



Research Article

Electrolyte Imbalance in Patients of Acute Myocardial Infarction: A Study from Central India

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Abstract

Background: Acute myocardial infarction is one of the manifestations of coronary heart disease, leading to morbidity and mortality. Electrolytes such as sodium and potassium are considered to be major determinants of electrophysiological properties of myocardial membrane and their imbalance after an episode of AMI is common. Hence, the present study was planned with the aim to evaluate serum sodium and potassium in patients of AMI.

Materials and Methods: The present study included 50 patients of AMI and 50 normal healthy individuals as controls. In all the subjects, sodium and potassium were measured by ion selective electrolyte analyzer.

Results: Both sodium and potassium were significantly reduced in patients of AMI as compared to controls (131.48 ± 6.31 meq/L vs. 139.32 ± 3.09 meq/L, $p < 0.001$ and 3.57 ± 0.81 meq/L vs. 4.36 ± 0.45 meq/L, $p < 0.001$, respectively).

Conclusion: In conclusion, electrolytes such as sodium and potassium could be estimated in AMI subjects, which will provide additional information with regard to treatment as well as prognosis.

Keywords: Acute myocardial infarction, sodium, potassium.

Introduction

Coronary heart disease is mainly caused by atherosclerosis and plaque formation on the surface of the coronary arteries¹ and acute myocardial infarction (AMI) is one of the manifestations of coronary heart disease, leading to morbidity and mortality². There are many symptoms of acute myocardial infarction but the most common is chest pain, which may travel into the shoulder, arm, back, neck or jaw. This type of

pain always starts from the center or left side of the chest and remains for few minutes. The onset of symptoms in acute myocardial infarction is usually gradual, over several minutes and rarely instantaneous³⁻⁵. In industrialized countries, AMI is one of the most common diseases, diagnosed in hospitalized patients. Worldwide, it is a growing cause of death and sudden cardiac death occurs at a rate of 3 million per year⁶.

Electrolytes play an important role in cellular function, intermediary metabolism, enzyme activities and electrical gradients⁷. Electrolytes such as sodium and potassium are considered to be major determinants of electrophysiological properties of myocardial membrane and their imbalance after an episode of AMI is common⁸. Hence, the present study was planned with the aim to evaluate serum sodium and potassium in patients of AMI.

Materials and Methods

Study Design and Subjects

The present study was carried out in the Department of Biochemistry and Department of Cardiology, Gajra Raja Medical College and J. A. Group of Hospitals, Gwalior after getting permission from Institutional Ethical Committee. The study included total 100 subjects, aged between 35-75 years of either sex. 50 of them were patients of AMI admitted to the Cardiology Department of J.A. Group of Hospitals, constituted the study group and rest 50 were normal healthy individuals and they formed the normal control group.

Each patient undergone an initial clinical and laboratory evaluation, which included the detailed clinical history, clinical examination, standard 12 lead ECG, routine blood investigations and cardiac biomarkers [CK-MB and cardiac troponin T (Card test)] as a part of routine assessment and diagnosis of AMI was made after critical review of all these information by a cardiologist.

Patients with diabetes mellitus, chronic muscle disease, renal disease, recent surgery, implanted pacemaker, autoimmune disease, arthritis, any inflammatory disease and subjects not willing to give consent were excluded from the study.

Written informed consent was taken from cases and controls after a full explanation of the study.

Biochemical Measurements

About 5 mL of venous blood sample was collected under all aseptic precautions from cases and controls and transferred to the sterile plane test tube. The blood was allowed to clot and

centrifuged at 3000 rpm for 5 minutes. Supernatant was collected in clean and dry test tube and used for analysis of sodium and potassium. Serum electrolytes were measured by ion selective electrolyte analyzer.

Statistical Analysis

Data are presented as mean±SD values. Statistical analysis and interpretation of data were done by Statistical Package for Social Science version 20 (IBM, SPSS statistics 20, Armonk, NY, USA). The statistical differences between cases and controls were determined by student independent sample t-test. Chi-square test is used for categorical data. *p*-value less than 0.05 was considered significant.

Results

The total 100 subjects were included in the present study, out of which 50 were patients of AMI and rest 50 were normal healthy individuals as controls. Table 1 shows the clinical characteristics of the studied subjects. The average age of AMI patients and control subjects were 61.96±10.31 years and 58.70±10.36 years respectively. There was no significant difference between these two groups with regard to age, indicating that cases and controls were age matched. Also, there was no significant difference in sex distribution between cases and controls. There were significant decreased in the levels of both sodium and potassium in AMI patients as compared to controls (131.48±6.31 meq/L vs. 139.32±3.09 meq/L, *p*<0.001 and 3.57±0.81 meq/L vs. 4.36±0.45 meq/L, *p*<0.001, respectively).

Table 1: Shows the clinical characteristics of the studied subjects.

Variables	Control subjects (n=50)	AMI subjects (n=50)
Age (years)	58.70±10.36	61.96±10.31 ^{NS}
Sex (M/F)	28/22	30/20 ^{NS}
Sodium (meq/L)	139.32±3.09	131.48±6.31 ^{**}
Potassium (meq/L)	4.36±0.45	3.57±0.81 ^{**}

Results are shown as mean±SD; ^{NS}Non significant; ^{**}Significant at *p*<0.001

Discussion

Acute myocardial infarction occurs when there is an abnormal ischemic alteration of the myocardium due to an inability of the coronary perfusion to meet the myocardial contractile demand⁹. In this study, we found significantly decreased levels of sodium and potassium in AMI patients as compared to that of age and gender matched control subjects. The significant decreased level of sodium in AMI patients is in accordance with the findings of Mati et al⁸, Mudaraddi et al¹⁰ and Mandole et al¹¹. In acute myocardial infarction, there occurs non osmotic release of vasopressin due to the acute development of left ventricular dysfunction in response to pain, nausea, and major stress, or in response to the administration of analgesics and diuretics. This could result in low sodium level in blood^{12,13}. Hyponatremia may be aggravated further in AMI by the concomitant activation of the renin-angiotensin system and increased catecholamine production¹⁴. According to the study done by Tang et al¹⁵, hyponatremia is linked to poor outcomes in patients with STEMI and non ST elevation coronary syndromes and the risk of mortality increased with severity of hyponatremia. Similarly, the significant decreased level of potassium in AMI subjects, as observed in our study, is in line with the studies done by Mati et al⁸, Mudaraddi et al¹⁰ and Mandole et al¹¹. The main reason for hypokalemia in patients of AMI is most likely an activation of the sympathetic nervous system leading to an influx of potassium from the extracellular to the intracellular body fluid compartment¹⁶. In the early phases of AMI, the sympathetic nervous system is activated, as reflected by elevated levels of plasma catecholamines and modulation of β adrenergic receptor signalling. This activation leads to intracellular influx of potassium and decrease in serum potassium levels¹⁷. Hypokalemia causes cellular hyperpolarity, increases resting potential, hastens depolarization, and increases automaticity and excitability. Because cardiac repolarization relies on potassium influx, hypokalemia lengthens

the action potential and increases QT dispersion. Thus, hypokalemia increases risk of ventricular arrhythmia and sudden cardiac death¹⁸.

Conclusion

In conclusion, we found statistically significant decreased levels of sodium and potassium in AMI patients. Hence, electrolytes such as sodium and potassium could be estimated in AMI subjects, which will provide additional information with regard to treatment as well as prognosis. However, further studies are needed in order to get more precise results.

References

1. Park K. Textbook of Preventive and Social Medicine. 19th Edition. 2007;286–287.
2. Oliver MF. Diet and Coronary heart disease. Br Med Bull 1981;37(1):49-58.
3. Aghaeishahsavari M, Noroozianavval M, Veisi P, Parizad R, Samadikhah J. Cardiovascular disease risk factors in patients with confirmed cardiovascular disease. Saudi Med J 2006;27:1358–61.
4. AlSaraj F, McDermott JH, Cawood T, McAteer S, Ali M, Tormey W, et al. Prevalence of the metabolic syndrome in patients with diabetes mellitus. Ir J Med Sci 2009;178:309–13.
5. Anwar A, Khan HA, Hafeez S, Firdous K. A comparative study of creatine kinase- MB and Troponin levels among diabetic and non diabetic patients with acute MI. Pak J Med Health Sci 2016;10:296–298.
6. Jeldsen KK. Hypokalemia and sudden cardiac death. Exp Clin Cardiol 2010;15(4):96-99.
7. Lobo DN. Fluid, electrolytes and nutrition. Physiological and Clinical aspects. Proc Nutr Soc 2004;63(3):453-466.
8. Mati E, Krishnamurthy N, Ashakiran S, Sumathi ME, Prasad R. Dyselectrolytemia in acute myocardial infarction-a retrospective study. J Clin Biomed Sci 2012;2(4):167-174.
9. Lim W, Qushmaq, Cook DJ, et al. Elevated Troponin & Myocardial infarction in the

- intensive care unit: a prospective study. *Crit Care* 2005;9:R636-644.
10. Mudaraddi R, Kulkarni SP, Trivedi DJ, Patil VS, Kamble S. Association of Serum Electrolytes and Urea Levels with Cardiac Markers in Acute Myocardial Infarction. *Int J Clin Biochem Res* 2015;2(4):233-235.
 11. Mandole MB, Howale DS, Mamatha MT, Sharma D, Gamit D, Pandit DP. Evaluation of renal function tests and serum electrolytes in patients with acute myocardial infarction. *Int J Biomed Res* 2016;7(9):676-679.
 12. Kennedy PG, Mitchell DM, Hoff brand BI. Severe hyponatremia in hospital inpatients. *BMJ* 1978;2:1251-1253.
 13. Adroge HJ, Madias NE. Hyponatremia. *N Engl J Med*. 2000; 342: 1581-1589.
 14. Kumar S, Berl T. Sodium. *Lancet* 1998;352:220-228.
 15. Tang Q, Hua Q. Relationship between hyponatremia and in hospital outcomes in Chinese patients with ST elevation myocardial infarction. *Intern Med* 2011;50:969-974.
 16. Verma S, Agarwal YB, Sharma SK, Doifode DV. Dyselectrolytaemia in acute myocardial infarction. *JACM* 2015;16(3-4):201-3.
 17. Shlomain G, Berkovitch A, Pinchevski-Kadir S, 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* 2016;95(23):e3778.
 18. Macdonald JE, Struthers AD. What is the optimal serum potassium level in cardiovascular patients?. *J Am Coll Cardiol* 2004;43(2):155-61.