Original Research Article

Study of serum sodium in acute myocardial infarction and its correlation with severity and complications of myocardial infarction

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Abstract

Aim: To analyse serum sodium in acute myocardial infarction and to observe its correlation with complications of myocardial infarction. **Methodology:** Study was conducted on 50 cases of acute myocardial infarction. Clinical examination, ECG examination, serum sodium and potassium estimation were performed on admission, then after 12, 24 and 48 hrs of cases of acute myocardial infarction. **Results:** Acute myocardial infarction was associated with modifiable risk factors like tobacco addiction, dyslipidemia, diabetes mellitus and hypertension. Acute anterior wall myocardial infarction was more commonly associated with hyperglycemia at admission and with poor prognosis ($p < 0.05$). Serum sodium level was low in patient with acute myocardial infarction, lower values seen in myocardial infarction associated with heart failure ($p < 0.05$). A positive correlation was observed in serum sodium level and severity of heart failure ($p < 0.05$). Serum sodium level was significantly lower in fatal cases as compared to non-fatal cases ($p < 0.05$). **Conclusions** It is important to understand that initial level of serum sodium is strongly correlated with cardiovascular complications of myocardial infarction. Hence estimation of serum sodium may help in rapid assessment of complications so that better management could be planned.

Keywords: Myocardial infarction, Serum sodium, Heart failure

Introduction

Myocardial infarction (MI) is a leading cause of mortality and disability of adults in urban and rural India, and occurs at a younger age than in western populations.[1] Serum sodium and potassium concentration have several important bearing in cases of myocardial infarction including several complication leading to fatal outcome. In the subject of acute myocardial infarction, sodium imbalance may occur from factors which were present before the incident occurred such as salt restricted diet, previous intake of diuretics, and presence of renal failure either overt or incipient, slowly occurring cardiac failure prior to infarction. The purpose of the work is to make a study of this aspect of serum sodium in acute myocardial infarction which is not only of academic interest but also will help in the prevention of complications and their management with consequent improvement in the mortality and morbidity of the disease.

Materials and methods

The present study was carried out on fifty (50) patients of acute myocardial infarction in the Coronary Care Unit of Department of Medicine, G R Medical College, Gwalior, over a period of 12 months from November 2009 to October 2010. The patients were examined clinically on admission with detailed history especially the complaints and history of risk factor for occurrence of acute myocardial infarction and a thorough physical examination was carried out. Serum sodium concentration was obtained in all patients on admission and analyzed as hyponatremia versus normonatremia. The relationships between hyponatremia and in-hospital mortality as well as heart failure were assessed.

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Collection of venous blood samples was done in both the groups on the day of admission within 12 hours from anticubital vein with all aseptic precautions in plain vacutainers for serum electrolytes, i.e., Na+ & K+.Blood was allowed to clot at room temperature for half an hour and then centrifuged at 3000 rpm for five minutes. The serum separated was used for the estimation.Serum electrolytes (Na+, K+) were measured by flame-photometry (Bio-Lab Diagnostic kit).The comparative study of serum and potassium levels was carried out between the controls and AMI, patients and AMI patients with and without history of Smoking, Hypertension and Diabetes Mellitus, also a study was carried out to evaluate the variations in serum electrolyte levels in AMI patients of age below 50 years and above 50 years.

ECG was recorded at the time of admission and subsequently twice daily and whenever required. Serum sodium and potassium were estimated at admission, then after 12 hrs, 24 hrs, and 48 hrs. Mean of the 4 reading was taken out. Based on the mean value serum sodium cases were categorized into two groups: Group A mean serum sodium level >135mmol/l and Group B ≤135mmol/l. Other biochemical parameters were taken into account like blood sugar, blood urea, serum aspartate amino transferase, serum alanine transferase, serum cholesterol etc.

Inclusion criteria

Individuals who had clinical history of ischemic chest pain lasting for > 20 min., electrocardiographic changes or elevation of serum cardiac biomarkers such as creatinine phosphokinase MB fraction and/or troponin were included in the study.

Exclusion criteria

Individuals who were suffering from long standing heart failure or chronic renal failure were excluded.

Consent

Written consent was obtained from the relatives of patients after explaining them the nature and purpose of the study. They were assured that confidentiality would be strictly maintained. The option to withdraw from the study was always open.

Observation chart

Table 1 :table showing age wise distribution (n=50)

Age Group (in yrs)	No. of patients	Percentage
26-35	4	8
36-45	11	22
46-55	11	22
56-65	14	28
66-75	8	16
76-85	2	4

Table 2: Showing serum sodium in cases of ami (acute myocardial infarction)

Type of failure	Group A (n=11)		Group B (n=39)	
	AWMI	IWMI	AWMI	IWMI
LVF	1	0	7	4
RVF	0	0	0	0
Biventricular failure	1	0	2	0

Table 3: Showing relation of cases of heart failure in killip's classification with different group (n=50)

Killip's Classes	Group A(n=11)	Group B(n=39)
I	9	26
II	1	3
III	0	5
IV	1	5

Table 4 : Showing relation of mortality rate with serum sodium level(n=50)

Serum sodium level (mmol/l)	Male	Female	Total
Group A (n=11)	0	0	0
Group B (n=39)	10	0	10

Results

Acute myocardial infarction was commonest in the age group of 56-65 yrs (Table – 1) and found to be more common in male.It was associated with modifiable risk factors like tobacco addiction, diabetes mellitus, hypertension and dyslipidemia. Serum sodium level was low in patient with acute myocardial infarction, lower values seen in myocardial infarction associated with heart failure ($p < 0.05$). Out of 12 patients, 11 patients were in group B, out of 3 of biventricular failure, 2 patient were in group B. P value <0.05 significant. (Table 3) A positive correlation was observed in serum sodium level and severity of heart failure ($p < 0.05$). (Table 4) Serum sodium level was significantly lower in fatal cases as compared to non-fatal cases. All the fatal cases were in group B, and all were males. ($p < 0.05$) (Table 5)Hence, there was significant correlation observed with serum sodium level and adverse outcomes of acute myocardial infarction.

Statistical analysis

Based on the mean value serum sodium cases were categorized into two groups: Group A mean serum sodium level >135mmol/l and Group B ≤135mmol/l. Other biochemical parameters were taken into account. The results so obtained were subjected to student's t-test and chi square test for statistical analysis. Data was compiled using MS excel 2007 and analysis was done with the help of Epi-Info 7 software . $p<0.05$ was taken as statistically significant.

Discussion

Coronary artery disease is amongst the most serious health problem all over the world including rapidly developing country like India where there is no respite from this problem. The present study was carried out on acute myocardial infarction with an aim to identify the complicated and fatal cases by estimating serum sodium and thereby providing rapid assessment of prognosis.

Predisposing factors Age and gender

In the present study, youngest patient was of 28 yrs old. 30% of the cases were <45 yrs of age which is in accordance with Singh et al. (2003)[2], stating prematurity for incidence of acute myocardial infarction and Gupta et al 1996[3] stating the same. Maximum incidence of myocardial infarction was found in the age group of 56-65 years. Similar observation was reported by Enas et al (2001). In the present study, 7 out of 50 cases were females i.e. 14%. The incidence of acute myocardial infarction is comparatively lower in females. Singh et al (1997)[5] observed the same in prevalence of coronary artery disease and coronary risk factors in rural and urban populations of north India.

Tobacco addiction

Tobacco users were associated with more complications (Pais P et al 2001)[6]. Death from myocardial infarction (MI) in India is exacerbated by smoking of bidis or cigarettes (Rastogi T et al 2005)[7]. Males smoking cigarettes or, more commonly, bidis (small unfiltered cigarettes hand rolled in a temburni leaf) is well established in India and has been recently documented as a major cause of death among Indian men. (Gajalakshmi V et al 2003)[8] (Gupta PC et al 2000)[9]. In present study, it was observed that tobacco addiction was associated with more complications. According to M Salehuddin et al (2008)[10], incidence of smoking was 35%.

Heart failure

It is an important complication of acute MI. Left ventricular dysfunction will cause the progression of heart failure and acceleration of the heart failure disease process can lead to deaths from progressive heart failure[11].To reduce progression to heart failure in a patient with acute MI, it is important to achieve the earliest possible reperfusion, whether by thrombolysis or primary percutaneous coronary intervention. Patients with acute MI should have an assessment of their left ventricular function, the potential for reversibility should be considered, and reversible ischaemia should be identified. Left ventricular dysfunction does not only occur with ST segment elevation MI but is also commonly associated with non-ST segment elevation MI (Dargie H et al 2005).

Biochemical parameters

Blood Sugar – In the present study, high blood sugar was detected in 5 cases amongst known diabetic and 15 cases amongst not-known diabetic. Out of 15, 14 cases were of anterior wall MI. It may be

attributed to stress hyperglycemia which is more evident in anterior wall MI due to more of sympathetic stimulation and catecholamine release. (p value <0.05).B Bala Raju et al (2008) observed complications like supraventricular tachycardia, ventricular tachycardia, fibrillations, Complete heart block, heart failure were encountered in 45% of hyperglycemic and 16% of normoglycemic. VK Katyal et al (2008)[12] reported acute hyperglycemia at admission in ACS patients adversely affects the outcome in such patients irrespective of whether they were known diabetics or otherwise before presenting with ACS. This observation was similar to the present study. Serum Cholesterol - High blood cholesterol was observed in 13 cases i.e. 26 % cases. Salehuddin et al (2008) observed dyslipidemia in 18% cases. Association of high cholesterol and ischemic heart disease is well established fact. According to pooling project research group (1975) coronary risk is contineum, i.e. higher the plasma cholesterol, the greater the coronary risk.

Serum Sodium

It was noted that in group A, mean serum sodium level was 136.7mmol/l and in group B was 128.8mmol/l. Severe hyponatremia (serum sodium<120 mmol/l) was found in 3 cases.This is in accordance with the view of Flear CTG et al (1979)[13] who found significant hyponatremia in patient with myocardial infarction. Though there is initial retention of serum sodium in cases of acute myocardial infarction with significant detoriation of cardiac function still there is hyponatremia. Total 39 cases of acute MI were hyponatremic out of 50 cases i.e. 78%. Wang et al (2006) studied the prognostic value of hyponatremia in patients with acute myocardial infarction in a study population of 670 patients with acute MI. He reported 66.4% (445 out of 670 cases) to be hyponatremic. This is similar to the observation in our study.

Goldberg A et al (2004) studied prognostic importance of hyponatremia in acute ST-elevation myocardial infarction. He found hyponatremia in 19.9% cases. In another study of hyponatremia and long-term mortality in survivors of acute ST-elevation myocardial infarction, Goldberg A et al (2006) reported 11% cases to be hyponatremic in acute MI.Singla et al (2007) studied 1,478 patients of both suspected acute coronary syndrome and non-STEMI, out of which 341 (23.1%) were hyponatremic on admission. Singh A K et al (2008)[16-18] studied effect of Hyponatremia on in-hospital adverse outcome in patients with Acute Coronary Syndrome. He observed 19.1% (42 out of 220 cases) to be hyponatremic. In an extended follow up, Singh A K et al (2009)[19]observed 136 cases to be hyponatremic out of total 564 i.e. 24.1%.

In the present study there was no significant difference of serum sodium level between patient of different age groups developing myocardial infarction and also there was no significant variation of serum sodium level between patients developing myocardial infarction at different sites. In the present study, all the cases with time interval between onset of chest pain and hospitalization< 6 hours were hyponatremic. Amongst cases of MI with hyponatremia when further analyzed, those presented within 6 hours of onset had significant serum sodium low as compared to those who presented >6 hours. The relation of serum sodium level in different complications of myocardial infarction was also studied in the present study.

In the present study it was observed that 11 out of 12 cases of left ventricular failure and 2 out of 3 cases of biventricular failure were hyponatremic (Group B) (p value <.05). Thus, there was correlation between serum sodium level of patients of MI developing cardiac failure and uncomplicated MI. The correlation of serum sodium with arrhythmia was studied. In the present study, out of 6 cases with premature complexes, 4 were hyponatremic. All the cases of complete heart block, supraventricular tachycardia, and ventricular tachycardia were hyponatremic. Out of 5 cases of conduction disturbances, 3 were hyponatremic. But, patient of myocardial infarction who developed arrhythmia, on the outcome, the values of serum sodium did not show any appreciable change compared to uncomplicated infarction.

Role of serum sodium in assessment of severity of acute myocardial infarction is consistent in the present study. Hyponatremic group i.e. Group B comprised of 39 patients, out of them 10 died and out of 10, 3 had severe hyponatremia (serum sodium <120mmol/L). No mortality was found in normonatremic group i.e. group A. Mortality rate amongst hyponatremic was 25.4% (10 cases out of 39).This observation is consistent with Wang et al (2006)[14]who observed 41.4% mortality in hyponatremic patients of acute MI. In his study, the inhospital mortality of each group was: group A (serum sodium > or = 135 mmol/L) was 7.6% (17/225), group B (serum sodium 120-135 mmol/L) was 8.1% (34/421), group C (serum sodium 120-135 mmol/L) was 33.3% (8/24) . According to Singh A K et al (2008)[18], adverse outcome in hyponatremic group were 10 (23.8%) and in nonhyponatremic patients (178) were 24 (13.48%) of acute MI.M Salehuddin et al (2008)[10] noticed 31 patients (31%) died in hyponatremic group as compared to 9 patients (9%) in nonhyponatremic group of acute MI.

Singh A K et al (2009) found the incidence of adverse events in hyponatremic group (136 cases) was 31 (22.79%), whereas in non-hyponatremic group(428 cases) was 66 (15.4%) (p <0.05).The mean of serum sodium concentration in fatal case was (120.2±8.1) mmol/l in contrast to mean serum sodium concentration of (132.1±5.82) mmol/l in nonfatal cases. So there was significant difference of serum sodium value between the two groups, which was statistically significant (p value < 0.05). The finding was in accordance to the observation made by Flear CTG (1979)[13]who showed significant difference in serum sodium value in fatal and non-fatal cases. Wang et al (2006)observed the serum sodium concentrations of the recovered group were (133.00 +/- 5.25) mmol/L, and that of the died group were (122.00 +/- 7.25) mmol/L (p value < 0.01).

The present study demonstrates a strong association between hyponatremia in the early phase of MI and long-term mortality in survivors of acute MI. Hyponatremia remained a strong and independent predictor of mortality after adjustment for established clinical predictors of adverse outcome, including LVEF. Furthermore, the relationship between hyponatremia and adverse outcome remained robust when assessed in low-risk patients (preserved LVEF and Killip class I during admission), as well as in high-risk patients (reduced LVEF and clinical evidence of HF at admission).Our results also show that hyponatremia in the acute phase of MI predicts future admissions for the treatment of HF, supporting the underlying pathophysiological relationship between hyponatremia and neurohormonal activation. Readmission for late HF in patients after MI is particularly ominous because these patients have a several fold increase in the risk of death when compared with other MI survivors.

Conclusion

A definite correlation was present between acute myocardial infarction complicated with cardiac failure and arrhythmias with hyponatremia. Serum sodium levels have positive correlation with severity, complications and prognosis of myocardial infarction.

What this study add to existing knowledge

It is important to understand that initial level of serum sodium is strongly correlated with cardiovascular complications and adverse outcomes of myocardial infarction. A definite correlation was present between acute myocardial infarction complicated with cardiac failure and arrhythmias with hyponatremia. Serum sodium levels have positive correlation with severity, complications and prognosis of myocardial infarction. Hence estimation of serum sodium may help in rapid assessment of severity of myocardial infarction and to predict complications for timely management.

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