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Original Research Article

Acute Kidney Injury in Patients with Stroke Presenting to a Tertiary Care Hospital, Hyderabad

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Abstract: *Acute kidney injury (AKI) in acute stroke is now widely recognized as a common and serious complication with major clinical implications. It contributes independently to worse functional outcomes and is a strong predictor of in-hospital, short-term, and long-term mortality, regardless of underlying comorbidities and stroke severity.* ***Objective:*** *To determine the frequency of acute kidney injury in patients presenting with acute stroke at a tertiary care hospital.* ***Methods:*** *This cross-sectional descriptive study was conducted for 3 months from 14-02-2025 to 13-05-2025, at the Nephrology ward of Liaquat University Hospital (LUH), Hyderabad. Patients aged 40–85 years presenting with acute stroke were enrolled, and those with chronic kidney disease, recurrent stroke, alcohol use, or intravenous drug abuse were excluded. Demographic data, including age, gender, smoking status, and residential status (rural or urban), were recorded. Stroke type was determined by reviewing computed tomography (CT) scans and classified as ischemic or hemorrhagic. Primary outcome, the occurrence of acute kidney injury (AKI), was also recorded.* ***Results:*** *A total of 95 participants were included, with a mean age of 57.97 ± 8.62 years. AKI was identified in 34.7% of stroke patients. Patients suffering from ischemic stroke demonstrated a markedly greater occurrence of acute kidney injury (45.9%) in contrast to those experiencing hemorrhagic stroke (14.7%) (p= 0.002). AKI also showed statistically significant associations with diabetes mellitus (p=0.046), smoking (p=0.001), and hypertension (p=0.002).* ***Conclusion:*** *AKI is a prevalent and serious concern among acute stroke patients, especially in those with ischemic stroke, diabetes mellitus, hypertension, and smoking history.*

Keywords: Acute Kidney Injury, Stroke, Ischemic, Hemorrhagic

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Introduction

Stroke, encompassing both ischemic and hemorrhagic types, continues to be a major contributor to global morbidity and mortality, imposing a substantial strain on healthcare resources. (1) Ischemic stroke accounts for approximately 85% of all cases. (2) Alongside well-recognized complications, emerging evidence identifies acute kidney injury (AKI) as a serious concern among stroke patients. (3) Beyond its immediate neurological impact, stroke is now recognized for a growing range of complications, among which acute kidney injury (AKI) has emerged as an important concern. AKI is defined as a sudden decline in kidney function, most often identified by a rapid rise in serum creatinine and/or a reduction in urine output. It can develop early during hospitalization for stroke, sometimes within the first few days, and may present in patients regardless of prior kidney disease. (4)

Reported incidence rates of AKI vary widely, depending on the criteria used, patient populations, and stroke severity. (5) Reported prevalence rates of AKI among stroke patients in Pakistan range from approximately 15% to 34%. (6-8) Factors such as severe stroke, hemorrhagic subtype, older age, preexisting hypertension, and diabetes have been consistently linked with an increased risk of developing AKI following a cerebrovascular event. (9-10)

AKI significantly worsens outcomes in stroke patients, making its early detection, prevention, and management essential components of modern stroke care. Understanding how often AKI occurs and its clinical associations in acute stroke allows clinicians to stratify risk better and apply timely kidney-protective measures in patients at greatest risk, ultimately improving prognosis and reducing mortality. Therefore, the objective of this study is to assess the frequency of acute kidney injury in patients presenting with acute stroke.

Methodology

This descriptive cross-sectional study was conducted after the approval of the Research Ethical Committee of LUMHS (notification no. LUMHS /REC/REC/-627 dated 13-02-2025) at the Nephrology ward of Liaquat University Hospital (LUH), Hyderabad, for 3 months from 14-02-2025 to 13-05-2025. The sample size of 95 patients presenting with acute stroke was calculated using the EPI sample size calculator, considering a prevalence of AKI in acute stroke of 19.2%, a 95% confidence level, and an absolute precision of 8%. Patients aged between 40 and 85 years of either gender presenting with acute stroke were included in the study. Those with chronic kidney disease, recurrent stroke, alcohol use, and intravenous drug abuse were excluded. Eligible patients presenting to the emergency or outpatient department were enrolled after informed written consent was obtained. Demographic data, including age, gender, smoking status, and residential status (rural or urban), were recorded. Stroke type was determined through review of computed tomography (CT) scans and classified as ischemic or hemorrhagic. AKI was diagnosed based on criteria including an increase in serum creatinine by at least 0.3 mg/dl within 48 hours and a reduction in urine output to less than 0.5 mL/kg/hour for more than 6 hours.

The gathered data were entered and processed using SPSS software version 25. Quantitative data are presented as mean ±standard deviation (SD), while qualitative data are expressed as frequencies and percentages. Following data stratification, relationships between variables were examined using the Chi-square test, and a p-value less than 0.05 was considered significant.

\Results

A total of 95 participants were included in the analysis. The mean age of the study population was 57.97 ± 8.62 years. The majority were male (71.6%), while females accounted for 28.4%.

Baseline Clinical Characteristics show that Hypertension was present in 61.1% of participants, while Diabetes mellitus (DM) was identified in 55.8%. Regarding stroke subtype, most patients had ischemic stroke. AKI occurred in 34.7% of participants. As shown in Table 1.

Table 1. Clinical Characteristics (n = 95)

Variable	Category	Frequency (%)
Hypertension	Yes	58 (61.1%)
	No	37 (38.9%)
Diabetes mellitus	Yes	53 (55.8%)
	No	42 (44.2%)
Smoking history	Smoker	26 (27.4%)
	Non-smoker	69 (72.6%)
Stroke subtype	Ischemic	61 (64.2%)
	Hemorrhagic	34 (35.8%)
Acute kidney injury	Present	33 (34.7%)
	Absent	62 (65.3%)

Bivariate analysis using the Chi-square test was performed to reveal associations between AKI and several clinical variables. Patients with ischemic stroke had a significantly higher incidence of AKI compared to those with hemorrhagic stroke (p=0.002), as shown in Table 2.

Table 2. Association of AKI with types of strokes (n = 95)

Stroke	AKI	
	Yes	No
Ischemic (61)	28(45.9%)	33(54.1%)
Hemorrhagic (34)	05(14.7%)	29(85.3%)
p=0.002		

Among diabetic patients, 23 out of 53 had AKI, while only 10 out of 42 non-diabetic patients had AKI (p=0.046)

Patients with hypertension showed a significantly higher incidence of AKI compared to those without hypertension (p=0.002), demonstrating a significant relationship between hypertension and AKI occurrence.

Smoking was significantly associated with AKI. Among smokers, 16 out of 26 patients had AKI compared to 17 out of 69 among non-smokers (p=0.001)

The frequency of AKI was higher among males (26/68) than females (7/27), but this association was not statistically significant (p=0.256).

Discussion

This study evaluated the frequency and associated risk factors of acute kidney injury (AKI) among stroke patients in a tertiary care setting. The findings demonstrate that AKI is a common complication post-stroke, affecting 34.7% of patients in this study. The results also reveal significant associations between AKI and clinical variables, including ischemic stroke subtype, diabetes mellitus, hypertension, and smoking status.

The observed incidence of acute kidney injury (AKI) among stroke patients in this study is consistent with both international and local research findings, underscoring AKI as a common and serious complication in this population with significant clinical implications. For instance, Yaqub S. et al. reported an AKI incidence of 34% in stroke patients, with a significant impact on short-term mortality, aligning closely with our results. (7) This high prevalence highlights AKI as a frequent condition that worsens prognosis after stroke. International meta-analyses and cohort studies further support this perspective. A comprehensive meta-analysis found that overall, AKI is very common after stroke. The development of AKI was strongly correlated with elevated mortality risk, poorer functional outcomes, and increased short- and long-term death rates. (11-12)

In this cohort, AKI was significantly more associated with ischemic stroke than with hemorrhagic stroke, consistent with prior reports. This pattern aligns with existing literature suggesting that ischemic strokes, through prolonged hypoperfusion and systemic inflammatory responses, increase the risk of renal impairment. (14-15) Conversely, while hemorrhagic stroke is also linked with AKI, data from Hayat teaching hospital, Pakistan, show a higher occurrence of AKI in severe hemorrhagic stroke cases, likely attributable to the added burden of acute hypertensive surges and the nephrotoxic effects of therapeutic interventions such as mannitol, diuretics, and antibiotics. (6) However, the current and prior regional findings suggest that, in terms of frequency and overall risk, ischemic stroke subtypes are more consistently linked with subsequent AKI, possibly due to their greater impact on systemic circulation and inflammatory milieu. (13)

A substantial association was identified between diabetes mellitus and the occurrence of AKI. Patients with diabetes were more likely to develop AKI than non-diabetics. This important relationship is supported by global evidence, which consistently lists diabetes as a primary risk factor for AKI in diverse populations. (16-17) The underlying mechanisms are linked to microvascular complications, chronic inflammation, and increased susceptibility to nephrotoxins among diabetic patients because chronic hyperglycemia and metabolic disturbances induce microvascular damage, endothelial dysfunction, and chronic inflammation. This creates a kidney environment that is fragile and less resilient to additional ischemic, toxic, or inflammatory insults, leading to a higher incidence and severity of AKI in diabetic populations. (18)

Hypertension emerges consistently as a major predisposing comorbid condition linked to AKI development post-stroke in this study. This corroborates global and local data showing hypertensive patients are at increased risk due to underlying chronic renal impairment and hemodynamic stress consequent to cerebrovascular events. (19-20) The mechanism likely involves chronic hypertension-induced structural

kidney damage that reduces renal reserve, rendering patients vulnerable to acute renal insults during stroke (21)

Smoking demonstrated a strong association with AKI in this study, consistent with multiple lines of international research that have established a robust link between smoking and the risk of AKI. Large cohort studies demonstrate that smokers exhibit a significantly higher likelihood of being hospitalized with AKI. Specifically, current smokers have more than double the risk, and even former smokers retain a slightly elevated risk for decades after cessation, highlighting the long-term renal effects of tobacco exposure. (22-23) Moreover, this risk increases in a dose-dependent manner with factors such as years of smoking, pack-years, and intensity. The mechanisms include smoking-induced endothelial dysfunction, oxidative stress, and direct nephrotoxicity. (24)

The finding that no statistically significant relationship exists between sex and acute kidney injury (AKI) incidence among stroke patients in this study aligns with multiple studies reporting similar AKI risks for both males and females. (25) Among stroke patients specifically, AKI incidence varies with stroke type and severity but not significantly with sex. In one cohort, AKI occurred in about 15.4% of stroke patients with no difference between males and females. Meta-analyses and pooled data show variability in AKI incidence related more to stroke subtype than to sex (26)

Limitations

This study has limitations; the use of data from a single center may limit the applicability of the findings to broader populations. Furthermore, important risk factors commonly reported in international research, such as sepsis and exposure to nephrotoxic medications, were not thoroughly examined in this analysis. Conducting future multicenter prospective studies would help to address these limitations and provide more comprehensive insights.

Conclusion

Acute kidney injury (AKI) represents a serious concern among stroke patients, especially those suffering from ischemic stroke, as well as individuals with diabetes, hypertension, and a history of smoking. Effective prevention and prompt management of these risk factors have the potential to enhance renal and neurological outcomes in this high-risk group significantly.

Declarations

Data Availability statement
All data generated or analysed during the study are included in the manuscript.
Ethics approval and consent to participate
Approved by the department concerned. (LUMHS /REC/REC/-627)
Consent for publication
Approved
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Conflict of interest

The authors declared the absence of a conflict of interest.

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All authors reviewed the results and approved the final version of the manuscript. They are also accountable for the integrity of the study.

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