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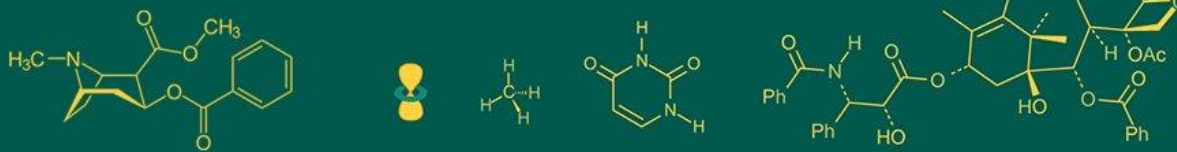
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A study on relationship between acute myocardial infarction and serum magnesium levels

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Abstract
Background and Objective: Myocardial infarction and its complications, such as arrhythmia, may have magnesium as an underlying cause. Adding magnesium to your diet can help your heart's metabolism, which in turn reduces the risk of calcium buildup and cell death. Researching the association between arrhythmias and serum magnesium levels in patients suffering from acute myocardial infarction was the primary goal of the study.
Method: A total of 50 instances of acute myocardial infarction were randomly selected from patients hospitalised to Department of General Medicine, Sambhram Institute of Medical Sciences and Research, BEML Nagar, Kolar Gold Fields, Karnataka, India. This study was conducted between the periods of over a 12 month period, from April 2017 to March 2018.
Results: One of the leading causes of death and disability globally is coronary artery disease. Arrhythmias and other consequences of coronary artery disease are leading causes of mortality. Compared to patients with normal magnesium levels, those with low magnesium levels after an acute myocardial infarction were more likely to develop ventricular arrhythmias, according to this study. Potentially lowering the occurrence of arrhythmias, magnesium replacement treatment may be administered to individuals with acute myocardial infarction who exhibit low serum magnesium levels. Patients' magnesium levels differ significantly between those with and without arrhythmias.
Conclusion: Patients experiencing arrhythmias are more likely to have low magnesium levels following an acute myocardial infarction. Acute myocardial infarction patients with low magnesium levels may benefit from magnesium therapy.

Keywords: Arrhythmias, magnesium, and myocardial infarction, therapy

Introduction
Pasteur proved that inorganic substances are necessary for yeast to grow in a laboratory setting. As a whole and in each of its three distinct compartments-intracellular, interstitial, and intravascular-the human body naturally strives to keep fluid balance proper. A multitude of factors, including hemodynamic and electrolyte dynamics, interact intricately to control this [1-3].

There is a time of rapid expansion happening in the field of mineral metabolism right now. New research suggests that minerals are essential for life just like proteins, lipids, and carbohydrates. Research on the value of minerals and vitamins, along with other active chemical substances, is currently receiving a lot of attention. Research has connected magnesium levels to an increased risk of acute myocardial infarction and its complications, including arrhythmias. Other cardiovascular disorders are also significantly affected by it [4, 5]. The myocardium cannot continue to perform its essential functions without magnesium ions. Patients who died suddenly from ischemic heart disease had a much lower concentration of magnesium in their myocardium. The rapid death caused by ventricular fibrillation in ischemic heart disease (IHD) is largely attributable to magnesium's involvement in this illness. According to some research, magnesium deficiency can lead to coronary vasospasm, which in turn can cause sudden death in patients with ischemic heart disease (IHD) [6-8].

According to the theory, hyperlipidemia, which magnesium shortage causes, aids in the formation of atheromatous plaques. At the present time, myocardial infarction is one of the leading killers. Many factors, including the exact nature of the disease itself, impact the prognosis. Finding out whether there is a connection between arrhythmias and serum magnesium levels in patients with acute myocardial infarction is the main goal of this research.

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Patients presenting within 12 hours after the beginning of symptoms of acute myocardial infarction were included in the study to see whether there was an association between serum magnesium levels and arrhythmias [9-11].

After reducing magnesium intake in rats, Greenberg noticed heart failure marked by fibroblast growth and polyplastic infiltration. Enzymes involved in oxidative phosphorylation require magnesium as an essential component. It was established that the disruption of the function of these magnesium-dependent enzymes was the cause of the observed abnormalities in rats. Magnesium was difficult to isolate and estimate in the early 20th century due to a lack of Standardisation in the procedure [12, 13]. For a long time, scientists paid little attention to studies that examined magnesium's effects on humans. Having said that, there were enough research looking at the significance of magnesium in non-primates. Research on magnesium metabolism in humans has been expedited by the emergence of more accurate and standardised methods for monitoring serum magnesium levels in laboratory settings [14, 15].

Materials and Methods

A total of 50 instances of acute myocardial infarction were randomly selected from patients hospitalised to Department of General Medicine, Sambhram Institute of Medical Sciences and Research, BEML Nagar, Kolar Gold Fields, Karnataka, India. This study was conducted between the periods of over a 12 month period, from April 2017 to March 2018.

Inclusion Criteria
- Chest Discomfort patients.
- Acute Myocardial Infarction in ECG.
- Cardiac Enzymes Elevation.

Exclusion Criteria
- People who are hypokalemic.

Results

Table 1: Patient demographics (age, sex)

Sr. No.	Age (yrs.)	Male	Female	Total
1.	30 to 40	7	1	8
2.	40 to 50	8	4	12
3.	50 to 60	9	4	13
4.	60 to 70	11	3	14
5.	70 to 80	3	-	3
Total		38	12	50

There were 38 men and 12 girls among the fifty cases studied in this research, for a ratio of four to one. Individuals in their 60s and 70s had the greatest incidence of acute myocardial infarction, followed by those in their 50s and 60s.

Table 2: Patients as per religion

Sr. No.	Religion	Patients	%
1.	Hindus	40	80%
2.	Muslims	10	20%

Table 2 presents the distribution of patients according to their religion. Out of the total 50 participants, 40 (80%) were Hindus and 10 (20%) were Muslims.

Table 3: Risk parameter

Sr. No.	Risk parameters	Patients
1.	Smoking	10
2.	Family history	20
3.	Obesity	5
4.	Hypertension	6
5.	Diabetes mellitus	5
6.	Dyslipidemia	4

Smoking is the predominant risk factor observed in patients with acute myocardial infarction, according to the study. Cigarette smoking expedites the development of coronary atherosclerosis in individuals of all genders and age groups, while also heightening the likelihood of thrombosis, plaque instability, and myocardial infarction. Moreover, it exacerbates angina by augmenting myocardial oxygen demands and diminishing oxygen delivery. Among the 50 individuals included in this study, 10 were smokers, 20 had a family history of the condition, and 5 were classified as obese.

Among the 50 patients included in this study, 6 individuals were identified as hypertensive based on their medical history and blood pressure measurements. The study revealed that hypertension is the second most significant risk factor for the occurrence of acute myocardial infarction. Among the 50 individuals examined in this study, 5 were diagnosed with diabetes and 4 were diagnosed with dyslipidemia.

Table 4: Time

Sr. No.	Time	Patients	%
1.	0-3 hours	10	20%
2.	3-6 hours	40	80%

In this study, 40 cases (80% of the total) arrived to the hospital within 3-6 hours after experiencing chest pain, whereas 10 cases (20%) arrived within 0-3 hours.

Table 5: Levels of magnesium in the serum of patients with arrhythmias

Sr. No.	Serum Mg (mg/dl)	Day-1	%	Day-5	%
1.	< 1.6	10	20%	10	20%
2.	1.6 to 2.50	20	40%	10	20%
3.	> 2.5	Nil	Nil	Nil	Nil

Table 5 presents the serum magnesium levels in patients with arrhythmias. On day 1, 60% of the patients had magnesium levels ranging from 1.6 to 2.50. On day 5, this percentage to 40%.

Table 6: Levels of magnesium in the serum of patients without arrhythmias

Sr. No.	Serum Mg (mg/dl)	Day 1	%	Day 5	%
1.	< 1.6	5	10%	5	10%
2.	1.6-2.5	15	30%	20	40%
3.	> 2.5	5	10%	0	-

Data from patients without arrhythmias may be found in Table 6, which shows that the total 50% mg level ranged from 1.6 to 2.50 mg on day 1, and by day 5, it had reached 50%.

Discussion

In the last ten years, magnesium has risen to prominence as a pivotal action in the study of heart health. Acute myocardial infarction and its consequences, including arrhythmias, have been associated to it. To keep the sodium-potassium pump running smoothly, magnesium is required for ATP activation. Furthermore, because of its calcium-inhibiting properties, magnesium has been associated with arrhythmias after an acute myocardial infarction. A ratio of 4:1 between males and females was achieved within the 50-patient trial group, which included 38 men and 12 females. Subjects in their sixties and seventies had the greatest incidence of acute myocardial infarction. On the first day, the average serum magnesium level for all 50 patients in this study was 1.78±0.32, and on the fifth day, it rose to 2.32±0.44. Acute myocardial infarction was the official diagnosis for 65 consecutive individuals whose magnesium levels were tested in this investigation [15-17]. In contrast to the control group and patients without cardiac chest discomfort, those who experienced acute coronary insufficiency or acute myocardial infarction (AMI) had lower serum magnesium concentrations. Twenty patients hospitalised for acute myocardial infarction had their serum magnesium levels measured on days 1, 7, and 12 of their stay. On the first day, serum magnesium levels dropped significantly across the board. Plasma magnesium levels drop significantly in the first three days following the start of ischemic heart disease, according to a study of sixty-seven patients. Nevertheless, the levels were back to normal within fifteen to twenty-five days after the illness began [16-18].

On the first day of the study, participants with arrhythmias had a substantially lower serum magnesium level than those without arrhythmias. The serum magnesium levels of both arrhythmia-prone and non-arrhythmia-prone individuals rose between days 1 and 5. This study compared the effects of a 24-hour magnesium infusion to a placebo on 48 patients who had suffered an acute myocardial infarction. Ventricular tachycardia was much less common during monitoring, but other ventricular arrhythmias were not significantly different [18-20].

The 273 participants in the trial were randomly assigned to receive intravenous magnesium or a placebo, with the latter being reserved for patients suspected of experiencing an acute myocardial infarction. The rate of ventricular arrhythmia was significantly lower in the magnesium group as compared to the placebo group. In this study, 103 patients with a recent diagnosis of acute myocardial infarction were given one of two treatments: A magnesium infusion over 48 hours or a placebo. Death rates have dropped dramatically. Furthermore, when comparing the magnesium group to the control group, there was a small but statistically significant decrease in the incidence of tachyarrhythmia that required therapy [21-23].

Along with a placebo, 400 individuals suspected of having an acute myocardial infarction (AMI) were given a continuous magnesium sulphate infusion for a set amount of time. Two hundred people were found to have suffered an acute myocardial infarction. There was no statistically significant difference between the placebo group and the magnesium group in terms of mortality or the incidence rates of ventricular dysarrhythmia requiring medication. A total of ninety-four patients suffering from acute myocardial infarction were randomly assigned to one of two groups:

One group was given a daily magnesium bolus injection of 30 mmol, while the other group received a placebo for three days. Neither the placebo group nor the magnesium group had significantly different rates of death or potentially fatal arrhythmias [24-26].

In a separate study, 100 participants who were thought to be suffering from an acute myocardial infarction were given a 24-hour magnesium infusion or a placebo. Six hundred and twenty-two people were found to have myocardial infarction. The frequency of tachyarrhythmia did not change throughout the 245-day monitoring period. A significant increase in Brady arrhythmias was, however, associated with magnesium infusion treatment. An infusion of magnesium, potassium, 10% glucose, or 2% glucose was administered to 264 patients who were randomly randomised to receive one of these treatments for suspected acute myocardial infarction. A total of 228 people were found to have myocardial infarction. Neither the magnesium group nor the placebo group showed any statistically significant differences in death rates or the incidence of ventricular tachycardia or fibrillation [25-27].

For the first three days of their hospital stay, seventy-six patients were randomised to receive either a placebo or a magnesium infusion at a rate of 0.38 mmol/l per kg every twelve hours. The incidence of ventricular tachycardia was not significantly different between the two groups, according to the study. Of the 905 patients admitted over a one and a half year period, 362 were admitted due to acute myocardial infarction and 563 were admitted for other reasons. Upon admission, the reference group's serum magnesium levels were significantly higher than those of the acute myocardial infarction and non-AMI groups. Acute myocardial infarction patients admitted with hypomagnesaemia were more likely to experience ventricular tachycardia, ventricular fibrillation, and severe ventricular premature beats [27-29].

Conclusion

Fifty individuals with a diagnosis of acute myocardial infarction were the subjects of this investigation. There were four times as many men as women in the research group, and those aged fifty to ninety-nine had the greatest rate of acute myocardial infarction. Eighty percent of the population was Hindu, with twenty percent being Muslim, according to the research. According to the research, patients most often cited chest pain as a symptom. Sweating was experienced by 25% of patients, dyspnea by 25%, and palpitations by 10%, all of which were associated by this symptom. According to the research, smoking is the biggest risk factor, followed by high blood pressure and diabetes.

References

1. Goyal A, Spertus JA, Gosch K, Venkitachalam L, Jones PG, Berghe VDG, *et al.* Serum potassium levels and mortality in acute myocardial infarction. Jama. 2012 Jan 11;307(2):157-64.
2. Keservani RK, Kesharwani RK, Sharma AK, Vyas N, Chadoker A. Nutritional supplements: An overview. J Curr Pharm Rev Res. 2010;1(1):59-75.

3. Khondokar RK, Hossain D, Hossain M. Retrospective analysis of acute myocardial infarction. Bang Heart J., 1987, 1(14).

4. Keservani RK, Sharma AK, Kesharwani RK. Nutraceutical and functional foods for cardiovascular health. InFood Process Engineering. Apple Academic Press; c2016 Dec 8. p. 291-312.

5. Reffelmann T, Ittermann T, Dörr M, Völzke H, Reinthaler M, Petersmann A, *et al.* Low serum magnesium concentrations predict cardiovascular and all-cause mortality. Atherosclerosis. 2011 Nov 1;219(1):280-4.

6. Larsson SC, Burgess S, Michaëlsson K. Association of genetic variants related to serum calcium levels with coronary artery disease and myocardial infarction. Jama. 2017 Jul 25;318(4):371-80.

7. Keservani RK, Sharma AK. Immunomodulatory and Antimicrobial effects of Nano Emulsions: Pharmaceutical development aspects and perspectives on clinical treatments. In Nano dispersions for Drug Delivery. Apple Academic Press; c2018 Sep 24. p. 115-130.

8. Classen HG. Magnesium and potassium deprivation supplementation in animals and man-aspects in view of intestinal absorption. Magnesium. 1984;3:257-264.

9. Keservani RK, Kesharwani RK, Sharma AK, Gautam SP, Verma SK. Developing New Functional Food and Nutraceutical Products.

10. Dmitruk. Magnesium and calcium blood plasma content in patients with ischemic heart disease. Vrach Delo. 1977;2(14):7.

11. Keservani RK, Sharma AK, Kesharwani RK, editors. Nutraceutical and functional foods in disease prevention. IGI Global; c2018 Jul 13.

12. Sachadeva, *et al.* Serum magnesium and platelet adhesiveness in acute myocardial infarction. JIMA. 1978;71:165.

13. Jarouliya U, Zacharia A, Keservani RK, Prasad GB. Spirulina maxima and its effect on antioxidant activity in fructose induced oxidative stress with histo-pathological observations. European Pharmaceutical Journal. 2015;62(2):13-9.

14. Peacock JM, Ohira T, Post W, Sotoodehnia N, Rosamond W, Folsom AR. Serum magnesium and risk of sudden cardiac death in the Atherosclerosis Risk in Communities (ARIC) Study. American heart journal. 2010 Sep 1;160(3):464-70.

15. Ceremuzynski L, Jurgiel R *et al.* Threatening arrhythmias in acute myocardial infarction are prevented by intravenous magnesium sulphate. Am Heart J 1989; 118:1333-1334.

16. Shechter M, Mark N, *et al.* Beneficial effects of magnesium sulphate in acute myocardial infarction. Am J Cardiol. 1990;66:271-274.

17. Smith LF, Heagerty AM. Intravenous infusion of magnesium sulphate after acute myocardial infarction: Effects on arrhythmias and mortality. Int. J Cardiol. 1986;12:175-180.

18. Abraham AS, Rosenmann D. Magnesium in the prevention of lethal arrhythmias in acute myocardial infarction. Arch. Intern Med. 1987;147:753-755.

19. Felstedt M, Boesgarurd, *et al.* Magnesium substitution in acute ischemic heart syndrome. Eur Heart J. 1991;12:1215-1218.

20. Singh RB, Sircar AR *et al.* Magnesium and potassium administration in acute myocardial infarction. Magnesium Trace Elem. 10. Morton BC, Nair RC, *et al.* Magnesium therapy in acute myocardial infarction. 1990;9:198-204.

21. Lopez AD, Murray CC. The global burden of ischemic heart disease 1990-2020. Nat Med. 1998;4:1241-1249.

22. Khondokar RK, Hossain D, Hossain M. Retrospective analysis of acute myocardial infarction. Bang Heart J. 1987;1:14.

23. Islam MN, Ali MA, Ali M. Spectrum of cardiovascular disease: The current scenario in Bangladesh, Bangladesh Heart J. 2004;19:1-7.

24. Akila A, Anandraj J, Karthikayan S. Serum magnesium levels in acute myocardial infarction. IOSR J Dent Med Sci. 2017;16:35-40.

25. Mhaskar DM, Mahajan SK, Pawar KC. Significance of serum magnesium levels in reference to acute myocardial infarction and role of intravenous magnesium therapy in prevention of cardiac arrhythmias following myocardial infarction. International Journal of Medicine & Public Health; c2013 Jul 1, 3(3).

26. Subramanyam NT, Vakrani GP. Serum magnesium in acute myocardial infarction. Journal of Evolution of Medical and Dental Sciences. 2015 Jul 27;4(60):10460-8.

27. Moradi M, Fariba F, Mohasseli AS. Relation between the serum ferritin level and the risk for acute myocardial infarction. Journal of research in health sciences. 2015 Jul 2;15(3):147-51.

28. Gazi E, Temiz A, Altun B, Barutçu A, Bekler A, Güngör Ö, *et al.* The association between serum uric acid level and heart failure and mortality in the early period of ST-elevation acute myocardial infarction. Türk Kardiyoloji Derneği Arşivi; c2014 Sep 1, 42(6).

29. Shlomai G, Berkovitch A, Kadir PS, Bornstein G, Leibowitz A, Goldenberg I, *et al.* The association between normal-range admission potassium levels in Israeli patients with acute coronary syndrome and early and late outcomes. Medicine; c2016 Jun, 95(23).