Study of the Occurrence and Prognostic Significance of Hyponatremia in Myocardial Infarction

Aarish Gujjar [1], **Vishvanayak** [2], **Anil Kumar**[3]

[1]Post Graduate Student, Department of Medicine, Teerthanker Mahaveer Medical College & Research Centre, Moradabad, Uttar Pradesh, India, [2]Professor, Department of Medicine, Teerthanker Mahaveer Medical College & Research Centre, Moradabad, Uttar Pradesh, India, [3]Associate Professor, Department of Biochemistry, Teerthanker Mahaveer Medical College & Research Centre, Moradabad, Uttar Pradesh, India.

Abstract

Background: Cardiovascular disease (CVD) is the commonest cause of natural death all over the world. Asians develop this disease nearly one to two decades earlier than the Western population. Though CVD does not always lead to immediate death yet may be associated with delayed mortality or morbidity leading to significant loss of productivity of an individual. Hence, it becomes imperative to assess clinical parameters that may not only prevent death but also helps in reducing morbidity. Hyponatremia is found to be one of the major causes of sudden as well as delayed deaths in patients experiencing acute myocardial infarction (AMI). As serum sodium estimation is an easy, inexpensive, and routine laboratory investigations performed in patients with AMI, we aimed to assess its prevalence and prognostic significance in such patients. **Subjects & Methods:** One hundred patients of AMI admitted in the Department of Medicine of our institution were enrolled in our study according to inclusion & exclusion criteria following approval from IEC. Serum sodium levels of all patients were recorded at the time of admission, at 48hours and at one month. All patients underwent ECG and echocardiography for assessment of their cardiac function as well as subgrouping into STEMI/NSTEMI. All patients were followed up for signs of congestive cardiac failure, arrhythmias & cardiogenic shock or death. The above data was analyzed with appropriate statistical tests. **Results:** In our study, 38 patients developed hyponatremia, 13 at the time of admission, 15 at 48hours and 10 at one-month time. Out of 62 patients with normal sodium, 9 developed CCF, 9 arrhythmias and 4 died. On the other hand, nearly 25 patients with hyponatremia developed CCF and 11 patients died. This showed that AMI patients with hyponatremia have poor outcome. **Conclusion:** There is significant occurrence of hyponatremia, patients of acute MI. Occurrence of hyponatremia in patients of acute myocardial infarction is associated with adverse cardiovascular outcomes viz. arrhythmias, congestive cardiac failure and death. Also, the occurrence of these adverse efect is directly correlated the severity of hyponatremia. Hence, serum sodium can be used as simple and effective tool for risk assessment in patients of acute myocardial infarction.

Keywords: Hyponatremia, Acute Myocardial Infarction.

Corresponding Author: Aarish Gujjar, Post Graduate Student, Department of Medicine, Teerthanker Mahaveer Medical College & Research Centre, Moradabad, Uttar Pradesh, India.
E-mail: aarishgujjar@gmail.com

Introduction

Today "CAD is the leading cause of the morbidity and mortality in the world" with 80% demise worldwide. India is foremost in the whole world in incidence, prevalence, complications and CAD related death.[1] Prevalence of CAD has increased three times in the last decades and is likely become the "most common cause of death worldwide by 2020".[2] Asian Indians juxtapose to other ethnicities with more predisposition to CVD's (> 5-10 % more) including coronary artery disease.[3,4]

Deaths due to infectious diseases have decreased over past many years due to improving socioeconomic conditions and consequent better living conditions. On the contrary, developing nations like India are witnessing sharp rise in incidence of Non communicable Diseases Particularly Cardiovascular diseases. Hence, efforts are needed to build strong community level 1' prevention programs.[5] 3,00,000 deaths due to acute coronary syndrome occurs worldwide.[6] WHO proclaimed cardiovascular disease "A Modern Epidemic."[7]

Numerous studies revealed that the overall rate of fatality subjects with MI or ACS in the 1st month is 50%, out of these deaths approximately 50% of death occur within

two hours.[8] SCD (sudden cardiac death) after Myocardial Infarction (death within 1hour) is mostly because of the alternation in the internal milieu at myocytes & purkinje fibres level which are majorly regulated by autonomic nervous system activity & electrolyte abnormality.[9] Hyponatremia (S. sodium concentration below 135 meq/L) is an easy and cost effective hormonal changes marker which serve to evaluate patients at high risk.

After Myocardial Infarction the low plasma sodium is common and the clinical outcome is accompanied by increased in concentration of sodium in plasma. In acute ST- Elevation Myocardial Infarction (STEMI), baroreceptor activation leads to activation of sympathetic nervous system releasing hormones eg. vasopressin and activation of RAS. Amount of changes in these neuro-hormon is directly related to the severity of damage of myocardium.[10]

Hence, the purpose of this study was testing the hypothesis that early hyponatremia can foretell the occurrence of arrhythmia, remodeling leading to Heart Failure and death.

Aim and Objectives

AIM

● To assess the occurrence and prognostic significance of hyponatremia in patients of acute myocardial infarction.

Objectives

- To assess occurrence of hyponatremia in patients of Acute MI.
- To assess prognostic significance of hyponatremia in patients of Acute MI

Subjects and Methods

This observational & hospital-based study was carried out following approval of institutional ethical committee on 100 acute MI patients admitted to Department of Medicine at TMMC&RC over a period of 12 months who gave consent to participate in the study and after applying following inclusion/exclusion criteria.

Inclusion Criteria

All patients diagnosed of Acute Myocardial Infarction using the case definition.[11]

Exclusion Criteria

- Patients with history of MI.
- Patients with congestive cardiac failure.
- Patients with liver Cirrhosis, nephrotic syndrome, renal failure.
- Patient's on diuretics.

Methodology

An Electrocardiogram was obtained at the time of presentation with serial ECG monitoring. Patient's CARDIAC MARKERS (CK-MB, TROP I) were done at the time of presentation along with routine investigations – CBC, LFT, Serum Electrolytes, Blood urea/creatinine, Lipid profile, etc. as indicated.

Serum sodium levels was measured on admission, after 48 hours and at 1 month and were correlated with LVEF as assessed by 2D ECHO.

- The patients of AMI were grouped into STEMI & NSTEMI with further subgrouping into:
- Normal serum sodium / Hyponatremia level at admission.
- Normal serum sodium / Hyponatremia at 48 hours.
- Normal serum sodium / Hyponatremia at 1 month.

These patient groups were evaluated for in-hospital/short-term morbidity and mortality due to Heart failure, Arrhythmias, Cardiogenic shock and Death.

Results

Age Distribution

Highest number of cases were in the 51-60 age group comprising of 35% followed 61-70 years group which constituted 15% of cases.

Sex distribution

Among 100 patients in our study, male outnumbered female with a ratio of 2.22:1
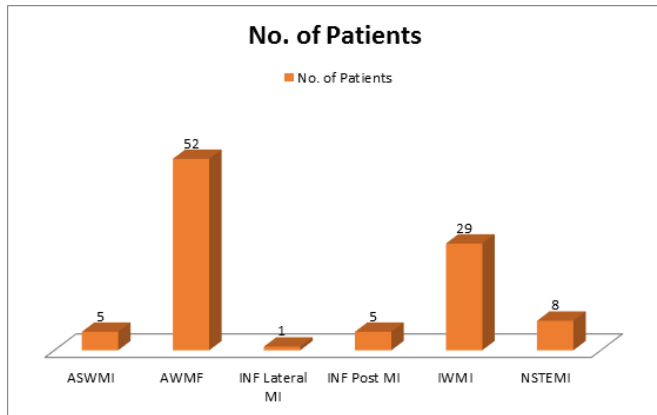
Table 1: Distribution of LVH

	Yes	No
LVH	35	65

Table 2: Distribution of RWMA

	Yes	No
RWMA	73	27

Table 3: Distribution of Type of AMI

Diagnosis	No. of Patients	Percentage (%)
ASWMI	5	5 %
AWMF	52	52 %
INF Lateral MI	1	1 %
INF Post MI	5	5 %
IWMI	29	29 %
NSTEMI	8	8 %
Total	100	100 %

No. of Patients

■ No. of Patients

Patients with hyponatremia developed poorer outcome in both short and long term, A total 25(25%) patients developed heart failure and 11 (11%) patients died.

Congestive heart failure and the hospital death occurred in 6(46.1%) and 3(23.07%) of the patient respectively who presented with hyponatremia at admission and 48 hrs (33.33%, 20.00%), the incidence of CHF and death was quite less in patient with normal sodium level.

Mortality in patients correlates with the severity of hyponatremia 5(100%) patient died with sodium levels <130mmol/l whereas 5(16%) death occurred in the patient having sodium level between 131-135. (odds ratio 5.0, p value 0.03)

■ <130 ■ 131-135
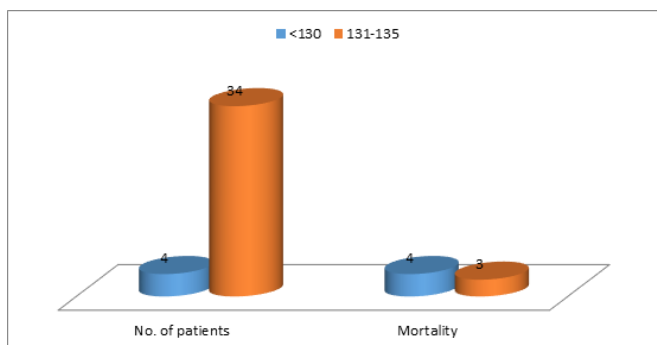
Discussion

This study shows that early phase of MI is frequently associated with hyponatremia which may be useful predictor of development of CHF during hospitalization. Also, early-development of hyponatremia is a potential predictor of impending HF, development of arrhythmias and cardiac death. This study alters us for the need for proper monitoring of HF, arrhythmias in patients with early diagnosed hyponatremia.

In our study, 38% patient developed hyponatremia - 13 patients at admission, 15 during the first 48 hours of hospitalization, and 10 after discharge during follow up at the end of 1 month. Similar result was found in a study of Goldberg et al,[9] in which 32.39% patients developed hyponatremia, 12.49% on admission and 19.89% during the first 3 days of hospitalization.

Tang Q et al,[12] in their study on ascertaining the relationship between hyponatremia and in-hospital outcomes in patients with myocardial infarction found that nearly 13% patients had hyponatremia on admission. Havranek S, et al,[13] studied 144 males, out of which 33.0% patients had hyponatremia and out of these 23.39% reached hyponatremia level at admission and 9.6% later. In this study it was found that males and older age group are associated with poor outcomes. Similar result was found in a study conducted by Lazzeri Cet al,[14] according to which mortality rates were high in older age group and male sex having MI with hyponatremia. These patients were also at increased risk of Heart failure and other MI related complications. Goldberg A, et al,[15] also found that patients with hyponatremia were generally older. Most of these patient develop heart failure and arrhythmia at admission.

Our study showed that LVEF is approximately 40±14 % in patients with hyponatremia on admission. Similar result is shown in a study conducted by Aziz M et al,[16] where LVEF was approximately 40% among patients with hyponatraemia. A study conducted by Alexander G et al shown that reduced LVEF (43±13.1%) among the patients who have hyponatraemia on admission.

In our study with total 11% deaths, 15.38% of patients were without hyponatremia while 13.3% patients were with hyponatremia on admission. Rest 13.33% developed hyponatremia after or on 48 hrs and 20.0% during one month of hospitalisation leading to death. According to the study conducted by Goldberg A, et al,[9] a total of 10.0% death take place within the thirty days of the admission, out of which 6.19% of patients were having normal sodium level while 19.79% of patients were having hyponatremia on admission and rest 16.79% people had hyponatremia after hospitalization.

Another study conducted by Goldberg A et al,[15] observed that of the 10.59% patient who died, 26 deaths (24%) occurred in patients with hyponatremia while 78 deaths (8.89%) were having normal sodium level respectively. Average sodium levels were found to be low during follow-up in dead patients than in patients who remain alive.

In present study, odd's ratio for 1 month mortality in patient with hyponatremia at admission and patient who had hyponatremia later on found to be higher (9.05, 7.29, and 5.04), this result was in similar to the study conducted by Goldberg A, et al.[17]

In this study, we observed that with increase in the severity of hyponatremia there is increase in mortality. Patients with sodium level <130mmol/L had 100% mortality while those

Table 4: Correlation Between Hyponatremia on Admission, 48 Hrs, and 1 Months and Outcome

	Normal	Hyponatremia			Odds Ratio	P value
		At the time of admission(n = 13)	At 48 hrs(n = 15)	At 1 months(n = 10)		
CHF	9 (14.51%)	6 (46.10%)	5 (33.33%)	5 (50.00%)	13.25	0.001
Outcome (Deaths)	4 (15.38%)	3 (23.07%)	2 (13.33%)	2 (20.00%)	9.21	0.04
Arrhythmia	9 (14.51%)	6 (46.10%)	6 (40.00%)	4 (40.00%)	7.61	0.025

Table 5: Table Showing Prognosis of Hyponatremia Patients and outcome.

Na$^+$ level ranges	Cases	Death	Odds Ratiop value
<130	4	4 (100%)	5.0 0.03
131-135	34	3 (7.89%)	

Table 6: Odds Ratio for Morality Group 1 (Patients with Normal Sodium Level) v/s Low Sodium Level

Group	Survivor	Non survivor	OD	P- value
I	58	4		
II	10	3	9.05	0.012
III	13	2	7.29	0.03
IV	8	2	5.04	0.004

Group 1: sodium concentration normal
Group II: at admission
Group III: at 48 hrs
Group IV: Hyponatremia at 1 month
Death was higher in hyponatremic groups as compared using ODDS ratio (I: 11.52, group II: 9.05, group III: 7.29, group IV 5.04)

with sodium level between 131-135 Meq/L had 7.89% deaths. Same observation was made in study conducted by Sijoy et al,[18] which showed increase in mortality at low sodium level where 100% mortality was found if sodium level were less than 130 meq/l and 11.1 % at sodium level 130-134 meq/l . Another study done by Aziz M, et al,[16] it was revealed that death occurred in 75% of patients with serum Na$^+$ level <130mmol/L while 18%. deaths occurred in patients with serum sodium level ranging 130-134 mmol/L. In their study, Tang Q, et al,[12] concluded that low sodium level is associated with poor outcome in hospitalized patients with acute ST-elevation myocardial infarction, and with increase in severity of hyponatremia there was increase in risk of mortality in hospitalized patients.

In our study, 25% patients developed heart failure out of which 16 (69.5%) were hyponatremic and 9% patient had normal sodium levels. In hyponatremic group, 46% patients develop heart failure at admission (odds ratio13.25; p=0.001%), according to the Goldberg A, et al.[9] Study Hyponatremia during repeat admission for Heart Failure was found to be more in patients who were having low sodium during the first admission (47.8% vs 23.1%; p =.02). Aziz M et al,[16]in his

study found that heart failure developed in 33% hyponatremic v/s 12% in normal.

In our study, in-hospital mortality had higher rates in patient having hyponatremia compared with normal patients (23.07% v/s 15.38%, p-value significant). Similar result was found in study conducted by Klopotowski M, et al,[19] that revealed that patient with reduced sodium level had increased rates of mortality in hospital (13.49% vs 3.79%, significant p-value).

In our study, Heart failure was found in the highest percentage in patients with sodium levels ranging around<134 meq/L, which showed severity of hyponatremia and heart failure are related.

In our study, total 25% patients developed arrhythmia later in myocardial infarction, out of which 64% (16/25) had hyponatremia and 36% (9/25) had normal sodium levels, which is in con-cordance with Aziz M et al,[16] study in which 24 percent patients developed arrhythmias (33% hyponatremic v/s 12% normal). Flear CT, et al,[11] found that ventricular arrhythmias are associated with reduced sodium level (<132 mmol/L).

Summary

- Older age group patients are more prone to hyponatremia.
- Males have more chance of myocardial infarction.
- 1-month mortality odd ratio is higher in hyponatremia patients.
- Arrhythmia is more commonly seen in hyponatremia patients.
- A significant direct relationship exists between severity of hyponatremia with mortality and heart failure.
- Heart failure at admission and post-discharge CHF are more frequently seen in patient who developed hyponatremia.
- Hyponatremia as an important risk factor for predicting mortality.
- • Low sodium levels on admission and early development of hyponatremia after admission is useful predictor of short-term outcome.

Conclusion

Patient of acute MI with hyponatremia are at higher risk of developing major adverse cardiovascular events like arrhythmia, heart failure and cardiac death especially male and elderly patients. These adverse Cardiovascular events directly correlate with severity of hyponatremia. Development of hyponatremia at admission and during first 48 hours in acute MI patients is an effective determinant of short-term outcome. Hence, serum sodium level can serve as a simple, affordable marker to assess risk status of the patient with myocardial infarction.

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