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Assessment of Serum Magnesium Levels in Patients with stroke and its Correlation with Severity of Neurological Disability

Dr. Suraj Rajpurohit,[1] Dr. Nasiba Khan,[2] Dr. Pradeep Mittal,[3] Dr. Ajeet Singh Shaktawat[4]

[1,2]Resident, Department of Medicine, SMS Medical College, Jaipur, India
[3]Senior professor and Unit head, Department of Medicine, SMS medical college, Jaipur, India
[4]Medical Suprentendent (MS), Ruhs, Jaipur, India

Correspondence Author: Dr. Ajeet Singh Shaktawat, Medical Suprentendent (MS) Ruhs, Jaipur. Email: suraj89rajpurohit@gmail.com

Introduction: Magnesium plays a significant role in multiple biological systems and acts as a cofactor in hundreds of enzymatic reactions in the human body.
Aim: Assessment of Serum Magnesium Levels in Patients with stroke and its Correlation with Severity of Neurological Disability.
Method: study conducted on 100 patients (both male and female) at Department of Medicine SMS MEDICAL COLLEGE and attached hospitals, JAIPUR From May 2020 till completed plus 1 month for statistical study. Patients diagnosed with CVA(Hemorrhagic and ischemic stroke), Age above 18 years of both sex and Patient who gave consent for this study were included. a blood sample was taken for serum magnesium levels. All data were entered in Microsoft Excel sheet and analysis was done by Epi info software of CDC USA.
Result: the serum magnesium in males and females was low <1.5 mg/dL in 45% of cases in age group of >61 yrs, 63.15% of cases with diabetes mellitus has serum magnesium levels of < 1.5mg/dL. There are significant differences between magnesium level in stroke patients (hemorrhage and infarct)and normal individuals($p<0.001$). The MRS was significantly high($p<0.001$) in stroke patients having magnesium level less than 1.5 mg/dl than having magnesium level above 1.5 mg/dl.
Conclusion: If a patient with a risk factor for stroke is found to have low levels of serum magnesium values during screening prophylactic supplementation with magnesium can prevent more disability.

Keywords: Stroke, Serum magnesium, ischemic, hemorrhagic.

INTRODUCTION:

WHO clinically defines a stroke as 'the rapid development of clinical signs and symptoms of a focal neurological disturbance lasting more than 24 hours or leading to death with no apparent cause other than vascular origin[1]. Stroke is a clinical syndrome divided into two broad categories that define its pathophysiology. Ischemic Strokes, accounts for 50% - 85% of all strokes worldwide and Hemorrhagic Strokes, accounts for 1% - 7%.[1,2]

Magnesium ions have a physiological role in multiple processes related to ischemia. Magnesium plays a significant role in multiple biological systems and acts as a cofactor in hundreds of enzymatic reactions in the human body. In the brain, magnesium is predominantly complexed with adenosine triphosphate. It is an important cofactor for cellular energy metabolism and protein synthesis.[3] The daily magnesium requirement for a human being is 200-300 mg. Magnesium has been directly implicated in hypocalcemia, tetany, hypokalemia, and arrhythmias. Magnesium may play a preventive and therapeutic role in stroke, ischemic heart disease, and bronchial asthma.[4]

Although a lot of research work was being carried out on the serum magnesium levels in stroke patients and its correlation with neurological disability worldwide, there is a dearth of information in literature pertaining to the serum magnesium levels in stroke patients. Globally, the correlation of serum magnesium levels with neurological disability in stroke patients is also not extensively studied. Our study is a relevant step towards the future to overcome the lacuna in this field. The results of this study will help bridge the knowledge gap and provide population relevant data on the serum magnesium levels and related factors in stroke patients.

AIM: Assessment of Serum Magnesium Levels in Patients with stroke and its Correlation with Severity of Neurological Disability.

METHOD:

It is a Hospital based cross-sectional study conducted on 100 patients (both male and female) at Department of Medicine SMS MEDICAL COLLEGE and attached hospitals,JAIPUR From May 2020 till completed plus 1 month for statistical study. Patients diagnosed with CVA(Hemorrhagic and ischemic stroke), Age above 18 years of both sex and Patient who gave consent for this study were included. Subjects with transient ischemic attack, Systolic BP less than 90,

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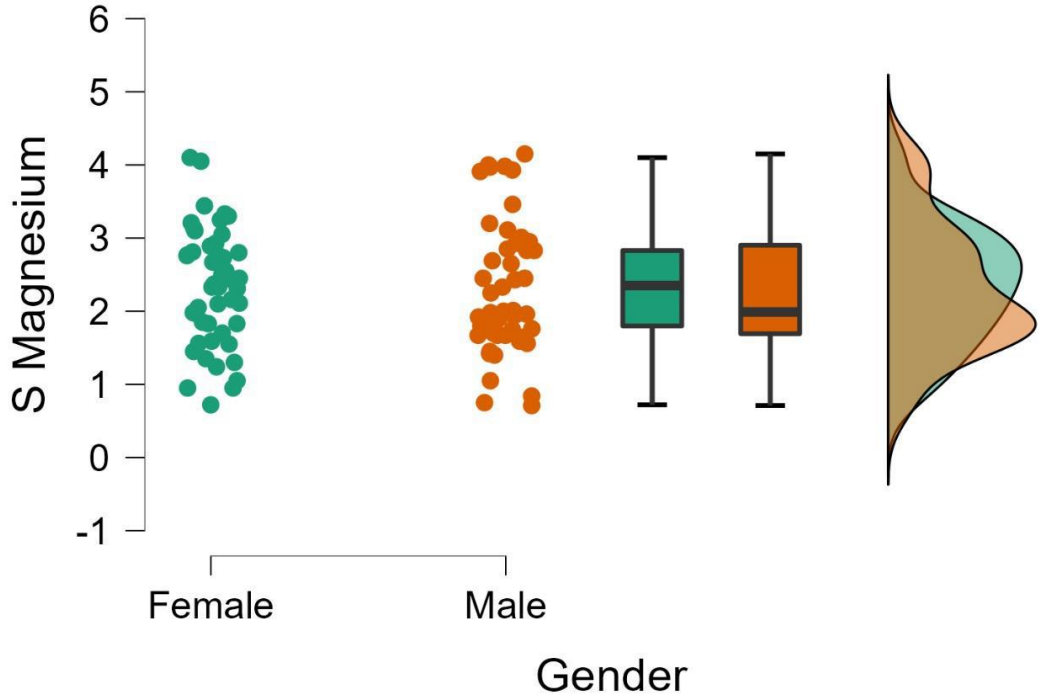
Serum creatinine>3mg/dl, Pregnant females and Clinical conditions where patients is taking magnesium sulphate were excluded. Sample size is calculated 50 in each group as previous study showed the minimum detectable difference of mean 1.08 and SD 0.665 for 80% power and 0.05 alpha error**.** All baseline informations were taken in preformed pre tested proforma and a blood sample was taken for serum magnesium levels. All data were entered in Microsoft Excel sheet and analysis was done by Epi info software of CDC USA.

RESULT:

Fig. 1. S. Magnesium in Females and males



In the study, the serum magnesium in males and females was low <1.5 mg/dL in 5% of cases in age group of >70 yrs, 40% of cases in the age group of 61-70 yrs, 35% of cases in the age group of 51 - 60 yrs, 15% of cases in the age group of 41-50 yrs, 5% of cases in the age group of 30 – 40 yrs.

Table 2. Serum magnesium levels in patient with DM and HTN

Serum Mg	**DM**		**HTN**	
	No. of patients	**Percentage(%)**	**No. of paiteints**	**Percentage(%)**
< 1.5	12	63.158 %	19	57.576 %
> 1.5	7	36.842 %	14	42.424 %

Among the study population , 63.15% of cases with diabetes mellitus has serum magnesium levels of < 1.5mg/dL, 36.8% of cases with diabetesmellitus has serum magnesium of >1.5 mg/dL. Àmong the cases with Systemic Hypertension 57.5% of cases had serum magnesium of <1.5mg/dL , 42.4% had serum magnesium of > 1.5mg/dL.

Table 3. One-way ANOVA to compare Serum Magnesium levels in three groups.

Patient Category	Mean ±SD	F	P value
Hemorrhagic (n=25)	1.853 ±0.412	31.208	< .001
Infarct (n=25)	1.732 ±0.752		
None (n=50)	2.835 ±0.712		

There are significant differences between magnesium level in stroke patients (hemorrhage and infarct)and normal individuals(p<0.001)

Table 4. Post-hoc comparison between different groups

Patient Category	**Patient Category**	**Mean Difference**	**Standard error**	**t**	**P**
Hemorrhagic	Infarct	0.121	0.187	0.648	0.794
Hemorrhagic	None	-0.981	0.162	-6.055	< .001
Infarct	None	-1.103	0.162	-6.803	< .001

Serum Magnesium level is significantly low in hemorrhagic patients and infarct patients when compared to normal patients. The serum magnesium is lower in infarct patients in compared to hemorrhagic stroke patients but was not

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statistically significant.

Table 5. Serum magnesium levels with neurological outcome (Modified Rankin score)

	Group	N	Mean	SD	SE	t value	p value
MRS	< 1.5	24	2.625	1.813	0.37	3.549	< .001
	> 1.5	76	1.329	1.473	0.169		

Modified Rankin Score was higher in the patients with low serum magnesium. The MRS was significantly high($p<0.001$) in stroke patients having magnesium level less than 1.5 mg/dl than having magnesium level above 1.5 mg/dl. This shows that the low level of serum magnesium have a poor neurological outcome in patients suffering from cerebrovascular accidents.

DISCUSSION:

The prevalence of low serum magnesium levels in acute cerebrovascular accidents was studied and found that there was a significant correlation between serum magnesium and CVA.

A case control study was conducted by University College of Medical Sciences, Delhi wherein serum magnesium was measured in 50 diagnosed cases of acute cerebrovascular accidents which included transient ischemic attack, ischemic stroke and hemorrhagic stroke. The results were that the patients who had suffered from ischemic stroke, hemorrhagic stroke andtransient ischemic attacks had significantly lower magnesium levels.[5]

A prospective study conducted by the university of Washington, Seatle published in the American Journal of Hypertension states that in adults with treated hypertension low magnesium before a stroke was associated with an increased risk of incident ischemic and hemorrhagic stroke independent of diuretic use when compared to normal serum magnesium levels.[6]

In our study we found low serum magnesium levels in stroke patients compared to controls. Serum magnesium levels found to be lower in ischemic stroke as comparedto hemorrhagic stroke but their difference is statistically insignificant. There is no significant difference of magnesium levels in male and female groups of stroke patients. We also found significant low serum magnesium level in hypertensive patients compared to normotensives.

In an article published in American journal of epidemiology reported that higher serum magnesium levels were associated with lower prevalence of hypertension and diabetes.[7] Lavanya *et al* in their study in 2018 observed the correlation of serummagnesium and with Cerebrovascular accidents and the neurologicaloutcome of those patients and found that there was significant correlation for serum magnesium with CVA.[8] Our study also found significant correlation between stroke and magnesium level and supports above study.

CONCLUSION:

If a patient with a risk factor for stroke is found to have low levels of serum magnesium values during screening prophylactic supplementation with magnesium can prevent more disability in the persons that will be involved by stroke in future and can reduce the social, emotional and economical losses and early recovery in patients who had been infused intravenous magnesium within two hours of onset of stroke or as early as possible.

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