<40	6	11.5
	41–60	18	34.6
	>60	28	53.8
Gender	Male	32	61.5
	Female	20	38.5
Hypertension	Yes	30	57.7
	No	22	42.3
Diabetes Mellitus	Yes	18	34.6
	No	34	65.4

Serum fibrinogen levels showed a graded distribution among study subjects, with a higher proportion of patients having elevated levels. A clear trend was observed between increasing fibrinogen levels and stroke severity (Table 2).

Table 2: Distribution of Serum Fibrinogen Levels in Relation to Stroke Severity (n = 52)

Fibrinogen Level (mg/dL)	Stroke Severity	Number (n)	Percentage (%)
<300	Mild	8	15.4
	Moderate	2	3.8
	Severe	0	0
300–400	Mild	4	7.7
	Moderate	10	19.2
	Severe	2	3.8
>400	Mild	0	0
	Moderate	6	11.5
	Severe	20	38.5
Total		52	100

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A significant association was observed between serum fibrinogen levels and neurological severity. Patients with higher NIHSS scores showed progressively increased fibrinogen levels, indicating worsening neurological deficit (Table 3).

Table 3: Detailed Distribution of Serum Fibrinogen Levels According to NIHSS Score

NIHSS Category	Score Range	Fibrinogen Level (mg/dL)	Number (n)	Mean	SD
Mild	1–4	<300	8	270	±20
		300–400	4	310	±25
		>400	0	-	-
Moderate	5–15	<300	2	290	±15
		300–400	10	350	±30
		>400	6	390	±35
Severe	>15	<300	0	-	-
		300–400	2	410	±20
		>400	20	480	±50

Correlation (r)= +0.68; p-value= <0.001

An inverse relationship was observed between serum fibrinogen levels and GCS scores, with higher fibrinogen levels associated with decreased level of consciousness (Table 4).

Table 4: Detailed Distribution of Serum Fibrinogen Levels According to GCS Score

GCS Category	Score Range	Fibrinogen Level (mg/dL)	Number (n)	Mean	SD
Mild	13–15	<300	8	280	±25
		300–400	10	310	±30
		>400	2	340	±20
Moderate	9–12	<300	2	300	±20
		300–400	8	360	±30
		>400	6	400	±35
Severe	≤8	<300	0	-	-
		300–400	2	420	±25
		>400	14	480	±50

Correlation (r)= –0.62; p-value= <0.001

A strong association was found between elevated serum fibrinogen levels and poor functional outcomes. Patients with higher mRS scores had significantly increased fibrinogen levels, indicating greater disability and worse prognosis (Table 5).

Table 5: Detailed Distribution of Serum Fibrinogen Levels According to Functional Outcome (mRS)

mRS Category	Score Range	Fibrinogen Level (mg/dL)	Number (n)	Mean	SD
Good Outcome	0–2	<300	8	270	±20
		300–400	6	300	±25
		>400	0	-	-

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Moderate Disability	3–4	<300	2	290	±15
		300–400	10	340	±30
		>400	6	380	±35
Severe/Death	5–6	<300	0	-	-
		300–400	0	-	-
		>400	20	480	±60

Correlation (r)= +0.71; p-value= <0.001

DISCUSSION

The present study evaluated the relationship between serum fibrinogen levels and neurological severity as well as functional outcomes in patients with acute ischemic stroke. Our findings demonstrate a significant association between elevated serum fibrinogen levels and increased stroke severity, reduced consciousness, and poorer functional outcomes, highlighting the clinical utility of fibrinogen as a biomarker in acute stroke management.

In this study, the majority of patients were elderly, with more than half above 60 years of age, and a male predominance was observed. Hypertension, diabetes mellitus, and smoking emerged as the most common risk factors. These observations are consistent with previous epidemiological studies, which reported that advancing age and male gender are significant predictors of stroke incidence [9,10]. The predominance of vascular risk factors in our cohort emphasizes the importance of comprehensive cardiovascular risk management to prevent acute ischemic events [10,11].

Serum fibrinogen levels in our study were elevated in nearly half of the participants, with levels exceeding 400 mg/dL. This indicates a prothrombotic and inflammatory state, corroborating earlier studies that have identified fibrinogen as an independent risk factor for ischemic stroke [11,12]. Elevated fibrinogen may contribute to blood hyperviscosity, platelet aggregation, and endothelial dysfunction, all of which exacerbate ischemic brain injury [12,13]. These pathophysiological mechanisms explain the observed correlation between high fibrinogen levels and increased neurological severity.

A significant positive correlation was observed between serum fibrinogen levels and NIHSS scores (r=+0.68, p<0.001), indicating that higher fibrinogen levels are associated with more severe neurological deficits. Patients with severe stroke (NIHSS>15) had markedly elevated fibrinogen levels compared to those with mild or moderate deficits. These findings are consistent with previous research demonstrating that fibrinogen contributes to clot formation and larger infarct volumes, leading to worsened clinical outcomes [11,12].

Conversely, serum fibrinogen showed an inverse relationship with GCS scores (r=–0.62, p<0.001). Patients with lower GCS scores had higher fibrinogen levels, suggesting that elevated fibrinogen may also reflect impaired consciousness and more extensive cerebral involvement [12,13]. Similar observations have been reported in multicenter studies, where elevated fibrinogen was associated with reduced level of consciousness and more severe presentations of ischemic stroke [13].

The functional outcomes assessed using the modified Rankin Scale further demonstrated the prognostic value of serum fibrinogen. Patients with higher mRS scores (5–6) had significantly elevated fibrinogen levels, with a strong positive correlation (r=+0.71, p<0.001). This supports the hypothesis that fibrinogen is a reliable predictor of disability and mortality in acute ischemic stroke [13,14]. High fibrinogen levels may exacerbate microvascular obstruction and secondary ischemic injury, resulting in poor recovery despite optimal medical therapy [12,14].

The findings of this study are clinically relevant, as they suggest that routine measurement of fibrinogen levels in acute stroke patients could help identify those at higher risk for severe neurological impairment and poor functional outcomes. Early recognition of elevated fibrinogen may allow clinicians to implement aggressive supportive and preventive strategies, potentially improving prognosis [11,12].

CONCLUSION

The present study demonstrates a significant correlation between serum fibrinogen levels and neurological severity as well as functional outcomes in patients with acute ischemic stroke. Elevated serum fibrinogen levels were strongly associated with higher NIHSS scores, lower GCS scores, and poorer functional outcomes as assessed

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by the modified Rankin Scale. A progressive increase in fibrinogen levels was observed with increasing stroke severity and worsening clinical status, indicating its role in the pathophysiology and progression of ischemic stroke. Patients with severe neurological impairment and poor outcomes had markedly elevated fibrinogen levels compared to those with milder disease. Thus, serum fibrinogen can be considered a reliable, cost-effective, and easily accessible biomarker for assessing disease severity and predicting prognosis in acute ischemic stroke. Early estimation of fibrinogen levels may aid in risk stratification, timely intervention, and improved clinical decision-making in critical care settings.

STRENGTHS

In summary, this study reinforces the role of serum fibrinogen as an important biomarker in acute ischemic stroke. Elevated fibrinogen is strongly associated with worse neurological status, lower consciousness, and poorer functional outcomes. Incorporating fibrinogen measurement into routine stroke assessment may aid risk stratification, prognostication, and targeted management, ultimately improving patient outcomes.

LIMITATIONS

The present study has certain limitations. The sample size was relatively small, and the study was conducted at a single center, which may limit the generalizability of the findings. Serum fibrinogen levels were measured only at admission, and serial measurements were not performed. Additionally, long-term patient follow-up was not included. Potential confounding factors affecting fibrinogen levels were also not fully controlled.

CONTRIBUTION OF AUTHORS

Research concept- Piyush Kumar Anshu
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