VOLUME - 14, ISSUE - 03, MARCH - 2025 • PRINT ISSN No. 2277 - 8160 • DOI : 10.36106/gjra

Original Research Paper

Medicine

RENAL PARAMETERS AND CLINICAL OUTCOMES IN CEREBROVASCULAR ACCIDENT PATIENTS: AN OBSERVATIONAL STUDY

Dr. Prayag Gupta

Dr. Jaishree Ghanekar

Dr. Kalluri Sai Manogna

ABSTRACT

Introduction: This study investigates the relationship between renal function and cerebrovascular accident outcomes, emphasizing that renal dysfunction, particularly in ischemic strokes and chronic kidney disease in hemorrhagic strokes, significantly affects stroke severity and prognosis, underscoring the need for routine renal evaluation in stroke management. **Methods:** This study conducted at a tertiary care institute in Navi Mumbai, analysed the correlation between renal parameters and outcomes of cerebrovascular accidents in 120 patients, focusing on the relationship between admission eGFR and CVA's clinical profile, severity, and outcomes, including adult patients with ischemic or hemorrhagic stroke while excluding those with specific contraindications. **Results:** In this study of 120 CVA patients, ischemic strokes (72.5%) were more prevalent than hemorrhagic ones (27.5%), with higher NIHSS scores and lower eGFR indicating worse outcomes and higher mortality, especially in hemorrhagic cases. Renal impairment was usually transient, but renal replacement therapy necessity indicated poorer outcomes, underscoring the importance of renal function monitoring. **Conclusion:** The study concludes that the renal function, particularly eGFR and serum creatinine levels, plays a crucial role in determining the severity and prognosis of cerebrovascular accidents, with lower eGFR linked to worse outcomes and higher mortality.

KEYWORDS : CVA, eGFR, NIHSS, Renal Dysfunction, Stroke Outcomes

INTRODUCTION:

Renal dysfunction is common among hospitalized stroke patients. Ischemic stroke frequently associates with renal dysfunction, while nearly a third of intracerebral hemorrhage (ICH) patients have chronic kidney disease (CKD) with an estimated glomerular filtration rate (e- GFR) below 60ml/minute per 1.73m ^ 2.[1,2] The severity of impairment and the need for renal replacement therapy during treatment are unaddressed concerns in the literature. Good overall medical care significantly affects stroke outcomes, considering the high morbidity and mortality of cerebrovascular accidents. CKD independently predicts poor clinical outcomes and post-stroke mortality.[3,4] Several factors, including anemia, oxidative stress, platelet dysfunction, electrolyte imbalance, and hyperhomocysteinemia, contribute to poorer outcomes in CKD patients. Even mild CKD stages increase the risk of future ischemic andhemorrhagic strokes. A decreased e-GFR below 40mL/min increases the risk of symptomatic stroke by 3.1 times in the general population. Thus, routine renal function evaluation in hospitalized cerebrovascular accident patients is crucial for better outcomes.[5–7]

CKD patients often have multiple vascular risk factors, such as hypertension, diabetes mellitus, dyslipidemia, and proteinuria. CKD-specific factors like accelerated atherosclerosis, vascular calcification, uremic toxins, prothrombotic tendency, and impaired cerebral auto-regulation also contribute to the association between renal dysfunction and stroke. Intracranial arterial calcification, which increases stroke risk, is more prevalent in CKD patients.[8,9] Some studies have reported a graded and independent relationship between eGFR and stroke risk, with a 43% increased risk for eGFR <60 ml/min. Ethnicity further modulates this risk, with Asians having a higher stroke risk than non-Asians. Proteinuria is a significant stroke risk factor, even without reduced GFR, after adjusting for other vascular risk factors.[7]

Due to limited knowledge on renal function trends in hospitalized stroke patients and a lack of clear guidelines on renal replacement therapy in such cases, our study explores renal function trends in all stroke patients hospitalized at our center.

MATERIAL AND METHODS:

The aim of this study was to study the correlation between renal parameters and outcome of Cerebrovascular accident. The objectives were:

1. To study the relation between eGFR at the time of admission (using serum creatinine) with clinical profile of CVA.
2. To study the correlation between eGFR and severity of CVA using NIHSS Score. 3.
3. To study the correlation between eGFR and outcome of CVA using modified Rankin scale.

Inclusion And Exclusion Criteria:

Inclusion Criteria: Patients diagnosed with either ischemic or hemorrhagic stroke resulting in a measurable neurological deficit, individuals of both gender aged 18 years and above.

Exclusion Criteria: Patients with any recent or significant past history of traumatic head injury, evidence of metastatic cancer, diagnosed with primary intracranial space-occupying lesion, and known diagnosis of chronic kidney disease will be excluded from the study.

A prospective observational study was conducted at the Department of General Medicine, MGM Medical College, located in Navi Mumbai, Maharashtra, India, during the period March 2021 to December 2022. Before starting the study, an approval was taken from the Institutional Ethics Committee. Written, signed informed consent was obtained from all participants before their enrolment. The patients were recruited in the study using a convenient sampling method.

Sample Size:

Sample size was calculated using the formula $n=Z^2\times p\times(1-p)/\ E^2$. Where p=8%, q=92%, Z=1.96 (at 5% level of significance). The required sample size was 113, which is rounded to 120. Hence a total of 120 patients were recruited in the study using non- probability sampling technique. The data will be collected with the help of

structured case sheet form and entered into MS-Excel worksheet and further analysis will be carried out using IBM SPSS Statistics 26.0 software.

In this study, patients admitted with acute stroke, both ischemic and hemorrhagic types, were closely monitored. Their serum creatinine levels were systematically measured at specific time intervals: upon admission, after 72 hours, on the 7th day, and at the time of discharge or in the event of death. These assessments were conducted at the Central Laboratory to ensure accuracy and consistency. The estimated Glomerular Filtration Rate (eGFR) was calculated from these serum creatinine values using the updated Chronic Kidney Disease Epidemiology Collaboration (CKD-EPI) equation. For a nuanced analysis, patients were stratified into different categories based on their eGFR readings ≥ 90, 60-89, 30-59, and <30 following the 2012 guidelines set by KIDGO. To evaluate the outcomes of the stroke, the modified Rankin scale was employed, and the in-hospital severity of the stroke was quantified using the NIHSS (National Institutes of Health Stroke Scale) score.

RESULTS:

The study population had a mean age of 57.93 (±13.64) years, with females comprising 72.5% and the 41-55 age group was most common (38.3%). Ischemic stroke was the predominant type, occurring in 72.5% of the patients (Table 1).

Table 1. Distribution Of Patients According To Demographic Information

Parameter		Frequency	Percentage
Age (years)	25-40	13	10.8%
	41-55	46	38.3%
	56-70	40	33.3%
	>70	21	17.5%
Min = 25 yrs, Max = 90 yrs, Mean±SD = 57.93±13.64 yrs			
Gender	Male	33	27.5%
	Female	87	72.5%
Type of Stroke	Ischemic	87	72.5%
	Hemorrhagic	33	27.5%

The age group 41-55 years had the highest incidence of both ischemic (30.0%) and hemorrhagic (8.3%) strokes. The overall distribution of stroke types was consistent across the age groups. (table 2)

Table 2. Age-wise Distribution Of Patients According To Type Of Stroke

Age (yrs)	Ischemic	Hemorrhagic	Total
25-40	10 (8.3%)	3 (2.5%)	13 (10.8%)
41-55	36 (30.0%)	10 (8.3%)	46 (38.3%)
56-70	30 (25.0%)	10 (8.3%)	40 (33.3%)
>70	11 (9.2%)	10 (8.3%)	21 (17.5%)
Total	**87 (72.5%)**	**33 (27.5%)**	**120 (100%)**

Hypertension was the most common co-morbidity among patients (40.8%), followed by diabetes (30.8%) and a smaller percentage with conditions like hypothyroidism, ischemic heart disease (IHD), cervical cancer, and polycythemia. According to addictions, smoking was the most prevalent (35.0%), followed by alcohol (25.0%) and tobacco use (23.3%). Notably, 35.8% of patients had no co-morbidities.

Table 3. Distribution According To Co-morbidities And Addictions

Parameter	Co-morbidities	Frequency	Percent
Co-morbidities	None	43	35.8%
	Hypertension	49	40.8%
	Diabetes	37	30.8%
	Hypothyroid	5	4.2%
	IHD	2	1.7%
	CA Cervix	1	0.8%
	Ploycythemia	1	0.8%
Addictions	Smoking	42	35.0%
	Alcohol	30	25.0%
	Tobacco	28	23.3%

Most patients had lesions on the left side of the brain (61.60%), while 35.80% had right-sided lesions and a small proportion (2.50%) had bilateral lesions. Only 6.67% patients were thrombolysed (table 4)

Table 4. Distribution according to Lesion side and Thrombolysation

Lesion Side	Left	74	61.60%
	Right	43	35.80%
	Bilateral	3	2.50%
Thrombolysed	Yes	8	35.80%
	No	79	2.50%

Hemoglobin (Hb) levels varied from 7.6 to 21.2 with a mean of 13.24 (±2.22). The Total Leukocyte Count (TLC) ranged between 10610 and 21430, averaging at 14788.6 (±1786) Platelet counts was observed between 0.74 and 5.5, with an average of 2.48 (±0.81). Sodium levels varied from 124 to 145, with a mean value of 134.38 (±4.03). Potassium levels varied from 3 to 5.3, with a mean of 3.99 (±0.52).

Table 5. Descriptive Statistics For Lab Parameters

	N	Min	Max	Mean	S. D
Hb	120	7.6	21.2	13.24	2.22
TLC	120	10610	21430	14788.6	1786
Platelet count	120	0.74	5.5	2.48	0.81
Sodium	120	124	145	134.38	4.03
Potassium	120	3	5.3	3.99	0.52

Table 6 indicates comparison of NIHSS based on the estimated Glomerular Filtration Rate (eGFR) at admission among different patient groups:

For patients with eGFR < 30 (n=1), the NIHSS score was consistently 18. In the eGFR 30 to 59 range, the NIHSS scores varied from 5 to 17, with an average of 16.8 (±3.33). Patients with eGFR 60 to 89 had NIHSS scores ranging from 4 to 35, with a mean of 12.58 (±6.93). For those with eGFR ≥ 90 (n=64), the scores ranged from 3 to 24, averaging at 9.3 (±4.12). The p-value of 0.014* indicates a statistically significant difference in the NIHSS scores across different eGFR categories

Table 6. Comparison Of The NIHSS Based On eGFR

eGFR at admission	N	Min	Max	Mean	S. D	p value
< 30	1	18	18	18		0.014*
30 to 59	17	5	17	16.8	3.33	
60 to 89	38	4	35	12.58	6.93	
≥ 90	64	3	24	9.3	4.12	

Table 7 presents a comparison of mean serum creatinine levels at various stages, based on different ranges of the NIHSS scores. The creatinine levels were significantly different across NIHSS score at the time of admission, on day 3, and on day 7 (p<.05). No significant difference was observed in the creatinine levels on discharge or death (p>0.05)

Table 7. Comparison Of Mean Creatinine According To HIHSS

Creatinine	NIHSS				p-value
	0-4	5-15	16-20	21-42	
on admission	0.77	0.88	0.92	0.93	0.045*
on day 3	0.65	0.93	0.99	1.01	0.049*
on day 7	--	0.93	1.18	1.03	0.023*
on discharge	--	0.88	1.43	1	0.08, NS
on death	--	1.17	2.2	1.17	0.12, NS

Table 8 reveals that among ischemic stroke patients, those with higher eGFR (≥90) consistently had larger proportions across all NIHSS score ranges at admission, day 3, day 7, and

on discharge. In contrast, patients with hemorrhagic stroke and higher eGFR (≥90) also showed a significant presence in various NIHSS score ranges, particularly notable on day 7 and at discharge. Lower eGFR groups (<30 and 30-59) had fewer patients across all NIHSS categories, indicating a potential link between renal function and stroke severity.

Table 8. Association Between eFGR And NIHSS At Various Durations

	eGFR at admission		NIHSS				Total
			0-4	5-15	16-20	21-42	
At Admission	Ischemic	<30	0	0	0	0	0
		30-59	0	9	2	0	11
		60-89	2	20	3	3	28
		>=90	3	42	2	1	48
	Hemorrhagic	<30	0	1	0	0	1
		30-59	0	6	0	0	6
		60-89	0	7	1	2	10
		>=90	1	13	2	0	16
At day 3	Ischemic	<30	0	0	0	0	0
		30-59	0	12	2	1	15
		60-89	0	19	5	1	25
		>=90	0	45	0	2	47
	Hemorrhagic	<30	0	2	0	0	2
		30-59	0	8	1	1	20
		60-89	0	8	0	1	9
		>=90	1	8	3	0	12
At day 7	Ischemic	<30	0	0	1	0	1
		30-59	0	9	3	2	14
		60-89	0	22	5	1	28
		>=90	0	39	3	2	44
	Hemorrhagic	<30	0	2	1	0	3
		30-59	0	6	2	1	9
		60-89	0	7	1	1	9
		>=90	0	9	3	0	12
On discharge	Ischemic	<30	0	0	1	0	1
		30-59	0	8	7	0	15
		60-89	0	18	2	1	21
		>=90	0	41	3	2	46
	Hemorrhagic	<30	0	0	1	0	1
		30-59	0	6	4	0	10
		60-89	0	4	2	0	6
		>=90	0	9	4	0	13

Table 9 shows that in the study, 5.8% of patients died (3.3% ischemic, 2.5% hemorrhagic), while 55.0% showed improvement in neurological status post-stroke (41.7% ischemic, 13.3% hemorrhagic). A total of 34.2% experienced no change in neurological status, and 5.0% had worsening conditions. Ischemic strokes were more prevalent, constituting 72.5% of cases.

Table 9. Association Between Type Of Stroke And Outcome

Outcome		Type of stroke				Total	
		Ischemic		Hemorrhagic			
		n	%	n	%	n	%
Death		4	3.3%	3	2.5%	7	5.8%
	Improvement in neurological status	50	41.7%	16	13.3%	66	55.0%
Discharge	No change in neurological	29	24.2%	12	10.0%	41	34.2%
	Worsening in neurological	4	3.3%	2	1.7%	6	5.0%
Total		87	72.5%	33	27.5%	120	100.0%

Table 10 indicates that the NIHSS score gradually increased from admission (mean 10.6) to discharge (mean 13.16), while creatinine levels also rose, starting from an average of 0.877 at admission to 1.024 at discharge, showing a trend of increasing stroke severity and renal impairment over time.

Table 10. Descriptive Statistics For NIHSS And Creatinine

	Time interval	Min	Max	Mean	S. D
NIHSS	At admission	3.0	35.0	10.6	5.28
	Day 3	4.0	35.0	11.47	5.22
	Day 7	5.0	35.0	12.3	5.05
	At Discharge	6.0	35.0	13.16	4.92
Creatinine	At admission	0.42	1.75	0.877	0.312
	Day 3	0.48	2.04	0.938	0.346
	Day 7	0.43	5.15	0.982	0.536
	At Discharge	0.46	6.89	1.024	0.7

Table 11 shows a comparison of creatinine levels across different modified Rankin Scale (MRS) scores. In the overall sample and across ischemic and hemorrhagic stroke types, creatinine levels generally increased with higher MRS scores, indicating worse outcomes. This trend was consistent from admission through day 7 and at discharge. Notably, creatininelevels were significantly higher in cases of death, especially in hemorrhagic stroke patients (3.5) compared to ischemic stroke patients (1.9).

Table 11. Comparison Of Creatinine According To MRS

		MRS					
		1	2	3	4	5	6
Overall Samle	On admission (n=120)	--	--	0.75	0.88	0.89	--
	Day 3 (n=120)	--	0.86	0.81	0.93	1.04	--
	Day 7 (n=120)	--	0.86	0.82	0.94	1.4	--
	On discharge	--	0.79	0.81	0.97	1.22	--
	On death (n=7)	--	--	--	–	--	2.32
Ischemic stroke	On admission	--	--	0.79	0.83	0.89	--
	Day 3 (n=87)	--	0.86	0.82	0.87	1.01	--
	Day 7 (n=87)	--	0.86	0.8	0.88	1.18	--
	On discharge (n=83)	--	0.87	0.81	0.92	1.12	--
	On death (n=4)	--	--	--	--	--	1.9
Hemorrhagic stroke	On admission	--	--	0.66	1.04	0.91	--
	Day 3 (n=33)	--	--	0.69	1.09	1.08	--
	Day 7 (n==33)	--	--	0.89	1.04	1.74	--
	On discharge (n=30)	--	0.65	0.85	1.05	1.38	--
	On death (n=3)	--	--	--	--	--	3.5

Table 12 indicates that the estimated Glomerular Filtration Rate (eGFR) generally decreased with higher modified Rankin Scale (MRS) scores, suggesting poorer renal function in patients with more severe stroke outcomes. This trend was observed in the overall sample and across both ischemic and hemorrhagic stroke types, from admission through to discharge. Notably, the lowest eGFR values were seen in cases of death, particularly in hemorrhagic stroke patients (eGFR 36.8) compared to ischemic stroke patients (eGFR 43.4).

Table 12. Comparison Of eGFR According To MRS

		MRS					
		1	2	3	4	5	6
Overall sample	On admission	--	--	105.5	95.6	92.4	--
	Day 3 (n=120)	--	95.3	102.7	86.5	81.5	--
	Day 7 (n=120)	--	95.3	98.2	90.1	66.3	--
	On discharge	--	102.5	99.5	85.7	70	--
	On death (n=7)	--	--	--	--	--	48
Ischemic stroke	On admission (n=87)	--	--	105.3	99.5	93.4	--
	Day 3 (n=87)	--	95.3	102.7	90.8	82.9	--
	Day 7 (n=87)	--	95.3	99.6	94.7	69.1	--
	On discharge (n=83)	--	91.6	101	89.4	73.8	--
	On death (n=4)	--	--	--	--	--	43.4

Hemorrhagic stroke	On admission (n=33)	--	--	106.2	82.2	93.6	--
	Day 3 (n=33)	--	--	103	76.8	77.7	--
	Day 7 (n==33)	--	--	89.9	80.7	57.1	--
	On discharge (n=30)	--	124.1	89.7	79.1	63.2	--
	On death (n=3)	--	--	--	--	--	36.8

Table 13 indicates association between eGFR levels and stroke outcomes at various stages. At admission, patients with higher eGFR (≥90) predominantly showed improvement in neurological status, while those with lower eGFR (<60) had varied outcomes including death, no change, or worsening in status. This pattern was consistent on day 3 and day 7, with patients in the higher eGFR category more frequently experiencing neurological improvement. At discharge, the trend continued, where a significant portion of patients with higher eGFR showed improvement. Notably, the occurrence of death was more dispersed across different eGFR levels, especially at earlier stages.

Table 13. Association Of eGFR With Outcome At Admission, Day 3, Day 7 And At Discharge

Outcome			eGFR				Total
			< 30	30-59	60-89	≥ 90	
At Admission	Overall	Death	0	0	5	2	7
		Improvement in neurological status	0	8	22	36	66
		No change in neurological status	1	8	9	23	41
		Worsening in neurological status	0	1	2	3	6
	Ischemic	Death	0	0	2	2	4
		Improvement in neurological status	0	3	20	27	50
		No change in neurological status	0	7	6	16	29
		Worsening in neurological status	0	1	0	3	4
	Hemorrhagic	Death	0	0	3	0	3
		Improvement in neurological status	0	5	2	9	16
		No change in neurological status	1	1	3	7	12
		Worsening in neurological status	0	0	2	0	2
At Day 3	Overall	Death	0	2	5	0	7
		Improvement in neurological status	1	10	20	35	66
		No change in neurological status	1	11	9	20	41
		Worsening in neurological status	0	2	0	4	6
	Ischemic	Death	0	1	3	0	4
		Improvement in neurological status	0	5	17	28	50
		No change in neurological status	0	8	5	16	29
		Worsening in neurological status	0	1	0	3	4
	Hemorrhagic	Death	0	1	2	0	3
		Improvement in neurological status	1	5	3	7	16
		No change in neurological status	1	3	4	4	12
		Worsening in neurological status	0	1	0	1	2
At Day 7	Overall	Death	2	3	2	0	7
		Improvement in neurological status	1	8	24	33	66
		No change in neurological status	1	10	11	19	41
		Worsening in neurological status	0	2	0	4	6
	Ischemic	Death	1	2	1	0	4
		Improvement in neurological status	0	4	19	27	50
		No change in neurological status	0	7	8	14	29
		Worsening in neurological status	0	1	0	3	4
	Hemorrhagic	Death	1	1	1	0	3
		Improvement in neurological status	1	4	5	6	16
		No change in neurological status	1	3	3	5	12
		Worsening in neurological status	0	1	0	1	2
At Discharge	Overall	Improvement in neurological status	1	10	19	36	66
		No change in neurological status	0	15	6	20	41
		Worsening in neurological status	0	1	2	3	6
	Ischemic	Improvement in neurological status	0	6	16	28	50
		No change in neurological status	0	10	4	15	29
		Worsening in neurological status	0	0	1	3	4
	Hemorrhagic	Improvement in neurological status	1	4	3	8	16
		No change in neurological status	0	5	2	5	12

		Worsening in neurological status	0	1	1	0	2

Table 14 shows that among patients who died, most had eGFR levels in the 60 to 89 range on admission and day 3. However, by day 7 and the day of death, the distribution shifted, with a higher percentage of patients in the 30 to 59 eGFR range.

Table 14. eGFR In Death Patients During The Course Of Admission

Day	eGFR								Total	
	< 30		30 to 59		60 to 89		≥ 90			
	n	%	n	%	n	%	n	%	n	%
Day of admission	0	0.0%	0	0.0%	6	85.7%	1	14.3%	7	100.0%
Day 3	0	0.0%	2	28.6%	4	57.1%	1	14.3%	7	100.0%
Day 7	1	14.3%	3	42.9%	3	42.9%	0	0.0%	7	100.0%
Day of death	1	14.3%	3	42.9%	3	42.9%	0	0.0%	[illegible]	[illegible]

DISCUSSION:

In our study, patient ages ranged from 26 to 90 years, with a mean of 57.93 ± 13.64 years. The majority were aged 41-55 years (38.3%), followed by 56-70 years (33.3%). This is comparable to other studies in India, such as Banerjee et al. (2016)[10] with a mean stroke onset age of 63 years, and the Indo-US Collaborative Stroke Project by Sylaja et al.[11] (2018) reporting a mean ischemic stroke age of 58.3 years. However, it contrasts with Dash et al.[12] (2014) found mean ages of 38.9 and 49.06 years, respectively.

In our study of 120 stroke patients, 87 (72.5%) were males and 33 (27.5%) females, reflecting a male predominance similar to other Indian studies. Dalal et al.[13] (2008) reported higher stroke incidence in men, and Mukhopadhyay et al.[14] (2012) found a male prevalence nearly double that of females. Shrestha et al.[15] (2017) also observed more male patients in both hemorrhagic and ischemic stroke cases. This male predominance is further supported by reviews from Kamalakannan et al.[16] (2017).In our study, hypertension was a significant co-morbidity in stroke patients, found in 28.3% alone and in combination with diabetes mellitus in 11.7%. Overall, 35.8% had no co- morbidities. This aligns with findings from Dash et al.[12] (2014) and Shrestha et al.[15] (2017), where hypertension was a major risk factor for both ischemic and hemorrhagic strokes.

In our study, 61.6% of patients had left-sided lesions, 35.8% right-sided, and 2.5% bilateral lesions. This is somewhat aligned with Wu et al.[17] (2015), who reported 47% left-sided and 43% right-sided lesions.

In our study, 72.5% of the 120 patients had ischemic strokes and 27.5% hemorrhagic strokes. This is comparable to other studies: Shrestha et al.[15] (2017) reported a near-equal split between hemorrhagic and ischemic strokes, while Sant Das et al.[18] (2021) and Salvadori et al.[19] (2021) found a higher prevalence of ischemic strokes at 58% and 65%, respectively.

In our study, 7 patients died, including 3 with hemorrhagic and 4 with ischemic stroke. Hemorrhagic stroke showed a poorer outcome, with a higher death rate (2.5%) and worsening neurological status (1.7%). In contrast, 41.7% of ischemic stroke patients improved. This aligns with Salvadori et al.[19] (2021), highlighting worse outcomes in hemorrhagic stroke compared to ischemic stroke.

In our study, the mean serum creatinine increased from 0.87 at admission to 1.024 at discharge. The mean Modified Rankin Scale (mRS) scores decreased over time, from 3.21 at admission to 2.55 at discharge, with a significant correlation to eGFR. The mean NIHSS score increased from 10.60 at admission to 13.16 at discharge. Blood urea levels rose slightly over the course of the study, but this change wasn't statistically significant. These findings are in line with Shrestha et al.[15] (2017) and Sant Das et al.[18] (2021), who also noted significant changes in renal and stroke severity parameters in their studies.

In our study, improvement in stroke outcomes was more common in patients with lower NIHSS scores (0-4 and 5-15), while higher mortality (3.3%) was observed in those with NIHSS scores of 21-42. Among patients with severe strokes (NIHSS 21-42), 3.3% died and 1.7% showed no improvement. In contrast, 49.2% of patients with NIHSS scores of 5-15 improved, but 25.8% showed no change and 5% worsened. This aligns with Wouters et al.[20] (2018), who found that baseline NIHSS scores were predictive of renal function and functional outcomes in stroke patients.

[illegible] K. AboAlSamh et al.[22] (2017), indicating that decreased renal function is associated with increased stroke severity, higher mortality, and poorer functional outcomes post-stroke.

CONCLUSION:

The study results suggest that renal function, as indicated by eGFR and serum creatinine levels, significantly impacts the outcomes of cerebrovascular accident (CVA) patients. Patients with lower eGFR typically presented with higher NIHSS and mRS scores, suggesting more severe stroke presentations and poorer prognoses. The majority of patients in the study had an eGFR ≥ 90 at admission, indicating relatively good renal function. However, those with reduced eGFR experienced worse outcomes, including higher mortality rates. The findings underscore the importance of vigilant renal function monitoring in stroke patients, especially considering factors like long-term hospitalization, use of nephrotoxic drugs, susceptibility to infections, and existing comorbidities. Effective management of renal function could be key in improving outcomes and reducing mortality in CVA patients.

REFERENCES:

1. Ovbiagele B, Schwamm LH, Smith EE, Grau-Sepulveda MV, Saver JL, Bhatt DL, et al. Hospitalized hemorrhagic stroke patients with renal insufficiency: clinical characteristics, care patterns, and outcomes. J Stroke Cerebrovasc Dis Off J Natl Stroke Assoc. 2014 Oct;23(9):2265–73.
2. Tsukamoto Y, Takahashi W, Takizawa S, Kawada S, Takagi S. Chronic kidney disease in patients with ischemic stroke. J Stroke Cerebrovasc Dis Off J Natl Stroke Assoc. 2012 Oct;21(7):547–50.
3. Morgenstern LB, Hemphill JC, Anderson C, Becker K, Broderick JP, Connolly ES, et al. Guidelines for the management of spontaneous intracerebral hemorrhage: a guideline for healthcare professionals from the American Heart Association/American Stroke Association. Stroke. 2010 Sep;41(9):2108–29.
4. Yahalom G, Schwartz R, Schwammenthal Y, Merzeliak O, Toashi M, Orion D, et al. Chronic kidney disease and clinical outcome in patients with acute stroke. Stroke. 2009 Apr;40(4):1296–303.
5. Kim HJ, Kim JK, Oh MS, Kim SG, Yu KH, Lee BC. A Low Baseline Glomerular Filtration Rate Predicts Poor Clinical Outcome at 3 Months after Acute Ischemic Stroke. J Clin Neurol Seoul Korea. 2015 Jan;11(1):73–9.
6. Schiffrin EL, Lipman ML, Mann JFE. Chronic kidney disease: effects on the cardiovascular system. Circulation. 2007 Jul 3;116(1):85–97.
7. Lee M, Ovbiagele B. Reno-cerebrovascular disease: linking the nephron and neuron. Expert Rev Neurother. 2011 Feb;11(2):241–9.
8. Nakayama M, Metoki H, Terawaki H, Ohkubo T, Kikuya M, Sato T, et al. Kidney dysfunction as a risk factor for first symptomatic stroke events in a general Japanese population--the Ohasama study. Nephrol Dial Transplant Off Publ Eur Dial Transpl Assoc- Eur Ren Assoc. 2007 Jul;22(7):1910–5.
9. Lee M, Saver JL, Chang KH, Liao HW, Chang SC, Ovbiagele B. Low glomerular filtration rate and risk of stroke: meta-analysis. BMJ. 2010 Sep 30;341:c4249.
10. Banerjee TK, Das SK. Fifty years of stroke researches in India. Ann Indian Acad Neurol. 2016;19(1):1–8.
11. Sylaja PN, Pandian JD, Kaul S, Srivastava MVP, Khurana D, Schwamm LH, et al. Ischemic Stroke Profile, Risk Factors, and Outcomes in India: The Indo-US Collaborative Stroke Project. Stroke. 2018 Jan;49(1):219–22.
12. Dash D, Bhashin A, Pandit AK, Tripathi M, Bhatia R, Prasad K, et al. Risk factors and etiologies of ischemic strokes in young patients: a tertiary hospital study in north India. J Stroke. 2014 Sep;16(3):173–7.
13. Dalal P, Bhattacharjee M, Vairale J, Bhat P. International Stroke Society - WHO Global Stroke Initiative: a report on population-based Mumbai stroke registry (2005-2006), India. Int J Stroke Off J Int Stroke Soc. 2009 Aug;4(4):239–40.
14. Mukhopadhyay A, Sundar U, Adwani S, Pandit D. Prevalence of stroke and

post-stroke cognitive impairment in the elderly in Dharavi, Mumbai. J Assoc Physicians India. 2012 Oct;60:29–32.
15. Shrestha P, Thapa S, Shrestha S, Lohani S, Bk S, MacCormac O, et al. Renal impairment in stroke patients: A comparison between the haemorrhagic and ischemic variants. F1000Research. 2017;6:1531.
16. Kamalakannan S, Gudlavalleti ASV, Gudlavalleti VSM, Goenka S, Kuper H. Incidence & prevalence of stroke in India: A systematic review. Indian J Med Res. 2017 Aug;146(2):175–85.
17. Wu O, Cloonan L, Mocking SJT, Bouts MJRJ, Copen WA, Cougo-Pinto PT, et al. Role of Acute Lesion Topography in Initial Ischemic Stroke Severity and Long-Term Functional Outcomes. Stroke. 2015 Sep;46(9):2438–44.
18. Das S, Lal K, Kumar N, Jesrani K, Farhad T. Evaluation of Renal Function in Patients of Acute Stroke and its Relationship with-in Hospital Mortality. J Res Med Dent Sci. 2021;9(11).
19. Salvadori E, Papi G, Insalata G, Rinnoci V, Donnini I, Martini M, et al. Comparison between Ischemic and Hemorrhagic Strokes in Functional Outcome at Discharge from an Intensive Rehabilitation Hospital. Diagn Basel Switz. 2020 Dec 28;11(1):38.
20. Wouters A, Nysten C, Thijs V, Lemmens R. Prediction of Outcome in Patients With Acute Ischemic Stroke Based on Initial Severity and Improvement in the First 24 h. Front Neurol. 2018;9:308.
21. Eun MY, Park JW, Cho BH, Cho KH, Yu S. Influence of Estimated Glomerular Filtration Rate on Clinical Outcomes in Patients with Acute Ischemic Stroke Not Receiving Reperfusion Therapies. J Clin Med. 2021 Oct 14;10(20):4719.
22. AboAlSamh DK, Abulaban AA, Khatri IA, Al-Khathaami AM. Renal dysfunction as a predictor of acute stroke outcomes. Neurosciences. 2017 Oct;22(4):320–4.