ORIGINAL RESEARCH PAPER

Volume - 14 | Issue - 05 | May - 2025 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr

INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

"PROGNOSTIC VALUE OF SERUM MAGNESIUM AND POTASSIUM LEVELS AT ADMISSION IN ACUTE CEREBROVASCULAR ACCIDENTS: A TERTIARY CARE HOSPITAL STUDY"

General Medicine

Dr Aditya R Deshmukh Medicine Resident, MRMC , Kalaburagi

Dr Shoukath A R Professor, Dept Of General Medicine, MRMC, Kalaburagi

Dr Hemanth Reddy Nukala Medicine Resident, MRMC, Kalaburagi.

Dr Pavan Medicine Resident, MRMC, Kalaburagi.

Dr Neelakantappa Medicine Resident, MRMC, Kalaburagi.

ABSTRACT

Introduction: stroke remains one of the leading causes of morbidity and mortality worldwide . electrolyte imbalances can further contribute to the increased morbidity and mortality. Chronic deficiencies of magnesium and potassium can lead to atherosclerotic and thrombotic events, increasing the risk of hypertension, diabetes, coronary artery disease (CAD), and cerebrovascular accidents (CVA). **Objectives**: To study the prognostic value of serum Magnesium and potassium levels at admission on Neurological outcome in patients with acute stroke. **Materials and Methods:** This prospective observational study involving 200 patients who met specific inclusion and exclusion criteria was done from may 2023 to October 2024. **Results:** Among the 200 patients,. Ischemic stroke was observed in 145 patients (72.5%), while 55 cases (27.5%) had hemorrhagic stroke. A significant inverse relationship was found between serum magnesium and potassium levels and Rankin scores (P<0.001). **Conclusion:** low serum magnesium and potassium levels at hospital admission are associated with poorer neurological outcomes in stroke patients. Additionally, identifying low magnesium and potassium levels in individuals with stroke risk factors and providing prophylactic supplementation may help to reduce stroke-related disability in the future.

KEYWORDS

acute stroke ,rankin scores ,magnesium, potassium.

INTRODUCTION

Cerebrovascular accidents (CVAs), commonly known as strokes, continue to be a major cause of death and long-term disability worldwide .The World Health Organization (WHO) characterizes a stroke as"rapidly developing clinical signs of focal (or global) disturbance of cerebral function with symptoms lasting 24 hours or longer or leading to death with no apparent cause other than of vascular origin [1]. In India, the stroke burden is raising , mainly due to factors such as lifestyle changes, old age, and common comorbid conditions like hypertension and diabetes. According to the Global Burden of Disease study in 2016, India recorded approximately 1,175,778 new stroke cases[2]. Further, a recent systematic review which is a cross-sectional research ,estimated the annual stroke incidence in our country range from 105 to 152 cases per 100,000 individuals[3].

Electrolyte disturbances are commonly observed in patients with acute stroke and can significantly effect both disease progression and outcome. Common imbalances include, hypokalemia, hyponatremia, hypocalcemia, hypomagnesemia , as well as phosphate irregularities[4]

Magnesium is a natural antagonist to calcium and plays an important role in maintaining vascular tone, blood pressure, and peripheral circulation . it is also a vital cofactor in metabolic processes and protein synthesis. Within the brain, it is mainly bound to adenosine triphosphate (ATP) and acts as a noncompetitive NMDA receptor antagonist. Low magnesium levels has been linked to vasoconstriction and damage to the vascular endothelium, contributing to the progression of atherosclerosis and thrombosis formation. magnesium helps to prevent atherosclerosis by reducing lipid accumulation within the walls of the aorta[5].

In the Atherosclerotic Risk in Communities (ARIC) study, serum magnesium levels were found to be inversely associated with the risk of hypertension and stroke, while dietary magnesium intake showed no such relationship. During a stroke, a large release of glutamate leads to an influx of calcium ions into brain cells, causing premature neuronal death. Magnesium mainly prevents this excessive calcium influx by blocking the glutamate effects and thereby protecting neurons from early death. Extracellular magnesium can inhibit this glutamate release and specifically block the NMDA receptors[5].

Hypokalemia can lead to vasoconstriction, neural damage, and cerebral edema all of which may contribute to delayed neurological recovery in stroke patients. The mechanism behind serum hypokalemia in acute stroke is that it causes release of catecholamines, which promotes the potassium transport into the intracellular space by activating the beta-2 adrenergic receptors. Additionally, potassium levels may decrease from the onset of the stroke due to inadequate dietary potassium intake prior to the event. A reduction in extracellular potassium levels can lead to membrane depolarization and an influx of calcium ions, resulting in ischemia and further neural damage. Furthermore, disturbances in electrolyte balance can cause a buildup of metabolites such as arachidonic and lactic acids, which worsen brain edema and contribute to further injury of brain tissue. Hypokalemia is linked to increased stroke mortality, irrespective of age or hypertension history. Patients with hypokalemia also tend to have lower Modified Rankin Scale scores, indicating negative influence on functional outcomes following a stroke[6] .

Timely identification and management of electrolyte imbalances are important, as they can significantly effect the patient outcomes, including increased mortality, extended hospital stay , and poorer functional recovery.

Objective

To study the prognostic significance of serum Magnesium and potassium levels at admission on Neurological outcome in patients with acute cerebrovascular accidents.

MATERIALS AND METHODS

Prospective observational study was conducted at mahadevappa rampure medical college,kalaburagi during the period of May 2023 To October 2024 on 200 patients admitted to ipd, department of general medicine with stroke . Data was analysed using appropriate inferential statastics.

Informed and written consent was obtained in patients own vernacular language. The purpose of the study was explained to the patient. detailed history, clinical examination and laboratory data of these patients at admission and then on a daily basis was be recorded as per the Proforma after applying inclusion and exclusion criteria. prognosis is assessed by comparing serum Magnesium and Potassium levels at admission with Modified Rankins Scale Score at the time of discharge.

The statistical data was analysed using IBM SpSS 25.0 version

software.

Chi square test is used for qualitative analysis.ANOVA test for correlation was applied for significance. P value of <0.05 isconsidered significant value.

Inclusion Criteria:

- Patients with acute cerebrovascular accidents lasting <72hrs.
- Patients above age of 25 of any gender.

Exclusion Criteria:.

- Patients with end stage renal disease.
- Patients with diarrhoea.
- Intracerebral hemorrhage or infarction caused by an infection or tumor.

RESULTS

Table No.01: Types of acute cerebrovascular accidents (CVA)

Types of CVA	Number of patients	Percentage
ISCHEMIC STROKE	145	72.5
HEMORRHAGIC STROKE	55	27.5
Total	200	100.0

Table 01 illustrates that the study observed 145 patients (72.5%) with Ischemic stroke and 55 cases (27.5%) with Haemorrhagic stroke.

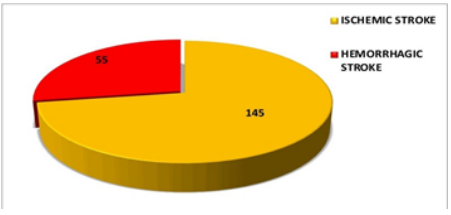

Figure No 01: Pie char represents types of acute cerebrovascular accidents (CVA)

Table no 02: MRS score wise classification of acute cerebrovascular accident patients

Modified Rankin Grade	Categories	No.	%
0	No Symptoms	0	0.0
1	no significant disability	23	11.5
2	light disability	72	36.0
3	moderate disability	51	25.5
4	Moderately severe disability	43	21.5
5	Severe disability	11	5.5
Total	---	200	100.0

Table 02 illustrates the findings of the Rankin grades in the study.

The majority of patients (36%) had a light disability, managing personal affairs independently but unable to resume all previous activities. Moderate disability was seen in 25.5%, needing some help but walking unassisted. About 21.5% had a moderately severe disability, requiring help with walking and personal care. Severe disability affected 5.5%, with patients bedridden and needing constant care. Only 11.5% had no significant disability.

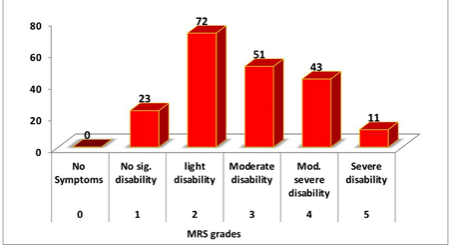

Figure No 02: Bar diagram shows MRS score wise classification of acute cerebrovascular accident patients

Table 03: Association Of Serum Magnesium And Potassium Levels With Neurological Outcome In Patients With Acute Cerebrovascular Accidents.

Neurological outcome Rankin Grades	No. of patients	Serum Magnesium	Serum Potassium
		Mean ± SD	Mean ± SD
0	0	---	---
1	23	2.12 ± 0.30	4.78 ± 0.61
2	72	1.97 ± 0.15	4.00 ± 0.69
3	51	1.78 ± 0.19	3.16 ± 0.36
4	43	1.50 ± 0.26	2.74 ± 0.34
5	11	1.28 ± 0.16	2.38 ±0.58
ANOVA test, P-value	50	F = 60.60, P =0.000, HS	F = 85.63, P =0.000, HS

Table 03 displays the results of a study that examined the relationship between the severity of neurological outcomes, as measured by Rankin Grades, and serum magnesium and serum potassium levels. The study found that as Rankin Grades increased, the mean serum magnesium and serum potassium levels have significantly decreased. This relationship was found to be statistically highly significant (P<0.001).

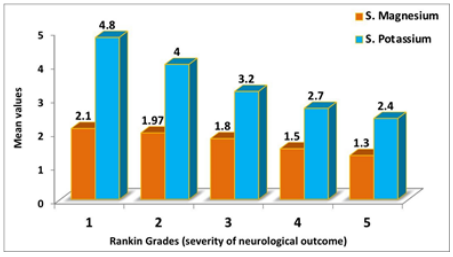

Figure No 03: Bar diagram represents mean serum magnesium and potassium levels with neurological outcome

DISCUSSION

- In our research, the age-wise distribution of stroke patients showed that the largest proportion, 61 individuals (30.5%), belonged to the 61–70 years ofage. Among the 200 stroke cases studied, 145 (72.5%) were ischemic and 55 (27.5%) were hemorrhagic, which is consistent with global data indicating the dominance of ischemic strokes. A significant number of patients also had comorbidities, with hypertension being present in 168 cases (84.0%) and diabetes mellitus in 72 cases (36.0%), reflecting the high prevalence of these conditions in the affected population.
- This study focused on evaluating the relationship between serum magnesium and potassium levels and stroke prognosis among both ischemic and hemorrhagic types. Findings revealed that reduced levels of magnesium and potassium were linked with greater stroke severity and poorer recovery outcomes, as measured by higher modified Rankin Scale (mRS) scores. These results support a neuroprotective role for both minerals, particularly in ischemic stroke, which comprised the majority (72.5%) of the cases analyzed.
- Patel R.K. et al[7].conducted a comparative study on serum magnesium levels and mRS scores across different stroke subtypes. Their analysis demonstrated that magnesium levels were markedly lower in both ischemic and hemorrhagic stroke patients compared to healthy controls ($p < 0.0001$). Furthermore, ischemic stroke patients had significantly lower mRS scores than those with hemorrhagic stroke ($p = 0.003$).
- In research by Tu X. et al[8]univariate and multivariate logistic regression analyses were used to evaluate predictors of poor 3-month outcomes based on mRS scores. The results indicated that hypomagnesemia substantially increased the risk of unfavorable outcomes (adjusted OR: 2.15 [1.16–3.98], $p = 0.015$). Age was also a key factor, with each additional year increasing the odds of a poor outcome (adjusted OR: 1.07 [1.04–1.09], $p < 0.001$). Hypertension independently raised the risk nearly twofold (adjusted OR: 1.95 [1.17–3.26], $p = 0.011$), and higher NIHSS scores were strongly associated with poorer recovery (adjusted OR: 1.32 [1.26–1.38], $p < 0.001$).
- According to Lavanya et al[9]. significant p-values were noted for serum magnesium, potassium, and hypertension ($p < 0.05$), suggesting their potential association with stroke outcomes. The study observed a substantial difference in mean serum magnesium levels between ischemic and hemorrhagic stroke groups ($p < 0.001$), emphasizing its relevance to stroke classification. Likewise, mean potassium levels differed significantly between the two stroke types ($p = 0.041$), implying a role in stroke pathophysiology. Hypertension also emerged as a significant factor ($p < 0.001$), underscoring its known status as a major stroke risk contributor. The study further reported a correlation between electrolyte levels and both the occurrence and outcome of

cerebrovascular events.

- In a population-based study by Johnson et al[10]the relationship between serum potassium levels and stroke outcomes was investigated. The findings indicated that higher potassium concentrations were associated with improved survival and reduced stroke severity, suggesting a possible therapeutic benefit of potassium supplementation.

CONCLUSION

- Lower serum magnesium and potassium levels at admission are associated with worse neurological outcomes in stroke patients. There is a significant correlation between higher disability (Rankin grades) and lower serum magnesium and potassium levels.
- Routine monitoring of serum magnesium and potassium levels should be considered in acute stroke patients.Prophylactic supplementation of magnesium and potassium in individuals with risk factors would prevent more disability if involved by stroke in future.

limitations

sample size constraints may effect the generizability of the results to broad population and study focussed on serum magnesium and potassium levels at admission without long term follow up of cases on neurological recovery.

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