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# EVALUATION OF SERUM ELECTROLYTES IN PATIENTS WITH ACUTE MYOCARDIAL INFARCTION

**Dr.U.Sarada** — Assistant Professor, Department of Biochemistry, Kurnool Medical College, Kurnool, Andhra Pradesh, India

**Dr.A.Padma Vijayasree** — Professor and Head, Department of Biochemistry, Kurnool Medical College, Kurnool, Andhra Pradesh, India

**ABSTRACT**

**Background:** Acute myocardial infarction (AMI) is one of the leading causes of morbidity and mortality across the world. Very few studies were done to see the association of serum electrolytes with acute myocardial infarction.

**Objectives:** To determine the pattern of changes of serum electrolytes in AMI patients and then compare with non AMI (i.e. healthy persons).

**Material and Methods:** This case control study was carried on 50 AMI patients and 50 healthy controls. 3 ml of blood was drawn from each patient within 6 hrs. of AMI, to estimate serum sodium, serum potassium, serum chloride, serum calcium and cardiac marker CK-MB. The same biochemical parameters were also determined in 50 age and gender matched controls for comparison.

**Results:** We found statistically significant decreased levels of serum sodium, serum potassium, serum calcium and non-significant difference in the levels of serum chloride in AMI cases as compared to controls.

**Conclusion:** We found Decresed Sodium (hyponatremia), Decreaed calcium (Hypocalcemia) and Decreased Potassium (hypokalemia) which may act as indicator of injury to myocardium. Further studies are needed to correlate all these parameters with the prognosis of AMI.

**KEYWORDS :** Acute myocardial infarction, Serum sodium, potassium, Chloride, calcium CK-MB.

## Introduction

Acute Myocardial Infarction (AMI) is a dreadful complication of cardiovascular disease causing increasing mortality worldwide. The prevalence of Myocardial Infarction (MI) is more in the middle income world (WHO, 2004) and it is well known that males are more commonly affected than females. This disease occurs when blood flow stops to part of the heart causing damage to the heart muscle thus increasing myocardial metabolic demand, decreasing delivery of oxygen and nutrients to the myocardium via the coronary circulation. The most common symptom is chest pain or discomfort which may travel into the shoulder, arm, back, neck or jaw. Often, it is in the center or left side of the chest and lasts for more than a few minutes. MI is one of the most common diseases diagnosed in hospitalized patients in industrialized countries. It is a growing cause of death worldwide. Sudden cardiac death occurs worldwide at a rate of 3 million per year (Jeldsen K. K., 2010)[1].

The electrolyte levels, being modifiable, play an important role in altering the prognosis of MI patients. These electrolyte level changes have been reported to be used to monitor AMI. There are several common electrolytes found in the body, each serving a specific and important role, but most are in some part responsible for maintaining the balance of fluids between the intracellular and extracellular environments. This balance is critically important for issues like hydration, nerve impulses,muscle function and pH level. The major electrolytes in the body are Potassium, Sodium, Magnesium, Calcium and Chloride. Serum Sodium, Potassium and Chloride are considered to be the major determinants of electrophysiological properties of myocardial membrane.

Potassium (K) is a main component of cellular fluid. This positive electrolyte helps to regulate neuromuscular function and osmotic pressure, Approximately 98% of this electrolyte is intracellular. Its main regulation is by the renal excretion and shift between the intracellular and extracellular compartments. Potassium is one of the electrolytes that play an important role in cardiac disease specially AMI. Hypokalemia defined as serum Potassium levels <3.5 mmol/l is portrayed as a determinant of excessive morbidity in such patients, particularly malignant ventricular arrhythmia. Several studies have shown association between hypokalemia, even mild hypokalemia with increased occurrence of cardiac arrhythmias in AMI patients (Nordrehaug J. E., 1985)[2].Hypokalemia in patients with AMI is thought to predict increased in-hospital morbidity, particularly arrhythmias and mortality (Xianghua F. et al., 2000)[3].

Sodium (Na) is the most abundant extracellular cation, a positively charged electrolyte that helps to balance fluid levels in the body and facilitates neuromuscular functioning. Serum Sodium imbalance has been also recorded in early phase of AMI in some studies (Goldberg A.et al., 2004)[4]. Hyponatremia defined as serum Sodium concentration < 135 mmol/l is relatively common among patients hospitalized with AMI (Tada Y. et al., 2011)[5].

Chloride (Cl) is the major Anion. Chloride is primarily found in extracellular fluid and works closely with Sodium to maintain proper balance and pressure of the various fluid compartments of the body (blood, inside cells and the fluid between cells). It is also vitally important for maintaining proper acidity in the body, passively balancing out the positive ions of blood, tissue and organs.

Calcium (Ca) ions play a vital role in the sequence of excitation-contraction of the cardiac muscle fibers and they are essential in both the cardiac and systemic vasculature (Lehmann G. et al., 2000)[6]. Furthermore, hypocalcemia impairs myocardial contractility and there are several reports of congestive heart failure caused by severe hypocalcemia, while long-standing hypocalcemia has been implicated in the pathogenesis of cardiomyopathy. Moreover, coronary spasm due to hypocalcemia has been reported as the most likely mechanism of chest pain in young patients mimicking AMI.

## Material and methods

We conducted this case control study on randomly selected 50 patients of AMI, hospitalized in the Intensive Care Unit (ICU) of Medicine Department, Kurnool Medical College, Kurnool only after taking informed consent from the study participants. Duration of the study is from January 2017 to June 2017. The approval from the Institutional Ethics Committee was duly taken for this research study. The diagnosis of AMI was done by on duty ICU physician based on clinical presentation, electrocardiography (ECG) and biochemical investigation. Fifty, voluntarily willing, consent giving, age and gender matched healthy controls were selected on the basis of following criteria.

### Inclusion criteria

(Different for AMI cases and healthy controls):

**For cases:**

Hospitalized in ICU with chest pain of at least 20 min duration ST-segment elevation of at least 2 mm in two or more successive leads of ECG and CK-MB level above 25 IU/L.

**For controls:**

Age and gender matched with cases. CK-MB level within physiological limits.

No history or clinical/laboratory evidence of AMI.

**Exclusion criteria**

(Same for controls as well as cases):

Presence of renal diseases, pulmonary diseases, liver diseases, neoplastic diseases, valvular heart disease, Diagnosed case of gout, acute infections, History of smoking, Known case of hypertension Known case of diabetes mellitus, Obesity with body mass index > 32 kg/m2.

Blood samples for the study were taken by venipuncture in plain vaccutainer. Hemolysed and lipemic samples were excluded from the study. Creatine kinase-MB (CK-MB) was estimated by modified IFCC method. Serum electrolytes were estimated by ion selective electrolyte analyzer. Serum Calcium is estimated by OCPC method.

**Statistical analysis**

The data of the study was analyzed by Graph pad prism software version 7. Students unpaired't' test was applied for the comparison of variables between controls and cases. P value <0.05 was considered as statistically significant.

**Results**

Table 1 shows, Out of 50 cases of AMI, 27(54%) were males and 23(46%) were females as compared to 26(52%) males and 24(48%) females in controls . CK- MB level was significantly elevated in AMI patients as compared to controls. Statistically significant reduced levels of serum sodium, serum potassium, serum calcium and non-significant difference in the levels of serum chloride were observed in AMI as compared to controls (Table 2).

**Table 1: Age and gender wise distribution of cases and controls**

| Variable | Control | Cases |
|---|---|---|
| Number of study subjects(n) | 50 | 50 |
| Mean age in years | 46.56± 1.728 | 47.04± 1.873 |
| Male: female ratio. | 27:23 | 26:24 |

**Table 2: Comparison of variables of controls and cases**

| Variable | Controls | | Cases | | 't' value | P value | Significance |
|---|---|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | | | |
| Age (years) | 46.56 | 1.728 | 47.04 | 1.873 | 1.33 | 0.186 | Non-significant |
| CK- MB(U/L) | 17.62 | 3.516 | 155.1 | 20.25 | 47.3 | <0.001 | Significant |
| Serum sodium (meq/L) | 140.1 | 2.976 | 131.9 | 1.729 | 16.93 | <0.001 | Significant |
| Serum potassium (meq/L) | 4.628 | 0.3124 | 3.7 | 0.203 | 17.61 | <0.001 | Significant |
| Serum chloride (meq/L) | 102.7 | 2.037 | 103.3 | 2.325 | 1.51 | 0.1343 | Non-significant |
| Serum calcium (mg/dl) | 8.602 | 1.215 | 7.508 | 1.411 | 1.87 | 0.00 | Significant |

**Discussion**

In this research, we found significantly elevated levels of CK-MB in patients of acute myocardial infarction as compared to controls. Being a cardiac marker, increased level of CK-MB in AMI was very well correlated with the ischemic necrosis and infraction of myocardium.

We observed that serum sodium level was significantly reduced in AMI cases when compared with normal healthy controls. These findings were in consistent with that of other studies[7,8]. In AMI, vasopressin undergo non-osmotic release due to acute development of left ventricular dysfunction due to pain and stress or may be due to use of analgesics or diuretics resulting in reduced level of sodium. According to one study, decrease in serum sodium level was due to hypoxia, ischemia and infarction resulted in increased permeability of sarcolemma to sodium[9,10].

The level of serum potassium found to be low (p<0.001) in AMI cases as that of healthy control groups. This is in accordance with other studies[7,8]. Hypokalemia observed in our study may be due to stress induced Catecholamine, that resulting in increased potassium uptake by the cells[11]. This is an acute stress effect and is due to shift of potassium from extracellular to intracellular space and is a result of stimulation of beta2 adrenoceptor agonists linked to sodium-potassium ATPase pump[12].

Our study also showed that there was decrease in total serum Calcium and serum ionized Calcium with p-value = 0.00 it is similar to the study of Ramasamy R. et al.(2013)[13] who reported significantly lowering in AMI with p-value < 0.001.Chloride Ion had no significant value in this study as similar as to Esha Mati E. et al. (2012) study[14].

**Conclusion**

Assessment of serum electrolytes could be important for AMI in terms of prognosis by evaluation of risk factors like electrolyte imbalance. This information could be useful for the treatment of AMI, for the assessment of short to long term mortality in AMI and to prevent further complications.

**Recommendations**

1. Estimation of serum electrolyte is good for diagnosis and prognosis of AMI.
2. We should take the sample as soon as the patient enters the hospital before any admission.
3. The estimation of serum Sodium level in patients with AMI should be done as early as possible on arrival of the patients in emergency department.

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