

STUDY OF SERUM MAGNESIUM LEVELS IN ELDERLY WITH ACUTE MYOCARDIAL INFARCTION

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ABSTRACT

BACKGROUND

Despite a significant reduction in the overall age adjusted mortality rates due to cardiovascular diseases in the last 2-3 decades, acute myocardial infarction continues to be the leading cause of mortality especially in people older than 65 years.

The aim of this study is to explore the status of serum magnesium among elderly patients with acute myocardial infarction (AMI) as a means to monitor the possibility of complications and outcome.

MATERIALS AND METHODS

This was a cross-sectional prospective study carried out in 100 patients aged 60 years and more, admitted in our hospital ICCU with a diagnosis of Acute Myocardial Infarction (MI). History collection, clinical examination, ECG, echocardiography, laboratory investigations were performed as a part of work up and all the patients were treated accordingly. The risk factors for MI were also recorded. The patients were followed up for 5 days of in-hospital stay, and were observed for development of complications and the outcome during discharge. Serum magnesium was estimated by Calmagite method and was correlated with site of lesion and occurrence of the complications.

RESULTS

66% of patients were aged between 60-69 years age group, with a male predominance of 56%. The most common addictive habit was smoking in 14% of patients followed by tobacco chewing in 13% of patients. The most common presentation was typical chest pain in 66% of patients and the 34% patients had atypical presentation. Acute MI with ST segment elevation was present in 69% of patients. Inferolateral wall hypokinesia was the commonest type seen on echocardiography. The mean serum magnesium levels in our study group was 2.0 mg/dl. The complications were higher in hypomagnesemia group (10%), followed by normomagnesemia group (8%) and least with hypermagnesemia (2%). The overall mortality was higher with high serum magnesium levels, which makes it 50% of total mortality.

CONCLUSION

Hypomagnesemia is a risk factor for coronary events and its complications in elderly population.

KEYWORDS

Elderly, Magnesium, Acute Myocardial Infarction.

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BACKGROUND

Despite a significant reduction in the overall age adjusted mortality rates due to cardiovascular diseases in the last 2-3 decades, acute myocardial infarction continues to be the leading cause of mortality especially in people older than 65 years.¹

The possibility of suffering acute myocardial infarction in elderly (>60 yrs.) age group is 8 times higher than in people of a less advanced age. More than 50% of in-hospital

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mortality from acute myocardial infarction occurs in subjects older than 60 years.

Incidence and prevalence of acute myocardial infarction progressively increases with age. In US over 60% of acute myocardial infarction occurs in patients of 65 years of age or older, while south Asians elderly have highest rate of coronary artery diseases around the globe.

Magnesium (Mg²⁺) is a critical cofactor in more than 300 intracellular enzymatic processes, many of which are integrally involved in mitochondrial function, energy production maintenance of trans-sarcolemmal ionic gradients, cell volume control, and resting membrane potential. Magnesium is a cardio protective element because of its beta adrenoreceptor blocking action, anti-platelet action and slowing the conduction in cardiac conducting system.

The ion stabilizing effect of magnesium helps in maintaining stable intra and extracellular concentrations of other electrolytes. Various studies have documented



significant alterations in Mg²⁺ and other electrolytes in patients with acute myocardial infarction.

Objective of Study

- To find relation between serum Magnesium levels and patients with Acute Myocardial Infarction in elderly.
- To know the rate of complications in elderly having Acute Myocardial Infarction and Magnesium levels.

MATERIALS AND METHODS

The elderly (>60years) patients irrespective of sex admitted in cardiac care unit of BLDE (DU) Shri B M Patil Medical College Hospital and Research Centre, with first episode of acute myocardial infarction and admitted within six hours of onset of symptoms were included in the study. It is a prospective cross-sectional study. The diagnosis of acute myocardial infarction was done on basis of history, clinical examination, ECG changes and Biochemical markers.

The patients with hepatitis, cirrhosis of liver, Crohn’s disease, chronic malnutrition and on drugs like diuretics, aminoglycosides, amphotericin, digitalis were excluded from the study.

Serum Magnesium is assessed in all the participants at the time of admission and is measured by Calmagite method. The ethical clearance is taken from institutional ethical committee and informed consent obtained from the participants.

RESULTS

Age	n	%
60-69	66	66
70-79	17	17
80-89	14	14
≥90	03	03
Total	100	100

Table 1. Distribution of Cases by Age

The participants were grouped with an age frequency of 10 years and found to have, patients aged between 60-69 were 66%, patients between the age 70-79 were 17%, patients between the age 80-89 were 14%, and one patient aged more than 90 years. Males constituted 56% while 44% were female.

The addictive habits were present in 30 patients. Smoking was the most common habit noted and was present in 14 patients, among which low serum magnesium was present in three patients, normal serum magnesium levels was present in ten patients and one, had high serum magnesium levels. Tobacco chewing was noted in 13 patients, among which low serum magnesium was present in two patients, normal serum magnesium levels was present in eight patients and three had high serum magnesium levels. Alcohol consumption was present in one patient and his serum magnesium levels were within normal limits. Dual habits like smoking with tobacco chewing and alcohol with tobacco chewing, were present in one patient each and both groups had normal serum magnesium levels.

Typical/ Atypical	<1.8 (low)		1.8-2.5 (normal)		>2.5 (high)		Total	p value
	n	%	n	%	n	%		
Typical	21	31.8	40	60.6	05	7.6	66	0.334
Atypical	09	26.5	19	55.9	06	17.6	34	
Total	30		59		11		100	

Table 2. Clinical Presentation and Serum Magnesium Levels

The study group admitted in cardiac care unit were classified based on the symptoms with which they presented during admission as typical (classical chest pain of myocardial infarction) and atypical. It was found that 66% patients presented with classical chest pain and were grouped under typical presentation and the 34% were grouped as atypical presentation.

Among the 66 patients with typical presentation 31.8% patients had low serum magnesium, normal serum magnesium was present in 60.6% and high serum magnesium levels in 7.6% patients.

In the second group with atypical presentation (34%), low serum magnesium was present in 26.5% patients, normal serum magnesium in 55.9% patients and high serum magnesium levels was present in 17.6% patients, making it 26.5%, 55.9%, 17.6% respectively.

ECG	<1.8 (low)		1.8-2.5 (normal)		>2.5 (high)		Total	p value
	n	%	n	%	n	%		
STEMI	20	29.0	42	60.9	07	10.1	69	0.837
NSTEMI	10	32.3	17	54.8	04	12.9	31	
Total	30		59		11		100	

Table 3. ECG Changes and Correlation with Serum Magnesium

The patients were classified into ST elevation myocardial infarction (STEMI) and Non-ST elevation myocardial infarction (NSTEMI) based on the ECG changes. ST elevation was seen in 69% and Non-ST elevation in 31%. Among the STEMI group, low serum magnesium was present in 20 patients, was within normal range in 42 patients and high serum magnesium levels was present in 7 patients making it, 29.0%, 60.9% and 10.1% respectively. The NSTEMI group had 10 patients with low serum magnesium levels, normal serum magnesium levels were present in 17 patients and high serum magnesium levels was present in 4 patients making it, 32.3%, 54.8% and 12.9% respectively.

Echocardiography Findings and Correlation with Serum Magnesium

The region of the heart involved was made out by bedside Echocardiography. The findings were grouped as anterior wall, anterolateral wall, inferior wall, inferolateral wall, and global, which included 27, 19, 14, 30 and 7 patients respectively. In three patient’s echocardiography could not be done as they succumbed.

Age	<1.8 (low)		1.8-2.5 (normal)		>2.5 (high)		Total	p value
	n	%	n	%	n	%		
60-69	18	60.0	41	69.5	07	63.6	66	0.543
70-79	04	13.3	11	18.6	02	18.2	17	
80-89	07	23.3	06	10.2	01	9.1	14	
≥90	01	3.3	01	1.7	01	9.1	03	
Total	30	100.0	59	100.0	11	100.0	100	

Table 4. Age and Serum Magnesium Levels

The estimated serum magnesium levels ranged from 1.1 mg/dl to 4.0 mg/dl. Low serum magnesium levels (<1.8 mg/dl) was present in 30 patients, 59 patients had normal serum magnesium levels, and 11 patients had high serum magnesium levels (>2.5 mg/dl). The mean serum magnesium levels in our study group was 2.0 mg/dl.

Complications	<1.8 (low)		1.8-2.5 (normal)		>2.5 (high)		Total	p value
	n	%	n	%	n	%		
BRADYARRHYTHMIAS	05	50.0	02	25.0	00	00.0	07	0.874
CCF	01	10.0	01	12.5	00	00.0	02	
SINUS BRADYCARDIA	00	00.0	02	25.0	01	50.0	03	
TACHYARRHYTHMIAS	03	30.0	03	37.5	01	50.0	07	
VENTRICULAR ECTOPICS	01	10.0	00	0.0	00	00.0	01	
Total	10	100.0	08	100.0	02	100.0	20	

Table 5. Complications and Serum Magnesium Levels

Among the participants, 20 patients had complications over a duration of 5 days of hospital stay. The complications noted were ventricular ectopic in one patient, congestive cardiac failure in two patients, sinus bradycardia in three patients, tachyarrhythmia (ventricular tachycardia, atrial fibrillations) in seven patients, bradyarrhythmia (bundle branch blocks, 1^o, 2^o, 3^o heart blocks) in seven patients.

The study group were distributed with respect to serum magnesium levels, as low, normal and high. Thirty patients had low serum magnesium levels and out of which 11 patients had complications accounting for 36.7%. The other group with normal serum magnesium levels had 59 patients and out which 11 patients had complications which accounts for 18.6% and the third group with high serum magnesium levels had 11 patients out of which 6 patients had got complications accounting for 54.5%. The complications occurring in patients with low serum magnesium were 10, among which 5 patients had bradyarrhythmia, 3 had tachyarrhythmia and each one had congestive cardiac failure and ventricular ectopic. The complications occurring in patients with normal serum magnesium were 8, among which 2 had Brady arrhythmia, 3 had tachyarrhythmia, one had congestive cardiac failure and another 2 had sinus bradycardia.

The complications occurring in patients with high serum magnesium were 2, among which 1 had tachyarrhythmia and other 1 had bradyarrhythmia.

Cause of Death	<1.8 (low)		1.8-2.5 (normal)		>2.5 (high)		Total	P value
	n	%	n	%	n	%		
CARDIAC FAILURE	1	100.0	0	0.0	0	0.0	1	0.874
CHB	0	0.0	0	0.0	2	50.0	2	
VT	0	0.0	1	33.3	0	0.0	1	
SUDDEN CARDIAC DEATH	0	0.0	2	66.7	2	50.0	4	
Total	1	100.0	3	100.0	4	100.0	8	

Table 6. Mortality and Serum Magnesium Levels

Among the 100 patients, 8% patients succumbed during the hospital stay. The causes were as follows. The cardiac failure and ventricular tachycardia were noted in one patient each, complete heart block in two patients and four had sudden cardiac death.

On correlating the serum magnesium levels with the cause of death, low serum magnesium levels were present in patients with congestive cardiac failure, patient with ventricular tachycardia had normal levels, both patients with complete heart block had high levels and two patients with sudden cardiac death had normal serum magnesium levels and the other two had high serum magnesium levels.

DISCUSSION

Our study is a cross sectional study conducted over a period of two years, which includes 100 elderly patients diagnosed with acute myocardial infarction, which includes both ST elevation myocardial infarction and Non-ST segment elevation myocardial infarction. The serum magnesium levels were obtained from these patients at the time of admission. All the patients were observed over a period of 5 days in our hospital for complications, which includes conduction abnormalities like sinus bradycardia, bradyarrhythmia (conduction blocks), tachyarrhythmias (ventricular tachycardia, supraventricular tachycardia, atrial fibrillation), ventricular ectopic and heart failure. The outcome of the patient during discharge was also noted. The serum magnesium levels were compared for the occurrence of complications and their outcome.

Age

A study by Savith A,² which was a cross sectional study in elderly patients with acute myocardial infarction, have found majority of patients aged between 60- 69 years, with mean age of 69.82 years. Mehta et al,³ showed age frequency predominance between the age group of 70-75 years which was higher than 65-69 year age group, where as our study showed majority of participants aged between 60-69 years, making it 66%.

Sex

A study by Savith A,² study showed male predominance over female, with a male to female ratio of 2.57:1, with 72% participants being male. In our study we had similar results with majority of patients being male which makes it 56%.

Habits

L.H. Bhatia and R.H. Naik,⁴ assessed the risk factors for acute myocardial infarction in elderly patients and found that smoking was most common addictive habit and was present in 43.01% of patients. A study by Savith A,² also showed smoking as most common addictive habit and was present in 58% of their study group. In our study the most common

addictive habit noted was smoking in 14% of patients followed by tobacco chewing seen in 13% of patients.

Clinical Presentation to Hospital

Wegner et al,⁵ conducted a study and categorized patients based on the presenting complaints with which they presented to hospital as typical and atypical presentation and found to have atypical presentation more common ranging from 38-60% in elderly with acute myocardial infarction. A study by Savith A,² showed typical presentation to be more common in 66.3% and atypical presentation being in 20.8%. The clinical presentation in patients, presenting to our hospital with typical symptoms is 66% which is similar to the study done by Savith A.²

ECG Changes

L.H. Bhatia and R.K. Naik,⁴ found that ST elevation myocardial infarction was present in 52.34% of elderly patients, and Non-ST elevation myocardial infarction was present in 36.45% and LBBB in 11.21%. The study by Savith A,² found to have ST elevation myocardial infarction more commoner making it 96% than Non-ST elevation myocardial infarction which was seen in only 4% of elderly patients presenting with acute myocardial infarction. In our study, the ECG changes on admission was more common of ST elevation myocardial infarction making it 69% and 31% patients had Non-ST elevation myocardial infarction.

Echocardiography

The study done by Savith A,² showed to have higher incidence of inferior wall myocardial infarction and was present in 48% of patients, followed by anterolateral wall MI in 26% patients and anteroseptal wall MI was in 22% of patients. On the other hand, our study showed a higher incidence of inferolateral wall involvement in 37%, followed by anterior wall in 27%, anterolateral wall in 19%, inferior wall in 14% and global hypokinesia in 7% of patients.

Serum Magnesium Levels at Admission

Abraham et al,⁶ studied 65 elderly patients with acute myocardial infarction and found to have reduced serum magnesium levels with a mean of 1.70 mg/dl and $p < 0.001$ and he compared these results with a control group which had normal serum magnesium levels, with mean of 1.91 mg/dl. Khan MA et al,⁷ studied 50 participants with ischemic heart disease, which included 25 cases with acute myocardial infarction, acute coronary insufficiency in 15 patients and angina pectoris in 10 Patients, the serum magnesium levels in this study group ranged between 1.5 to 3.0 mg/dl, with a mean of 2.1 mg/dl. The mean serum magnesium levels in our study group, which had 100 participants with acute myocardial infarction was 2.0 mg/dl, which lies within the normal range.

Serum Magnesium Levels and Complications

Sachdev et al,⁸ studied serum magnesium levels in 30 patients with myocardial infarction and found that arrhythmias were more common with the patients having hypomagnesemia, the patients were intervened with magnesium infusion, the occurrence of ventricular tachycardia significantly reduced ($p < 0.001$) but the other arrhythmias were unaffected. While, in our study conduction abnormalities, both bradyarrhythmia and tachyarrhythmia were noted in all three groups of serum magnesium levels and 8% of patients belonged to hypomagnesemia group, followed by 7% of patients in normomagnesemia group and only one patient in hypermagnesemia group.

T. Dyckner⁹ conducted a similar study and found to have high incidence of ventricular ectopics in patients with hypomagnesemia. In this study one patient had ventricular ectopic beats with low serum magnesium levels. The same study also showed an increase in the incidence of AV Blocks with increase in serum magnesium levels, while in our study patients with third degree AV Block had both hypermagnesemia and normomagnesemia, but no patients with hypomagnesemia had AV Blocks.

The intervention for the same with intravenous and oral magnesium is found to be beneficial and was seen in LIMIT-2¹⁰ study, favouring magnesium supplementation. The major trials namely ISIS-4¹¹ and MAGIC¹² has showed no additional benefits, but also no adverse outcomes, though both these trials vary in study design.

Mortality

In this study the all case mortality was 8%.

CONCLUSION

It has also been proposed that serum magnesium levels decrease with increasing age and the elderly (>60 years) are at high risk for hypomagnesemia, due to the decreased intake, stress and chronic medications.

Low magnesium is proposed to be a risk factor for occurrence of many systemic diseases like diabetes mellitus, hypertension, dyslipidaemia which in turn is a risk factor for coronary events. Low magnesium is also implicated in the propagation of atherosclerosis as it increases serum

triglyceride levels, increases reactive oxygen species, and also increases platelet aggregation, which together act as an initiating factor for atherosclerosis and thus progresses to myocardial infarction. Low magnesium level is also seen in complications like arrhythmias (ventricular tachycardia, torsade de pointes, conduction blocks) heart failure following myocardial infarction.

Hence, in all elderly patients with myocardial infarction who are at a higher risk than adults should always undergo screening for serum magnesium levels irrespective of clinical features and ECG changes.

In patients with low serum magnesium levels, correction with oral supplementation in mild to moderate hypomagnesemia and with intravenous magnesium in severe hypomagnesemia should be done. It may be followed by oral supplementation as a long-term treatment.

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