Original article

Hyponatremia A Prognostic Indicator in Acute myocardial Infarction

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ABSTRACT:

BACKGROUND AND OBJECTIVE OF THE STUDY: Hyponatremia, is the most common electrolyte disorder in the hospitalized patients. It has been found to be an independent predictor of cardiovascular mortality, morbidity and longer hospital stay in patients with heart failure. Its clinical significance in acute myocardial infarction (AMI) is yet to be determined. Hence we proposed present study with aim to investigate the prognostic importance of hyponatremia in AMI as a marker in determining the in-hospital mortality.

MATERIALS AND METHODS: A total of 100 consecutive patients admitted in ICCU, Department of Medicine, S. Nijalingappa medical college and Hanagal Shri kumareshwar hospital & research centre, Bagalkot from 1st December 2014 for a period of around 1 year were included in study considering the inclusion and exclusion criteria. Relevant detailed history was taken. Plasma sodium concentrations for each patient were estimated on admission and 24hrs, 48hrs & 72 hours thereafter. Patients were followed up till an event of death or discharge.

RESULTS: In our study 30% of patients with AMI had hyponatremia on admission and 31% developed hyponatremia after 72hours. With the use of logistic regression and univariate analysis various risk factors were compared among survivors & non survivors, it was found that troponin I and hyponatremia were significant independent predictors in determining the mortality.

CONCLUSION: Hyponatremia on admission is one of the significant predictors of in-hospital mortality. Hence plasma sodium levels can be used as a simple biomarker in predicting the prognosis of the patients with AMI.

KEYWORDS: Hyponatremia, Acute Myocardial Infarction, in-hospital mortality, prognostic indicator

INTRODUCTION:

The incidence of myocardial infarction (MI) in the world differs greatly.[1] The Global estimate of age-standardized CVD death rate of 272 per 1,00,000 population in India is higher than the global average of 235 per 1,00,000 population.[2] The crude coronary heart disease (CHD) incidence rate was 300.6/100,000 person-years for men and 47.9/100,000 person-years for women according to a Spanish study.[3] In India, there is increasing CHD prevalence over the last 60 years, from 1% to 10% in urban populations and <1% to 6% in rural populations. The incidence of MI in India is 64.37/1000 people in men aged 29-69 years. Premature mortality in terms of years of life lost because of CVD in India has increased by 59%.[2, 4]

In acute phase of ST elevation MI, due to activation of the Baroreceptors, there is activation of the sympathetic nervous system leading to release of hormones like vasopressin and also activation of renin angiotensin system. Extent of this neuro-hormonal change is related to the severity of the myocardial damage. Hyponatremia is relatively common in patients with acute MI. Few studies have also shown that hyponatremia has been associated with poor outcomes in patients with STEMI and NSTEMI. In addition to that, they have also found that the risk of mortality increased with severity of hyponatremia. However clinical

importance of hyponatremia in both STEMI and NSTEMI has not been clearly understood. Hence the present study was undertaken to test the hypothesis that hyponatremia, a simple bio-marker of neurohormonal activation during acute phase of MI may predict the inhospital mortality among the ST elevation MI subjects.[5-8]

MATERIALS and METHODS:

This is a Cross-sectional study conducted for a period from 1st December 2014 to 31st December 2015. A total of 100 patients presenting with chest pain lasting for more than 20 minutes with characteristic ECG changes suggestive STEMI consisting of ST elevation ≥ 1 mm in ≥ two contiguous limb leads, ST elevation ≥ 2mm in ≥ two contiguous precordial leads and non Q wave MI, admitted in ICCU Department of Medicine, S. Nijalingappa medical college and Hanagal Sri Kumareshwar hospital and research centre, Bagalkot. Patients with previous MI, Congestive cardiac failure, Cirrhosis of liver, Nephrotic syndrome, renal failure, patients with chest infection, bronchogenic carcinoma, and lastly patients on diuretics were excluded from the study. Informed consent was taken and ethical clearance was obtained from IEC. The socio-demographic data, clinical history and details about the risk factors of CAD were collected using a questionnaire & interview method. Clinical history included age, sex, past history of diabetes, hypertension, smoking, etc. Clinical examination included Vitals, General Examination and Systemic Examination with detailed examination of Cardiovascular system. Venous blood samples were drawn at the time of admission before initiation of treatment. All blood samples were processed within 30 minutes of blood collection. For each patient serum sodium concentration were obtained on admission, at 24hrs, 48hrs and 72 hours. Other relevant routine investigations were also done. The primary end point was all cause mortality in the hospital. Hyponatremia was defined as serum sodium concentration of less than 135mmol/L (<135mEq/L).

Statistical Analysis: Data were entered in excel and analysed with recent available software. Results were presented as mean ± SD. Data were analyzed using SPSS version 16.0. Categorical variables were analyzed by chi-square test and the continuous variables withindependentt- test between the groups. The logistic regression was performed to assess various factors associated with in-hospital mortality. The fit of the model was assessed using Hosmer-Lemeshow goodness of fit test.A P value < 0.05 was considered statistically significant.

RESULTS:

In the present study, the mean age of the study participants was 60.78+11.15years with a range of 30 to 90 years. 40(40.0%) of the subjects were females and 60 (60.0%) were males. [Graph-1]

Majority 53 (53.0%) had history of either diabetes or hypertension or both. 37 (37.0%) were smokers, 29 (29.0%) had habit of tobacco consumption, 28 (28.0%) were alcoholics.

Most patients 89 (89.0%) of the study subjects had high / abnormal levels of Troponin-I followed by high levels of CKMB 76 (76.0%). Among the parameters of lipid profile, 44 patients (44.0%) had high levels of triglycerides, high LDL in 37 (37.0%) and high total cholesterol in 27 (27.0%). 13 patients (13.0%) had low levels of HDL. 47 patients (47.0%) had high levels of random blood sugar.Among the renal parameters, 17 patients (17.0%) had high levels of serum creatinine followed by 8 patients (8.0%) with high blood urea levels respectively. 9 (9.0%) of the participants had anaemia. 46 (46.0%) had abnormal (high/low) leucocyte count and 13 (13.0%) had abnormal (high/low) platelet count.

30 (30.0%) of the AMI patients had hyponatremiaon admission and 24 hours after admission; followed by 32 (32.0%) after 48 hours and 31 (31.0%) after 72 hours of admission. [Table-1]There was significant hyponatremia among those who died compared to those who recovered from acute MI (P<0.05). [Table-2, Graph-2] There was no statistically significant difference between the age among those who died (59.17±12.33) compared to patients who recovered (61±11.03) from acute MI (t = -0.53, P>0.05). Other various risk factors viz., gender, past history of hypertension, diabetes, family history of Ischaemic heart disease, personal history of smoking, alcohol, tobacco chewing, high levels of random blood sugar, blood urea, serum creatinine, serum triglycerides, serum total cholesterol, serum LDL and low levels of serum HDL with the levels of sodium in the serum. All these were not significantly associated with the outcome of MI (P>0.05). Among the cardiac enzymes i.e. CKMB and Troponin I, Troponin I was significantly associated with the outcome of MI (P<0.05). [Table-3, Table-4] . On multivariate analysis (logistic regression model by forward method) considering all the risk factors of mortality due to AMI, hyponatremia on admission and Troponin I were independent significant predictors of inhospital mortality (P<0.05).Troponin I with adjusted OR=6.9, 95% C.I: 1.32-36.78,P< 0.05, shows that the risk of dying is 6.9 times more among those with increased Troponin I compared to those with normal Troponin I levels. Hyponatremia on admission with adjusted OR=0.78, 95% C.I: 0.64-0.94 P<0.05, indicates that with unit fall in sodium levels, the odds of survival reduces by 78%. [Table-5]

Graph-1:Age-wise distribution of males and females.

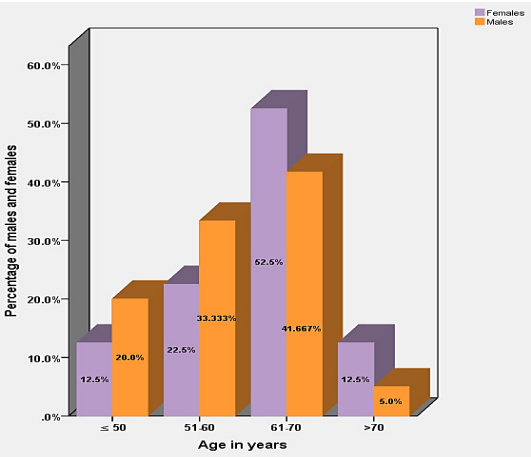

Table-1: Percentage of study subjects with hyponatremia following an episode of Acute MI

Hyponatremia	Total	Percent
Admission**(n=100)**	30	30.0
24 hours**(n=100)**	26	26.0
48 hours**(n=100)**	32	32.0
72 hours**(n=100)**	31	31.0

Graph-2: Percentage of survivors and non-survivors among those with different sodium levels in the serum

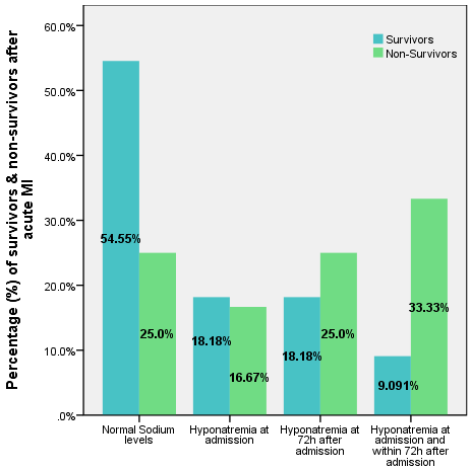

Table-2: Comparison of mean values of different electrolytesamong two different comparative groups of recovery and death as survival outcomes after acute MI

Particulars	Survived [n=88] (Mean±SD)	Died [n=12] (Mean±SD)	t – value (95% C.I)	*P*- value
Sodium levels at admission	137.16±4.98	132.17±4.15	3.31 [2.00 to 7.98]	0.001*
Sodium levels at 24 hours after admission	137.07±4.30	133.33±3.02	2.90 [1.18 to 6.28]	0.005*
Sodium levels at 48 hours after admission	136.77±3.85	133.08±3.23	3.16 [1.38 to 6.00]	0.002*
Sodium levels at 72 hours after admission	136.76±4.68	132.42±3.96	3.06 [1.53 to 7.15]	0.003*

*indicates a significant statistical difference between the groups with *P*<0.05

Table-3: Association of various probable risk factors based on history with the outcome of Acute MI

Variables		Outcome of Acute MI		χ^2 Value (*P*-Value)
		Survived (Row %)	Died (Row %)	
Gender	**Females**	36 (40.9)	04 (33.3)	0.25
	Males	52 (59.1)	08 (66.7)	(0.61)
Past h/o HTN	**Present**	29 (80.6)	07 (19.4)	2.95
	Absent	59 (92.2)	05 (7.8)	(0.09)
Past h/o DM	**Present**	32 (88.9)	04 (11.1)	0.04
	Absent	56 (87.5)	08 (12.5)	(0.83)
Family h/o IHD	**Present**	05 (100.0)	0 (0.0)	0.72
	Absent	83 (87.4)	12 (12.6)	(0.39)
Smoking	**Present**	31 (83.8)	06 (16.2)	0.98
	Absent	57 (90.5)	06 (9.5)	(0.32)
Alcohol	**Present**	23 (82.1)	05 (17.9)	1.26
	Absent	65 (90.3)	07 (09.7)	(0.26)
Tobacco chewing	**Present**	26 (89.7)	03 (10.3)	0.1
	Absent	62 (87.3)	09 (12.7)	(0.7)

*indicates a significant statistical difference between the groups with $P<0.05$

Table-4: Association of various other probable risk factors with the outcome of Acute MI

Variables		Outcome of Acute MI		χ^2 Value (*P*-Value)
		Survived (Row %)	Died (Row %)	
Random Blood Sugar	**Normal**	45 (87.8)	06 (12.2)	0.005
	Abnormal	43 (88.2)	06 (11.8)	(0.94)
Blood Urea	**Normal**	82 (89.1)	10 (10.9)	1.39
	Abnormal	06 (75.0)	02 (25.0)	(0.23)
Serum Creatinine	**Normal**	74 (89.2)	09 (10.8)	0.61
	Abnormal	14 (82.4)	03 (17.6)	(0.43)
Serum Triglycerides	**Normal**	52 (92.9)	04 (07.1)	2.84
	Abnormal	36 (81.8)	08 (18.2)	(0.09)

Serum Total Cholesterol	**Normal**	64 (87.7)	09 (12.3)	0.02 (0.86)
	Abnormal	24 (88.9)	03 (11.1)	
Serum HDL	**Normal**	76 (87.4)	11 (12.6)	0.26 (0.60)
	Abnormal	12 (92.3)	01 (7.7)	
Serum LDL	**Normal**	57 (90.5)	06 (09.5)	0.98 (0.32)
	Abnormal	31 (83.8)	06 (16.2)	
Troponin I	**Normal**	06 (54.5)	05 (5.5)	13.09 (<0.001)*
	Abnormal	82 (92.1)	07 (08.9)	
CKMB	**Normal**	20 (83.3)	04 (16.7)	0.65 (0.42)
	Abnormal	68 (89.5)	08 (10.5)	

*indicates a significant statistical difference between the groups with *P*<0.05

Table-5: Comparison of important biomarkers of mortality among patients with hyponatremia in Acute MI using Logistic Regression:

Parameters Predicting mortality (Significant on univariate analysis)	***P*- value**	**Odds Ratio**	**95% CI**
Sodium levels at admission	0.009	0.78	0.64-0.94
Troponin I levels	0.02	6.97	1.32-36.78

*indicates a significant statistical difference between the groups with *P*<0.05

DISCUSSION:

Hyponatremia is a common hospital-acquired electrolyte disorder that is often associated with high mortality and morbidity. So this study was taken to establish the implication of hyponatremia on AMI. In our study, hyponatremia was present in 30% of patients on admission and 31 % after 72 hours of admission. Tang et al., in their study of 1,620 patients reported that 212 (13.1%) patients had hyponatremia on presentation (sodium <135 mmol/L).[7] In a similar study conducted by Aziz F, Doodi S, Penupolu S, et al. among study sample of 128 patients with AMI, hyponatremia was present on admission in 36 patients (28%), hyponatremia developed in 25 patients during first 72 hours of hospitalization.[9]

In the present study, a total of 12 deaths occurred, among them 25% (3/48) had normal sodium levels, 16.7% (2/16) had hyponatremia on admission and remaining 58.3%(7/24) had developed hyponatremia at 72hours after admission.Current study shows that the mortality rate was higher in the patients admitted with hyponatremia than in the normonatremic group similar to the study finding by Tang et al.[7] Harsoor S *et al*., in their study found hyponatremia as the significant independent

predictor of in-hospital mortality on multivariate analysis.Alexander C *et al*., also showed that after logistic regression analysis and adjustment for other important co-variants hyponatremia on admission remained strong independent predictor of mortality. These studies are in concordance with the current study findings that considering all the risk factors of mortality due to AMI, hyponatremia on admission was an independent significant predictor (P<0.05).[10, 11]

LIMITATIONS:

It was a purposive sampling and the sample size being small, study lacks the generalizability and hence needs to be carried out in larger samples. The patients who survived of AMI with hyponatremia were not followed up for other short term outcomes like heart failure, length of hospital stay and long term outcomes like re-admission, re-infarct and 30 day mortality.

CONCLUSION:

Hyponatremia on admission was found to be significant predictor of in-hospital mortality. Hence hyponatremia can be used as a proxy indicator to assess the prognostic implication of Acute Myocardial Infarction.

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