

Comparison of serum magnesium levels and sequential organ failure assessment score in patients with systemic inflammatory response syndrome

Pranav Ravi Kulkarni, Ashok Raja, Ramkumar Murali, Jagadeesan Mohanan*, Prasanna Karthik Suthakaran, Kannan Rajendran, Mageshkumar Sivanesan, Damodharan Jayachandran
Corresponding author
Jagadeesan Mohanan
drjagadeesan@gmail.com

ABSTRACT

BACKGROUND

Systemic Inflammatory Response Syndrome (SIRS) is an inflammatory condition which affects multiple systems in the body and often occurs as a response which is immunologically mediated by the protective immune system to infectious agent. Magnesium plays a vital role in sepsis and systemic inflammatory response syndrome (SIRS) The aim of this study is to estimate the serum magnesium concentrations in patients with SIRS in the medical ICU, to correlate with prognosis of SIRS patients by comparison with sequential organ failure assessment scoring and to assess the clinical outcome.

MATERIALS AND METHODS

This Observational analytical study was conducted in 100 patients admitted at the medical intensive care unit of Saveetha medical college and hospital, chennai who satisfy the diagnostic clinical criteria for SIRS. Detailed clinical examination was done for each patient. Serum magnesium levels were sent and the results were analysed.

RESULTS

In the study, 100 patients were included. The mean age of the study population was 42.92 ± 16.69 years. 70 % of the patients in the study group were male and 30 % were females. The mortality rate in the hypomagnesemia group was 81.8% where as it was 14.3 % in the normomagnesemia group. There was Significant mortality in the hypomagnesemia group when compared to the normomagnesemia group. The mean duration of ICU stay for patients in the hypomagnesemia group was 5.424 days and in the normomagnesemia group it was 5.286 days. Among 66 patients with hypomagnesemia 50 patients required mechanical ventilation and it was 66 %. Among 28 patients in normomagnesemia group, 2 patients required ventilatory support.

CONCLUSION

Serum magnesium levels have prognostic value in patients diagnosed as SIRS. Serum magnesium concentration shows association with increased mortality rate. There is significant greater need for mechanical ventilation and increased duration of stay under ventilator support in the patients with lower magnesium levels. There is a significant association in prognosticating the patients with SOFA scoring in hypomagnesemia and magnesium correction may improve the outcomes in sepsis and SIRS patients.

Keywords – SIRS, SOFA score ,serum magnesium ,mortality ,mechanical ventilation, hypomagnesemia, normomagnesemia

INTRODUCTION

Systemic Inflammatory Response Syndrome (SIRS) is an inflammatory condition which affects multiple systems in the body and often occurs as a response which is immunologically mediated by the protective immune system to infectious agent. SIRS is closely associated with sepsis, a state wherein the patients satisfy the criteria for SIRS and also when its etiology is suspected to be of infectious nature. Systemic inflammatory response syndrome is a critical state and is associated with systemic inflammatory response, multiple organ injury and organ failure. Two or more of the following clinical or laboratory findings should be present to make a diagnosis of SIRS 1)temperature $<36\text{ }^{\circ}\text{C}$ ($96.8\text{ }^{\circ}\text{F}$) or $>38\text{ }^{\circ}\text{C}$ ($100.4\text{ }^{\circ}\text{F}$),2) Heart rate $>90/\text{min}$,3) Respiratory rate $>20/\text{min}$ or $\text{PaCO}_2 <32\text{ mmHg}$ (4.3 kPa), 4)WBC count $<4 \times 10^9/\text{L}$ ($<4000/\text{mm}^3$) or $>12 \times 10^9/\text{L}$ ($>12,000/\text{mm}^3$), or $>10\%$ band.

The development of the SOFA score was an attempt to objectively and quantitatively describe the degree of organ dysfunction over time and to evaluate morbidity in intensive care unit (ICU) septic patients. The SOFA scoring scheme daily assigns 1 to 4 points to each of the following six organ systems depending on the level of dysfunction: respiratory, circulatory, renal, hematology, hepatic and central nervous system.

Magnesium plays a vital role in sepsis and systemic inflammatory response syndrome (SIRS) especially in seriously decompensated patients in the intensive medical care unit. Hypomagnesemia has been found to be associated with progression towards occurrence of functional impairment of multiple organs and SIRS in patients treated in Intensive medical care unit. Magnesium deficiency leads on to aggravated production of cytokines which favour inflammation. Also production of endothelins is increased.

The aim of this study is 1) to estimate serum magnesium concentrations in patients with Systemic Inflammatory Response Syndrome (SIRS) in the medical ICU, 2) to correlate serum magnesium concentrations with prognosis of SIRS patients by comparison with SOFA scoring.

3) To assess the clinical outcome in patients found to have abnormal magnesium levels in relation to duration of ICU stay, mortality rate, need for mechanical ventilation and duration of ventilator support.

MATERIALS AND METHOD

It is an Observational analytical study, the study was conducted at the medical intensive care unit of Saveetha medical college and hospital, chennai on 100 patients. The study protocol was approved by the institutional ethics committee. Informed consent was taken from them. The patients admitted to the Intensive Medical Care Unit of Saveetha medical college, chennai, who satisfy the diagnostic clinical criteria for Systemic Inflammatory Response Syndrome were included. History of fever and breathlessness was noted. Temperature and other vital signs were recorded. Detailed history and history of other underlying disease conditions including hypertension, diabetes mellitus, ischemic heart diseases, chronic kidney disease, chronic diarrhea was taken. History of chronic drug intake, and other systemic illness were obtained. Patients with chronic kidney disease, on diuretic therapy, history of alcohol abuse, receiving magnesium supplements or magnesium containing antacids, Chronic diarrhea or malabsorptive states were excluded. The diagnosis of SIRS was confirmed for each patient before they were included in the study.

RESULTS;

In the study, 100 patients were included and 44 patients (44%) were in the 21 - 40 yrs age group. (table 1) The mean age of the study population was 42.92 ± 16.69 years. The median age was 41 yrs. The lowest age was 14 years and highest age was 79 years. 70 % of the patients in the study group were male and 30 % were females (table 2).

66% of patients had serum Mg levels less than 1.3, 28% had 1.4 – 2.4 and 6% had more than 2.5. (table 3) The mortality rate in the hypomagnesemia group was 81.8% whereas it was 14.3 % in the normomagnesemia group (table 4). Significantly greater mortality rate was observed in the hypomagnesemia group when compared to the normomagnesemia group.

The mean duration of ICU stay for patients in the hypomagnesemia group was 5.424 days and in the normomagnesemia group it was 5.286 days (table 5). Among 66 patients with hypomagnesemia 50 patients required mechanical ventilation and it was 66 %. Among 28 patients in normomagnesemia group, 2 patient required ventilatory support (table 6). The mean duration of mechanical ventilatory support for the hypomagnesemia group was. 45 days and in the normomagnesemia group was 2 days. The difference is found to be statistically significant. (P value = < 0.001)

Table 7 shows the association of serum magnesium levels and SOFA score. Hypomagnesemia was associated with low SOFA scores and hence higher mortality.

Table 1 – Age distribution of study population

Age in years	No. of cases	Percentage
< 20	6	6
21 – 40	44	44
41 – 60	32	32
> 60	18	18
Total	100	100

Table 2 – Sex distribution of study population

SEX	No. of cases	Percentage
Male	70	70
Female	30	30
Total	100	100

Table 3 – Serum magnesium levels in SIRS

Serum magnesium	No. of cases	Percentage
< 1.3	66	66
1.3 – 2.5	28	28
> 2.5	6	6
Total	100	100

Table 4 – Mortality rate in SIRS

Magnesium	Mortality			
	Yes	Percentage	No	Percentage
< 1.3 (66)	54	81.8	12	18.2
1.3 – 2.5 (28)	4	14.3	24	85.7
> 2.5 (6)	0	0	6	100

Table 5 -Serum magnesium and duration of icu stay of sirs patients

Magnesium	Mean duration
< 1.3 (66)	5.424
1.3 – 2.5 (28)	5.286
> 2.5 (6)	5.333

Table 6 – Serum magnesium and need for mechanical ventilation in SIRS

Magnesium	Ventilation Needed	
	No. of cases	Percentage
< 1.3 (66)	50	66
1.3 – 2.5 (28)	2	7.1
> 2.5 (6)	0	0

Table 7- Serum magnesium and its correlation with sofa scoring

Sr magnesium levels	SOFA SCORE 19-24	SOFA SCORE 10-18	SOFA SCORE 0-9
<1.3(66)	48	14	4
1.3-2.5(28)	12	6	10
>2.5(6)	2	1	3

DISCUSSION

Magnesium is a vital electrolyte in the normal metabolism of the human body. The deficiency of magnesium can lead on to disastrous consequences if not detected at the right time and is supposed to be an important underestimated electrolyte abnormality especially in the intensive care unit setting. Sepsis is an independent risk factor for developing hypomagnesemia during ICU stay as reported by Soliman et al⁵.

The deficiency of magnesium has been associated with the occurrence of Systemic Inflammatory Response Syndrome (SIRS). Sepsis, which is SIRS which has got an infectious etiology is supposed to be associated with hypomagnesemia. The purpose of this study was to estimate serum magnesium levels in the SIRS patients who have been admitted to the medical intensive care unit and to assess the prognostic value of serum magnesium in these patients by comparison with SOFA score.

The study was done on 100 patients and the mean age in this particular study was 42.92 ±16.69 yrs. Most of the patients in the study was in the age group of 21-40 yrs and the least number were in the age group less than 20 yrs. In this study hypomagnesemia was found in 66 % of patients

The previous studies have measured the total serum magnesium and the prevalence of hypomagnesemia was in the range of 14 to 70 %. The prevalence of magnesium deficiency in seriously ill patients in a study done by Mousavi et al in Tehran, Iran was 33 %.

The association between serum magnesium levels and mortality while in the intensive care unit was an important aspect of this study. In this study in patients with hypomagnesemia the mortality rate was 81.8 % and in patients with normal serum magnesium levels the mortality rate was found in this study to be 14.3% and

was found to be statistically significant. The association between magnesium levels and mortality rate has been found to vary in different studies. Also magnesium supplementation may be beneficial in lowering the mortality rate.

In the study conducted by Rubeiz G et al¹, Soliman et al⁵ it was found that there was increased mortality rate in the setting of hypomagnesemia occurring in the intensive care unit. In the study conducted by Guerin et al² it was found that there was no difference in ICU mortality between patients with hypomagnesemia and patients with normal serum magnesium levels. The higher mortality rate in patients with hypomagnesemia may be due to multiple other factors also like cardiac rhythm disturbances and hypokalemia. Also the association of hypomagnesemia with sepsis and SIRS may be another cause for the observed increased mortality rate in the study.

The difference in the duration of ICU stay was studied and it was found that in the patients with low magnesium levels the mean duration of ICU stay was 5.424, in the normomagnesemia group it was 5.286. The hypermagnesemia group had mean duration of ICU stay of 5.333.

Prolonged mechanical ventilator dependence has been reported in hypomagnesemia patients in previous studies. In this study duration of mechanical ventilation was significantly more in the hypomagnesemia group than in the patients with normal serum magnesium levels.

Fiaccordori et al¹⁶ in his study had shown that patients with hypomagnesemia needed ventilator support for more days. Patients with low serum magnesium has high SOFA score on admission and on daily follow up had poor outcome and increased mortality rate. whereas patients with normal serum magnesium and hypermagnesemia has low SOFA scores and had better outcome.

CONCLUSION

Serum magnesium levels have prognostic value in the patients diagnosed as SIRS in the ICU setting. Serum magnesium concentration shows association with increased mortality rate in the critical care unit. There is significant greater need for mechanical ventilation and increased duration of stay under ventilator support in patients with lower magnesium levels. The duration of ICU treatment was not significantly related with the serum magnesium concentration. There is a significant association in prognosticating the patients with SOFA scoring in hypomagnesemia and definite magnesium correction is indicated to improve the outcomes in sepsis and SIRS patients.

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AUTHORS CONTRIBUTIONS:

‘Author 1’ designed the study, performed the statistical analysis, wrote the protocol, and wrote

the first draft of the manuscript. ‘Author 2,3 ’ managed the literature search, analyses of the study and final approval. All authors read and approved the final manuscript.”

CONSENT FORM: NA

ETHICAL APPROVAL: OBTAINED

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