Section: General Medicine

Original Research Article

# THE INCIDENCE OF ACUTE KIDNEY INJURY IN CEREBROVASCULAR ACCIDENT AND WHETHER RENAL FUNCTION TESTS PREDICT OUTCOMES IN ISCHEMIC AND HEMORRHAGIC STROKE IN GOVERNMENT VELLORE MEDICAL COLLEGE HOSPITAL

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## Abstract

**Background:** AKI is a sudden decline in kidney function, linked to higher in-hospital mortality, especially in stroke patients with compromised renal health. This study aimed to evaluate renal function and its impact of renal function on the outcomes of ischemic and haemorrhagic stroke. **Materials and Methods:** This observational study was conducted on 100 stroke patients at the Government Vellore Medical College and Hospital over 1 year. Each participant was asked pre-specified questions according to the proforma. Blood samples were collected for laboratory investigations. Clinical presentation and brain computed tomography (CT) confirmed the presence of ischemic and haemorrhagic strokes. Renal function tests were performed on day 0 and after 48 hours. **Result:** Of the 100 patients, 46% were male and 54% were female, with 37% having diabetes mellitus and 54% having systemic hypertension. The majority (67%) experienced ischemic strokes, and 33% had haemorrhagic strokes. The mean age was 61.01±11.18 years, and the mean eGFR was 58.45±24.23. Creatinine and urea levels increased significantly after 48 h ($p<0.0001$). Ischemic stroke patients had significantly lower eGFR and higher urea and creatinine levels at admission and after 48 hours than haemorrhagic stroke patients ($p<0.0001$). There was no significant difference in gender or SHTN between stroke types ($p=0.437$ and $p=0.726$, respectively), but a significant difference was observed in the level of consciousness and diabetes mellitus ($p=0.026$ and $p<0.0001$, respectively). **Conclusion:** The ischemic group showed lower eGFR, higher rates of diabetes, and more significant increases in urea and creatinine levels than the haemorrhagic group. There were no age or sex predilections for acute kidney injury, although age may influence outcomes.

## INTRODUCTION

Acute kidney injury (AKI) is defined as an abrupt deterioration in kidney function, manifested by an increase in serum creatinine level, a decrease in urine output, or both. The development of AKI portends a higher risk of in-hospital death, which has been demonstrated in general medical and surgical hospitalisations as well as in specific settings, such as following acute myocardial infarction and cardiac surgery, and in the intensive care unit.[1] In studies involving septic patients, the development of AKI is associated with a two to three-fold higher risk of in-hospital mortality.[2] Stroke is the second most common cause of death and the leading cause of neurological disability worldwide, with huge economic costs and tragic human consequences. The epidemiology of acute renal dysfunction after stroke is routinely overlooked after stroke events. However, data on the frequency and prognosis of AKI in patients with stroke are lacking.

The coexistence of adverse conditions such as anaemia, oxidative stress, platelet dysfunction, and electrolyte imbalance has been implicated in the poor

prognosis of these patients when compared to normal patients. Patients with stroke may initially undergo contrast CT, which may also lead to contrast nephropathy. It has been a recent concern that by adequate hydration and avoiding nephrotoxic drugs, as most of the patients in the elderly age group whose renal system is already compromised collecting data about the incidence and prevalence of acute kidney injury, we can create awareness of poor outcomes and prognosis in stroke patients with acute kidney injury compared with patients with normal renal function.

Our goal was to determine the frequency of AKI in patients hospitalised for ischemic stroke or ICH. Stroke is the leading cause of neurological disability worldwide with a huge social and economic impact.[3] Chronic kidney disease (CKD) is associated with an increased risk of stroke.[4] Some of this relates to shared traditional risk factors, such as hypertension, hypercholesterolemia, diabetes mellitus, and cigarette smoking.[5] However, CKD itself has also been recognized as a risk factor for stroke.[6] In a recent systematic review and meta-analysis comprising 83 studies and 30,392 strokes, Masson et al. demonstrated that stroke risk increased by 7% for every 10 ml/min/1.73 m2 decline in glomerular filtration rate (GFR).[7]

AKI is a clinical syndrome defined as an abrupt decrease in kidney function, resulting in the disturbance of fluid, electrolyte, and acid-base homeostasis. AKI ranges from mild, asymptomatic injury to severe injury requiring renal replacement therapy (RRT). Over the last decade, with the development and wide adoption of international classification systems,[8] there has been an increasing amount of research into the incidence of AKI and its influence on adverse outcomes in both high and low-income countries.[9]

**Aim:** This study aimed to evaluate renal function and its impact on ischemic and haemorrhagic stroke outcomes.

## MATERIALS AND METHODS

This observational study included 100 patients with haemorrhagic and ischemic stroke at the Government Vellore Medical College and Hospital between September 2018 and August 2019. This study was approved by the Institutional Ethics Committee before initiation, and informed consent was obtained from all patients.

**Inclusion Criteria**

Patients of both genders, with ischemic and haemorrhagic stroke admitted for a minimum of five days during the study period were included.

**Exclusion Criteria**

Patients with subarachnoid haemorrhage, transient ischemic attack, loss of consciousness, brain tumour, or head trauma who denied consent were excluded.

**Methods:** Each participant was asked pre-specified questions according to the proforma. Blood samples were collected for laboratory investigations. The presence of ischemic and haemorrhagic stroke was confirmed by clinical presentation and computed tomography brain. Renal function tests were performed on day 0 and after 48 hours. Investigations done were complete blood count, electrocardiogram, routine urine examination, spot albumin-creatinine ratio, liver function test, blood sugar, total cholesterol, renal function test, and computed tomography (CT).

**Statistical Analysis:** Data were presented as mean, standard deviation, frequency and percentage. Continuous variables were compared using an independent-sample t-test. Categorical variables were compared using Pearson's chi-square test. Significance was defined as P values less than 0.05 using a two-tailed test. Data analysis was performed using IBM-SPSS version 21.0 (IBM-SPSS Science Inc., Chicago, IL).

## RESULTS

Of the 100 patients, 46% were male and 54% were female. 37% of patients had diabetes mellitus and 54% had systemic hypertension. The majority of patients (67%) experienced an ischemic stroke, while 33% had a haemorrhagic stroke. Most patients had impaired consciousness, with 43% being stuporous, 37% being drowsy, 8% comatose (8%), and 12% remained conscious. [Table 1]

The mean age of the participants is 61.01 ±11.18 years and the mean eGFR is 58.45 ± 24.23 mL/min/1.73m². The mean creatinine level at admission was 1.27 ± 0.36, and after 48 h, it significantly increased to 1.86 ± 0.86, with a p-value of <0.0001. Similarly, the mean urea level at admission was 44.64 ± 5.58, which significantly increased to 58.90 ± 17.58 after 48 h with a p-value of <0.0001. [Table 2]

The average age of patients with haemorrhagic stroke (52.21 ± 9.07) was lower than patients with ischemic stroke (65.34 ± 9.47), with no significant difference (p=0.571). The eGFR was significantly lower in patients with ischemic stroke (47.84 ± 16.38) than in those with haemorrhagic stroke (79.98 ± 23.43) (p<0.0001).

Urea levels at admission were significantly higher in ischemic stroke patients (46.66 ± 4.72) than in haemorrhagic stroke (40.55 ± 4.96); (p<0.0001). Similarly, urea levels after 48 hours showed a significant increase in ischemic stroke patients (64.24 ± 17.06) compared to those with haemorrhagic strokes (48.06 ± 13.21), (p< 0.0001).

Creatinine levels at admission were also significantly higher in ischemic stroke patients (1.28 ± 0.63) than in haemorrhagic stroke (1.01 ± 0.33), with a p-value of < 0.0001. After 48 hours, creatinine levels were significantly elevated in ischemic stroke patients (2.14 ± 0.82) compared with haemorrhagic strokes (1.28 ± 0.63), with a p-value of < 0.0001. [Table 3]

There was no significant difference in gender and SHTN between the stroke types (p=0.437, p=0.726). There was a significant difference in the level of consciousness and diabetes mellitus between stroke


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types (p=0.026 and p<0.0001, respectively). [Table 4]

**Table 1: Gender and clinical characteristics.**

| | | Frequency (%) |
|---|---|---|
| Gender | Male | 46 (46%) |
| | Female | 54 (54%) |
| Diabetes mellitus | Yes | 37 (37%) |
| | No | 63 (63%) |
| Systemic hypertension | Yes | 54 (54%) |
| | No | 46 (46%) |
| Type of stroke | Haemorrhagic | 33 (33%) |
| | Ischaemic | 67 (67%) |
| Level of consciousness | Comatose | 8 (8%) |
| | Conscious | 12 (12%) |
| | Drowsy | 37 (37%) |
| | Stuporous | 43 (43%) |

**Table 2: Age and renal function parameters**

| | | Mean ± SD | 95% C. I | | P-value |
|---|---|---|---|---|---|
| | | | Lower | Upper | |
| Age | | 61.01 ±11.18 | 58.79 | 63.23 | - |
| eGFR | | 58.45 ± 24.23 | 53.64 | 63.25 | - |
| Creatinine | At admission | 1.27 ± 0.36 | 1.2 | 1.34 | <0.0001 |
| | After 48 hours | 1.86 ± 0.86 | 1.69 | 2.03 | |
| Urea | At admission | 44.64 ± 5.58 | 43.53 | 45.75 | <0.0001 |
| | After 48 hours | 58.9 ± 17.58 | 55.41 | 62.39 | |

**Table 3: Comparison of age and renal parameters with type of stroke**

| | | Type of stroke | | P-value |
|---|---|---|---|---|
| | | Haemorrhagic | Ischemic | |
| Age | | 52.21 ± 9.07 | 65.34 ± 9.47 | 0.571 |
| eGFR | | 79.98 ± 23.43 | 47.84 ± 16.38 | <0.0001 |
| Urea | At admission | 40.55 ± 4.96 | 46.66 ± 4.72 | <0.0001 |
| | After 48 hours | 48.06 ± 13.21 | 64.24 ± 17.06 | <0.0001 |
| Creatinine | At admission | 1.01 ± 0.33 | 1.28 ± 0.63 | <0.0001 |
| | After 48 hours | 1.28 ± 0.63 | 2.14 ± 0.82 | <0.0001 |

**Table 4: Comparison of gender and clinical characteristics with type of stroke**

| | | Type of stroke | | P-value |
|---|---|---|---|---|
| | | Haemorrhagic | Ischemic | |
| Gender | Female | 16 (48.7%) | 38 (56.7%) | 0.437 |
| | Male | 17 (51.5%) | 29 (43.3%) | |
| Level of consciousness | Comatose | 4 (12.1%) | 4 (6%) | 0.026 |
| | Conscious | 8 (24.2%) | 4 (6%) | |
| | Drowsy | 11 (33.3%) | 26 (38.8%) | |
| | Stuporous | 10 (30.3%) | 33 (49.8%) | |
| SHTN | Yes | 16 (48.5%) | 30 (44.8%) | 0.726 |
| | No | 17 (51.5%) | 37 (55.2%) | |
| Diabetes mellitus | Yes | 10 (30.3%) | 53 (79.1%) | <0.0001 |
| | No | 23 (69.7%) | 14 (20.9%) | |

## DISCUSSION

The mean age of our study was 61.01 ± 11.18 as stroke is going to be a disease mainly in the elderly age group. The study conducted by Covic et al. reported a mean age of 66.1 ± 11.5 years.[10] In the study by Khatri et al., the mean age was 64 ± 16 years.[11] Lin et al. found a mean age of 66.1 ± 13.59 years.[12] Mohamed et al. reported a mean age of 64.4 ± 14.7 years.[13] In Saeed et al.'s study, the mean age was 71 ± 31 years.[14] Finally, Tsagalis et al. reported a mean age of 70.3 ± 11.9 years.[15]

In our study, the male patients were 46 and female patients were 54. It included 16 (48.7%) female patients, whereas in males, it was 17 (51.5%) among the 33 haemorrhagic variants. Of the 67 ischemic variants, 38 were female (56.7%), whereas 29 were male (43.3%), and there was no significant difference between males and females for both variants. In our study population, 63 patients were diabetic and 37 were non-diabetic. 46 were hypertensive, and 54 were non-hypertensive. Among the 67 patients, 53 (79.1%) had diabetes mellitus of the ischemic variant. For the haemorrhagic variant, 10 (30.3%) of the 33 patients showed a significant difference between the two variants (p < 0.001). Hypertension was observed in 16 (51.5%) of the 33 patients, whereas in ischemic patients, hypertension was observed in 30 (55.2%) of the 67 patients, which was not significant. Comparing the level of consciousness, comatose patients are 4 (12.1%) of the 33 haemorrhagic variants and 4 (6%) of the 67 ischemic variants. Conscious patients were


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also statistically significant among the haemorrhagic variants, which was 8 (24.2%), whereas in ischemic patients, it was 4 (6%). Therefore, both conscious and comatose patients were on the haemorrhagic side based on the number of lesions. In drowsy patients, 11 (33.3%) of 33 were haemorrhagic variants, whereas in ischemia, 26 (38.8%) were haemorrhagic variants. Of 33 with haemorrhage, stuporous patients were 10 (30.3%), whereas among 67 patients in ischemia, stuporous patients were 33 (49.5%). Mannitol is used in most haemorrhagic patients and comatose patients in ischemic stroke, but the relationship of the use of mannitol as an individual aetiology factor for AKI was not studied.

The mean urea level at admission was 44.64 ± 5.58 and after 48 hours 58.90 ± 17.58. ($p<0.001$), which was significant. Comparison of the mean urea at admission in the haemorrhagic variant was 40.55 ± 4.96, whereas in Ischemia, 46.66 ± 4.72, which shows a significant difference ($p<0.001$), which could also be attributed to the presence of diabetes mellitus among ischemia in our study group. The mean urea level after 48 hours was 48.06 ± 13.21 in the haemorrhagic variant, whereas in ischemia it was 64.24 ± 17.06, which was significant ($p<0.001$).

The mean creatinine at admission was 1.01 ± 0.33 in the haemorrhagic variant, whereas in ischemia 1.28 ± 0.63 ($p<0.001$). The mean creatinine after 48 hours was 1.28 ± 0.63 in the haemorrhagic variant whereas in ischemic 2.14 ± 0.82 with $p<0.001$. The mean creatinine at admission was 1.27 ± 0.36, after 48 hours 1.86 ± 0.86 with the rise showing more than 0.3 mg/dl showing a significant increase in creatinine ($p <0.001$). The creatinine value increase of more than 0.3 mg/dl within 48 hours, could be due to the presence of co-existing comorbidities such as diabetes mellitus, cardiac failure, and increased age at the time of presentation, and more severe presentation is seen in ischemic variants. However, the use of mannitol and its association with AKI have not yet been established. The mean eGFR is 79.98 ± 23.43 in the haemorrhagic variant and Ischemic 47.84 ± 16.38, with a significant value ($p <0.001$).

**Limitations**

This study had no age limitations, which affected the renal function as age progressed. The presence of diabetes mellitus and hypertension, which can alter the course of the progression of acute kidney, was not considered within the variant. A history of renal disease was considered; however, during the time of admission, USG was not performed to confirm the presence of small kidneys as a chronic disease process because such patients are more prone to renal function deterioration than those with normal function.

## CONCLUSION

When comparing both groups, the eGFR was lower in the ischemic group than in the haemorrhagic group. The presence of diabetes mellitus was higher in the ischemic variant than in the haemorrhagic variant. The variations in urea and creatinine levels after 48 h were significantly elevated in the ischemic variant group in both groups. There was no age-specific distribution between the two groups; however, as there was no age limitation, they could play a role in deciding the outcome. There was no specific sex predilection for AKI occurrence.

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