http://jmscr.igmpublication.org/home/
ISSN (e)-2347-176x ISSN (p) 2455-0450
crossref DOI: https://dx.doi.org/10.18535/jmscr/v12i08.13

IGM Publication
Journal Of Medical Science And Clinical Research
An Official Publication Of IGM Publication

Original Research Article

Serum Magnesium level with SOFA score in predicting the Prognosis among Acute Coronary Syndrome patients and its associated complications in tertiary care centre

Authors
Dr Uthaya Sankar M. K[1], Dr Vidhya B[2]*, Dr Adrin Suthir A[3]
[1]Professor and Unit Chief, [2,3]Post Graduate Resident
Department of Internal Medicine
Sri Manakula Vinayagar Medical College and Hospital – Puducherry
*Corresponding Author
Dr Vidhya B[2]

Abstract

Introduction: *Magnesium is an essential element in functioning human body. Low magnesium is associated with membrane destabilization, whereas high concentrations are membrane stabilizing and therefore, antiarrhythmic. Acute coronary syndrome comprises of ST segment elevated myocardial infarction (STEMI), non-ST segment elevated myocardial infarction (NSTEMI) and unstable angina where the blood flow to the heart is decreased. Magnesium plays important role in Sepsis and attributed to its effects on Immune System. Hypomagnesemia is commonly observed in patients admitted to Intensive Care Unit*

Aim: *To find the prevalence of Serum Magnesium levels with SOFA score in assessing the prognosis in Acute Coronary Syndrome patients and its associated complications.*

Methodology: *This is hospital-based cross-sectional study. The sample size was calculated to be 77. All patients of age more than 18 years who are diagnosed to have Acute Coronary Syndromes were included in this study after screening for the exclusion criteria. After written consent, all patients were subjected into study. Clinical presentation and demographic profile and lab parameters were assessed.*

Results: *In this study of 77 patients the mean age was 60 ± 10.8; age group between 51-70 had highest proportion of 57%. About 71.40% are male, while 29% are female. Chest pain observed in 100% of patients while palpitation seen in 98.7%. Highest proportion of comorbidity seen in Type 2 Diabetes 90%, followed by Systemic Hypertension at 64%. The majority of patients across most variables fall into the Normomagnesemia category. The differences in distribution of age, gender, comorbidities, Troponin I status, and ECG changes & SOFA score across the magnesium levels categories are not statistically significant, as indicated by the P values being greater than 0.05. These patients did not develop any arrhythmic complications.*

Conclusion: *This study showed no significant relationship between the Serum Magnesium and SOFA score and good prognosis among patients with acute coronary syndrome. However, further studies are required to increase the understanding of the association between Serum Magnesium and SOFA score in various study settings to diagnose the patient earlier and take necessary preventive measures and treatment to prevent the occurrence of complications.*

Keywords: *Acute coronary syndrome, Serum Magnesium, SOFA score, Normomagnesemia.*

Introduction

Magnesium is an essential element of the functioning human body; adult's body contains almost 24 g of magnesium, with 50%-60% present in the bones and the rest present in soft tissues. The serum magnesium level represents less than 1% of the total body magnesium.

The deficiency of magnesium can evoke hyperlipidemia and subsequently, atherogenic deposits in coronary arteries leading to atherosclerosis. Hence, it is crucial for the cardiovascular system. Low magnesium concentration within the myocardial cell is associated with membrane destabilization, whereas high concentrations are membrane stabilizing and therefore, antiarrhythmic[(1)].

The incidence of abnormalities of Magnesium occurring in critically ill patients in ICU is 65%.Hypomagnesemia is caused by conditions like inadequate dietary magnesium intake and gastrointestinal and renal disorders and correlates with increased morbidity and mortality in hospitalized patients and correlates with prolonged duration of ICU stay, increased need and time of requirement of mechanical ventilation (MV), increased incidence of sepsis and other electrolyte disturbances (hypocalcemia and hypokalemia)[(2)].

Methods

Study Design

This hospital-based cross-sectional study was conducted among patients who are diagnosed as Acute Coronary Syndromes admitted in Medical ICU from department of General Medicine in SMVMCH a tertiary care centre in Puducherry from December 2023 to May 2024.

Patients included in this study were those who are diagnosed to have Acute Coronary Syndromes (ACS) (ACUTE STEMI/ NSTEMI/ UNSTABLE ANGINA) with age more than 18 years and less than 75 years and comorbidities such as Type 2 Diabetes Mellitus and Systemic Hypertension. Patients with Chronic Kidney Disease, documented hypomagnesemia / hypermagnesemia before admission, previous magnesium supplementation, mortality within 24 hours of admission to ICU were excluded. The sample size was calculated to be 77 based on the prevalence of 60% of MI in patients seen in the study by Mercedes Sotos - Prieto et al.

After the informed and written consent, the patients were asked to inquire about the basic demographic details of the patients, such as name, age, gender, followed by a brief history of the patient explored in that the patient was inquired about the presence of the type 2 diabetes mellitus, hypertension, smoking and alcoholic history and the presence of acute coronary syndrome were confirmed based on the electrocardiogram. Then, all the patients were subjected to a Troponin I card test. The patients were then evaluated on the Serum Magnesium level, Complete Blood Count, Renal Function Test and ABG, Serum Bilirubin from the venous sample taken on the anti-cubital vein. All the samples were taken on the same day of admission to the hospital within 2 hours, and all the samples were processed within one hour after taking the blood samples.

Serum Magnesium levels will be corelated with Severity of SOFA score in Acute Coronary Syndromes patients. These patients will be further divided into Hypomagnesemia, Normomagnesemia, Hypermagnesemia and analysed with SOFA scores.

Ethical declaration

All the procedures performed in this study involving the human participants were done by the ethical standards of the Internal Human Ethics Committee and the Scientific Research Committee of the Sri Manakula Vinayagar Medical College and Hospital, Puducherry, Puducherry, via reference no. SMVMCH-EC/ECO/AL/195/2024 and National Research Committee, 1964. Helsinki Declaration and its latest amendments.

Statistical analysis

All the data were entered in Microsoft Excel and analysed via the SPSS software version 25.0. and the independent t-test was used to compare the means, and the p-value of <0.05 is considered statistically significant.

Results

A total of 77 patients participated in the study. The mean age of the patients with ACS was found to be 60 ± 10.8. 57% of the patients who participated in the study were more than 50 years old, and more than half of the patients (71.40%) were males, whereas the female contributed 29% only. Chest pain observed in 100% of patients while palpitation seen in 98.7% followed by 83.1% are Dyspnoeic, Type 2 DM was present in 90% of the patients, whereas hypertension were present in only 64% of the patients.

Table:1: Comparison of Socio demographic details, Comorbidity & Clinical Parameters with Serum Magnesium levels (N=77)

S.no	Variable	Category	Hypomagnesemia	Normomagnesemia	Hypermagnesemia	P value*
1.	Age	30- 50	5	15	1	0.3
		51- 70	7	36	1	
		>71	5	7	0	
2.	Gender	Male	13	40	2	0.5
		Female	4	18	0	
3.	Comorbidity	SHTN	13	34	2	0.9
		T2DM	16	51	2	
		CKD	2	4	0	
1.	Troponin I	Positive	10	28	1	0.7
		Negative	7	30	1	
2.	ECG changes	Unstable Angina	7	31	2	0.6
		STEMI	6	17	0	
		NSTEMI	4	10	0	

Chi-square test*

Fig: 1: Relation between ECG changes vs Serum Mg levels

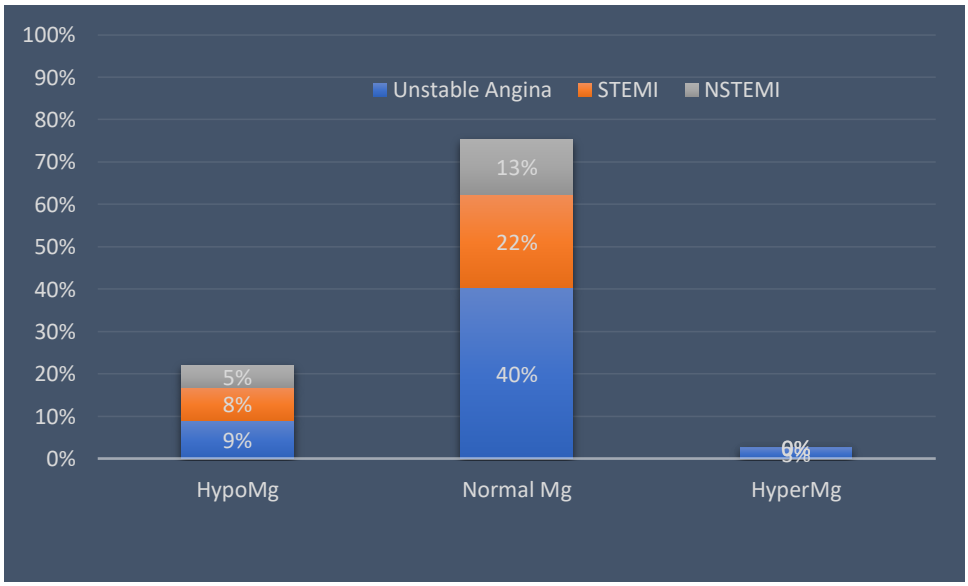

Fig: 2: Relation between Serum Magnesium levels and SOFA Score

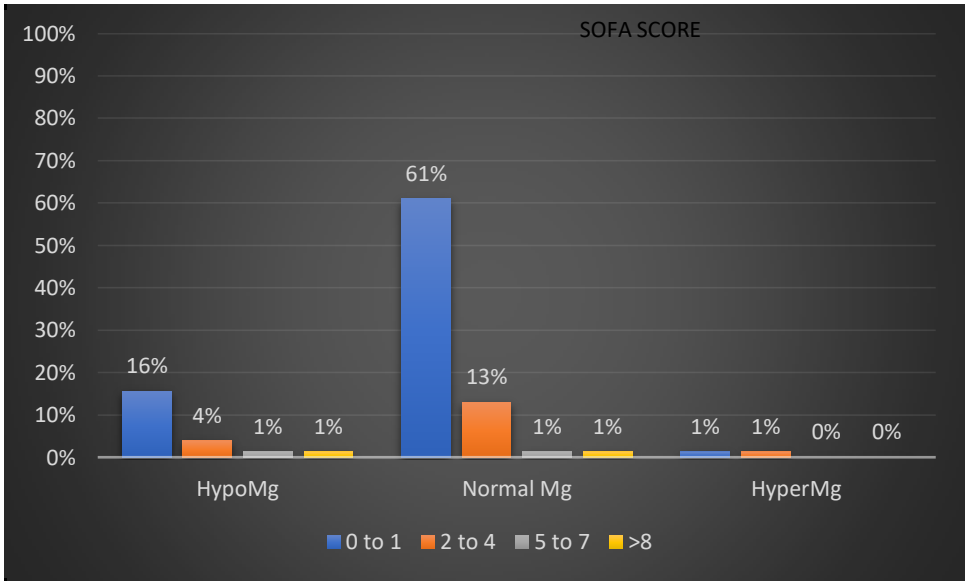

Table: 2: Correlation between Serum Magnesium levels and SOFA Score (N=77)

S.no	Variable	Category	Hypomagnesemia	Normomagnesemia	Hypermagnesemia	r value	p value
1.	SOFA Score	0-1	12	47	1	-0.1	0.2
		2-4	3	10	1		
		5-7	1	1	0		
		>8	1	0	0		

Table: 3 Comparison of ECG changes with SOFA Score (N=77)

S.no	ECG changes	SOFA SCORE				P value
		0-1	2-4	5-7	>8	
1.	Unstable Angina	31	8	0	1	0.10
2.	STEMI	15	6	2	0	
3.	NSTEMI	14	0	0	0	

Discussion

Acute Myocardial Infarction (AMI) also known as Acute Coronary Syndrome (ACS) is the leading cause of global deaths over the years [(3)]. Most of it occurs more at the early stage of ICU patients since the high incidence of malignant arrhythmias. However, the exploration of the early-stage biomarker to ICU patients is critical for indicating the risk of in hospital death[(4)].

More importantly, serum magnesium is an easily detected, cheap laboratory marker that is used as early-stage biomarker in predicting In hospital death in AMI patients[(5)].

Tan L et al conducted a study with 9005 patients with AMI revealed that serum magnesium levels at 2.2 to ≤2.4 and more than 2.4 mg/dL were both significant predictors of all-cause in-hospital mortality. Furthermore, a level of 2.2 to ≤2.4 of serum magnesium showed a higher risk of in-hospital mortality compared to a level of more than 2.4 mg/dL[(6)]

In our study, the normal range for serum magnesium was set at 1.6-2.6 mg/dL and we found that the majority of patients across most variables fall into the Normomagnesemia category at time of admission. The differences in distribution of age, gender, comorbidities (SHTN, T2DM, CKD), Troponin I status, and ECG changes across the magnesium status categories are not statistically significant, as indicated by the P values being greater than 0.05 as evident from Table:1

Lakshman Lal et al conducted a study in 40 patients with diagnosed case of acute myocardial infarction and found that Serum magnesium concentration in acute myocardial infarction group ranged from 0.42 to 1.56 mg/l with a mean value of 1.01 mg/l and it is statistically significant (P < 0.01). Thus the study concluded that 80% of patients have hypomagnesemia within first 48 h after a heart attack [7]. In our study, only 22% of patients have Hypomagnesemia (serum magnesium level <1.6mg/dl) at the time of admission.

Vineesha Gonuguntla et al study showed that the incidence of hypomagnesemia and hypermagnesemia was 40.9 and 13.9% respectively in patients with sepsis admitted to the ICU. Hypomagnesemia (HypoMg) was associated with significantly higher mortality (51.3%) as compared to normomagnesemia (NormoMg) (29.3%) and hypermagnesemia (HyperMg) (23.1%) (HypoMg vs NormoMg, HypoMg vs HyperMg, p = 0.001, 0.002 respectively). The association of baseline SOFA scores with serum Mg levels was statistically significant (p = 0.001)[8].

In our study from Fig.2, and Table: 2, indicates that there is no strong correlation between SOFA scores and magnesium levels, as evidenced by the r value of -0.1 and a p value of 0.2, suggesting no statistically significant relationship. The majority of patients, regardless of SOFA score, tend to fall into the normomagnesemia category. This observation is particularly prominent in patients with lower SOFA scores (0-1). However, as the SOFA score increases, the number of patients in each category decreases, limiting the ability to draw definitive conclusions for higher SOFA scores.

Also from Fig.1, Table: 3, it is evident that Unstable Angina seen in most patients (31) have a SOFA score of 0-1, with fewer patients having scores of 2-4 (8), and very few having scores >8 (1). No patients have scores of 5-7. In STEMI, The majority of patients (15) have a SOFA score of 0-1, with some patients having scores of 2-4 (6) and a few having scores of 5-7 (2). No patients have scores >8. In NSTEMI, All patients have a SOFA score of 0-1 (14), with no patients having higher scores The P value for the distribution across the ECG changes is 0.10, indicating that the differences in SOFA scores across these ECG changes are not statistically significant.

During this study, there is no patients had developed any arrhythmic complications and there is no mortality. Our study showed majority of patients fall into Unstable Angina, and into the Normomagnesemia category. This observation is most prominent in patients with lower SOFA scores (0-1). Thus this study implicates that there is no strong correlation between ACS and SOFA scores and magnesium levels, suggesting no statistically significant relationship.

Limitation

The study was conducted in a single centre with relatively few patients. The inflammatory factors, malnutrition, natriuretic peptides, and other laboratory parameters associated, which were not evaluated.

Conclusion

This study implicates that there is no strong correlation between ACS and SOFA scores and magnesium levels, suggesting no statistically significant relationship between the Serum Magnesium levels and SOFA score and good prognosis among patients with acute coronary syndrome. However, further studies are required to increase the understanding of the association between Serum Magnesium and SOFA score in various study settings to diagnose the patient earlier and take necessary preventive measures and treatment to prevent the occurrence of complications.

References

1. Sabah Z, Wani J, Deajim M, Zomia AS, Asiri A, et al. Serum Magnesium in

Patients With Acute Myocardial Infarction and Its Effect on Cardiac Complications and Mortality in Myocardial Infarction Patients. Cureus. 2023 Apr 26;15(4).

2. Huijgen HJ, Soesan M, Sanders R, Mairuhu WM, Kesecioglu J, Sanders GT. Magnesium levels in critically ill patients. What should we measure? Am J Clin Pathol 2000;114(5):688–695. DOI: 10.1309
3. Barnett R. Acute myocardial infarction. Lancet. (2019) 393:2580. doi: 10.1016/S0140-6736(19)31419-9.
4. Valley TS, Iwashyna TJ, Cooke CR, Sinha SS, Ryan AM, Yeh RW, et al. Intensive care use and mortality among patients with ST elevation myocardial infarction: retrospective cohort study. BMJ. (2019) 365:l1927. doi: 10.1136/bmj.l1927.
5. Sanders GT, Huijgen HJ, Sanders R. Magnesium in disease: a review with special emphasis on the serum ionized magnesium. Clin Chem Lab Med. (1999) 37:1011–33. doi: 10.1515/CCLM.1999.151.
6. Tan L, Xu Q, Li C, Liu J, Shi R: High-normal serum magnesium and hypermagnesemia are associated with increased 30-day in-hospital mortality: a retrospective cohort study. Front Cardiovasc Med. 2021, 8:625133.
7. Lal L, Murmu H. Serum Magnesium in Patients with Acute Myocardial Infarction. Int J Sci Stud 2016;4(3):167-169.
8. Gonuguntla V, Talwar V, Krishna B, Srinivasan G. Correlation of Serum Magnesium Levels with Clinical Outcome: A Prospective Observational Study in Critically Ill PatientsAdmitted to a Tertiary Care ICU in India. Indian Journal of Critical Care Medicine: 2023 May;27(5):342.
9. Sotos-Prieto M, Baylin A, Campos H, Qi L, Mattei J. Lifestyle cardiovascular risk score, genetic risk score, and myocardial infarction in Hispanic/Latino adults living in Costa Rica. Journal of the American Heart Association. 2016 Dec 20;5(12):e004067.
10. Hasan MZ, Nahar K, Sharif JU, Paul SC, Thakur AK, Mahmud A, Siddique NA, Islam MR, Paul GK. Serum Magnesium Level and It's Relation in Predicting Adverse In-Hospital Outcome in Patients with First Attack of Myocardial Infarction. Mymensingh Medical Journal: MMJ. 2023 Jan 1;32(1):65-72.
11. Upala S, Jaruvongvanich V, Wijarnpreecha K, Sanguankeo A. Hypomagnesemia and mortality in patients admitted to intensive care unit: a systematic review and meta-analysis. QJM: An International Journal of Medicine. 2016 Jul 1;109(7):453-9.
12. Chen M, et al,The influence of serum magnesium level on the prognosis of critically ill patients 2015 Mar.
13. Singh A, Museedi AS, Grossman SA. Acute Coronary Syndrome. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2024 [cited 2024 Mar 21].
14. Kumar A, Cannon CP. Acute Coronary Syndromes: Diagnosis and Management, Part I. Mayo Clin Proc. 2009 Oct;84(10):917–38.
15. Sreeniwas Kumar A, Sinha N. Cardiovascular disease in India: A 360-degree overview. Med J Armed Forces India. 2020 Jan;76(1)
16. Antman EM, Anbe DT, Armstrong PW, Bates ER, Green LA, Hand M, et al. ACC/AHA guidelines for the management of patients with ST-elevation myocardial infarction. Circulation. (2004) 110:588–636. doi: 10.1161/01.CIR.0000134791.68010.