

**SERUM MAGNESIUM LEVELS IN PATIENTS WITH ACUTE MYOCARDIAL
INFARCTION****Dr. Mayank Arora¹, Dr. Shivang Sharma^{*2}, Dr. T. R. Sirohi³ and Dr. Saurabh Singhal⁴**¹Assistant Professor, PG Dept. of Medicine, Subharti Medical College.²Junior Resident 3rd Year, PG Dept. of Medicine, Subharti Medical College.³Professor, Department of Medicine, Subharti Medical College.⁴HOD Department of Medicine, Subharti Medical College.***Corresponding Author: Dr. Shivang Sharma**Junior Resident 3rd Year, PG Dept. of Medicine, Subharti Medical College.

Article Received on 03/08/2019

Article Revised on 23/08/2019

Article Accepted on 13/09/2019

ABSTRACT

Aim and objective: To study serum magnesium levels in patients with acute myocardial infarction. **Material Method:** The present prospective observational study was conducted in the department of Medicine at Chatrapati Shivaji Subharti Hospital from 2017 to 2019. The study group comprised of 50 patients with acute myocardial infarction. Patients were enrolled in the study on the basis of inclusion and exclusion criteria and after obtaining written informed consent from patients and approval from Institutional Ethical Committee. **Result:** Serum magnesium level (mg/dL) i.e. <1.6, 1.7-2.4 and >2.4 was found in 40%, 60% and 0% of the subjects respectively on day 1. On day 5, serum magnesium level (mg/dL) <1.6 was reported only in 8% of the subjects while >2.4 level was revealed in 46% of the subjects in the present study. In the present study groups, the serum magnesium level on day-1 was 1.83 whereas on day 5, the same was 2.27. There was an increase in serum magnesium from Day-1 to Day-5 with statistically significant difference. **Conclusion:** Serum magnesium levels on admission were significantly low in patients of MI. Serum Mg levels were found to be lower in acute MI cases at presentation within 24 hours as compared to matched controls. Serum Mg levels raised towards normal values by 5th day. So it can be concluded that measurement of serum magnesium levels is of prognostic significance in acute MI.

INTRODUCTION

Magnesium is the fourth most common cation in the body, and the second most common intracellular cation after potassium. It has a fundamental role as a co-factor in more than 300 enzymatic reactions involving energy metabolism and nucleic acid synthesis. It is also involved in several processes including: hormone receptor binding; gating of calcium channels; transmembrane ion flux and regulation of adenylate cyclase; muscle contraction; neuronal activity; control of vasomotor tone; cardiac excitability; and neurotransmitter release. In many of its actions it has been likened to a physiological calcium antagonist.^[1-3]

Epidemiological studies trace the prevalence of cardiovascular disease and cardiac deaths to the degree of magnesium depletion induced by a diet and drinking water low in magnesium.^[4] Magnesium

deficiency has been demonstrated in 7–11% of hospitalized patients and is found to co-exist in up to 40% of patients with other electrolyte abnormalities, particularly hypokalaemia or hypophosphataemia and, to a lesser extent, hyponatraemia and hypocalcaemia.^[5]

Studies from the general population have linked magnesium deficiency with endothelial dysfunction, insulin resistance, hyperaldosteronism and inflammation^[6], all of which are associated with vascular calcifications. On the other hand, hypomagnesaemia is associated with traditional Framingham cardiovascular risk factors, such as diabetes, lipid disorders, and hypertension.^[7] Low serum magnesium was also a strong predictor of an increase in left ventricular mass in a large German cohort of patients, even after adjustment for many covariates including hypertension.^[8] Hypomagnesaemia induces an atherogenic lipid profile through activation of 3-hydroxy-3-methyl-glutaryl-CoA reductase (HMG-CoA reductase) next to a decrease of lecithin-cholesterol acetyltransferase and lipoprotein lipase activity.^[9]

Acute myocardial infarction (MI) continues to be a major public health problem in the industrialised world and is becoming an increasingly important problem in developing world. In MI, there occurs functional deficit of available magnesium due to trapping of free magnesium in adipocytes, because soap are formed when free fatty acids are released by catecholamines-induced lipolysis. Magnesium (Mg) has been implicated in the pathogenesis of acute MI and its complications^[10]

Recent investigations have postulated a role for magnesium in many aspects of cardiac disease: control of hypertension, reduction of mortality in myocardial infarction, coronary vasospasm, and sudden death in soft-water areas.^[11,12] Although hypomagnesemia has been reported to cause major ventricular arrhythmias even in the absence of cardiac disease, most cases have been associated with toxic reaction to digitalis or acute myocardial infarction. In a study from Sweden, Dyckner^[13] showed a 46% incidence of hypomagnesemia in 342 patients with acute myocardial infarction and demonstrated that these patients had a threefold greater frequency of ventricular arrhythmias. Other studies, however, have demonstrated a variable incidence of hypomagnesemia. Abraham *et al*^[14] showed that patients with acute myocardial infarction in Israel had lower serum magnesium levels than controls, but there was no significant difference in arrhythmia frequency in the patients with lower serum magnesium levels. In a study from Nebraska, Rector *et al*^[15] showed that serum magnesium levels were decreased in patients whose acute myocardial infarction had been complicated by congestive failure or by ventricular fibrillation. Chadda *et al*^[16] reported decreased serum magnesium levels in patients with acute myocardial infarction in New York City, whereas others in North America have been unable to show any difference in serum magnesium levels between patients with and without acute myocardial infarction. Because these reports differed in study design, sample size, and geographic region, interpretation of their significance is difficult.

Hence it can be said that magnesium ions are considered essential for the maintenance of functional integrity of myocardium. The serum magnesium concentration was found to have great significance in acute MI. So, the present study was undertaken to evaluate the levels of serum magnesium in acute MI.

MATERIAL AND METHOD

The present prospective observational study was conducted in the department of Medicine at Chatrapati Shivaji Subharti Hospital from 2017 to 2019.

The study group comprised of 50 patients with acute myocardial infarction. Patients were enrolled in the study after obtaining written informed consent from parents and approval from Institutional Ethical Committee.

Inclusion criteria

1. Patients who presented to the hospital within 24 hours of onset of symptoms and diagnosed with acute myocardial infarction.

Exclusion criteria: It excludes patients with the following characteristics:

- 1) Patients having hypokalemia.
- 2) Patients on medicines which cause alteration in serum magnesium level e.g. Aminoglycosides,

Amphotericin B, Cituximab, Cyclosporine, Digoxin, Diuretics (loop, thiazides, osmotic).

- 3) Patients receiving magnesium containing antacids.
- 4) Patients with history of chronic alcohol abuse.
- 5) Patients with malabsorption or chronic diarrhoea.
- 6) All pregnant women.

Investigation

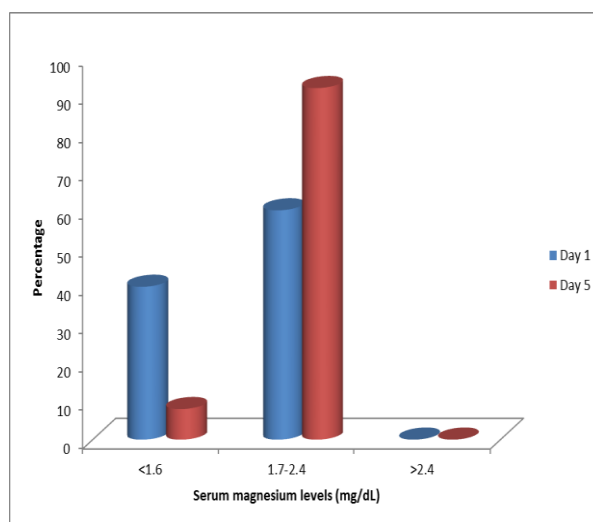
Serum magnesium level.

RESULTS AND OBSERVATIONS

Table 1: Serum magnesium levels among the study subjects.

Serum magnesium levels (mg/dL)	Day 1		Day 5	
	N	%	N	%
<1.6	20	40	4	8
1.7-2.4	30	60	46	92
>2.4	0	0	0	0

Serum magnesium level (mg/dL) i.e. <1.6, 1.7-2.4 and >2.4 was found in 40%, 60% and 0% of the subjects respectively on day 1. On day 5, serum magnesium level (mg/dL) <1.6 was reported only in 8% of the subjects while >2.4 level was revealed in 46% of the subjects (table 1, graph 1).



Graph 1: Serum magnesium levels among the study subjects.

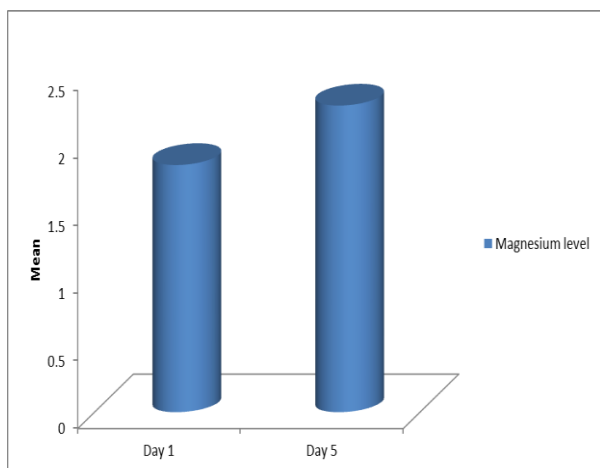
Table 2: Serum magnesium level among the study population.

Variables	Magnesium level	
	Day 1	Day 5
Mean	1.83	2.27
SD	0.34	0.47
t test	4.68	
p value	0.01*	

*: statistically significant

In the present study groups, the serum magnesium level on day-1 was 1.83 whereas on day, the same was 2.27. There was an increase in serum magnesium from Day-1

to Day-5 with statistically significant difference as shown in table 2, graph 2.



Graph 2: Serum magnesium level among the study population.

DISCUSSION

Magnesium ion has recently been considered as a principle cardiovascular cation. It has many critically significant roles in the maintenance of normal homeostasis of the body. It plays a major role in cardiac homeostasis. Magnesium is essential ATP activation necessary for the maintenance of the sodium-potassium pump. Magnesium deficiency has been attributed to the causation of arrhythmias in acute myocardial infarction patients.^[17]

The magnesium ion is becoming a major cardiovascular cation during these decades. It has been implicated in the pathogenesis of acute myocardial infarction and complication like arrhythmias. Magnesium inhibits the accumulation of calcium ion, improves the myocardial metabolism and reduces the myocardial cell death. It also helps in the activation of ATP which maintains the sodium potassium pump and also because of its calcium blocking action, it is implicated in relation to arrhythmias after an acute myocardial infarction.^[18] Hence it can be said that magnesium ions are considered essential for the maintenance of functional integrity of myocardium. The serum magnesium concentration was found to have great significance in acute MI. So, the present study was undertaken to evaluate the levels of serum magnesium in acute MI.

Serum magnesium level

Serum magnesium level (mg/dL) i.e. <1.6, 1.7-2.4 and >2.4 was found in 40%, 60% and 0% of the subjects respectively on day 1. On day 5, serum magnesium level (mg/dL) <1.6 was reported only in 8% of the subjects while >2.4 level was revealed in 46% of the subjects in the present study. In the present study groups, the serum magnesium level on day-1 was 1.83 whereas on day, the same was 2.27. There was an increase in serum magnesium from Day-1 to Day-5 with statistically significant difference. M.Arun karki et al⁹⁸ reported

serum magnesium <1.6 in 20% of the subjects on day 1 and on day the same was among 4% of the subjects. The overall mean magnesium level was 1.86 and 2.26 on day 1 and 5 respectively.

Low serum magnesium has been implicated in cardiovascular mortality, but results are conflicting. Total body magnesium depends on dietary intake and recent studies showed that vast majority of elderly do not consume the average dietary requirement for magnesium.^[19] The prevalence of magnesium in the general population is estimated at 2%^[20], but it may be as high as 53% in specific high risk group such as patients with chronic heart failure.^[21] Although hypomagnesemia may have acute and chronic complications, serum magnesium is still measured relatively in frequently.

It can be said that patients with acute myocardial infarction with low magnesium level are more prone to develop ventricular arrhythmias compared to those who are having normal magnesium levels. Magnesium replacement therapy in patients with acute myocardial infarction who is having low serum magnesium level.

CONCLUSION

Serum magnesium levels on admission were significantly low in patients of MI. Serum Mg levels were found to be lower in acute MI cases at presentation within 24 hours as compared to matched controls.

Serum Mg levels raised towards normal values by 5th day.

So it can be concluded that measurement of serum magnesium levels is of prognostic significance in acute MI.

BIBLIOGRAPHY

1. Altura BM. Importance of Mg in physiology and medicine and the need for ion selective electrodes. *Scand J Clin Lab Invest*, 1994; 217: 5–9.
2. Altura BM, Altura BT, Carella A, Gebrewald A, Murakawa T, Nishio A. Magnesium–calcium interaction in contractility of vascular smooth muscle; Magnesium versus organic calcium channel blockers on myogenic tone and agonist induced responsiveness of blood vessels. *Can J Physiol Pharmacol*, 1987; 65: 729–45.
3. Abraham AS, Eylath U, Weinstein M, Czaczkes E. Serum magnesium levels in patients with acute myocardial infarction. *N Engl J Med.*, 1977; 296: 862–3.
4. Ryan MF. The role of magnesium in biochemistry: an overview. *Ann Clin Biochem*, 1991; 28: 19–26.
5. Whang R, Dei TO, Aikawa J. Predictors of clinical hypomagnesaemia–hypokalaemia, hypophosphataemia, hypocalcaemia. *Arch Intern Med.*, 1984; 144: 1794–6.
6. Navarro-Gonzalez JF, Mora-Fernandez C, Garcia-Perez J. Clinical implications of disordered

- magnesium homeostasis in chronic renal failure and dialysis. *Semin Dial*, 2009; 22: 37–44.
7. Yogi A, Callera GE, O'Connor SE, He Y, Correa JW, Tostes RC, Mazur A, Touyz RM: Dysregulation of renal transient receptor potential melastatin 6/7 but not paracellin-1 in aldosterone- induced hypertension and kidney damage in a model of hereditary hypomagnesemia. *J Hypertens*, 2011; 29: 1400–1410.
 8. Reffelmann T, Dörr M, Ittermann T, Schwahn C, Völzke H, Ruppert J, Robinson D, Felix SB: Low serum magnesium concentrations predict increase in left ventricular mass over 5 years independently of common cardiovascular risk factors. *Atherosclerosis*, 2010; 213: 563–569.
 9. Maier JA: Endothelial cells and magnesium: implications in atherosclerosis. *Clin Sci (Lond)*, 2012; 122: 397–407.
 10. Elliot M Antman, Eugene Braunwald. *Acute Myocardial infarction in Heart Disease*, 6th edition, Philadelphia Saunders, 2001; 1114-1137: 1171-1172.
 11. Turlapaty PDMV, Altura BM: Magnesium deficiency produces spasms of coronary arteries: Relationship to etiology of sudden death ischemic heart disease. *Science*, 1980; 208: 198-200.
 12. Marier JR: Cardio-protective contribution of hard waters to magnesium intake. *Rev Can Biol Exp.*, 1978; 37: 115-125.
 13. Dyckner T: Serum magnesium in acute myocardial infarction. Relation to arrhythmias. *Acta Med Scandm*, 1980; 207: 59-66.
 14. Abraham AS, Eylath U, Weinstein M, et al: Serum magnesium levels in patients with acute myocardial infarction. *N Engl J Med.*, 1977; 296: 862-863.
 15. Rector WG, DeWood MA, Williams RV, et al: Serum magnesium and copper levels in myocardial infarction. *Am J Med Sci.*, 1981; 281: 25-29.
 16. Chadda KD, Reilly T, Lichstein E, et al: Alteration of serum magnesium in acute myocardial infarction, abstracted. *Clin Res.*, 1976; 24: 611A.
 17. Akila A, Anandraj J, Karthikayan S. Serum Magnesium Levels in Acute Myocardial Infarction. *IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)*, 2017; 16(5): 35-40.
 18. Karki MA, Balasubramaniyan S, Prabhu G, Barath J. Study of serum magnesium level in patients with acute myocardial infarction at presentation and its prognostic correlation. *Int J Modn Res Revs.*, 2015; 3(10): 945-47.
 19. Del Gobbo LC, Imamura F, Wu JH, de Oliveira Otto MC, Chiuve SE, Mozaffarian D. Circulating and dietary magnesium and risk of cardiovascular disease: A systematic review and meta-analysis of prospective studies. *Am J Clin Nutr.*, 2013; 98: 160-73.
 20. Liamis G, Rodenburg EM, Hofman A, Zietse R, Stricker BH, Hoorn EJ. Electrolyte disorders in community subjects: Prevalence and risk factors. *Am J Med.*, 2013; 126: 256-63.
 21. Adamopoulos C, Pitt B, Sui X, Love TE, Zannad F, Ahmed A. Low serum magnesium and cardiovascular mortality in chronic heart failure: A propensity-matched study. *Int J Cardiol*, 2009; 136: 270-7.