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Prospective Study of Outcome of Acute ST Elevation Myocardial Infarction with Hyponatremia and Hyperglycemia

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Abstract

Background: In acute ST-elevation myocardial infarction (STEMI), hyponatremia occurs due to neurohormonal activation. Magnitude of this neurohormonal change is related to the severity of myocardial damage while in patients with acute myocardial infarction, elevation of plasma glucose levels is associated with worse outcomes. The present research was undertaken to study the outcome of acute STEMI with hyponatremia and hyperglycemia.
Method: Study included 102 consecutive patients with diagnosis of acute STEMI admitted in ICCU of a tertiary care centre. Risk factors, clinical presentation, demographic features, Electrocardiogram findings and type of myocardial infarction with serum sodium and blood sugar level on admission were studied with their association with death were documented.
Results: The mean age of patient was 59.1±13.105 years, ranged from 24-83 years with male predominance (52.9 %).All patients were presented with chest pain (100%), while 92.15% patients presented with sweating. Maximum number of patients (44.10%) were having inferior wall MI with mortality of 10.There was significant association found between hyponatremia and death (p=0.016). Similarly, there was significant association between hyperglycaemia and mortality with p value 0.025.Out of 38 patients who had both hyponatremia and hyperglycaemia 14 patients died. Cardiogenic shock was most common complication which occurred in 13(65%) patients, while second most common was arrhythmia.
Conclusion: Lower the level of serum sodium in acute STEMI patients, higher will be the mortality, while higher the blood sugar level on admission more will be the mortality among acute ST elevation MI patients.
Keywords: Myocardial infarction , Hyponatremia, Hyperglycaemia, Electrocardiogram, Glucose, Sodium, Mortality, Arrhythmia.

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1. Introduction

ST-segment elevation myocardial infarction (STEMI) is one of the presentations of acute coronary syndromes [1]. STEMI continues to be a major health problem in the industrialized world and is becoming an increasingly important problem in developing countries. [2]. Acute STEMI will result in activation of neurohormonal mechanism which causes hyponatremia by secretion of enzymes like renin, vasopressin and norepinephrine [3-5]. Blood glucose on admission (i.e., acute hyperglycaemia) is a common feature during the early phase after acute myocardial infarction (AMI), even in the absence of a history of diabetes mellitus [6]. The prognostic value of the blood glucose level in patients with AMI was first suggested in 1975[7]. Since then, numerous studies have described the association between acute hyperglycaemia and adverse outcome in patients with AMI [8-12]. Some studies have shown that hyponatremia is associated with poor outcomes in patients with STEMI and NSTEMI, and

the risk of mortality increased with severity of hyponatremia. [13-15]

The present study was undertaken to study the prognostic importance of hyponatremia and hyperglycaemia in acute ST elevation MI patients admitted in ICCU of tertiary care hospital.

2. Materials and methods

After obtaining Institutional Ethics Committee approval and written informed consent from either participants or close relatives, this prospective study was conducted in total 102 consecutive patients of acute STEMI admitted in ICCU of tertiary health care centre. Only patients who satisfied World Health Organization definition for diagnosis of acute ST elevation myocardial infarction were included.

Diagnosis of acute STEMI was made in presence of at least two of the following three criteria:

1) Clinical history of classical ischemic chest pain.
2) Electrocardiographic changes s/o of acute ST elevation MI.
3) Positive serum cardiac markers.

A detailed history was noted, clinical examination, biochemical examination on admission were done for all the patients. Data of every patient with complete details i.e. age, sex, complaints and other details were entered in a predesigned pro-forma.

Blood samples were drawn aseptically by single prick at the time of admission from peripheral vein and investigated for blood sugar level and serum sodium, serum cardiac markers, serial ECG, lipid profile, chest x-ray and 2-D echo. Risk factors, like hypertension, smoking, alcoholism were observed.

Data was collected and entered in MS-excel 2013 and corrected for typographic errors and analysed using SPSS 16.0 version.

3. Observation and Results

We conducted hospital based cross sectional observational study of serum sodium and glucose in acute STEMI and also analysed its correlation with early mortality in hospital stay [5 days], total data of 102 cases [Males = 54 (52.9%) and Females = 48 (47.1%)] recruited in our study and were analysed.

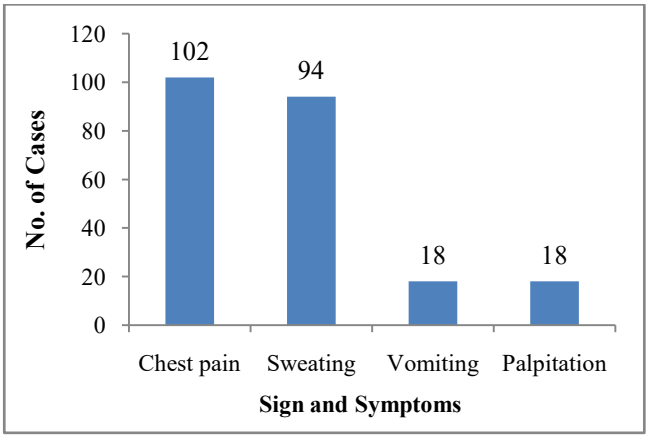
Out of 102 patients, 82 patients were discharged while 20 patients expired. The mean age of patient was 59.1±13.105 years, ranged from 24-83 years. Maximum numbers of patients (41.2%) were in the age group of 60-69 years followed by 70-79 years (17.6%), (Table 1).

Table 1: Age Distribution of Cases

Age group(Years)	No. of patients	Percentage
<30	4	3.9
30 to 39	3	2.9
40 to 49	16	15.7
50 to 59	15	14.7
60 to 69	42	41.2
70 to 79	18	17.6
≥80	4	3.9
Total	102	100

Figure 1 shows graphical representation of signs and symptoms on presentation in acute STEMI.

Figure 1: Signs and Symptoms of Patients of Acute STEMI on Presentation



Systemic hypertension was most common risk factor present in 35 patients (34.3%), followed by deranged (high) lipid profile (21; 20.6%); smoking (22; 21.6%) and alcoholism (11; 10.8%). The maximum numbers of patients (44.1%) were diagnosed with inferior wall myocardial ischemia followed anterior wall myocardial infarction (19.6%) as shown in table 2.

Table 2: Distribution of patients according to diagnosis [based on ECG]

	Frequency	Percent
ALWMI	18	17.6
ASWMI	12	11.8
AWMI	20	19.6
IPWMI	7	6.9
IWMI	45	44.1

Out of 48 patients with hyponatremia 15(31.25%) patient died while 33 were discharged and 46 patients had serum sodium level within normal range out of which 5 (10.87%) patient died and 8 patients had serum sodium level more than 145 mEq/L and all of them were discharged, (Table 3).

There was significant association found between hyponatremia and death with p value of 0.016.Similarly, there was significant association between hyperglycaemia and mortality with p value 0.025 with x^2 value 7.412 and degree of freedom of 2 as shown in table 3.

Table 3: Correlation of serum sodium level and blood sugar level with outcome

Serum sodium level(mEq/L)	Died	Discharged	Total	Percentage of mortality
<135	15	33	48	31.25%
135 to 145	5	41	46	10.87%
>145	0	8	8	0.00%
Pearson Chi-Square= 8.307, df=2 and P value = 0.016				
Blood sugar level	**Died**	**Discharge**	**Total**	**Percentage of mortality**
<140mg%	1	29	30	3.33%
140-200mg%	16	42	58	27.58%
>200mg%	3	11	14	21.42%
Pearson Chi-Square= 7.412, df=2 and P value = 0.025				

Out of 102 patients, 38 patients had both hyponatremia and hyperglycemia both on presentation to hospital compared to rest all patients (64 patients) and 14 (36.84%) patients died with degree of freedom 1 and p-value 0.00073 which shows significant finding and patients presented with both hyponatremia and hyperglycemia, mortality will be more, (Table 4). Among our patients, most common complication that occurred was cardiogenic shock followed by arrhythmia.

Table 4: Relationship between patients presenting with both hyponatremia and hyperglycemia to rest all patients

	DIED	LIVE	Total
Hyperglycaemia + hyponatrmia	14 (36.84%)	24 (63.16%)	38 (100%)
Remaining	6 (9.38%)	58 (90.63%)	64 (100%)
Total	20 (19.61%)	82 (80.39%)	102 (100%)
Pearson Chi-Square= 11.4, df = 1, P value = 0.00073			

4. Discussion

The present study found that the high risk people are patients who presented with hyponatremia and hyperglycemia at the time of admission with acute myocardial infarction. At the time of admission around 47.1% of patients were hyponatremic. The mean age of patient was59.1±13.105 years, ranged from 24-83 years with male predominance which is comparable with the other studies [16-18]. Systemic hypertension was most common risk factor as similar to Basu [17] and Devi *et al* [19]. 32 patients had mild hyponatremia out of which 8 died, 13 patients had moderate hyponatremia out of which 5 patients died and 3 patients had severe hyponatremia out of which 2 died. This shows that, as severity of hyponatremia increases, mortality also increases. These findings are correlated well with the study done by Patil *et al* [16] and Basu [17].

The hyponatremia was present in 44% of patients. Within 5 days of admission total of deaths were 19.6% (20 deaths), in which 75% (15) of patients presented with hyponatremia. The significant risk factor determining mortality was hyponatremia, when we compared the outcome among survivors and non survivors; it was found that apart from sex, age, hypertension, and diabetes; hyponatremia and hyperglycemia on admission was significant among them. Similarly in Goldberg *et al* [20] study, mortality was found to be increased in patients with hyponatremia and also independent risk factor for 30 days mortality was hyponatremia. In present study, 32 patients had mild hyponatremia out of which 8 (25%) died, 13 patients had moderate hyponatremia out of which 5 (38.46%) patients died and 3 patient had severe hyponatremia out of which 2(66.66%) died. So it is clear that mortality tend to increase with severity of hyponatremia. Other studies with greater sample size conducted by Goldberg *et al* [20], Klopotowski *et al* [21] and Tang and Hua [22] showed a significant association between mortality and hyponatremia. The different prognostic factors of myocardial infarction such as severity of left ventricular function, hemodynamic alteration and the extent of neurohumoral activation were to incorporate by the development of hyponatremia.

According to Malmberg *et al* [23] study, there is a graded rise in cardiovascular risk with increasing hyperglycemia in patients with overt diabetes. The magnitude of this effect was illustrated in a meta-analysis of 13 prospective cohort studies (10 in type 2 diabetes, including the UKPDS. For every one-percentage point

increase in glycosylated hemoglobin (HbA1c), the relative risk for any cardiovascular event was 1.18 (95% CI 1.10-1.26), another study saying a review of 4224 patients in trials of fibrinolysis or primary PCI in patients with STEMI found a U-shaped relationship between the serum glucose (mostly admission values) and the 30-day rate of death or recurrent MI [24]. In present study, maximum number of death occurred in group with range of blood sugar from 140-200mg%. Out of 102 patients, 30(29.40%) had blood sugar less than 140 mg% on admission with 1 mortality, 58 (56.90%) patients had blood sugar level in the range of 140-200 mg% with mortality of 16 and 14 (13.70%) patients had blood sugar level more than 200 mg% with mortality of 3. Thus, higher the blood sugar level on admission more will be the mortality. Similar findings are reported in the previous studies [25-27].

There is a positive association between the serum glucose at the time of MI and mortality in patients with and without diabetes [25,27,28]. One analysis of hyperglycemia in patients with acute MI found that spontaneous hypoglycemia was associated with increased hospital mortality, but not hypoglycemia associated with insulin therapy [29]. Hyperglycemia may be directly toxic to ischaemic brain, may disrupt blood brain barrier and promote hemorrhagic infarct conversion. So, hyperglycemia on admission in acute ST elevation myocardial patients is suggestive of increased risk of in-hospital mortality after ischemic stroke in non-diabetic patients and increased risk of poor functional recovery in non-diabetic stroke survivors also [30].

5. Conclusion

From the observations of present study it is clear that lower the level of serum sodium in acute STEMI patients, higher will be the mortality while higher the blood sugar level on admission more will be the mortality among acute STEMI patients. However, mortality was found to be high in patients who were hyponatremic and orhyperglycemic on admission. Thus, there is linear relationship between hyponatremia and hyperglycemia with mortality in patients of acute STEMI.

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