On Admission Hypomagnesemia and its Adverse Effects in Critically Ill Patients Admitted to ICU in Tertiary Care Centre

Bharath M.S.[1], Udayashankar. R. Hiregoudar[2]

ABSTRACT

Introduction: Magnesium is the fourth most abundant cation in the human body and the second most abundant intracellular cation after potassium. It serves as a cofactor in more than 300 enzymatic reactions. It is involved in neuromuscular excitability and maintenance of cardiac rhythm. Hypomagnesemia is reported in up to 20% of patients in medical wards and as many as 65% of patients in ICUs. Study aimed to study hypomagnesemia in critically ill patients and to correlate its association with the following parameters: Duration of stay in MICU, requirement for ventilatory support, duration of ventilator support, APACHE score and mortality.

Material and Methods: Present research was the prospective observational study for the relationship between Magnesium parameters and clinical outcome for critically ill medical patients. A total of 200 patients were taken up in the study from Intensive Care Unit, Rajarajeswari medical college and Hospital for a period of two years

Results: Among 200 patients, 37% (74) patients had hypomagnesemia. The patients with hypomagnesemia had higher mortality rate (56.8% vs 20.4%), more frequent need for ventilatory support (55.4% vs 48.1%).Patients with hypomagnesemia more frequently had sepsis (72.9% vs44.4%).Patients with diabetes had hypomagnesemia more frequently (33.8% vs 15.7%). Duration of ventilation and hospital stay did not vary with low or normal Magnesium.

Conclusion: Our study has found high prevalence of hypomagnesemia in critically ill patients. Higher mortality rate was observed in critically ill patients having hypomagnesemia. The requirement for ventilatory support was significantly higher in hypomagnesemic patients. Hypomagnesemia was commonly associated with sepsis and diabetes mellitus and higher APACHE scores. The duration of MICU stay, serum potassium, serum calcium did not vary in patients with low magnesium and normal magnesium.

Keywords: APACHE score, Critically ill, Diabetes, Hypomagnesemia, MICU, Sepsis, Ventilation

INTRODUCTION

Magnesium is the fourth most abundant cation in humans and the second most abundant intracellular cation after potassium. It is a cofactor in more than 300 enzymatic reactions mainly involving transfer of phosphate group, for example formation of ATP. It is involved in neuromuscular excitability and maintenance of cardiac rhythm. Hypomagnesemia is a common finding in routine medical practice, mainly in critically ill patients but remains unidentified. Because magnesium depletion may not be accompanied by low serum levels, the incidence of hypomagnesemia is even higher than indicated by the studies of hypomagnesemia. A causal relationship between hypomagnesemia and increased mortality has been suggested in the literature[2].

Causes of magnesium deficiencies comprises of gastrointestinal and renal wasting, drug-induced, metabolic diseases, endocrine disorders, redistribution of magnesium stores and several other conditions. Clinical presentation of hypomagnesemia include neuromuscular, neurologic, psychiatric and cardiac disorders, which may considerably increase the morbidity and mortality. Hypomagnesemia is easily mistaken for hypocalcaemia or hypokalemia, a condition with which it is often associated. It is difficult to treat hypocalcaemia or hypokalemia secondary to hypomagnesemia unless magnesium is corrected.[3]

Objectives of this study was to evaluate Hypomagnesemia in critically ill patients and to determine the outcomes such as - Requirement for ventilatory support, duration of ventilatory support, mortality and conditions predisposing hypomagnesemia.

MATERIAL AND METHODS

The study was done on 200 patients admitted to Intensive Care Unit, Rajarajeswari medical college and Hospital for a period of two years. We prospectively studied a series of 200 critically ill patients admitted to Intensive care unit. A study was conducted on 200 critically ill patients who were admitted to ICU. History was taken, general physical examination and a detailed systemic examination was done. Routine blood investigations were sent. Serum samples drawn at the time of admission of the patients were sent for estimation of serum magnesium levels.

Inclusion criteria: Critically ill patients aged above 16 years admitted to Medical Intensive Care Unit.

Exclusion criteria: All patients who received magnesium before transfer to Medical Intensive Care Unit.

STATISTICAL ANALYSIS

Descriptive and inferential statistical analysis has been applied in the present study. Results on categorical measurements are presented in Number (%) and results on continuous measurements are presented on Mean SD (Min-Max) and. Significance is assessed at 5% level of significance.

Chi-square/ Fisher Exact test has been used to find the significance of study parameters on categorical scale between two or more groups. Analysis of variance (ANOVA) has been

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used to find the significance of study parameters between three or more groups of patients.

The Statistical software namely SPSS version 15 was used for the analysis of the data and Microsoft word and Excel have been used to generate graphs, tables etc**.**

Significant figures -

+ Suggestive significance (P value: 0.05<P<0.10)

* Moderately significant (P value: 0.01<P ≤ 0.05)

** Strongly significant (P value: P≤0.01)

RESULTS

Among 200 patients, 74 had hypomagnesemia,18 had hypermagnesemia (figure-1), 25 (33.8%) of diabetic patients had low magnesium levels (figure-2). 54 (72.9%) of patients who had sepsis had low magnesium levels which was significantly associated with levels of serum magnesium with P<0.001** (figure-3). Out of 74 patients who had hypomagnesemia, 41 (55.4%) required ventilatory support (figure-4), 42 out of 71 (56.8%) of Mortality had low magnesium levels which is significantly associated with low levels of serum magnesium with P<0.001** (figure-5). Higher APACHE score was significantly associated with low level serum magnesium with P<0.001** (figure-6). Need for ventilation was significanly associated with low levels of serum magnesium with P=0.007**

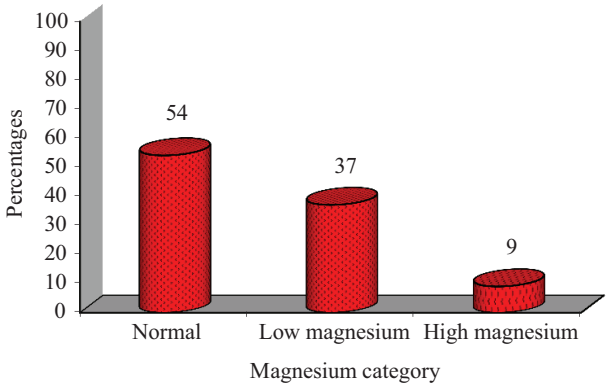

Figure-1: Magnesium category

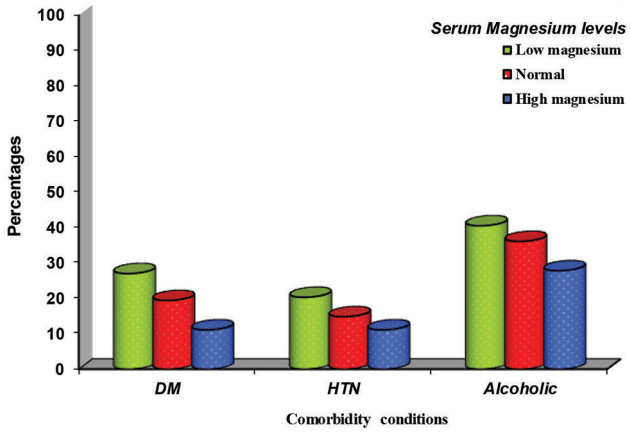

Figure-2: Correlation of levels of Serum magnesium with Comorbidity conditions

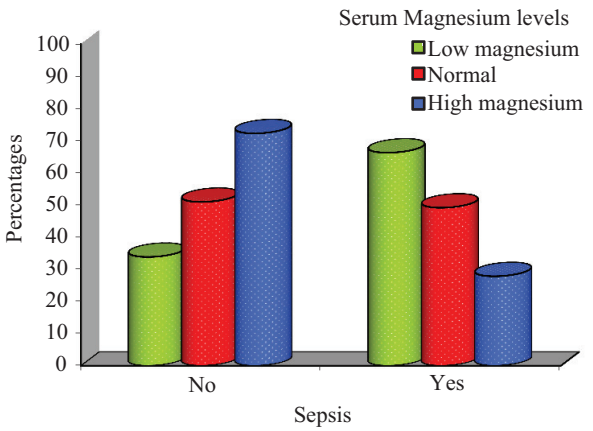

Figure-3: Correlation of levels of Serum magnesium with Sepsis of patients studied

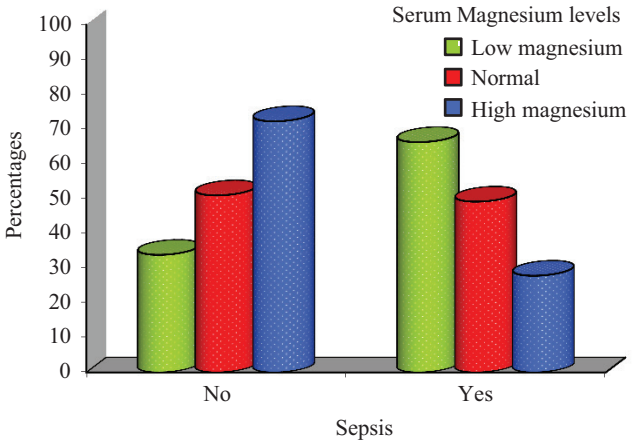

Figure-4: Need for ventilation

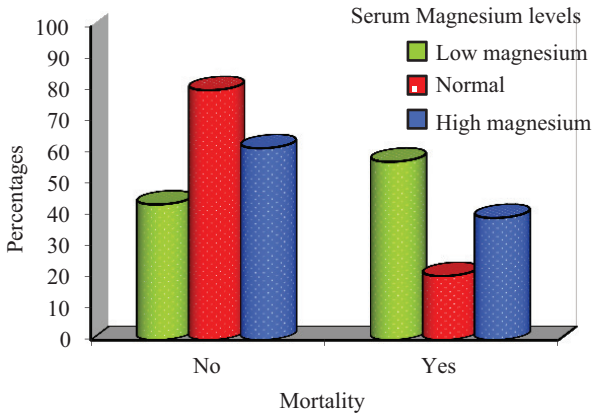

Figure-5: Mortality

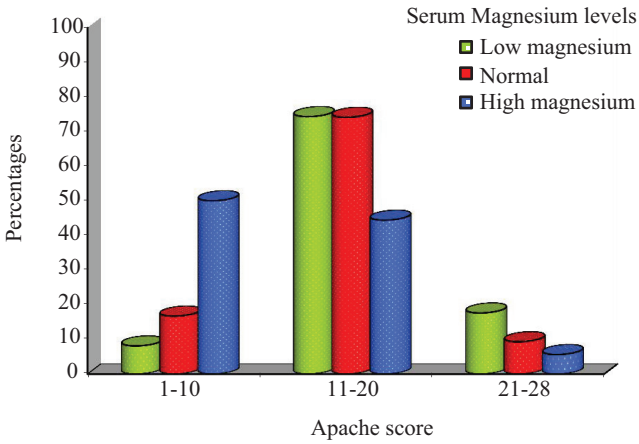

Figure-6: Comparison of Apache score according to magnesium levels

Study	Year	No. of patients	Magnesium measured	Low magnesium	High magnesium
International studies					
Ryzen et al[5]	1985	94	Total	51%	-
Chernow et al[6]	1989	193	Total	61%	5%
Reinhart et al[7]	1989	102	Total	20%	9%
Rubeiz et al[8]	1993	197	Total	20%	7%
Guerin et al[9]	1996	179	Total and	44%	6%
			Erythrocyte	66%	4%
Huijigen et al[10]	2000	115	Ionized	14%	12%
Deheinzelin et al[11]	2000	226	Total	45.6%	-
Soliman et al[12]	2003	422	Ionized	18%	14%
Safavi et al[13]	2007	100	Total	51%	-
Limaye et al[1]	2011	100	Total	52%	7%

Table-1: Prevalence of hypomagnesemia in critically ill patients in other related studies

DISCUSSION

Magnesium is the second most common intracellular cation. It is neceessary for enzyme activity, synthesis of nucleic acids and proteins, and has an important role in the physiology of neuromuscular and cardiovascular systems. Total body magnesium is approximately 1000 mmols, of which 60% is distributed in bone, 20% in skeletal muscle, and less than 1% in the extracellular fluid. In the circulation, 65% of serum magnesium is free (ionised), about 20% is protein bound, and the rest is combined with various anions (eg: phosphate and citrate). Magnesium homeostasis is regulated by intestinal absorption (predominantly in the ileum and colon), and renal reabsorption (65-75% by the thick ascending loop of Henle, 15-20% in the proximal tubules). The most commonly used method for assessing magnesium status is total serum magnesium concentration. Spot or 24-hour urine magnesium may be useful in determining hypomagnaesemia due to renal or intestinal wasting.[4]

Table-1 gives the prevalence of hypomagnesemia and its outcomes in various studies done on critically ill patients and the results of this study. Majority of the studies carried out previously have measured total serum magnesium. The prevalence of hypomagnesemia was in the range of 14% to 70%. In the present study 37% critically ill patients were found to have hypomagnesemia. Some studies have measured RBC magnesium as it is a better index of intracellular magnesium as compared with serum magnesium. It is evident from the table that in the two studies which had measured ionized magnesium, (Huijigen et al and Soliman et al)[10] the prevalence of hypomagnesemia was much lower (14% and 18% respectively) whereas in the studies which have measured RBC magnesium the prevalence of hypomagnesemia was higher (20% to 70%). Zaloga GP, Wilkens R et al[14] had measured ultrafiltrable magnesium which approximates ionized magnesium. In a study conducted by Limaye et al, 52% patients had hypomagnesemia.[1]

CONCLUSION

High prevalence of hypomagnesemia in critically ill patients was observed in our study.The Requirement for ventilatory support was significantly higher in hypomagnesemic patients. Hypomagnesemia was strongly associated with sepsis, diabetes mellitus and higher mortality rates and higher APACHE scores.[2] However it was not associated with duration of ICU stay, hospital stay, hypocalcemia and hypokalemia. Limitation of our study was correction of hypomagnesemia by magnesium supplementation and its potential benefit was not attempted and assesed.

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