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Original Research Article

Study of Serum Magnesium Levels in Subjects of Cerebrovascular Accidents with Respect to in Hospital Outcome

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Abstract:

Background: Magnesium is the major intracellular divalent cation. It is important for normal neuromuscular function. Many emerging data suggest the role of magnesium in neuroprotection, prevention and treatment of stroke. However the role of magnesium in cerebrovascular accidents has not been thoroughly studied. In near future magnesium's role in many neurological diseases including cerebrovascular accidents could be discovered.

Methods: A total of 30 subjects with cerebrovascular accidents and 30 subjects who were admitted or visited to OPD for other reasons were studied . A serum magnesium level <1.6 mg/dl was defined as hypomagnesemia. Comparison was made based on gender, outcome in terms of discharge, death and modified Rankin scale. Frequency tables were used, chi square test and Pearson's formula were used and results were obtained.

Results: Cerebrovascular accidents were more common in males compared to females. However there was no statistically significant association between magnesium level subjects with cerebrovascular accidents and in healthy subjects (P value – 0.5). There was no statistically significant association between serum magnesium level and in hospital outcome (P value- 0.4). There was also no statistically significant association of poor modified Rankin score and serum magnesium level (P value – 0.1)

Conclusion: The present study did not show any association between hypomagnesemia and occurrence of cerebrovascular accidents and poor in hospital outcomes.

Keywords: Magnesium; Cerebrovascular accidents; Hypomagnesemia.

Introduction

Cerebrovascular diseases include some of the most common and devastating disorders: ischemic stroke and haemorrhagic stroke. Stroke is the second leading cause of death worldwide, with 6.2 million dying from stroke in 2015, an increase in 830,000 since the year 2000.While stroke has grown in the incidence, it is declining among the affluent and rising among those with less access to medical access. In the United States, the incidents of stroke has declined steadily since at least 1958, and stroke is currently the fifth leading cause of death with 133,000 dying in 2014.Despite the progress, however, stroke remains the most common disabling disease in the United States and in many forms is prevent able. [1] Magnesium plays an essential role in numerous enzymatic processes, cellular metabolic, and neuronal function. It also functions in a protective role against excessive excitation that can lead to neuronal cell death (excitotoxicity), and has been implicated in multiple neurological disorder S [2]. Due to these important functions within Magnesium modulates vascular smooth muscle tone, peripheral vascular resistance, and blood flow dynamics. Magnesium also plays crucial roles in haemostasis by accelerating activation of factor X via factor VII – tissue factor, causing conformational changes in coagulation factor IX that augment its biological activities, potentiating platelet aggregation, and decreasing levels of the intrinsic antithrombotic protein S and Common. [3] Although some studies have discovered the potential of magnesium as a neuro protective agent, human trials have not demonstrated the efficacy of intravenous (IV) magnesium administration. With increasing interest in the disability burden of stroke, this study aims to study the role of hypomagnesaemia in the occurrence of cerebrovascular accidents.

Objective

- To study the serum magnesium levels in Cerebrovascular accidents

- To study the Serum magnesium levels in Cerebrovascular accidents with respect to in hospital outcomes.

Materials and Methods

This study was cross-sectional, observational study conducted in Department of medicine, Mysore medical college and research institute, Mysore among patients admitted in medicine ward or intensive care unit and in patients visiting outpatient department from the month of September 2023 to November 2023.

Inclusion Criteria

- 30 Subjects aged 18 – 60 years of both sexes with stroke.
- 30 Subjects aged 18 – 60 years of both sexes in normal control group

Exclusion Criteria

- Cases with hemiparesis or any focal neurological findings other than stroke including head trauma, metabolic encephalopathy, brain abscesses, brain tumour, migraine.
- Transient ischemic attack.
- Renal failure.
- Subjects taking magnesium supplements.

Methodology

- After taking the institutional ethical clearance for the study, purpose of study will be explained to the subjects and attenders. Written consent were taken from the subjects.
- Relevant history and clinical examinations were done. Blood samples for Serum Magnesium Levels
- Brain imaging by CT scan or MRI brain
- Modified Rankin scale was used to estimate the neurological disability of the patients. Scoring is done from 1 to 6. A score of 1 means there is no significant disability despite symptoms and patient is able to carry out all usual duties and activities. A score of 2 means slight disability and patient is unable to carry out all previous activities but able to look after own affairs without assistance. A score of 3 is given to patients with moderate disability i.e. requiring some help but able to walk without assistance. A score of 4 means moderately severe disability i.e. unable to walk and attend to bodily needs without assistance. A score of 5 means severe disability i.e. bedridden, incontinent and requiring constant nursing care and attention. A score of 6 is given to those who die.

Statistical Analysis: Data was collected, coded and fed in Statistical Package for Social Sciences (SPSS) for statistical analysis. Descriptive statistics analysis was carried out including frequency and percentage. The results of the study were tabulated.

Frequency Table

Table 1: Distribution of study subjects based on Gender in CVA patients

Gender		Frequency	Percent
	Male	20	66.7
	Female	10	33.3
	Total	30	100.0

Table 2: Distribution of study subjects based on Serum Magnesium levels

Serum magnesium level mg/dL		Subjects with CVA	Healthy Individuals
	<1.6	3	1
	1.6 to 2.6	25	27
	>2.6	2	2
	Total	30	30

Table 3: Outcome in CVA Patients

Outcome		Frequency	Percent
	Death	7	23.3
	Discharged	23	76.7
	Total	30	100.0

Table 4: Gender in Normal Patients

Gender		Frequency	Percent
	Male	23	76.7
	Female	7	23.3
	Total	30	100.0

Table 5: Distribution of study subjects based on Serum Magnesium level in Normal patients

Serum magnesium level mg/dL	Frequency	Percent
<1.6	1	3.3
1.6 to 2.6	27	90.0
>2.6	2	6.7
Total	30	100.0

Table 6: Serum Magnesium level in CVA patients and outcome cross tabulation

		outcome		Total	Chi-square value	p-value
		Death	Discharged			
Serum magnesium level (mg/dl)	<1.6	0	3	3	1.74	0.4
	1.6 to 2.6	6	19	25		
	>2.6	1	1	2		
Total		7	23	30		

When we studied association of serum magnesium levels and outcome by applying Chi-square test results was not statistically significant (P -value -0.4) (may be because of small sample size)

Table 7: Distribution of study subjects based on Serum Magnesium levels in Healthy and subjects with CVA

Serum Magnesium level (mg/dl)		Subjects with CVA	Healthy Individuals	Chi-square	p-value
	<1.6	3	1	1.07	0.58
	1.6 to 2.6	25	27		
	>2.6	2	2		
	Total	30	30		

When we studied association of serum magnesium levels with healthy subjects and subjects with CVA by applying Chi-square-test, results was not statistically significant (P-value – 0.5)
(may be because of small sample size)

Table 7: Correlation between serum magnesium levels and mRS

Serum Magnesium level (mg/dl)	Number of patients (mRS)
<1.6	1(5) 1(4) 1(3) 1(1)
1.6 to 2.6	6(6) 1(5) 1(4) 9(3) 7(2)
>2.6	1(6) 1(4)
Total	30

When studied the association between serum magnesium levels with modified Rankin score, using Pearson's formula, results were not statistically significant
(P value -0.1)

Discussion

The study groups were matched equally according to age and sex. This study shows male predominance of CVA. However there is no significant correlation between serum magnesium level and cerebrovascular accident. And no significant correlation was found between serum magnesium level and in hospital outcome with regard to mortality. There was also no correlation between serum magnesium levels and modified Rankin score. Since normal concentrations of extracellular magnesium and calcium are crucial for normal neuromuscular activities there might be role of magnesium in neuroprotection. Hypomagnesemia causes generalized alterations in neuromuscular function including tetany, tremor, seizures, muscle weakness, ataxia, nystagmus, vertigo, apathy, depression, irritability, delirium, and psychosis. Study conducted by Sudra Samavarchi Tehrani et al. in Iran from 2015 to 2017 'Association of serum of serum magnesium levels with risk factors, severity and progression in ischemic and haemorrhagic stroke' concluded that magnesium level were higher in ischemic stroke patients compared to haemorrhagic ones and these levels were associated with many risk factors

contributing to a Stroke. [4] Study conducted by R. K. Patel et al. In Raipur in 2018, 'Assessment of serum magnesium levels in stroke patients and its correlation with severity of neurological disability' concluded that magnesium deficiency predisposing to atherosclerosis, the known modifiable risk factor for stroke. [5] Study conducted by Susanna et al. in 2019 in UK 'Serum magnesium and calcium levels in relation to ischemic stroke' concluded that Genetically higher serum magnesium concentration are associated with a reduced risk of cardio embolic stroke, but found no significant association of genetically higher serum calcium concentration with ischemic stroke subtype. [6] Study conducted by Kotwal V et al. in Jammu in 2020, 'Serum magnesium levels in patients of ischemic stroke and its correlation with neurologic disability' concluded that ischemic stroke patients had serum magnesium levels as compared to healthy subjects in this study and also lower levels were seen in those with higher neurological disability. [7] So magnesium may have role in neuro protection and magnesium supplementation in patients with vascular risk factors of stroke and also magnesium replacement in early phase of ischemic stroke may reduce the infarct size. Study conducted by Hyun Ryu et al. in Korea in 2021, 'Hypomagnesaemia as a prognostic marker of ischemic stroke' concluded that hypomagnesaemia was a strong prognostic marker of poor functional outcome in certain subgroups, especially in patients with mild stroke severity and cardio embolic stroke. [8] Another study conducted by James E Siegler et al. in USA from 2008 to 2010, 'Acute decrease in serum magnesium level after ischemic stroke may not predict decrease in neurologic function' suggested that patients who have low Mg2+ at baseline or a reduction in Mg2+ 24 hours after admission are not at a higher risk of experiencing ND or poor short-term outcome. Ongoing prospective interventional trials will determine if hyperacute aggressive magnesium replacement affords neuroprotection in Stroke. [9] There are several shortcomings in the present study including small sample size and not taking into consideration of other comorbidities like hypertension and diabetes which might alter the findings of the study. So further large scale studies are necessary to study the association between serum magnesium and cerebrovascular accidents.

Conclusion

The present study did not show correlation between serum magnesium levels in cerebrovascular accident subjects and with respect to in hospital outcome in terms of mortality and modified Rankin score. Small study sample may be one of the reasons and hence needs further studies in this regard with larger study population to study about the role of serum magnesium in neuro protection, prevention of stroke and limiting the disability.

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