Study of Serum Magenesium in Patients with Acute Myocardial Infarction

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Introduction

Acute Coronary Syndrome is a major health burden worldwide and causes more deaths and disability and incurs greater economic cost than any other illness in the world. It is also a leading cause of death in India, and its contribution to mortality is rising [1,2]. Genetic factors, high-fat and energy-rich diet, Hypertension, Smoking, sedentary lifestyle, obesity, less exercise, insulin resistance and Type 2 Diabetes Mellitus are the most powerful risk factors for Acute Coronary Syndrome (ACS). Ischemic heart diseases is growing among low-income groups, but primary prevention has delayed the disease to later in life across socioeconomic groups [2]. Magnesium has several functions in the human body. It acts as a cofactor for more than 300 enzymes, regulating a number of fundamental functions such as muscle contraction, neuromuscular conduction, glycemic control, myocardial contraction, and blood pressure [3,4]. Magnesium is of major importance in the treatment of arrhythmia and coronary artery disease. Patients with coronary heart disease (CHD) suffer from magnesium deficiency. Oral combination therapy with magnesium and potassium improves endothelial function in these patients and reduce platelet dependent thrombosis [5,6]. Magnesium has been implicated in the pathogenesis of acute myocardial infarction and its complications like arrhythmias, it plays a significant role in other cardiovascular diseases as well [7]. Magnesium ions are considered essential for the maintenance of the functional integrity of the myocardium. Hypomagnesaemia is associated with an increased risk of cardiac arrhythmia by decreasing effect of magnesium against calcium at the atrioventricular node, which lead to unstable membrane potentials and conduction of impulses and increase the susceptibility to arrhythmia. [8] Also, myocardial infarction is one of the common causes of death at present where prognosis depends on multiple factor of which many still remain unexplained. This study is designed to know the relationship between serum magnesium levels and arrhythmias in patients with acute myocardial infarction.

Aims and Objectives

AIM: To estimate the level of serum magnesium in patients with acute myocardial infarction.

Objectives

1. To study serum magnesium level after an acute myocardial infarction.

2. To correlate serum magnesium level with the complication of acute myocardial infarction (arrhythmia).

Review of Literature

Medical knowledge in the 18th and 19th centuries was grounded in clinical observation and anatomical dissection. Cardiovascular science emerged in the physiological era of the late 19th and early 20th centuries. The World Health Organization (WHO) criteria have been classically used to diagnose MI. A patient is diagnosed with MI if two (probable) or three (definite) of the following criteria are satisfied:

1. Clinical history of ischemic type of chest pain lasting more than 20 minutes.
2. Changes suggestive of MI in serial E.C.G. tracings.
3. Rise and fall of cardiac enzymes such as Creatine Kinase, Troponin T and LDH is o-specific for heart.[9]

Coronary Circulation, Anatomy of Coronary Arteries [10]

There are 2 main Coronary arteries, the Left main Coronary artery (LCA) and Right Coronary artery (RCA). The right and left Coronary arteries encircle the epicardium like the crown encircles the head, hence the name "coronaries". They arise from the aortic bulb, which is made up of three aortic sinuses. Anatomically the three sinuses are disposed such that, one is anterior and two are posterior. The RCA arises from the anterior sinus and LCA from posterior sinus, the remaining right posterior sinus being non- Coronary one. The RCA is dominant system in about 85% of individuals. It means in about 85% individuals, it supplies the posterior diaphragmatic portion of the interventricular septum and the diaphragmatic surface of the left ventricle.

Right Coronary Artery: The RCA originates from the right aortic sinus at a point lowerthan the origin of LCA. It passes down the right atrioventricular groove towards crux.The first branch of RCA is considered the conus artery. In 50% of the individuals, this vessel arises from the right Coronary ostium. In the other 50% of individuals, it arises from a separate ostium in the right aortic sinus. It serves as collateral in patients with LAD obstruction.

The second branch of RCA is the Sino-atrial node artery. It has been found that this artery originates from RCA in 59%, from left circumflex artery (LCX) in 38% and dual supply in the remaining 3%. It sends branches to the sinus node, also to the right atrium or both atria.

Left Main Coronary Artery: Left Coronary artery supplies greater volume of myocardium, almost all left ventricle and left atrium, and most of inter-ventricular septum.

Branches: It has two major branches namely left anterior descending artery (LAD) and left circumflex artery (LCX). Anterior descending artery produces right and left anterior ventricular rami and also anterior and posterior septal rami.

Left Circumflex Artery (LCX): LCX passes down the left ventricular groove, gives off obtuse marginal branches supplying free wall of left ventricle along its lateral aspect. Anterior and posterior rami of circumflex are small and supply left ventricle. Anterior ventricular branches – two to three in number, run parallel to diagonal artery. Posterior ventricular branches – are few and supply part of left ventricle.

Coronary artery dominance. The artery that supplies the posterior descending artery (PDA) and the posterolateral artery (PLA) determines the Coronary dominance.

- If the right Coronary artery (RCA) supplies both these arteries, the circulation can be classified as "right-dominant".

- If the left circumflex artery (LCX) supplies both these arteries, the circulation can be classified as "left-dominant".

- Approximately 90% of the general population are right-dominant, 10% are left-dominant.

Natural History of Acute Coronary Syndromes In India[11]

- Patients are younger at presentation (mean age 57.5 years).

- Lower socioeconomic groups are substantially affected (75%).

- STEMI is more common in Indians as compared to the West.

- Medical attention is received late (median 6 hr after onset of symptoms).

- Majority of patients receive thrombolysis (80%).

- Median door-to needle time (DTN) is 50 min.

- Standard of care medications are received less often.

- 30-day mortality is higher as compared to the west.

- Most patients reach hospital by private/public transport.

- Most patients pay directly for their own treatment

The Electrocardiogram-The importance of E.C.G is:

- To diagnose Myocardial Infarction.

- To differentiate transmural from subendocardial Infarction.

- To diagnose arrhythmias.

- To assess the prognosis.

Coronary Artery	Infarct Location	ECG Signature
Proximal LAD	Large anterior wall	ST elevation : I, aVL, V1-V6
More distal LAD	Antero-apical	ST elevation : V2-V4
Distal LAD	Anteroseptal	ST elevation :V1-V3
Early obtuse, marginal	High lateral wall	ST elevation : 1, aVL, V4-V6
More distal marginal branch, circumflex	Small lateral wall	ST elevation: I, aVL, or V4-V6
Circumflex of LCA	Posterolateral	ST elevation :V4-V6; STdepression V1-V2
Distal RCA	Small inferior wall	ST elevation : II, III, aVF; ST depression: I, Avl
Proximal RCA	Large inferior wall	ST elevation : II, III, aVF
	posterior wall	ST depression: I, L, V1- V3
	Some lateral wall	ST elevation : V5-V6
RCA	Right ventricular	ST elevation: V2R- V4R; some STelevation : V1, or ST depression: V2, V3
	Usually inferior	ST elevation : II, III, aVF

Table No.1: Presence of abnormal Q-waves, loss of R-waves and typical ST elevation>2 mm and coving are suggestive of Myocardial Infarction (Goldmann, 1986).

Material and Methods

The present study was an observational study entitled **"Study of Serum Magnesium Levels in Patients with Acute Myocardial Infarction** was conducted at Sri Aurobindo Medical College & PG Institute, Indore, a 1200 bedded tertiary care and referral center situated in heart of the city with state of the art technology catering to all sections of the society. It is a super specialty teaching hospital offering post graduate courses in broad

as well as super specialties. The hospital gets referral from a number of states surrounding Indore like Rajasthan, Haryana, Uttar Pradesh, Maharashtra, and other parts of Madhya Pradesh.

Duration of Study: The study was conducted over a period of 18 months from December 2016 to May 2018 among the patients who presented as in- patients with a diagnosis of ACS at Sri Aurobindo Medical College & PG Institute, Indore

Sample Size: 101 cases presenting with Acute Coronary Syndrome at our center during the period of study were studied and analyzed. The informed consent was obtained from the patients.

Sampling: Purposive sampling (non-probability) technique was used to recruit a sample from the population of patients who were admitted with acute coronary syndrome at Sri Aurobindo Medical College and Post Graduate Institute, Hospital during the period of study that met inclusion-exclusion criterion for this study.

Inclusion Criteria-Those patients presenting to the hospital within 24 hours of onset of symptoms were taken. Patients were considered to have acute myocardial infarction, only if they had following criteria:

- Patient with age > 18 years
- Typical ECG changes of acute myocardial infarction
- Elevated cardiac enzymes

All patients giving the written consent for participation in the study.

Exclusion Criteria

- Patients age< 18 years
- Patients with alcoholic cirrhosis and diarrhoea
- Patients with history of abnormal renal function
- Patients on diuretic therapy
- Patients on magnesium compounds

- Patients presenting more than 24 hours after episode

Procedure Planned

- All the patients with Acute Coronary Syndrome will be thoroughly investigated.
- All patients will be subjected to meticulous history and physical examination as per proforma.
- Blood samples will be obtained via a direct venous puncture within 24 hours of admission.

Investigations Planned-All patients will be subjected to following investigations:

Serum magnesium, Troponin T / Troponin I / CPK MB, Serum creatinine, Blood Urea, Chest X-ray PA view, ECG

Data collection and methods: A properly designed proforma (Appendix I) for each patient was designed and filled which included registration details(Name, IPD/OPD no., Age, Sex etc), presence of classic cardiovascular risk factors (diabetes mellitus, systemic hypertension, obesity, and smoking), and history of known vascular disease (ischemic heart disease). A detailed general examination was conducted which included looking for Pulse, Blood Pressure, Temperature and Respiratory Rate. Detailed Systemic examination was also done which included examination of Respiratory System, Cardiovascular System, Nervous System and Per Abdomen examination.

Statistical Technique: The raw data were entered into the computer database and the responses of frequencies were calculated and analyzed by using the raw data of 101 subjects. Statistical software, SPSS version 17.0 Trial was used to carry out the statistical analyzes. Student 't' test will be carried out if data found to be normal. P value< 0.05 will be considered as significant. Mean and standard deviation of various parameters will be observed and for qualitative parameters % will be observed.

Method of Serum Magnesium Estimation Method: Colorimetric end point test, Reagent: Xylidyl blue reagent, Magnesium standard: 2.5 mg/dL.

Principle: Magnesium combines with Calmagite in an alkaline medium to form a red colored complex. Interference of calcium and proteins is eliminated by the addition of specific chelating agents and detergents. Intensity of the color formed is directly proportional to the amount of magnesium present in the sample.

Specimen: Non-hemolyzed serum or lithium heparin plasma may be analyzed since the magnesium concentration inside erythrocytes is 10 times greater than that in the ECF, hemolysis should be avoided and serum should be separated from the cell as soon as possible.

Reference range for magnesium-Serum magnesium: 1.7 – 2.2 mg/dl.

Observation and Results

The present study entitled **"Study Serum Magnesium Levels In Patients With Acute Myocardial Infarction"** was carried out in the department of Medicine at Sri Aurobindo Medical College and Post- Graduate Institute, Indore (Madhya Pradesh).

A total of one hundred and one patients, who had acute coronary syndrome, aged more than 18 years of both the sexes that further met the inclusion criteria were purposively selected as subjects during specified study period.

Table 2: Distribution Of Study Population According To Diet

Diet	Frequency (N)	Percent(%)
Veg	32	31.6
Mix	69	68.4
Total	101	100

In the present study of 101 patients, 32 (31.6%) patients were vegetarian by diet and 69 (68.4%) of them consumed mixed diet. Non- vegetarian run higher risk of acute myocardial infarction owning to their higher content of cholesterol in their diet compared to the vegetarian.

Table 3 : Distribution Of Study Population According To Age.

Age	Frequency	Percentage
25-40	15	14.8
41-55	35	34.6
56-70	36	35.8
71-90	15	14.8
Total	101	100

The distribution of age of studied acute coronary syndrome patients can be easily observes in table 4. Analysis of table showed that 36(35.8%) of the acute coronary syndrome patients were more frequently belonged to age group of 56-70 years and that followed by 34.6% patients noticed within age group of 41-55 years.

Table 4: Risk Factors Associated With Acute Coronary Syndrome Patients.

Risk factors	No. of cases	Percentage
Diabetes	22	21.8
Hypertension	32	31.6
h/o ischemic heart diseases	17	16.8
Smoking	56	55.4

In the present study of 101 patients, 22(21.8%) patients were found to be diabetics, 32(31.6%) patients were found to be hypertensive. 17(16.8%) patients were having history of ischemic heart diseases and smoking is the most

common risk factor found in the patients with acute myocardial infarction.

Table 5: Distribution Of Patients According To Serum Magnesium Levels (mg/dl)

Serum Magnesium category

Sr. No.	Sr. Magnesium level	Number of patients	Percent
1	<1.7 mg/dl	64	63.4
2	1.7-2 mg/dl	32	31.7
3	>2 mg/dl	5	5.0
	Total	101	100.0

In this study we found serum magnesium levels <1.7 mg/dl in 64(63.4%) of patients presented to us with acute coronary syndrome.

Table. 6: Association Between Serum Magnesium Levels And Complication (Arrythmia) T-Test

Group Statistics					
	Arrythmia category	N	Mean	Std. Deviatio	Std. Error
Serum Magnesium (mg/L)	Yes	40	1.5728	.19767	.03125
	No	61	1.6846	.18274	.02340

The above table shows that out of 101 patients, 40 patients had arrhythmias. The mean value of serum magnesium with arrhythmias is 1.57±0.197 those without arrhythmias is 1.68±0.182. There is a significant difference in the magnesium level in patient with arrhythmias and without arrhythmias.

Discussion

In our study we include total number of 101 patients of acute coronary syndrome, of which 79 were male and 22 were female, during the study period from December 2016 to May 2018 from IPD of Department Of General Medicine At Sri Aurobindo Medical College And Post Graduate Institute, Indore. The purpose of our study was to study serum magnesium levels in patients with acute myocardial infarction, and to correlate serum magnesium levels with the complication of acute myocardial infarction (arrythmia). Magnesium is the fourth most abundant cation in the human body and the second most abundant intracellular cation. Nevertheless, serum magnesium concentration though less sensitive, is a highly specific indicator of tissue magnesium status. Magnesium ion has recently been considered as a principle cardiovascular cation. It has many critically significant roles in the maintenance of normal homeostasis of body. It plays a major role in cardiac homeostasis. Magnesium is essential in ATPase activation, necessary for the maintenance of the sodium-potassium pump. Magnesium deficiency has been attributed to the causation of arrythmia in acute myocardial infarction. Govind Mohan et al[12] demonstrated mean serum Mg levels in 53 acute MI cases to be statistically significant of 1.38±0.21mg/dl (p<0.001) on 1st day and 2.35±0.23 mg/dl on 10th day compared to mean value of 2.51±0.16mg% in 30 controls. Further, they reported even lower serum Mg levels of 1.26± 0.19 mg/dl on 1st day in 42 cases of acute MI with complications compared to 1.41 ±0.13 mg/dl in all 11 cases of acute MI without complications. It was observed that serum Mg were lowest in patients who died due to major arrhythmias and cardiogenic shock followed by pump failure.

Conclusion

Coronary artery disease is a major cause of morbidity and mortality throughout the world. Major cause of death

in coronary artery disease are due to complications like arrhythmias. In the present study, patients with acute myocardial infarction with low magnesium level are significantly associated with arrhythmias. Magnesium replacement therapy in patients with acute myocardial infarction who is having low serum magnesium level may reduce the incidence of arrhythmias and may contribute mortality benefits. So, it can be concluded that measurement of serum magnesium levels is of prognostic significance in patients with acute myocardial infarction.

Summary

The study was observational study which comprised of 101 patients of Acute Coronary Syndrome. In our case study, serum magnesium levels in patients with acute myocardial infarction were determined and correlation of serum magnesium level with the complication of acute myocardial infarction (arrythmia) was done.

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