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ORIGINAL ARTICLE

Frequency of hypomagnesemia in patients presenting with acute coronary syndrome.

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ABSTRACT… Objective: To assess the rate of hypomagnesemia in patients presenting with ACS in a local population. **Study Design:** Cross Sectional Descriptive study. **Setting:** Faisalabad Institute of Cardiology (FIC), Faisalabad. **Period:** 17th January 2022 to 16th July 2022 (six months). **Methods:** Nonprobability consecutive sampling was used to enroll 185 ACS patients, aged 35–80 years. Excluded patients were those on diuretics, alcoholics or with malabsorption. Hypomagnesemia was defined as serum magnesium levels below normal range (1.7 to 2.5 mg/dl) and were measured in all patients. Chi square tests were used to explore the relationships of the data through SPSS version 21. **Results:** A total of 185 patients (mean age 57.67±10.70 years, 65.4% male) had a mean serum magnesium level of (1.81±0.31 mg/dl). Out of 185 patients, hypomagnesemia was seen in 34 (18.4%) patients. Prevalence was 21.1% in unstable angina, 15.4% in STEMI, and 20.3% in NSTEMI, with no significant association (p=0.665, across ACS types). No significant correlation was seen between hypomagnesemia and age, gender, and BMI (p>0.05). **Conclusion:** Hypomagnesemia was seen in (18.4%) of ACS patients, and no significant correlation was seen with demographic or clinical characteristics. Hypomagnesemia in ACS patients merits routine screening to help identify high-risk individuals so that management strategies can be guided.

Key words: Acute Coronary Syndrome, Hypomagnesemia, Serum Magnesium, Unstable Angina.

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INTRODUCTION

The group of conditions due to an acute, total or partial occlusion of the coronary arteries, caused by acute decreased blood flow to the coronary artery, is known as acute coronary syndrome (ACS). ACS is a broad spectrum ranging from STEMI (30%), NSTEMI (25%), U.A. (38%), depending on Cardiac Biomarkers of myocardial necrosis (Troponin T, Troponin I and CKMB) to ECGs in patients with acute cardiac chest pain.[1] ACS may occur with or without electrocardiographic changes and without elevations of biochemical markers, but when the diagnosis is supported by a history of previously documented coronary artery disease or by confirmatory investigations.[2] About 4% of the body intracellular cation is magnesium. Plasma concentration levels in normal adult range from 1.7 to 2.5 mg/dl. The large majority of the body's reserves lie within the skeletal mass.[3] Magnesium provides ion stabilizing effect to help maintain stable intra and extracellular concentrations of other electrolytes. Significant alterations in magnesium (Mg +2) and other electrolytes have been documented in studies of patients with Acute Myocardial Infarction and also functional deficit of available magnesium from trapping of free magnesium in adipocytes because soaps are formed when free fatty acids are released during lipolysis by catecholamines.[4-5]

A couple of years ago in a study published in the Journal of Internal Medicine[6] a low serum magnesium level was a significant independent predictor of all cause and cardiovascular mortality independently of preexisting cardiovascular risk factors including diabetes and hypertension in a sample from a northern German based population. More recently it has been shown that low serum magnesium is found commonly in about 12% of hospitalized patients and as much as 60 to 65% among intensive care patients. Low serum magnesium is being talked about widely as having a link with ACS and its real role is being questioned.[1]

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The frequency of hypomagnesaemia in ACS in one study was 8.2%.[7] However, the results on serum magnesium value in a subsequent study showed that 22%[8] cases were suffering from hypomagnesemia. Another study that measured serum magnesium level showed 24.7% of cases were suffering from hypomagnesaemia.[9] Another study on serum magnesium level showed hypomagnesemia in 12.5% of patients with STEMI and 9.7% with UA.[10]

The rationale of this study sought to assess the frequency of hypomagnesaemia in patients with ACS in local population. The frequency of hypomagnesemia in ACS patients was found to be low in literature with controversial evidence.[7,9] In order to find out to what extent this frequency is seen in our ACS population, we conducted this study with the recommendation of screening ACS patients for hypomagnesemia.

METHODS

This research was carried out as a cross sectional descriptive study at the Emergency Cardiology Department of Faisalabad Institute of Cardiology, Faisalabad. The research synopsis was approved by ethical review committee (12-2018/IMEC/FIC/FSD) and study done on interval of 17th January 2022 to 16th July 2022 (six months). The aim was to evaluate the frequency of hypomagnesemia in patients with ACS. By using a 95% confidence interval, with a 5% margin of error with an anticipated prevalence of hypomagnesemia of 8.2% in ACS patients, a sample size of 185 cases was calculated. The study used non probability consecutive sampling to select the participants. Patients aged between 35 and 80 years and either gender were included if they presented with active ACS, as defined by the operational definition, within 12 hours of symptoms onset. Patients who received diuretics, had history of alcoholism or malabsorption (medical records) or abuse of laxatives or patients with malnutrition (medical records) were excluded.

Patients were enrolled into the study from the FIC emergency department after giving informed consent. Demographic data were obtained as detailed name, age, gender, BMI and type of ACS, along with contact information. The 3cc BD syringes drew off blood under strict aseptic conditions and blood samples were placed in sterile containers in the laboratory in order to analyze serum magnesium levels. Hypomagnesemia was identified in the presence of magnesium levels below the normal range, as defined by the operational definition, when samples were processed in the hospital's laboratory. The results of all finding were systematically coded on a pre designed Performa.

SPSS version 21 was used to perform a data analysis. Age, BMI and gender were presented as Mean ± Standard Deviation and type of ACS and hypomagnesemia as frequencies and percentages. Data were stratified by age, gender, BMI and type of ACS to explore associations. The chi square test was performed post stratification to compare frequency of hypomagnesemia among different subgroups. The statistical significance was judged to be at $p \leq 0.05$. Findings were intended to contribute to the burden of hypomagnesemia in ACS patients, to support clinical management and decision-making in a high risk population.

RESULTS

The study included a total of 185 patients with acute coronary syndrome, with a mean age of 57.67±10.70 years (range: 35 to 80). Among the participants, 121 (65.4%) were male, and 64 (34.6%) were female. The mean BMI was 26.33±1.99 kg/m² (range: 19.87 to 32.87), and the mean serum magnesium level was 1.81±0.31 mg/dl (range: 1.0 to 3.2). Regarding the type of acute coronary syndrome (ACS), 78 patients (42.2%) presented with STEMI, 69 (37.2%) with NSTEMI, and 38 (20.5%) with unstable angina. Hypomagnesemia was observed in 34 patients (18.4%), while 151 patients (81.6%) had normal magnesium levels. Table-I

In this study, hypomagnesemia was observed in 34 out of 185 patients (18.4%). Among age groups, 11 patients aged 35–50 years (20.4%), 17 aged 51–65 years (19.8%), and 6 aged 66–80 years (13.3%) had hypomagnesemia, showing an overall insignificant association (p=0.601). Gender-wise, 21 males (17.4%) and 13 females (20.3%) had hypomagnesemia, with no significant difference (p=0.621). Regarding BMI, hypomagnesemia was present in 7 patients with normal BMI (14.3%), 27 overweight patients (20.3%), and none among

obese patients (0.0%), also statistically insignificant (p=0.461). Among acute coronary syndrome (ACS) types, hypomagnesemia was found in 8 patients with unstable angina (21.1%), 12 with STEMI (15.4%), and 14 with NSTEMI (20.3%), showing no significant correlation (p=0.665). Table-II

TABLE-I

Demographic characteristics, clinical presentations of patients with acute coronary syndromes (n=185)

Variables	Number	Percentage	Mean ± SD	Range
Age	-	-	57.67±10.70	35 to 80
Gender:			-	-
Male	121	65.4%		
Female	64	34.6%		
BMI (kg/m²)	-	-	26.33±1.99	19.87 to 32.87
Magnesium level (mg/dl)	-	-	1.81±0.31	1.0 to 3.2
Type of ACS:			-	-
STEMI	78	42.2%		
NSTEMI	69	37.2%		
Unstable Angina	38	20.5%		
Hypomagnesemia			-	-
Yes	34	18.4%		
No	151	81.6%		

TABLE-II

Prevalence of hypomagnesemia across demographics and clinical factors (n=185)

		Age (years)			Total
		35-50 n=54	51-65 n=86	66-80 n=45	
Hypomagnesemia	Yes	11 (20.4%)	17 (19.8%)	6 (13.3%)	34 (18.4%)
	No	43 (79.6%)	69 (80.2%)	39 (86.7%)	151 (81.6%)
P-value		**0.601 (Insignificant)**			

		Gender		Total
		Male n=121	Female n=64	
Hypomagnesemia	Yes	21 (17.4%)	13 (20.3%)	34 (18.4%)
	No	100 (82.6%)	51 (79.7%)	151 (81.6%)
P-value		**0.621 (Insignificant)**		

		BMI			Total
		Normal n=49	Overweight n=133	Obese N=3	
Hypomagnesemia	Yes	7 (14.3%)	27 (20.3%)	0 (0.0%)	34 (18.4%)
	No	42 (85.7%)	106 (79.7%)	3 (100.0%)	151 (81.6%)
P-value		**0.461 (Insignificant)**			

		Types of ACS			Total
		Unstable angina n=38	STEMI n=78	NSTEMI n=69	
Hypomagnesemia	Yes	8 (21.1%)	12 (15.4%)	14 (20.3%)	34 (18.4%)
	No	30 (78.9%)	66 (84.6%)	55 (79.7%)	151 (81.6%)
P-value		**0.665 (Insignificant)**			

DISCUSSION

There is a demonstrated role for magnesium in the action of more than 300 enzymes and many diverse diseases including cardiovascular disorders.[11,12] Magnesium has also been linked to coronary artery disease prognosis.[11]

In present study patients' mean age was 57.67±10.70 years. Cases were stratified by age of patients (aged 35-50 years). Total of 11 patients (20.4%) were hypomagnesemic and 43 (79.6%) had normal magnesium levels. Hypomagnesemia was present in 17 (19.8%) patients and normal magnesium level in 69 (80.2%) patients 51to 65 years of age. It was 6 (13.3%) in patients aged 66 - 80 years and 39 (86.7%) had normal magnesium level. The mean difference was not significant (p>0.05). Previous studies have demonstrated that hypomagnesemia is a common electrolyte abnormality in ACS patients, and hypomagnesemia is a predictor of poor cardiovascular outcomes including arrhythmias and risk of mortality. Nevertheless, the results obtained in this study do not show a pronounced difference in the value of magnesium for ACS patients across the different age groups, and the thus reported lack of a significant difference across age groups in this study can be interpreted that the factors other than age also have a substantial impact on the level of magnesium in ACS patients.[13]

Furthermore, the observed prevalence of hypomagnesemia in this study (13.3–20.4%) aligns with some earlier findings but is relatively lower compared to reports in populations with more severe ACS or advanced comorbidities. This discrepancy may reflect differences in study populations, methodology, or regional dietary magnesium intake.[14]

In present study, we had 121 (65.4%) males and 64 (34.6%) females. For gender of patient, the data was stratified. Among male patients, hypomagnesemia was found in 21 patients (17.4%), and 100 patients (82.6%) had normal magnesium level. Hypomagnesemia was observed in 13 (20.3%) of female patients and normal magnesium was present in 51 (79.7%) female patients. This difference was not significant (p>0.05). Although in our findings, hypomagnesemia seems slightly higher in female patients than male patients. In patients with acute coronary syndromes, however hypomagnesemia did not reportedly depend on gender suggesting that gender did not affect hypomagnesemia in these subjects.[15] This is consistent with the notion that hypomagnesemia is a known risk factor in cardiovascular disease, but that its prevalence may not be strongly unilateral by gender.[16]

In our study, Patients were (26.33±1.99 kg/m2) in terms of mean BMI. The patient's data was stratified based on BMI. Hypomagnesemia was found in 7 (14.3%) patients whereas 42 (85.7%) had normal magnesium level in patients with normal BMI. Hypomagnesemia was seen in 27 (20.3%) and normal magnesium in 106 (79.7%) in overweight patients. There were 0 (0.0%) obese patients with hypomagnesemia and 3 (100%) obese patients with normal magnesium level. The difference was not significant (p>0.05). The observed lack of hypomagnesemia in obese patients contrasts with other studies suggesting a potential link between obesity and hypomagnesemia possibly due to chronic inflammation or insulin resistance.[17]

However, the limited sample size for obese patients in this study (n=3) may have skewed the results, underscoring the need for larger cohorts to determine a more definitive association. Interestingly, the highest prevalence of hypomagnesemia occurred in overweight individuals, which could suggest a subtle metabolic interplay influencing magnesium homeostasis in this subgroup.[18] Nevertheless, the overall findings align with other literature[19-20] indicating that BMI alone may not serve as a robust predictor for hypomagnesemia in ACS patients.

In present study, mean magnesium level of patients was (1.81±0.31 mg/dl). 34 patients (18.4%) were found to have hypomagnesemia, and 151 (81.6%) had normal magnesium level. In a previous study, the incidence of hypomagnesaemia in patients presenting with ACS was reported as 8.2% and in another study hypomagnesaemia was reported in 22% of the patients with ACS.[7,8] A study of serum magnesium levels found (24.7 %) cases suffering from hypomagnesaemia.[9] Hypomagnesemia was found in 12.5 % of STEMI, 9.7 % of UA, 29.7 % of NSTEMI in another study[10] and it was proven

that 6.9–11 % of hospitalized patients with acute myocardial infarction had a lack of magnesium.[10,11]

In present study data was stratified by type of ACS which reported 38 (20.5%) patients with unstable angina, 78 (42.2%) with STEMI and 69 (37.3%) with NSTEMI. Hypomagnesemia was seen in 8 (21.1%) and normal magnesium in 30 (78.9%) patients of unstable angina. Hypomagnesemia occurred in 12 (15.4%) and normal magnesium level in 66 (84.6%) of patients with STEMI. Hypomagnesemia occurred in 14 (20.3%) patients with NSTEMI and 55 (79.7%) had normal magnesium level. This difference was insigficant ($p>0.05$).

Using data collected by Makoui and Taneva[2], hypomagnesemia was present in 23.6% patients of ACS.[12] Furthermore, Purvis and Movahed[21] reported they have found hypomagnesemia in 7.7% patients with ACS. It is known that hypomagnesemia exists in ACS patients. The proper supplementation should be taken in time after early assessment of serum magnesium.

Hypomagnesemia and ACS

Several studies have highlighted the role of magnesium in cardiovascular health. Hypomagnesemia is associated with arrhythmias, increased platelet aggregation, and vascular spasm, all of which contribute to the pathophysiology of ACS. For example, a study by Yusuke et al[22] reported a higher prevalence of hypomagnesemia in ACS patients compared to controls, emphasizing its role in adverse outcomes. However, our findings demonstrate a relatively lower prevalence of hypomagnesemia in ACS subtypes, aligning with study that suggest magnesium levels may not significantly vary by ACS type.

ACS Subtypes and Magnesium Levels

Previous research indicates mixed findings regarding magnesium levels in specific ACS subtypes. In contrast to our results, a study by Misbah et al[23] noted a higher prevalence of hypomagnesemia in STEMI patients compared to NSTEMI suggesting a potential subtype-specific relationship. Our study, however, found no significant difference between STEMI and NSTEMI in hypomagnesemia prevalence, which could be attributed to differences in population demographics, sample size, or methodologies.

Unstable Angina and Magnesium Deficiency

Our finding of 21.1% hypomagnesemia in unstable angina patients is consistent with studies like Dr. Uthaya et al[24] which linked hypomagnesemia with unstable angina but found the prevalence to vary widely depending on the severity and chronicity of the condition. The insignificant difference in magnesium levels across ACS subtypes in our study highlights the need for further exploration into whether hypomagnesemia's role is primarily a marker of systemic inflammation or a direct contributor to the pathogenesis of ACS.

Clinical Implications

Despite the lack of significant differences in magnesium levels between ACS subtypes, the overall prevalence of hypomagnesemia (18.4%) in this cohort underscores the need for routine monitoring of magnesium levels in ACS patients. This aligns with recommendations from studies like Harsha[25] which advocate for magnesium supplementation as part of ACS management to mitigate complications like arrhythmias.

CONCLUSION

This study revealed that hypomagnesemia was present in 18.4% of patients presenting with acute coronary syndromes (ACS) in a local population. No significant associations were found between hypomagnesemia and age, gender, BMI, or type of ACS. These findings suggest the importance of screening for hypomagnesemia in ACS patients to identify potential risks and guide management strategies. Further research is recommended to explore the clinical implications and potential benefits of magnesium supplementation in this population.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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1	**Munir Ahmad:** Manuscript writing.
2	**Farah Naz:** Study design.
3	**Ali Ehsan:** Data analysis.
4	**Muhammad Yasir:** Results, references.
5	**Jasia Raham Din:** Proof read.
6	**Omer Qadeer:** Data collection.