Section: General Medicine

Original Research Article

EVALUATION OF SERUM MAGNESIUM LEVELS IN PATIENTS WITH ACUTE MYOCARDIAL INFARCTION

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ABSTRACT

Background: Acute myocardial infarction (AMI) is a major cause of morbidity and mortality worldwide. Identifying and managing the risk factors associated with complications, such as arrhythmias, is crucial for improving patient outcomes. This study aimed to investigate the relationship between serum magnesium levels and the incidence of arrhythmias in patients with AMI. **Materials and Methods:** A total of 100 patients with AMI were analysed to assess their demographic characteristics, addictive habits, comorbid conditions, clinical symptoms, complications, and biochemical markers. Serum magnesium levels were measured and compared between patients with and without arrhythmias. **Results:** The mean age of the patients was 58.52 ± 12.16 years, with 68% male and 32% female. Among them, 31% were smokers, and 24% consumed alcohol. Comorbid conditions included diabetes mellitus (23%), hypertension (34%), and ischaemic heart disease (16%). Elevated creatine phosphokinase MB (CPKMB) levels were present in 44% of the patients, and 32% tested positive for Troponin T. Serum magnesium levels were significantly lower in patients with arrhythmias (1.69 ± 0.19 mg/dL) compared to those without arrhythmias (2.64 ± 0.21 mg/dL) ($p<0.0001$). The prevalent clinical symptoms included chest pain (92%), breathlessness (71%), sweating (68%), and palpitations (71%). Complications included tachyarrhythmia (11%), bradyarrhythmia (12%), premature ventricular contractions (4%), bigeminy (4%), shock (14%), shock with arrhythmia (8%), and no arrhythmia (47%). **Conclusion:** This study demonstrated a significant association between lower serum magnesium levels and increased incidence of arrhythmias in patients with AMI. Therefore, it can be concluded that the measurement of serum magnesium levels is of prognostic significance in AMI.

INTRODUCTION

Acute myocardial infarction (AMI) is one of the most prevalent diseases in developing countries. Indians are four times more prone to AMI than people from other countries because of a combination of genetic and lifestyle factors that promote metabolic dysfunction. The incidence of myocardial infarction in India is 64.37 per 1000 people.[1,2] Magnesium is the fourth most common cation in the body and the second most common intracellular cation after potassium. It plays a crucial role in various physiological processes, including hormone receptor binding, calcium channel gating, transmembrane ion flux, and adenylate cyclase regulation. In addition, magnesium is involved in muscle contraction, neuronal activity, vasomotor tone control, cardiac excitability, and neurotransmitter release. In many of its functions, magnesium acts as a physiological calcium antagonist.[3,4]

In humans, less than 1% of the total body magnesium is found in serum and red blood cells. The majority of the magnesium was distributed between the bone (53%), muscle (27%), and soft tissues (19%). Magnesium deficiency is common and often multifactorial.5 Previous studies have linked the prevalence of cardiovascular disease and cardiac deaths to magnesium depletion caused by a diet and drinking water low in magnesium.[6-8] Magnesium deficiency has been observed in 7–11% of hospitalized patients and can co-exist in up to 40% of patients with other electrolyte abnormalities, particularly hypokalemia, hypophosphatemia, and, to a lesser extent, hyponatremia and hypocalcemia.[9]

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Research on the general population has linked magnesium deficiency to inflammation, hyperaldosteronism, insulin resistance, and endothelial dysfunction, all of which are associated with vascular calcification. Therefore, it can be inferred that magnesium ions are crucial for maintaining the functional integrity of the myocardium. It was found that serum magnesium concentration plays a significant role in cases of AMI.[2,4,9] Consequently, this study aimed to investigate the relationship between serum magnesium levels and the incidence of arrhythmias in AMI patients.

MATERIALS AND METHODS

This cross-sectional study included 100 patients diagnosed with AMI at a tertiary-care hospital.

Inclusion Criteria

Patients aged ≥ 18 years who presented with clinical, electrocardiographic, and biochemical evidence of AMI were included in the study.

Exclusion Criteria

Patients with chronic kidney disease, known magnesium supplementation, or other conditions affecting magnesium levels were excluded from the study.

Ethical Considerations

The study protocol was approved by the Institutional Ethics Committee, and informed consent was obtained from all patients or their legal representatives before participation in the study. Patient confidentiality was maintained throughout the study, and data were anonymised for analysis.

Data Collection

Data on age, gender, and other relevant demographic information were collected using patient medical records and direct interviews. Information on smoking status and alcohol consumption was obtained through patient self-reports during initial assessments. The presence of comorbid conditions, such as diabetes mellitus (DM), hypertension (HTN), and ischaemic heart disease (IHD), was determined based on patient history, medical records, and relevant clinical investigations.

Clinical symptoms and complications

The patients were monitored for common symptoms of AMI, including chest pain, breathlessness, sweating, and palpitations. Complications such as tachyarrhythmia, bradyarrhythmia, ventricular premature contractions (VPC), bigeminy, shock, and arrhythmia have been documented.

Biochemical markers

Blood samples were collected from all patients upon admission and analysed for biochemical markers. Creatine phosphokinase MB (CPKMB) and Troponin T levels were measured using standard laboratory techniques to assess the extent of myocardial injury.

Serum magnesium measurement

Serum magnesium levels were measured using a photometric method with an automated analyser and were recorded in mg/dL.

Arrhythmia assessment

The patients were continuously monitored for arrhythmias by electrocardiographic (ECG) monitoring throughout their hospital stay. Arrhythmias were classified based on standard criteria and the presence or absence of arrhythmias was documented.

Statistical Analysis

Continuous variables are expressed as means and standard deviations, while categorical variables are summarised as frequencies and percentages. The mean serum magnesium levels were compared between the two groups using the Student's t-test. A p-value <0.0001 was considered statistically significant.

RESULTS

Patient demographics and clinical characteristics

We analysed 100 patients with acute myocardial infarction (AMI). The mean age of the patients was 58.52 ± 12.16 years, with a gender distribution of 68% male and 32% female. Among the patients, 31% were smokers, and 24% consumed alcohol. Regarding comorbidities, 23% had diabetes mellitus (DM), 34% had hypertension (HTN), and 16% had ischaemic heart disease (IHD). Additionally, 44% of the patients exhibited elevated creatine phosphokinase MB (CPKMB) levels and 32% tested positive for Troponin T. [Table 1]

Table 1: Patient demographics and clinical characteristics of study participants

Variables (n=100)		Frequency	Percentage
Age (mean)		58.52	12.16
Gender	Male	68	68%
	Female	32	32%
Addictive habits	Smoking	31	31%
	Alcohol	24	24%
Comorbidities	DM	23	23%
	HTN	34	34%
	IHD	16	16%
Clinical biomarkers	High CPKMB	44	44%
	Positive Troponin T	32	32%

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Clinical symptoms and complications

Among the clinical symptoms observed, chest pain was the most prevalent (92%), followed by breathlessness (71%), palpitations (71%), and sweating (68%). [Figure 1] Complications, such as tachyarrhythmia, bradyarrhythmia, ventricular premature contractions (VPC), bigeminy, shock, shock with arrhythmia, and no arrhythmia, were recorded at frequencies of 11%, 12%, 4%, 4%, 14%, 8%, and 47%, respectively. [Figure 2]

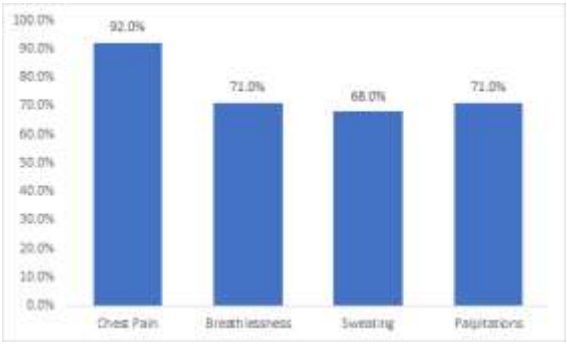

Figure 1: Frequency of clinical symptoms in patients with AMI

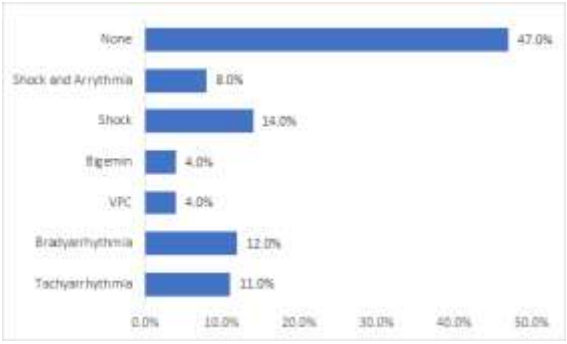

Figure 2: Frequency of complications in patients with AMI

Serum magnesium levels and arrhythmias

The mean serum magnesium level in patients with arrhythmia was significantly lower (1.69 ± 0.19 mg/dL) compared to those without arrhythmia (2.64 ± 0.21 mg/dL) ($p < 0.0001$). [Figure 3]

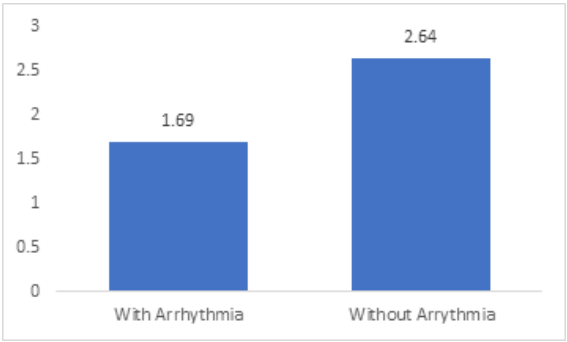

Figure 3: Serum magnesium levels in patients with and without arrhythmia

DISCUSSION

This study aimed to investigate the relationship between serum magnesium levels and the incidence of arrhythmias in patients with AMI. The mean age of the study population was 58.52 years, reflecting the typical age group affected by AMI.[10] Vedamanickam et al. observed that 73% of patients with AMI were over 41 years old, highlighting that AMI predominantly affects older individuals.[11] In our study, the gender distribution showed a higher prevalence in males (68%) compared to females (32%), aligning with existing literature that suggests men are more susceptible to heart attacks at a younger age compared to women.[12,13] Khot et al. also revealed a male predominance.4 The analysis of addictive habits revealed that 31% of the patients were smokers, and 24% consumed alcohol, both of which are known risk factors for cardiovascular diseases.[14] Mathur et al. reported that smoking was prevalent in 82% of the subjects, while hypertension and diabetes mellitus were observed in 64% and 46% of the subjects, respectively.[9]

In our study, comorbidities such as DM, HTN, and ischaemic heart disease were prevalent among patients (23%, 34%, and 16%, respectively). These conditions are well-established risk factors for AMI, and their presence underscores the importance of comprehensive cardiovascular risk management in individuals with these comorbidities.[15] In our study, the high prevalence of elevated creatine phosphokinase MB (CPKMB) levels (44%) and positive Troponin T (32%) among the patients highlights the extent of myocardial injury, as these biomarkers are critical indicators of cardiac muscle damage.

A key finding of this study was the significant difference in serum magnesium levels between the patients with and without arrhythmias. This finding is consistent with previous research suggesting that hypomagnesaemia is a risk factor for arrhythmias in AMI patients. Mg plays a crucial role in maintaining normal cardiac rhythms by stabilising cellular membranes and modulating ion transport. Thus, lower magnesium levels can predispose patients to arrhythmic events, highlighting the need for routine monitoring and correction of magnesium deficiency in patients with AMI.

Chandran and Kumanan reported that the mean magnesium levels for arrhythmia patients on days 1 and 5 were 1.70±0.16 and 1.76±0.51, respectively, compared to 2.10±0.19 for patients without arrhythmias. In patients without arrhythmias, the mean magnesium level was 2.26±0.20. There was a significant difference in the magnesium levels between patients with and without arrhythmias. In cases of acute myocardial infarction, patients with lower magnesium levels are more prone to develop arrhythmias.[16]

Vedamanickam et al. observed that the mean serum magnesium level in AMI patients was 1.23±0.98

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mg/dL, compared to 2.12±0.68 mg/dL in the control group, a statistically significant difference. Thus, they concluded that low serum magnesium levels were significantly associated with AMI patients and their comorbidities.[11] Additionally, Khot et al. demonstrated that serum magnesium levels are a significant predictor of complications and mortality, with a cutoff of 1.7 mg% showing high sensitivity and specificity. The study underscores the importance of magnesium levels in predicting outcomes and suggests its potential as a prognostic marker in AMI cases.[4]

The clinical symptoms most commonly reported by patients included chest pain (92%), breathlessness (71%), sweating (68%), and palpitations (71%). These symptoms are typical of AMI and highlight the acute presentation of the condition. The study also documented the occurrence of various complications, including tachyarrhythmia (11%), bradyarrhythmia (12%), ventricular premature contractions (VPC) (4%), bigeminy (4%), shock (14%), shock with arrhythmia (8%), and no arrhythmia (47%). Khot et al. found that common symptoms of AMI included chest pain, breathlessness, sweating, and palpitations.[4] In our study, during hospitalization, complications such as arrhythmia and shock occurred in 16% of cases. The relatively high incidence of these complications, particularly arrhythmias and shock, emphasises the severity of AMI and the need for vigilant clinical management to mitigate adverse outcomes.

CONCLUSION

This study demonstrated a significant association between lower serum magnesium levels and an increased incidence of arrhythmias in patients with AMI. These findings highlight the importance of routine monitoring and correction of magnesium deficiency to prevent arrhythmia. The prevalence of comorbid conditions and their correlation with elevated biochemical markers further underscore the need for a comprehensive approach to managing patients with AMI. Future studies should explore the potential benefits of magnesium supplementation in reducing arrhythmic events. Therefore, it can be concluded that the measurement of serum magnesium levels is of prognostic significance in AMI.

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