



ASSOCIATION OF SERUM URIC ACID LEVELS WITH ACUTE CEREBROVASCULAR ACCIDENT(CVA): AN OBSERVATIONAL STUDY.

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Abstract

Background: Stroke is a major cause of morbidity and mortality worldwide, and serum uric acid (SUA) has been implicated as a potential biomarker associated with cerebrovascular disease. The present study was conducted to evaluate the association between serum uric acid levels and acute cerebrovascular accident (CVA) and to assess its relationship with demographic and vascular risk factors. **Materials and Methods:** This hospital-based prospective observational cross-sectional study was conducted at Sir Takhtasinhji Government Hospital, Bhavnagar, Gujarat, India, from March 2024 to November 2024. A total of 130 patients aged ≥ 18 years with CT/MRI-confirmed acute CVA presenting within 48 hours of symptom onset were included. Serum uric acid levels were measured using the uricase-peroxidase enzymatic method. Patients were categorized into hypouricemic, normouricemic, and hyperuricemic groups. Demographic characteristics, stroke subtype, hypertension, diabetes mellitus, and smoking status were analyzed in relation to SUA levels. **Results:** Ischemic stroke was the predominant subtype, accounting for 77.7% of cases, while hemorrhagic stroke constituted 22.3%. Hyperuricemia was observed in 33.8% of patients and was slightly more common in ischemic stroke patients. Higher mean SUA levels were observed among hypertensive, diabetic, and smoking patients compared to their counterparts. Male predominance was noted among stroke patients, and the majority of cases occurred in individuals aged > 60 years. **Conclusion:** Elevated serum uric acid levels were frequently observed among acute CVA patients, particularly in association with ischemic stroke and major vascular risk factors. Serum uric acid may serve as a simple and cost-effective biomarker for identifying patients at increased cerebrovascular risk.

Keywords: Acute cerebrovascular accident; Serum uric acid; Ischemic stroke; Hyperuricemia; Stroke risk factors.



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INTRODUCTION

Cerebrovascular accident (CVA), commonly known as stroke, remains one of the leading causes of morbidity and mortality worldwide, imposing a significant burden on healthcare systems and affected individuals alike. Understanding the various risk factors and biomarkers associated with CVA is crucial for early detection, prevention, and effective management of this debilitating condition. [1] Serum uric acid, a product of purine metabolism, has garnered attention in recent years for its potential role in neurological disorders, including CVA. Elevated levels of uric acid have been implicated in oxidative stress and inflammation, both of which are key pathological processes in the development and progression of stroke. [2]

Uric acid acts as a double-edged sword in the human body. While it possesses antioxidant properties that can protect neurons from oxidative damage, excessive levels may lead to pro-oxidant effects, exacerbating neuronal injury during ischemic events. This dual role makes it a molecule of significant interest in the context of acute CVA. [3] Previous studies have produced mixed results regarding the association between serum uric acid levels and stroke outcomes. Conversely, other studies have found that elevated uric acid is associated with increased stroke severity and poorer outcomes. [4] Factors such as patient age, gender, and comorbid conditions may influence this association, contributing to the inconsistent results observed in the literature. [5]

Age and gender are well-established determinants of stroke risk and outcomes. Elderly individuals and males are generally at higher risk for CVA, and these demographic factors may also interact with serum uric acid levels in complex ways. Understanding these interactions is essential for developing targeted interventions and personalized treatment strategies. [6] So, present study aims to determine the association of serum uric acid levels with acute cerebrovascular accident (CVA) patients.

MATERIALS AND METHODS

This hospital-based prospective observational cross-sectional study was conducted at Sir Takhtsinhji Government Hospital, Bhavnagar, Gujarat, India, to evaluate the association between serum uric acid (SUA) levels and acute cerebrovascular accident (CVA). The study was carried out over a period of nine months from March 2024 to November 2024. Adult patients aged ≥ 18 years with computed tomography (CT) or magnetic resonance imaging (MRI)-confirmed acute ischemic or hemorrhagic stroke presenting within 48 hours of symptom onset were included in the study after obtaining written informed consent from the patient or legally authorized representative.

Patients with a history of transient ischemic attack within the previous 90 days, gout, chronic kidney disease stage 3–5, hypothyroidism, prior coronary or peripheral vascular disease, pregnancy, lactation, or those receiving urate-lowering drugs, corticosteroids, diuretics, or cisplatin were excluded to avoid confounding factors affecting serum uric acid metabolism.

A consecutive sampling technique was used, and a total of 130 eligible patients were enrolled. Sample size was calculated using Epi Info™ version 7.2 considering a 30% prevalence of hyperuricemia among stroke patients, 95% confidence interval, and 8% absolute precision. Detailed demographic characteristics, vascular risk factors, and clinical findings were recorded using a predesigned case record form. Stroke subtype was confirmed using neuroimaging studies.

Within two hours of admission, 5 mL of venous blood was collected under aseptic precautions. Serum was separated after centrifugation and analyzed for serum uric acid using the uricase–peroxidase enzymatic method on an auto-analyser with standard quality control procedures. Additional laboratory investigations including fasting blood glucose, serum creatinine, and lipid profile were also recorded.

Patients were categorized into normouricemic (SUA ≤ 6.8 mg/dL) and hyperuricemic (SUA > 6.8 mg/dL) groups. Data were entered into Microsoft Excel and analyzed using Statistical Package for the Social Sciences (SPSS) software. Continuous variables were expressed as mean $\pm$ standard deviation, while categorical variables were expressed as frequencies and percentages. Independent sample t-test, Mann–Whitney U test, Chi-square test, and Fisher’s exact test were applied as appropriate. Multivariable regression analysis was performed to adjust for potential confounders. A p-value < 0.05 was considered statistically significant. The study protocol was approved by the Institutional Ethics Committee of Government Medical College, Bhavnagar, and the study was conducted in accordance with the Declaration of Helsinki.

RESULTS

Ischemic stroke constituted the majority of cases (78%), whereas hemorrhagic stroke accounted for 22% of the study population. The prevalence of hyperuricemia was comparable between ischemic and hemorrhagic stroke subtypes (34% vs. 31%, respectively), suggesting the absence of a significant stroke subtype–specific association with elevated serum uric acid levels. Notably, a single case of hypouricemia was observed in the hemorrhagic stroke group, which may warrant further individual evaluation, as previous experimental studies have suggested a potential relationship between reduced uric acid levels and endothelial vulnerability. Overall, the distribution of serum uric acid levels appeared largely similar across both ischemic and hemorrhagic stroke phenotypes in the present study.

Table 1. Stroke type corelated with Uric acid level and Demographic data

Parameters		Hypouricemia n=3	Normal n=83	Hyperuricemia n=44	Total
Stroke type	Haemorrhagic (22%)	1	19	9	29
	Ischaemic (78%)	2	64	35	101
Age wise distribution	18-30	0	1	2	3
	31-45	0	14	5	19
	46-60	0	22	17	39
	>60	3	47	19	69
Gender wise distribution	Male	3	46	29	78
	Female	0	37	15	52

Among the 130 patients with acute cerebrovascular accident (CVA), ischemic stroke was the predominant subtype across all age groups, accounting for 100% of cases in the 18–30 years age group and 81.2% in patients aged >60 years. Hemorrhagic stroke was observed more frequently in the 46–60 years age group (28.2%) and less commonly among older patients. Male patients demonstrated a higher proportion of ischemic stroke, reflecting a greater burden of vascular risk factors, while hemorrhagic stroke distribution was relatively comparable between both sexes.

Table 2. Distribution of study participants according to Serum Uric acid level

Serum uric acid range(mg/dl)	Number of patients
1 to 3	3
3.1 to 5	31
5.1 to 7	54
7.1 to 9	41
>9	1

The majority of patients had serum uric acid levels between 5.1–7 mg/dL, accounting for 54 cases, followed by 41 patients with levels between 7.1–9 mg/dL. Thirty-one patients had serum uric acid levels ranging from 3.1–5 mg/dL, while only 3 patients had levels between 1–3 mg/dL. A markedly elevated serum uric acid level of >9 mg/dL was observed in only one patient. the mean SUA was 5.99 ± 1.96 mg/dL (range 1.0–10.2). Overall, most patients demonstrated serum uric acid values within the upper-normal to elevated range, indicating a higher prevalence of hyperuricemia among acute cerebrovascular accident patients.

Table 3. Distribution of study participants according to SUA and Diabetes status

Diabetes	Hypouricemia	Normal	Hyperuricemia	Total
Yes	1	35	23	59
No	2	48	21	71
Total	3	83	44	130

Among the 130 patients with acute cerebrovascular accident (CVA), diabetes mellitus was present in 59 patients, while 71 patients were non-diabetic. In the diabetic group, 23 patients had hyperuricemia, 35 had normal serum uric acid levels, and 1 patient had hypouricemia. The mean serum uric acid level among diabetic patients was 6.27 ± 2.04 mg/dL, with values ranging from 1.0 to 10.2 mg/dL. In comparison, among non-diabetic patients, 21 had hyperuricemia, 48 had normal uric acid levels, and 2 patients had hypouricemia. The mean serum uric acid level in non-diabetic patients was slightly lower at 5.77 ± 1.89 mg/dL, with a range of 1.2 to 9.9 mg/dL. Overall, diabetic patients demonstrated relatively higher mean serum uric acid levels and a greater proportion of hyperuricemia compared to non-diabetic patients.

Table 4. Distribution of study participants according to SUA and Hypertension

Hypertension	Hypo	Normal	Hyper	Total
Yes	2	49	34	85
No	1	34	10	45
Total	3	83	44	130

Among the 130 patients with acute cerebrovascular accident (CVA), hypertension was present in 85 patients, while 45 patients were non-hypertensive. In the hypertensive group, 34 patients had hyperuricemia, 49 had normal serum uric acid levels, and 2 patients had hypouricemia. The mean serum uric acid level among hypertensive patients was 6.15 ± 2.00 mg/dL, with values ranging from 1.0 to 10.2 mg/dL. In contrast, among non-hypertensive patients, 10 had hyperuricemia, 34 had normal uric acid levels, and 1 patient had hypouricemia. The mean serum uric acid level in non-hypertensive patients was lower at 5.60 ± 1.82 mg/dL, with a range of 1.2 to 9.7 mg/dL. Overall, hypertensive patients demonstrated relatively higher mean serum uric acid levels and a greater proportion of hyperuricemia compared to non-hypertensive patients.

Table 5. Distribution of study participants according to SUA and Smoking

Smoking status	Hypo	Normal	Hyper	Total
Ever / Current	1	45	29	75
Never	2	38	15	55
Total	3	83	44	130

Among the 130 patients with acute cerebrovascular accident (CVA), 75 patients were categorized as ever/current smokers, while 55 patients had never smoked. In the ever/current smoker group, 29 patients had hyperuricemia, 45 had normal serum

uric acid levels, and 1 patient had hypouricemia. The mean serum uric acid level among smokers was 6.20 ± 2.05 mg/dL, with values ranging from 1.0 to 10.2 mg/dL. In comparison, among non-smokers, 15 patients had hyperuricemia, 38 had normal uric acid levels, and 2 patients had hypouricemia. The mean serum uric acid level in non-smokers was lower at 5.70 ± 1.85 mg/dL, with a range of 1.2 to 9.7 mg/dL. Overall, ever/current smokers demonstrated relatively higher mean serum uric acid levels and a greater proportion of hyperuricemia compared to non-smokers.

DISCUSSION

The present study was conducted to evaluate the association between serum uric acid (SUA) levels and acute cerebrovascular accident (CVA) and to assess the influence of demographic and vascular risk factors on SUA distribution among stroke patients. A total of 130 radiologically confirmed acute CVA patients were included in the study. Ischemic stroke constituted the predominant subtype, accounting for 77.7% of cases, while hemorrhagic stroke comprised 22.3% of the study population. Hyperuricemia was observed in both stroke subtypes, with a slightly higher prevalence among ischemic stroke patients (34%) compared to hemorrhagic stroke patients (31%). Similar findings were reported by Devi et al. and Suman Kumar Kotwal et al., who also demonstrated higher SUA levels among ischemic stroke patients [7,8]. In contrast, studies conducted by Chouhan and Sisodia and Kori et al. reported a greater association of hyperuricemia with hemorrhagic stroke [9,10]. These variations may be attributed to differences in sample size, demographic profile, associated comorbidities, and regional vascular risk patterns.

Age distribution analysis revealed that the majority of stroke patients in the present study were older than 60 years (53.1%), indicating an increased burden of cerebrovascular disease with advancing age. Comparable findings were observed in the study by Suman Kumar Kotwal et al., where elderly patients represented the major proportion of acute stroke cases [8]. The mean SUA level observed in the present study was 5.99 mg/dL, which was relatively lower than that reported by Kori et al. and Devi et al., [7,10] but comparable to the findings of Shafeekh et al. and Suman Kumar Kotwal et al., [8,11]. Increasing age is known to contribute to endothelial dysfunction, oxidative stress, and metabolic derangements, which may explain the higher prevalence of stroke and elevated SUA levels among elderly individuals.

Gender-wise analysis demonstrated a male predominance in both ischemic and hemorrhagic stroke subtypes. Among males, ischemic stroke cases were more common compared to females, reflecting the higher prevalence of vascular risk factors such as smoking, hypertension, and diabetes mellitus among men. Similar male predominance has been reported in studies by Devi et al., Chouhan and Sisodia, and Kori et al., [7,9,10]. The higher SUA levels observed among male stroke patients may be related to lifestyle factors, hormonal influences, and greater exposure to modifiable cardiovascular risk factors.

The overall prevalence of hyperuricemia in the present study was 33.8%, which was lower than the prevalence reported by Kori et al. (77%) [10], Chouhan and Sisodia (84%) [9], Prasad et al. (50%) [12], and Shafeekh et al. (43.9%) [11]. Despite the comparatively lower prevalence, a substantial proportion of acute CVA patients demonstrated elevated SUA levels, supporting the potential role of uric acid as a marker of vascular and metabolic dysfunction. Elevated SUA levels have been associated with oxidative stress, endothelial injury, inflammation, platelet aggregation, and accelerated atherosclerosis, all of which contribute to cerebrovascular events.

Diabetes mellitus was associated with relatively higher mean SUA levels in the present study (6.27 ± 2.04 mg/dL). Similar findings were observed in studies by Prasad et al. and Kori et al., which also reported elevated SUA levels among diabetic stroke patients [10,12]. Insulin resistance and impaired renal uric acid excretion commonly seen in diabetes mellitus may contribute to hyperuricemia and increased vascular risk. Likewise, hypertensive patients in the present study demonstrated higher mean SUA levels (6.15 ± 2.00 mg/dL) compared to non-hypertensive individuals. Comparable observations were reported by Chouhan and Sisodia, Kori et al., Devi et al., and Suman Kumar Kotwal et al., [7-10]. Hypertension-induced vascular endothelial damage and reduced renal perfusion may play an important role in elevated uric acid levels among these patients.

Smoking was also found to be associated with increased SUA levels in the present study. Ever/current smokers demonstrated a higher prevalence of hyperuricemia and higher mean SUA levels (6.20 ± 2.05 mg/dL) compared to non-smokers. Similar observations were reported by Shafeekh et al., [11] that smoking contributes to oxidative stress, inflammation, and vascular injury, which may enhance uric acid production and worsen endothelial dysfunction, thereby increasing cerebrovascular risk.

Overall, the findings of the present study suggest that elevated serum uric acid levels are frequently observed among acute CVA patients, particularly in association with ischemic stroke, advancing age, male gender, hypertension, diabetes mellitus, and smoking. Although the exact causal relationship between hyperuricemia and stroke remains uncertain, SUA

may serve as a useful and inexpensive biomarker for identifying patients at increased cerebrovascular and cardiometabolic risk.

CONCLUSION

The present study showed that elevated serum uric acid levels are frequently associated with acute cerebrovascular accident (CVA), particularly ischemic stroke. Higher serum uric acid levels were commonly observed among elderly patients, males, and individuals with hypertension, diabetes mellitus, and smoking history. These findings suggest that serum uric acid may serve as a simple and cost-effective biomarker reflecting underlying vascular and metabolic risk in stroke patients. Further large-scale studies are required to clarify its prognostic and therapeutic significance in acute CVA.

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