Section: General Medicine

Original Research Article

A STUDY ON CORRELATION BETWEEN SERUM MAGNESIUM LEVELS AND OCCURRENCE OF ARRHYTHMIAS IN PATIENT WITH ACUTE MYOCARDIAL INFARCTION

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ABSTRACT

Background: Acute myocardial infarction in the most common cause of morbidity and mortality worldwide. Most of the deaths in acute myocardial infarction can be attributable to arrhythmias. Magnesium is a cation found predominantly in the intracellular compartment and has a pivotal role in myocardial contractility. This study aims to correlate serum levels of magnesium and occurrence of arrhythmias in patients presenting with acute myocardial infarction.

Material and methods: This prospective study included 60 patients with acute myocardial infarction who presented to the casualty of ¬¬Department of General Medicine Ayaan Institute of Medical Sciences over a period of 1 year. Serum magnesium levels were assessed on Day 1 and Day 5 of presentation.

Results: Males: females ratio observed in present study was 2:1. Most cases of myocardial infarction were reported during 4th and 5th decades of life. Alcohol was the most common risk factor observed in present study. Anterior wall myocardial infarction was the most common type of MI. the serum magnesium levels were significantly lower in patients with arrhythmias than those without arrhythmias.

Conclusion: The study advocates for the routine assessment of magnesium levels in AMI patients and considers magnesium supplementation as a potential therapeutic strategy to improve clinical outcomes by mitigating the risks of severe cardiac events following myocardial infarction.

Keywords: Acute myocardial infarction, serum magnesium levels, arrhythmias, ventricular tachycardia.

INTRODUCTION

Magnesium, as the second most common intracellular cation, serves as a vital cofactor in numerous enzyme systems within human cells. Its role in normal myocardial physiology encompasses improving myocardial metabolism, inhibiting calcium accumulation and myocardial cell death, enhancing vascular tone and resistance, reducing cardiac arrhythmias, and improving lipid metabolism. Additionally, magnesium has been shown to reduce vulnerability to oxygen-derived free radicals, improve endothelial function, and inhibit platelet function, making it a crucial element in maintaining the functional integrity of the myocardium.[1-6]

Its levels have been found to be significantly depleted in the myocardium of individuals who have experienced sudden death due to ischemic heart disease (IHD). This depletion has been linked to the occurrence of ventricular fibrillation, which is a leading cause of sudden death in IHD cases. Additionally, magnesium deficiency has been suggested to contribute to coronary vasospasm, further implicating its role in the sudden death of IHD. Furthermore, magnesium deficiency has been

theorized to play a part in the development of atheromatous plaques and hyperlipidemia, indicating its involvement in various aspects of cardiovascular health.[7-9]

Some studies have shown a decline in serum magnesium concentration within the first 24 to 48 hours after myocardial infarction, others have reported no significant change. Unfortunately, serum magnesium measurements are not routinely conducted, leading to a lack of essential data. There remains uncertainty regarding whether the low cardiac magnesium content precedes myocardial infarction or is a consequence of it.[10]

To address the need for a better understanding of the role of magnesium in AMI management, the present study aims to investigate serum magnesium levels in acute myocardial infarction cases in South India to improve understanding and management of this critical health concern.

MATERIAL AND METHODS

This hospital based prospective observational study was conducted by the Department of General Medicine over a period of 1 year (March 2023 to Feb 2024). The study was conducted in the casualty, OPD and ICU of ¬¬Department of General Medicine, Ayaan Institute of Medical Sciences.

The study included all the patients who presented within 12 hours of onset of acute myocardial symptoms such as chest discomfort along with positive ECG changes and elevated cardiac enzymes.

Patients with hypokalemia or patients who were already on diuretics or patients who presented after 12 hours of onset of symptoms were excluded from the study. A total of 60 patients were included in the study.

A detailed history was taken for all the selected cases along with a thorough physical examination. All patients were subjected to the following investigations such as complete blood picture, renal function tests, liver function tests, serum electrolytes, lipid profile, cardiac enzymes, blood sugar levels, urine examination, serum magnesium levels, 12- lead ECG, and 2D echocardiography.

Acute myocardial infarction was defined according to the American College of Cardiology and American Heart Association guidelines which are:-

1. **Presence of clinical symptoms:** chest pain radiating to arms, neck jaw or back. Presence of other associated symptoms such as dyspnea, nausea, vomitings, diaphoresis and a sense of impending doom
2. **Presence of ECG changes:** ST- elevation MI: Persistent ST elevation in two contiguous leads with the following thresholds
   - ≥1 mm (0.1 mV) in all leads other than leads V2-V3
   - ≥2 mm (0.2 mV) in men ≥40 years
   - ≥2.5 mm (0.25 mV) in men <40 years
   - ≥1.5 mm (0.15 mV) in women
   - Non-ST-segment elevation myocardial infarction (NSTEMI): ST-segment depression, T-wave inversion, or no significant ECG changes. However, diagnosis often relies more heavily on cardiac biomarkers.
3. Elevated cardiac troponins levels.

Ethical committee approval was taken prior to start of the study. All the data was entered in Microsoft Excel and analyzed. Chi- square test was used for significance.

RESULTS

A total of 60 patients who presented with acute myocardial infarction were included in the study.

Majority of the study patients were males (n = 40) and the rest were females (n=20). The male: female ratio is 2:1.

The mean age of study group is 51.3 years. Most of the patients belonged to 40-50 years of age group (n = 25; 41.7%), followed by 50-60 years (n = 15; 25%). Acute myocardial infarction below 40 years of age was accounting to 11.7% (n = 7). [Table 1]

Alcohol intake was the most common risk factor observed in present study, accounting for a staggering 83.3% of the study population. This is followed by smoking (75%); diabetes (66.7%); and hypertension (58.3%). [Table 2]

Most of the patients presented within 6 hours of onset of symptoms (58.3%). The rest of 41.7% presented between 6-12 hours of onset of symptoms. [Table 3]

Chest discomfort was the most common presenting complaint seen in all the 60 patients, followed by palpitations (95%) and shortness of breath (91.6%). [Table 4]

Most common type of MI observed in present study was anterior wall MI (38.3%), followed by inferior wall MI (30%).

Amongst the 60 patients, 35 patients (58.3%) had arrhythmias.

Serum magnesium levels were recorded on Day 1 and Day 5 of presentation. The mean serum Magnesium levels on Day 1 was 1.8 + 0.41 and on Day 5 was 1.94 +1.2. [Table 5]

The difference in serum magnesium levels in patients with arrhythmias and without arrhythmias was significant on Day 1 and Day 5 of presentation.

The most common arrhythmia observed in present study was ventricular tachycardia (25%). [Table 6]

Table 1: Age wise distribution

Age (in years)	Frequency
30-40 years	7 (11.7%)
41-50 years	25 (41.7%)

51- 60 years	15 (25%)
61-70 years	13 (21.6%)

Table 2: distribution of risk factors

Risk factor	frequency
Smoking	45 (75%)
Alcohol intake	50 (83.3%)
Obesity	20 (33.3%)
Family history of coronary artery disease	5 (8.3%)
Hypertension	35 (58.3%)
Diabetes	40 (66.7%)
Dyslipidemia	25 (41.7%)

Table 3: duration of presentation

Duration	No. of cases
0-6 hours	35 (58.3%)
6- 12 hours	25 (41.7%)

Table 4: symptomatology

Symptoms	No. of cases
Chest discomfort	60 (100%)
Shortness of breath	55 (91.6%)
Diaphoresis	50 (83.3%)
Palpitations	57 (95%)

Table 5: type of myocardial infarction

Location	Frequency
Anterior wall MI	23 (38.3%)
Inferior wall MI	18 (30%)
Anteroseptal MI	10 (16.7%)
Anterolateral MI	6 (10%)
Posterior wall MI	3 (5%)

Table 6: serum magnesium levels comparison

Magnesium levels	Complication	Frequency	Mean	P value
Day 1 levels	With arrhythmia	31	1.72+ 0.23	0.0024 (significant)
	Without arrhythmia	29	2.4+ 0.36	
Day 5 levels	With arrhythmia	27	1.84+0.19	0.005 (significant)
	Without arrhythmia	33	2.51+ 0.48	

DISCUSSION

Acute myocardial infarction is a medical emergency and in time management can save lives. In present study, 60 patients had presented with acute myocardial infarction within 12 hours of onset, to the casualty of ¬¬Department of General Medicine Ayaan Institute of Medical Sciences.

Males were the most predominant gender observed in present study, with males: female ratio being 2:1. In study conducted by Chandranet al,[11] 62% were males and 38% were females.

Most common age group observed to have myocardial infarction in present study was 41-50 years. in study done by Yadav et al,[12] and Baset et al,[13] the majority of the patients belonged to 51-60 years of age.

Amongst the risk factors, alcohol intake (83.3%) was the most common risk factor observed in present study, followed by smoking (75%) and diabetes (66.7%). Prior family history of acute myocardial infarction was seen in 5 patients, all of them being below 40 years of age. Kelly et al,[14] however, reported 25% of significant family history.

Most common presenting complaint in this study was chest discomfort, followed by palpitations and dyspnea. Yadavet al,[12] and Baset et al,[13] also reported similar such distribution.

In present study, anterior wall MI (38%) was the most common, followed by inferior wall MI. (30%). Basetet al,[13] reported similar such distribution of type of MI. However, Misiriyaet al,[15] et al observed inferior wall MI to be the most common type, followed by anterior wall MI (50% and 43.9% respectively). In present study, 5% had posterior wall MI, which is similar to study by Misiriyaet al.[15]

In present study, 31 patients had developed arrhythmias (52%), which is similar to the study done by Baset et al,[13] (58%).

The mean serum magnesium levels on Day 1 and Day 5 were 1.8 + 0.41 mg/dL and1.94 + 1.2mg/dL respectively. The difference in mean values of serum magnesium levels was significant in patients with arrhythmias versus those without arrhythmias, with the values being lower in patients with arrhythmias.

The serum magnesium levels rose when compared from Day 1 to Day 5 in both patients with and without arrhythmias.

Abraham et al,[16] conducted a review of the serum magnesium levels of 65 consecutive patients admitted with a diagnosis of acute myocardial infarction. They found that the serum magnesium concentrations were low in patients who had experienced AMI (average 1.70 mg/dl, $p<0.001$) or acute coronary insufficiency (average 1.61 mg/dl, $p<0.01$), but not in the control group or patients with non-cardiac chest pain (average 1.91 mg/dl).

Similarly, Singh et al,[17] examined the serum magnesium levels of twenty acute myocardial infarction patients on the 1st, 7th, and 12th day of admission. They observed a notable decrease in serum magnesium levels on the first day in all cases.

Sachadeva et al,[18] (1978) analyzed magnesium levels in 30 myocardial infarction patients within 24 hours, and on the 5th and 8th days post-infarction, finding levels of 1.83±0.087 mg%, 1.91±0.149 mg%, and 1.97±0.089 mg%, respectively. These levels were significantly lower than the control group, which had an average level of 2.44±0.162 mg%. The results demonstrated a statistically significant deficiency in magnesium that displayed a gradual increase over the days studied, showing a pattern similar to that observed in the current study.

Dyckneret al,[19] published in ActaMedicaScandinavica regarding the relationship between serum magnesium levels and arrhythmias in patients who had experienced acute myocardial infarction. The findings indicated that low serum magnesium is a common feature in patients following an acute myocardial infarction and that this deficiency may have a significant relationship with the development of arrhythmias during the acute phase of the condition.

CONCLUSION

The conclusion of the study centers on the observation that most patients with acute myocardial infarction (AMI) exhibit significantly lower serum magnesium levels in comparison to healthy individuals. The study emphasizes that these low levels of magnesium are associated with a range of severe complications post-myocardial infarction, such as arrhythmias. The findings suggest that depleting levels of serum magnesium has a critical role in the exacerbation of clinical outcomes in AMI patients.

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Conflicts of Interest: Nil.

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