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To Assess the Risk of Kidney Injury in Young Patients Presenting with Stroke in A Tertiary Care Centre

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Abstract

Introduction: Stroke is one of the leading causes of disability and mortality worldwide. While neurological outcomes are well studied, systemic complications such as acute kidney injury (AKI) are often overlooked, despite their significant impact on prognosis. AKI following stroke can prolong hospitalization, increase mortality, and predispose patients to chronic kidney disease (CKD). The burden is especially relevant in young adults, who are increasingly presenting with stroke and may face lifelong consequences. This study was designed to assess the risk of kidney injury in young stroke patients and to analyze its associations with clinical and biochemical risk factors.

Aims and Objectives: The primary objective was to assess the risk of AKI in young stroke patients. Secondary objectives were to evaluate associations between AKI and stroke subtype (ischemic vs. hemorrhagic), determine transient versus persistent renal dysfunction, and study correlations between AKI and comorbidities such as hypertension, diabetes, and albuminuria.

Materials and Methods: This cross-sectional analytical study was conducted at Ganesh Shankar Vidyarthi Memorial Medical College, Kanpur, over one year. Eighty patients aged 18–49 years with first-ever ischemic or hemorrhagic stroke within 72 hours of onset were included. Patients with pre-existing CKD or confounding conditions were excluded. Renal function was assessed using estimated glomerular filtration rate (eGFR) and urine albumin-to-creatinine ratio (ACR) at admission and on day seven. Statistical analysis was performed using SPSS v20, with $p<0.05$ considered significant.

Results: of the 80 patients, mean age was 36 years, with slight female predominance (52.5%). Hypertension was highly prevalent (88.75%), while diabetes was observed in 22.5%. AKI developed in 36 patients (45%): 26 (32.5%) transient and 10 (12.5%) persistent. Ischemic stroke (61.25% of cases) was strongly associated with AKI, accounting for 86.1% of all AKI cases ($p<0.001$). Hypertension showed a significant correlation with renal dysfunction, particularly in Stage II and hypertensive crisis categories, while diabetes did not. Albuminuria was a strong predictor: 75% of patients with

microalbuminuria and all with microalbuminuria developed AKI.

Conclusion: Young stroke patients are at a substantial risk of renal dysfunction, particularly those with ischemic stroke and hypertension. While most AKI cases were transient, a significant proportion had persistent dysfunction, raising the risk of CKD. Albuminuria proved to be a reliable early marker of renal injury. These findings underscore the need for routine renal monitoring, early detection strategies, and targeted management in young stroke patients to improve long-term outcomes.

Keywords: Stroke, Acute kidney injury, Ischemic stroke, Hypertension, Albuminuria, Young adults, Chronic kidney disease.

Introduction

Stroke is one of the leading causes of mortality and morbidity worldwide, second only to cardiovascular disease in terms of global health burden. Defined by the World Health Organization as a rapid onset of neurological dysfunction due to vascular causes, it remains a significant contributor to disability-adjusted life years (DALYs). While stroke is typically studied for its neurological consequences, recent attention has turned toward its systemic effects, particularly on renal function. Acute kidney injury (AKI) is a recognized complication in many critical illnesses, and evidence suggests that it occurs frequently in patients after a cerebrovascular accident. Importantly, AKI worsens outcomes, lengthens hospital stays, increases the risk of chronic kidney disease (CKD), and contributes to higher mortality.

The phenomenon of stroke-related kidney dysfunction can be explained by the brain–kidney axis, where complex interactions between hemodynamics, inflammatory responses, neurohormonal dysregulation, and oxidative stress converge to impair renal function. Hemodynamic instability reduces perfusion to the kidneys, while the systemic inflammatory cascade triggered by stroke releases cytokines that damage renal tissue. Neurohormonal changes, particularly overactivation of the renin-angiotensin-aldosterone system, exacerbate renal vasoconstriction, while oxidative stress further injures renal tubules. These mechanisms underline why AKI is such a common and serious problem in stroke patients.

Young patients with stroke deserve particular attention. Though stroke is more common in older populations, an increasing incidence has been observed among younger individuals aged 18 to 49 years. In developing countries, about 30% of all strokes occur in this age group, compared to 5–10% in Western populations. These individuals face a longer lifetime burden of disability, reduced productivity, and higher healthcare costs. Moreover, traditional risk factors like hypertension and diabetes do not always account for the occurrence of stroke in young adults, pointing toward other unexplored contributors such as endothelial dysfunction, oxidative stress, autoimmune factors, and novel vascular risks. Since these same processes play a role in kidney disease, studying renal involvement in young stroke patients is vital.

This dissertation was conducted at Ganesh Shankar Vidyarthi Memorial Medical College, Kanpur, to explore the risk of AKI in young stroke patients. It aimed not only to determine prevalence but also to analyze associations with stroke subtype, hypertension, diabetes, and albuminuria, thereby filling an important knowledge gap for the Indian population.

Aims and Objectives

The primary objective of this study was to assess the risk of kidney injury in young patients with stroke. The secondary objectives were to evaluate differences in renal

impairment between ischemic and hemorrhagic stroke, to distinguish between transient and persistent renal dysfunction, and to explore correlations between AKI and conventional comorbidities such as hypertension and diabetes. Additionally, the study sought to determine the role of microalbuminuria and macroalbuminuria as predictors of renal injury, thereby identifying potential biomarkers for early risk stratification.

Materials and Methods

This was a cross-sectional analytical study carried out over one year, from February 2024 to February 2025, in the Department of Medicine at Ganesh Shankar Vidyarthi Memorial Medical College, Kanpur.

Inclusion criteria

The study population included 80 consecutive young patients aged 18 to 49 years presenting with their first-ever ischemic or hemorrhagic stroke within 72 hours of symptom onset.

Exclusion criteria

Patients with pre-existing chronic kidney disease, urinary tract infection, sepsis, shock, recent endovascular procedures, or other confounding conditions were excluded to ensure that renal impairment observed could be attributed to stroke itself.

Sampling method

Sampling was random among eligible patients admitted to the inpatient department. Informed consent was obtained from all participants, and ethical approval was granted by the institutional ethics committee. The sample size of 80 was calculated based on the estimated prevalence of stroke in young adults in India, with a 95% confidence level and 5% margin of error.

Study method

Data were collected using structured patient interviews, medical records, biochemical assays, and imaging. Clinical parameters included age, sex, blood pressure, body mass index, and medical history. Laboratory investigations comprised complete blood count, kidney function tests, HbA1c, fasting and postprandial glucose, serum phosphate, intact parathyroid hormone, and urine albumin-to-creatinine ratio (uACR). Imaging included non-contrast CT or MRI brain to confirm stroke and ultrasonography of kidneys, ureters, and bladder to exclude chronic disease.

Renal function was assessed by estimated glomerular filtration rate (eGFR) calculated via the CKD-EPI formula. AKI was defined as eGFR <90 ml/min/1.73m² at admission. Patients were re-evaluated after seven days to classify renal outcomes. Those whose eGFR normalized were categorized as transient AKI, while those with persistently reduced function were labeled as persistent AKI. Statistical analysis was performed using SPSS version 20.0, with chi-square tests for categorical variables and one-way ANOVA for continuous variables. A p-value <0.05 was considered significant.

Results

The mean age of patients was 36 years, with a range from 20 to 45 years. Slight female predominance was observed (52.5% females vs. 47.5% males). Hypertension was highly prevalent, seen in nearly 89% of cases, with stage II hypertension being the most common category.

Table1: Distribution of cases according to presence of hypertension. (N = 80)

Hypertension	Number of cases
Absent	9 (11.25%)
Present	71 (88.75%)

Stage I HTN	12 (15%)
Stage II HTN	42 (52.5%)
Hypertensive crisis	17 (21.25%)

Type 2 diabetes mellitus was present in 22.5% of patients, with an additional 27.5% being prediabetic.

Table 2: Distribution of cases according to presence of Type 2 Diabetes mellitus (N = 80)

Type 2 Diabetes mellitus	Number of cases
Normal	40 (50%)
Pre-diabetic	22 (27.5%)
Diabetic	18 (22.5%)

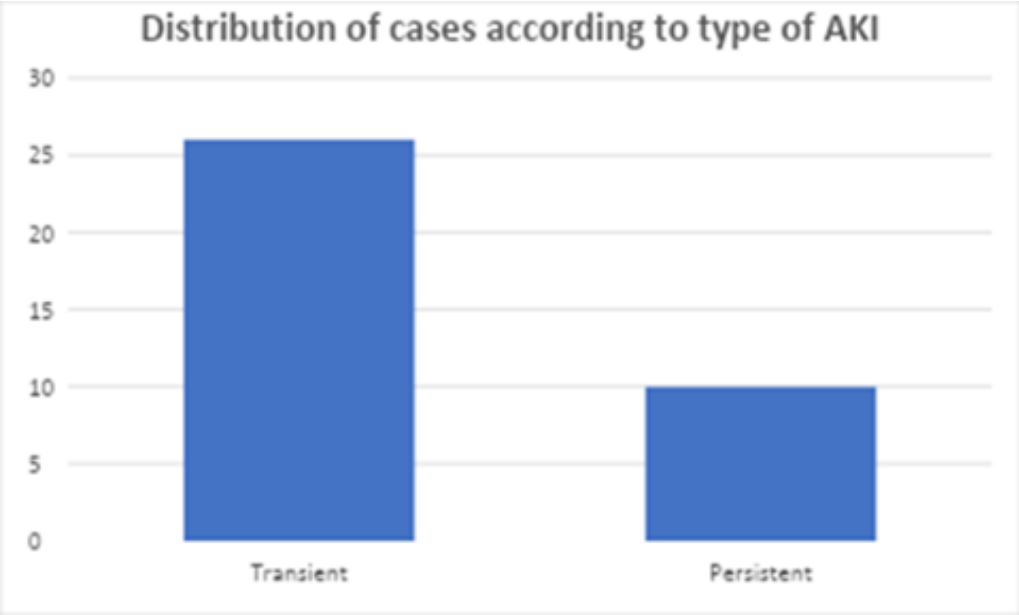
Out of 80 patients, 36 (45%) developed acute kidney injury. Of these, 26 (32.5%) had transient impairment, while 10 (12.5%) had persistent renal dysfunction beyond one week. This indicates that most renal injury following stroke is reversible, though a significant minority remain at risk for progression to CKD.

Table 3: Distribution of cases according to acute kidney injury (N = 80)

Acute kidney injury	Number of cases
Present	36 (45%)
Absent	44 (55%)

Table 4: Distribution of cases according to type of AKI (N = 80)

Type of AKI	Number of cases
Transient	26 (32.5%)
Persistent	10 (12.5%)

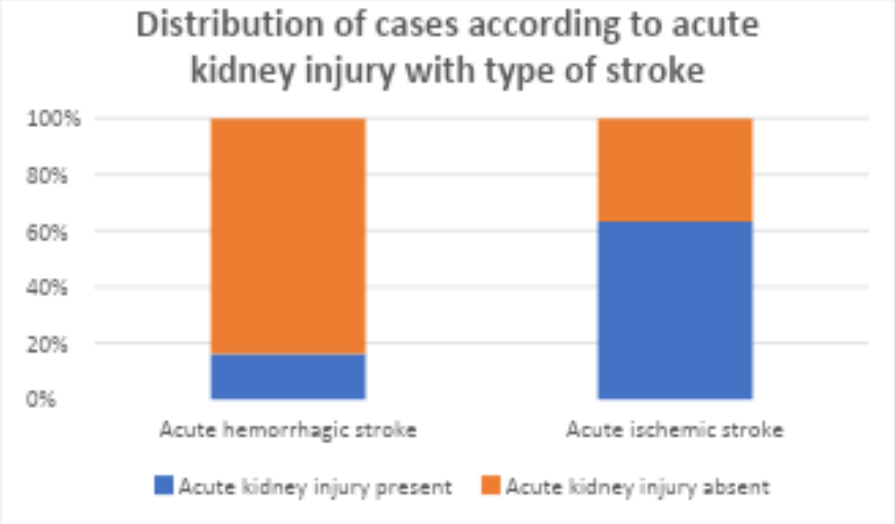


Graph 1: depicting distribution of cases according to type of AKI

Stroke subtype was significantly associated with renal outcomes. Ischemic stroke accounted for 61.25% of cases, while hemorrhagic stroke represented 38.75%. Among patients with AKI, 86.1% had ischemic stroke, whereas only 13.9% had hemorrhagic stroke, establishing ischemic events as a major risk factor for renal impairment.

Table 5: Association of acute kidney injury with type of stroke (N = 80)

Type of stroke	Acute kidney injury present	Acute kidney injury absent	p-value
Acute hemorrhagic stroke	5 (13.88%)	26 (59.09%)	<0.001
Acute ischemic stroke	31 (86.11%)	18 (40.9%)	



Graph 2: depicting distribution of cases according to type of AKI

Table 6: Distribution of cases according to urine albumin to creatinine ratio (N = 80)

Urine ACR	Number of cases
Normal	33 (41.25%)
Microalbuminuria	44 (55%)
Macroalbuminuria	3 (3.75%)

Albuminuria was another important finding. Microalbuminuria was detected in 55% of patients, macroalbuminuria in 3.75%, and normal ACR in 41.25%. AKI was present in 75% of microalbuminuria cases and in all patients with macroalbuminuria, highlighting uACR as a strong predictor of kidney dysfunction.

Discussion

This study demonstrates that AKI is a frequent complication in young stroke patients, affecting 45% of the cohort, which is markedly higher than prevalence reported in previous international studies. Earlier reports by Tsagalis et al. (2009) and Bai et al. (2020) documented AKI rates of 21% and 14% respectively in mixed-age stroke populations. The higher frequency observed here suggests that young patients may have unique risk profiles that predispose them to renal injury, possibly related to non-traditional mechanisms like oxidative stress, endothelial dysfunction, and inflammation.

A key outcome was the association of ischemic stroke with AKI. More than four-fifths of renal injury cases occurred in ischemic stroke patients, consistent with

global literature. Mechanistically, ischemia–reperfusion injury, microvascular dysfunction, thromboembolic events, and systemic inflammatory responses all play a role. Hemorrhagic stroke, while serious, did not show such strong correlation with renal dysfunction in this cohort.

Another crucial finding was the predominance of transient AKI. In most patients, renal function recovered within a week, suggesting that acute hemodynamic and inflammatory disturbances were reversible. However, persistent AKI in 12.5% of patients highlights the need for long-term monitoring, since this group remains at risk for developing CKD. These observations align with Hojs Fabjan et al. (2014), who showed that a subset of stroke patients experience lasting renal decline.

Hypertension was the most significant modifiable risk factor linked with AKI. Severe hypertension likely exacerbates glomerular damage, accelerates vascular injury, and reduces renal autoregulatory capacity. The correlation between advanced stages of hypertension and renal injury emphasizes the need for rigorous blood pressure control in stroke management.

In contrast, diabetes mellitus did not show a meaningful association with AKI in this cohort. Only 22.5% of patients were diabetic, and AKI rates were similar in diabetics and non-diabetics. This suggests that in young stroke patients, diabetes may not play as prominent a role in acute renal impairment as hypertension does.

Albuminuria emerged as a powerful biomarker, with microalbuminuria strongly associated with AKI. Since albuminuria reflects glomerular injury and endothelial dysfunction, its presence in stroke patients suggests that glomerular mechanisms are central to renal damage. Studies such as Watanabe et al. (2016) support the idea that albuminuria in ischemic stroke patients predicts poor outcomes and kidney dysfunction, reinforcing the role of uACR as a simple, non-invasive risk marker.

The clinical implications are significant. Early recognition of renal impairment in stroke patients could guide nephroprotective strategies, prevent fluid and electrolyte imbalances, and improve outcomes. Since persistent AKI may progress to CKD, regular follow-up of renal function is warranted. Integrating nephrology into stroke care pathways could mitigate long-term complications.

Conclusion

This dissertation highlights that young stroke patients are at a substantial risk of developing acute kidney injury, with nearly half of the studied cohort experiencing renal dysfunction. Ischemic stroke, severe hypertension, and albuminuria were major contributors, whereas diabetes did not show significant impact. Importantly, most cases of AKI were transient, but persistent renal impairment in some patients indicates risk for chronic kidney disease and warrants ongoing follow-up.

The findings emphasize the need for routine renal assessment in young stroke patients. Incorporating eGFR and urine ACR measurements into stroke management protocols could enable early detection of renal involvement. Blood pressure control should be prioritized as a preventive measure, while nephrology consultation may be beneficial for high-risk patients.

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