Study of Serum Magnesium, Potassium and Calcium in Acute Myocardial Infarction Patients

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A myocardial infarction happens when blood flow stops or decreases to the coronary arteries of the myocardial muscle, resulting in damage to the heart muscle. Magnesium is important electrolyte plays vital role in suppressing arrhythmias during myocardial ischemia and during reperfusion. Potassium is the most abundant cation of intracellular fluid. A significant correlation between hypokalemia and ventricular fibrillation is recorded. Calcium plays a vital role in myocardial muscle contraction. To study serum levels of magnesium, potassium and calcium in acute myocardial infarction patients. Material and methods: This was a prospective case control study conducted in Prathima Institute of medical sciences Nagunur, Karimnagar, Telangana state, India between January 2015 to December 2015. A total 50 acute myocardial infarction patients and 50 normal age and sex matched healthy controls selected for study. Serum magnesium estimated by colorimetric xylidyl blue complex method, serum potassium estimated by ion selective electrode method and serum calcium by OCPC method. Statistical analysis carried out using statistical software SPSS version 16 and p-value < 0.05 considered statistically significant. Results: Serum levels of magnesium, potassium and calcium were significantly decreased in acute myocardial infarction patients when compared healthy controls and is statistically significant (<0.05) Conclusion: The above study suggested decreased serum level of key elements such as magnesium, potassium and calcium in acute myocardial infarction patients when compared to healthy controls. Estimation and correction of these elements may play a pivotal role in management of patients with acute myocardial infarction

Keywords: Acute myocardial infarction; Hypomagnesium; Hypokalemia; Hypocalcaemia.

Ischemic heart disease is a term used for a group of closely related syndrome resulting from hypoxia to cardiac muscle. A myocardial infarction results when blood flow decreases or stops to the coronary arteries of the myocardium, resulting in damage to the cardiac muscle. Ischemia consists of not only insufficiency of oxygen, but also decreased availability of nutrient molecules and inadequate removal of metabolic products.[1,2]

Hypomagnesemia is a common condition which is observed in 12-14% of patients admitted to hospital and occurrence of hypomagnesemia is as high as 60-65% in patients admitted in intensive care unit section. Magnesium plays vital part in

decreasing arrhythmias during ischemic condition and also during reperfusion. Magnesium also helps in increasing the ventricular threshold of arrhythmias in normal condition.[3,4] Potassium is the most abundant cation of intracellular fluid. A significant correlation between Hypokalemia and ventricular fibrillation is observed. Diuretics therapy in acute MI seems to be correlated with occurrence Hypokalemia but according to one study out of 100 patients with Hypokalemia and ventricular fibrillation only 30 were on diuretics therapy.[5] Calcium performs very important functions in our body and deficiency calcium manifests from asymptomatic to life threatening conditions. Calcium plays an vital role in contraction myocardial muscle.[6] Hence present study is undertaken to study serum levels of magnesium, potassium and calcium in acute myocardial infarction patients and compared with healthy controls.

MATERIAL AND METHODS

This was a prospective case control study conducted in Prathima Institute of medical sciences Nagunur, Karimnagar, Telangana state, India between January 2015 to December 2015.A total 50 acute myocardial infarction patients selected from patients admitted in intensive care unit ward and 50 normal age and sex matched healthy controls selected from general population. Statistical analysis was carried out using statistical software SPSS version 16 and p-value < 0.05 was considered statistically significant.

Inclusion criteria

1. Cases: 50 acute myocardial infarction patients who were diagnosed by ECG and biochemical markers. Sample collected within 24 hours after diagnosis

2. Controls : 50 normal age and sex matched healthy individuals

Exclusion criteria

1. Cases of AMI on diuretic therapy
2. Chronic diseases
3. Diabetes mellitus
4. Hypertension

Collection of Blood Samples

About 5ml of venous blood collected under aseptic conditions in plain vial for biochemical tests at admission within 24 hours after diagnosis.

Immediately after collecting sample serum is separated and properly stored.

The following tests carried out in cases and controls.

1. Serum Magnesium
2. Serum Potassium
3. Serum calcium

Estimation of serum magnesium[7]

Serum magnesium estimated by colorimetric xylidyl blue complex method. Magnesium ion forms a color complex with xyldyl blue under alkaline conditions. The intensity of the color developed is directly proportional to the magnesium ion concentration in the sample.

Estimation of serum Potassium[8]

Serum potassium estimated by ion selective electrode method. The ISE module for potassium employs ether membrane electrodes. An electrical potential is developed according to Nernst equation. When compared to internal reference solution electrical potential is translated into voltage and then to the ion concentration of the sample

Estimation of serum calcium[9, 10]

Serum calcium estimated by OCPC method. Calcium ions reacts with o-cresopththalein complex in alkaline solution and forms an intense violet colored complex which is directly proportional to the calcium ion concentration

RESULTS

A total number of 100 subjects were included in the study of which 50 consist of cases and 50 were controls. Among 50 cases 42 were male and 8 were females and their mean age was 59.4±1.6 years and among 50 controls 40 were male and 10 were females and their mean age was 58.3±7.1 years.

Sex	Study group		Control group	
	Male	Female	Male	Female
(n)	42	08	40	10

DISCUSSION

The findings from present study observed that, serum mean level of Magnesium, Potassium and Calcium were significantly (p< 0.001)

Table 1. Comparison of Serum Magnesium, Potassium and calcium in
Controls and acute myocardial infarction patients

Groups		Magnesium (mg/dl)	Potassium (mmol/L)	Calcium (mg/dl)
Controls	Mean ± SD	2.12 ± 0.29	4.63±0.38	9.46± 0.53
Acute myocardial infarction	Mean ± SD	1.41 ± 0.23	3.61±0.31	7.64±0.41
Controls vs Acute myocardial infarction	Mean difference	0.71	1.02	1.82
	t*	13.54	14.70	19.20
	P	< 0.001	< 0.001	< 0.001

* Unpaired t- test, P value < 0.001 considered as highly significant

decreased in acute myocardial infarction patients when compared to healthy controls

Magnesium is one of the vital mineral in body. Magnesium helps in myocardial metabolism, inhibits accumulation of calcium, improves vascular tone, improves cardiac output and reduces arrythmias[11]. The mean serum level of magnesium decreased in acute myocardial infarction patients compared to healthy controls which is similar to study conducted by Choudhury MBK et al.[12].

Patients diagnosed with acute myocardial infarction with concurrent hypomagnesium likely to have two to three fold increase in incidence of ventricular arrhythmia.[13] The exact reason for magnesium deficiency in patients with acute myocardial infarction is not clearly known. According to one researcher low serum magnesium in acute myocardial infarction patients may be due shift of magnesium from extracellular to intracellular compartment.[14] according to another study there is a significant decrease in magnesium and potassium levels due o the catecholamine induced circulating high free fatty acid levels causes binding and precipitation of these minerals resulting in sudden decrease in magnesium and potassium levels[11]

The mean serum level of potassium significantly decreased in acute myocardial infarction patients compared healthy controls. In previous studies a significant association between hypokalemia and ventricular arrhythmias demonstrated. Diuretics therapy given in myocardial infarction patients correlated with hypokalemia but out of 100 patients with hypokalemia who developed ventricular fibrillation only 30 were on diuretics treatment. The likely reason for hypokalemia in the early phase of an acute myocardial infarction is seems to be associated with increased activation of the sympathetic nervous system causing influx of potassium from the extra cellular to the intracellular fluid compartment[15]

Calcium performs very important functions in our body and is essential for cardiac function where it is required for myocardial contraction. Serum calcium level was significantly decreased in acute myocardial infarction patients when compared to healthy controls this is in accordance to study conducted by Kafka H et al.[16]

Deficiency of calcium in our body manifests from asymptomatic to life threatening disorders. Cardiovascular manifestations of calcium deficiency are prolonged QT interval, cardiac arrhythmias and failure of heart. However hypocalcaemia leading to occurrence of acute coronary syndrome or coronary artery spasm have been rarely reported[6,17]. According to one study low serum calcium is associated with cardiovascular risk factors such as hypertension, diabetes mellitus type 2 and left ventricular systolic dysfunction. This might be a contributing factor for higher cardiovascular mortality in the low calcium group.[18]

Limitation(s)

This study is carried out in small number of sample size; hence further study involving a larger sample size in different setup is needed for better understanding.

CONCLUSION

In present study we have observed that there is decreased levels of magnesium, potassium and calcium in acute myocardial infarction

patients when compared healthy controls and was statistically significant (<0.05). Thus it is suggested from the above study that estimation and supplementation of magnesium, potassium and calcium may play a vital role in management of acute myocardial infarction patients.

Conflict of Interest

There is no conflict of interest.

Funding Source

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