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Prognostic Importance of Hyponatremia in Acute ST Elevation Myocardial Infarction (STEMI)

Authors
Dr Vikas[1], Dr Gurdeep Kaur[2]
[1]Resident, [2]Professor and Unit Head
Department of General Medicine, R.N.T Medical College, Udaipur, India

Abstract

Aim: *To find out the prognostic importance of hyponatremia in relation with survival outcome in patients with acute STEMI.*

Materials and Methods: *200 patients presenting to the emergency department of medicine of RNT medical college and associated hospital from May 2017 to November 2017, with signs and symptoms of Acute STEMI, were included in the study with their informed consent and after applying the inclusion and exclusion criteria. Plasma sodium levels were assessed on admission, and at 24hr, 48 hr and 72 hr thereafter, with hyponatremia being defined as levels less than 135 meq/l.*

Results: *The study comprised of 132 cases (66%) with normal sodium levels, 28 cases (14%) with hyponatremia on admission, and 40 cases (20%) who developed hyponatremia after admission within 72 hrs. Hyponatremic cases were significantly associated with higher mortality, more no. of risk factors, higher killip class, reduced ejection fraction and higher Troponin T values.*

Conclusion: *Hyponatremia on admission or early development of hyponatremia in patients with acute STEMI is an independent predictor of 30-day mortality, thus serving to identify patients at high risk.*

Introduction

Cardiovascular disease is one of the leading causes of morbidity and mortality across the world. Worldwide, there are 3 million sudden cardiac deaths per year due to acute myocardial infarction.[1] World Health Organization (WHO) has declared cardiovascular disease as a modern epidemic.[2]

Acute Myocardial Infarction (MI), being one of the manifestations of coronary heart disease, is a medical emergency and has physical, economic and psychological effects on human being[3]. With decline in infectious disease related death due to accelerated economic development and life style changes promoting atherosclerosis, developing countries especially India are experiencing a sharp increase in ischemic heart disease and MI. Given the wide disparity of available resources to treat MI in developing countries, major efforts are needed to strengthen primary prevention programs at community level.[4]

ST-segment elevation myocardial infarction (STEMI) is one of the presentations of acute coronary syndromes. STEMI continues to be a major health problem in the industrialized world and is becoming an increasingly important problem in developing countries.

Hyponatremia is a common electrolyte disorder among hospitalized patients especially in heart failure, nephrotic syndrome, or cirrhosis. It

is recognized as a predictor of adverse outcomes in hospitalized patients, and its prognostic implications are usually attributed to the severity of the underlying condition. Serum sodium, potassium and calcium are considered to be major electrolytes associated with electrophysiological properties of myocardial membrane.

Hyponatremia is a major electrolyte disturbance in ill subjects, especially in postoperative period and in volume overloaded cases and its homeostasis play a major role in the cellular function.[5-7]

It has been identified as an independent predictor of short- term mortality, long- term mortality, and re-hospitalization because of heart failure.[8-10]

In acute STEMI, baroreceptor activation leads to activation of sympathetic nervous system releasing hormones like vasopressin and also activation of renin angiotensin system. Magnitude of these neuro-hormonal changes is related to the severity of the myocardial damage. Hyponatraemia (serum sodium <135meq/ l) as a marker of these hormonal changes may serve as a simple, easily available and cost effective marker to identify patients at high risk .

Hyponatremia is common after MI, and clinical improvement is accompanied by rise in plasma sodium concentration.[11]

The neurohormonal activation that accompanies acute myocardial infarction is similar to that which accompanies heart failure. While the prognostic value of hyponatremia in chronic heart failure is well established, data in the setting of acute STEMI are lacking. Whether hyponatremia (sodium <135mEq/L) in the acute phase of ST-segment elevation myocardial infarction is just a marker of "more ill" patients or decreased sodium concentration is able to exert a direct adverse effect on the cardiovascular system is still unknown. Thus, the aim of this study is to evaluate the importance of hyponatremia as a pre-dictor of prognosis in patients with acute STEMI.

Materials and Methods

It was a hospital based descriptive observational study. Study was conducted from May 2017-November 2017 in the Department of Medicine, RNT Medical College and associated hospital, Udaipur.All patients presenting to the emergency department with signs and symptoms of Acute STEMI(200 cases) were included in the study.

Inclusion Criteria

All acute myocardial infarction patients having

a) Chest pain lasting more than 20 minutes
b) Diagnostic ECG changes of acute STEMI.
c) Elevated cardiac troponin T levels

Exclusion Criteria

Acute coronary syndrome without ST elevation.

Qualifying patients underwent detailed history and clinical examination. Patients of acute myocardial infarction received thrombolytic therapy (tissue type plasminogen activator or streptokinase). Plasma sodium concentrations were evaluated by blood samples taken on admission and at 24, 48 and 72 hours thereafter.

Study end Points and Definitions

The primary end point was all cause mortality within 30 days following myocardial infarction. Mortality data after discharge but within 30 days of myocardial infarction was obtained over telephonic conversation. Plasma sodium concentrations were determined by using an ion selective electrode auto analyzer.

Hyponatremia was defined as sodium level less than 135mmol/L (<135 mEq/L)

Statistical Method

SPSS software was used for statistical analysis.

- Mean
- Suitable parametric and non parametric tests
- Univariate and multivariate logistic regression tests to determine the association between hyponatremia and 30-day mortality.

Results

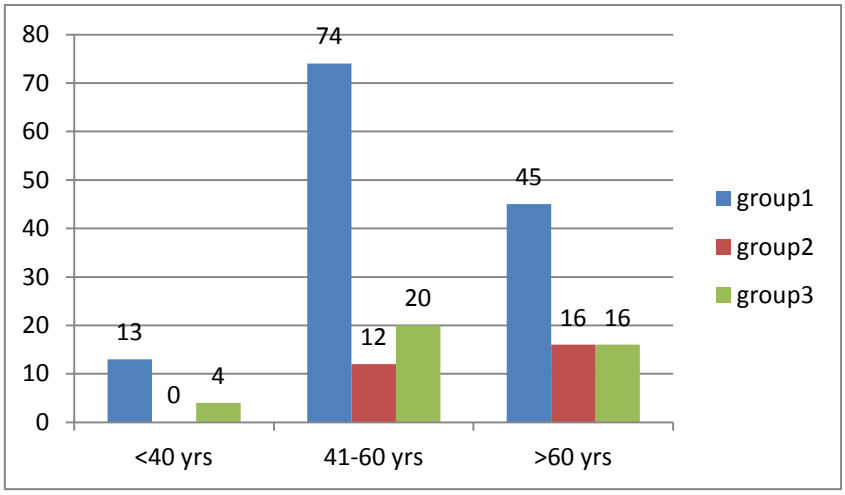
In this study of 200 cases, Group 1 comprised of 132 cases (66%), group 2 included 28 cases (14%)and group 3 included 40 cases(20%)

Table showing Age wise distribution among cases

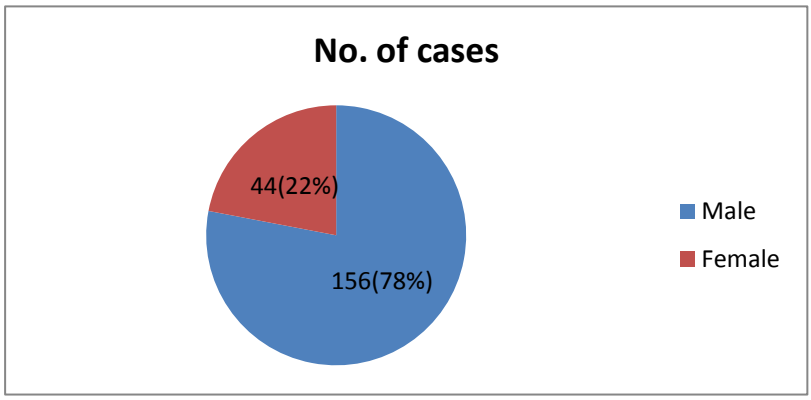
Age group in yrs	No of cases
<40	17
40-60	106
>60	77

Majority of the cases in this study (53%) were in the age group of 40-60 years.

Graph 1-Age wise distribution



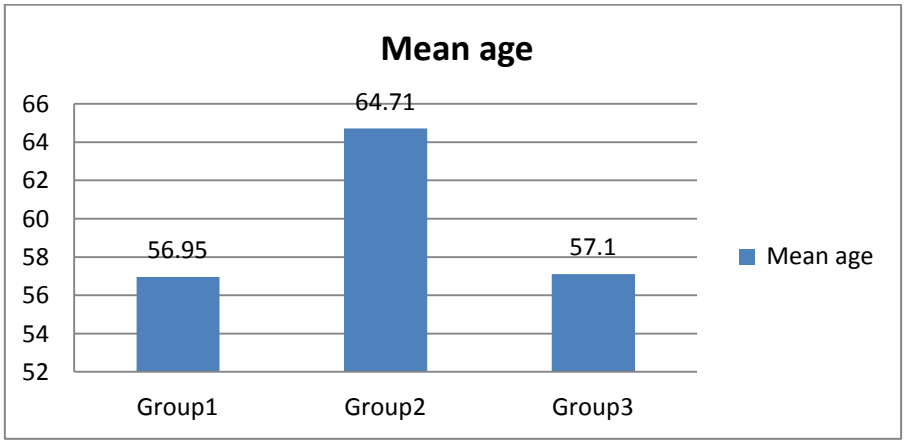
Graph 2-Sex wise distribution among cases



Among 200 patients studied, 78% were Males and 22% were Females

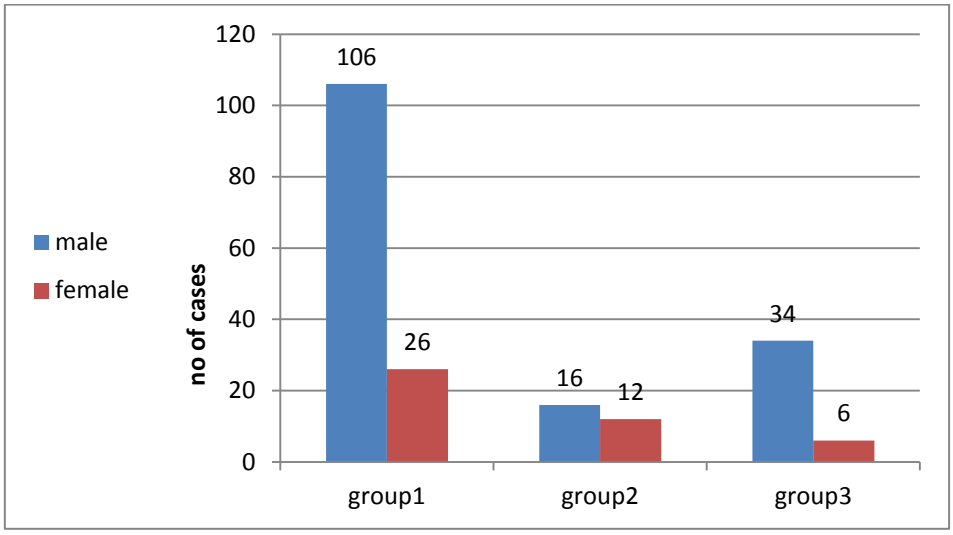
In this study, M: F ratio was 3.5:1

Graph 3-Mean age in study group

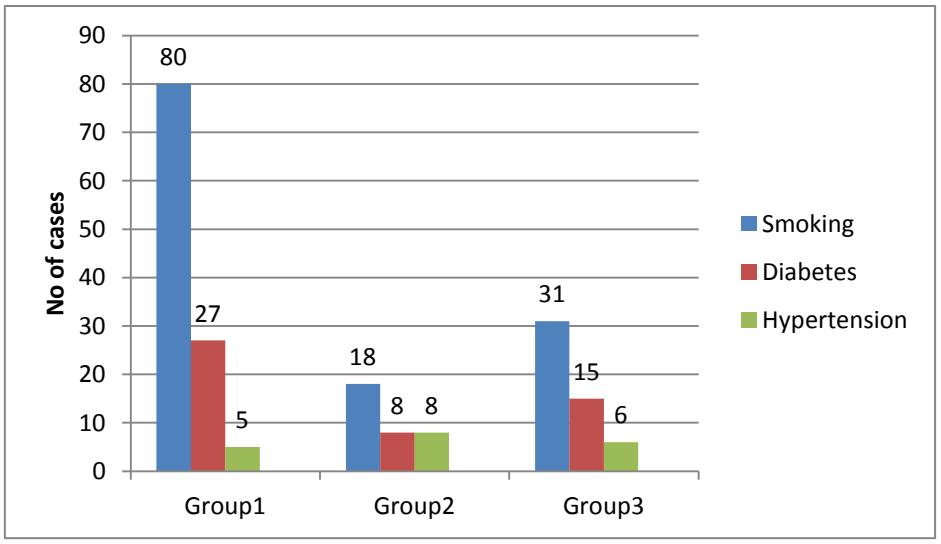


The mean age in cases with hyponatremia on admission was higher than the other cases

Graph 4-Sex wise distribution in various groups

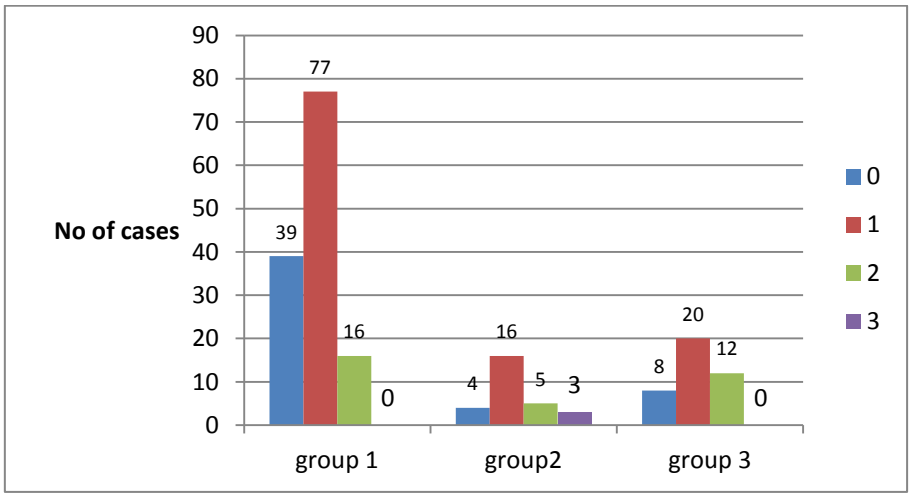


Graph 5: Risk factors in various groups



The hyponatremic cases more often had associated hypertension in comparison with the cases having normal sodium levels which was found to be highly significant risk factor.(p value 0.000)

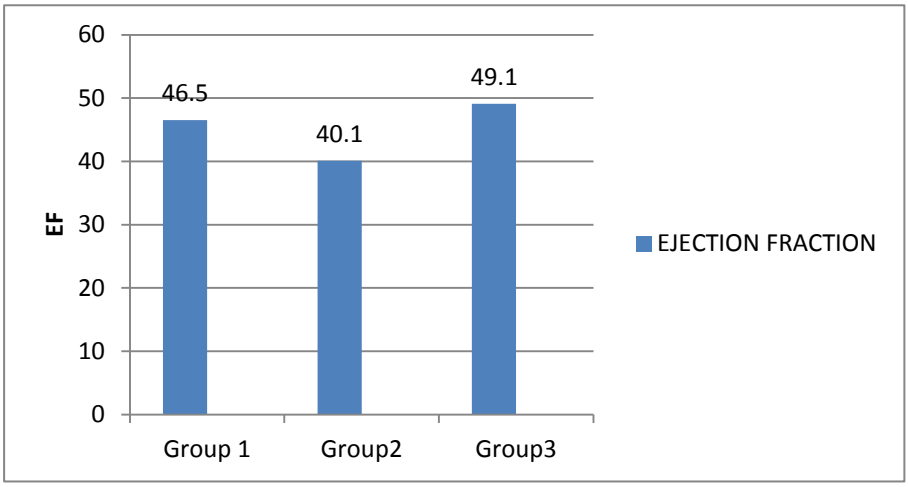
Graph 6: showing relation of hyponatraemia with no of risk factors



0=No risk factor, 1= 1 risk factor, 2=2 risk factors, 3=3 risk factors

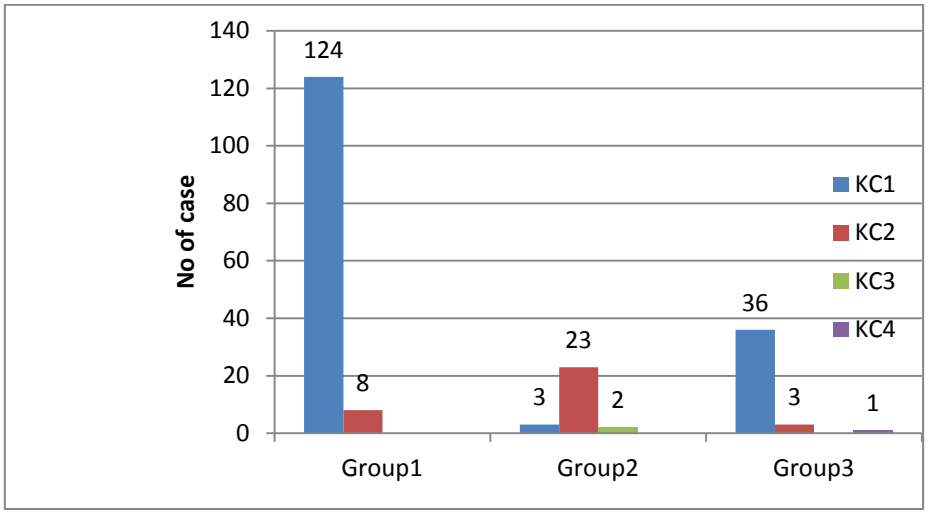
Hyponatremic cases on admission were more often associated with three risk factor than the other groups

Graph 7 Ejection fraction in various groups



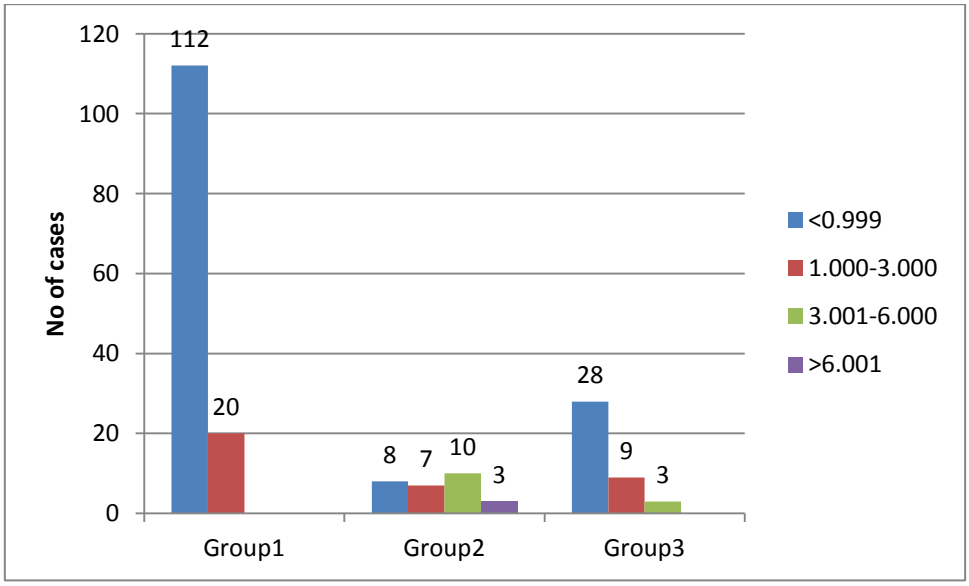
The mean ejection fraction was significantly lower in the cases with hyponatremia on admission (p value 0.025)

Graph 8-Killip class in various groups



Higher killip class was more often found in hyponatremic cases. (significant p value 0.001)

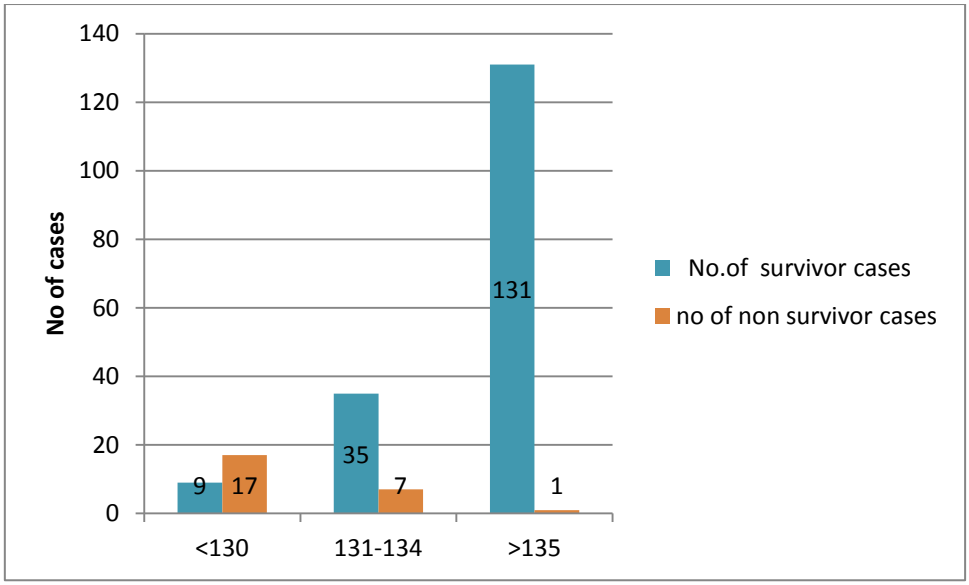
Graph 9 –Group wise Troponin-T values



Majority of the cases with hyponatremia on admission had troponin T value above 3.000(13 out of 28 cases, p value significant 0.001)

Characteristics	Normal sodium level(n=132)	Hyponatraemia on admission(n=28)	Hyponatraemia within 72 hrs(n=40)	P value
Age(yrs)	56.95±11.90	64.71±9.46	57.10 ±10.05	0.145
Male sex(n=156)	106(67.9)	16(10.2)	34(21.7)	0.013
Diabetes(n=50)	27(54)	8(16)	15(30)	0.083
Smoking(n=129)	80(62)	18(13.9)	31(24)	0.148
Hypertension(n=19)	5(26.3)	8(42.1)	6(31.5)	0.000
Anterior infarction (n=138)	80(57.9)	24(17.3)	34(24.6)	0.001
Killip class-1/2(n=197)	132(67)	26(13.1)	39(19.7)	0.001
killip class -3/4(n=3)	0	2(66.6)	1(33.3)	0.001
Ejection fraction (%)	46.5±12.5	40.1±8.39	49.10±9.24	0.025
Troponin-T	0.646±.490	2.865±2.361	1.0112±1.011	0.001

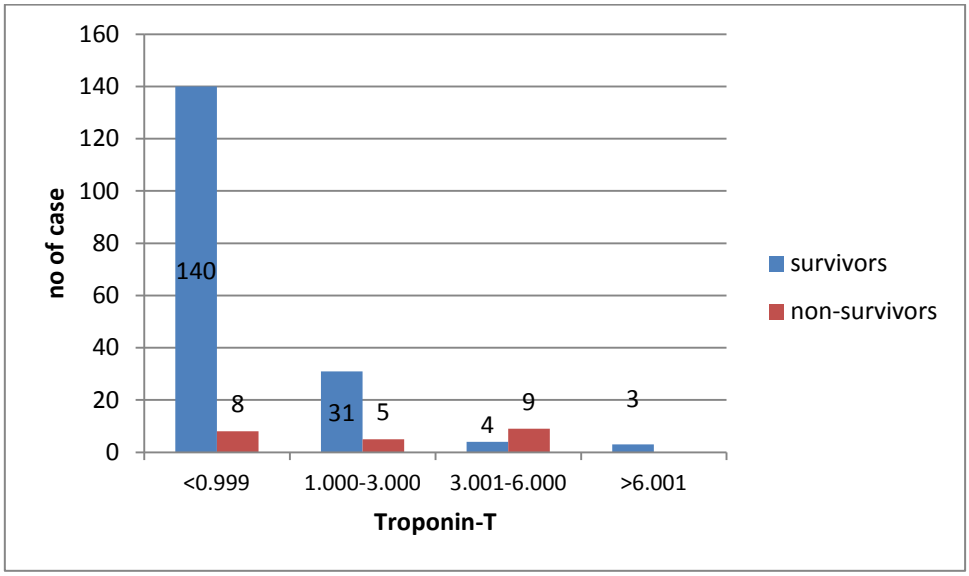
Graph 10: Showing severity of Hyponatraemia and outcome in terms of survival:



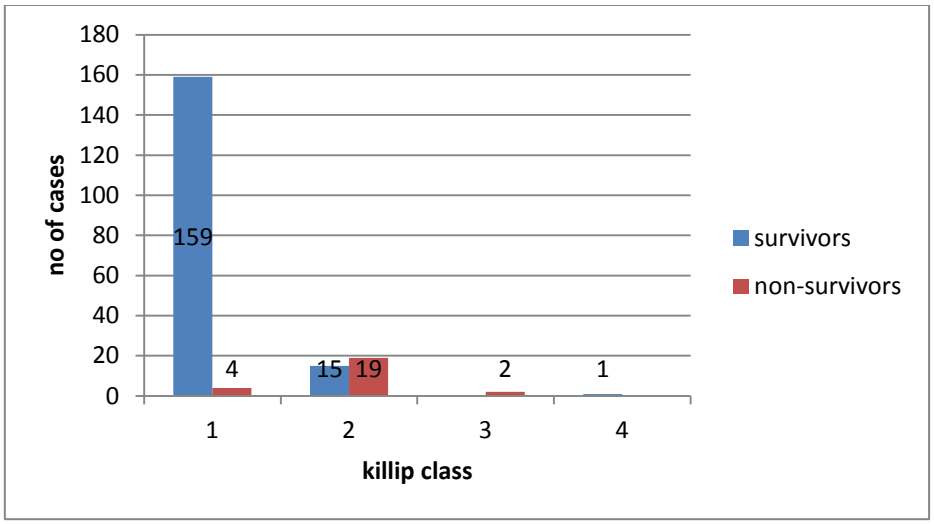
Majority of the cases who had serum sodium levels less than 130 meq/l died within 30 days, indicating that survival outcome is related to severity of hyponatremia.

	Survivors(n=175)	Non survivors(n=25)	P value
Age (yrs) mean ±SD	57.50±11.91	62.04±7.12	0.065
Sex Male Female	141(80.5%) 34(19.4%)	15(60%) 10(40%)	0.020
Hyponatraemia	45(25.7%)	23(92.5%)	0.000
Smoking	113(64.5%)	16(64.0%)	0.955
Diabetes	43(24.5%)	7(28%)	0.711
Hypertension	11(6.2%)	8(32%)	0.000
Infarct site Anterior Inferior	 118(67.5%) 57(32.5%)	 20(80%) 5(20%)	 0.001
Killip class 1 Class 2 Class3 Class4	159(90.8%) 15(8.5%) 0 1(0.5%)	4(16%) 19(76%) 2(8%) 0	0.000
EF(%) mean±SD	47.11±11.7	39.48±8.65	0.002
Troponin-T	0.77±0.744	2.831	0.000

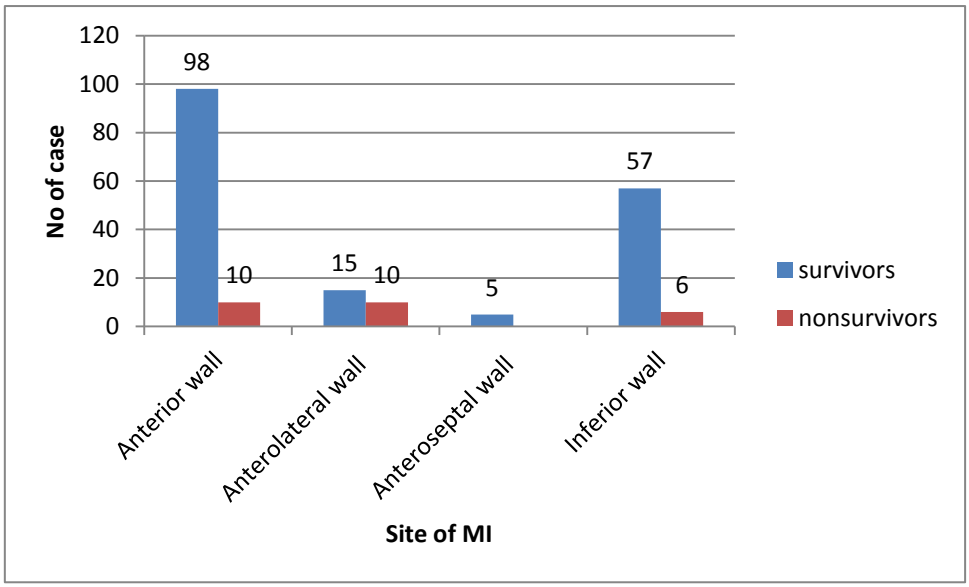
Graph 11: Values of Troponin in relation with outcome:



Graph 12: showing relation of KILLIP class with survival outcome:



Graph 13: showing relation of site of myocardial infarction with survival outcome:



In our study adverse outcome (mortality) was found to be associated significantly with anterior infarction, higher killip class and higher Troponin T levels.

Discussion

The study was done in 200 cases of Acute STEMI. This study comprised of 132(66%) cases with normal serum sodium levels (group 1), 28 cases (14%) with hyponatremia on admission (group 2) and 40 cases (20%) who developed hyponatremia within 72 hrs after admission (group 3). Similar proportion of hyponatremics on admission (17%) and those who developed hyponatremia within 72 hrs (23 %) was found in a study by Prashant et al.[45]

Maximum no. of cases were in the age group of 41-60 yrs. The mean age in cases with hyponatremia on admission (64.71yrs) was higher than the other cases. Thus, patients who presented with hyponatremia on admission were older than patients with normal sodium levels This was similar to a study by Kurian et al[46], in which mean age in hyponatremics (64.18 yrs) on admission was higher than others. However no statistical significance was found in determining older age as a risk factor for hyponatremia.

Among the various risk factors studied (smoking , diabetes, hypertension, prior diuretic therapy and prior history of IHD), hyponatremia was significantly associated with hypertension.

Hyponatremia at admission was also found to be significantly associated with lower ejection fraction with mean ejection fraction lower in group 2 (40.1%) (p value 0.025). This result was comparable to studies by Harsoor et al[47] and Prashant et al[45], in which mean ejection fraction in hyponatremic cases was 37.8% and 41.1% respectively.

Hyponatremic cases(group 2 and 3) were more often associated with higher killip class and anterior infarction (significant p value 0.001) comparable to studies by Prashant et al[45], Kurian et al[46] , Goldberg et al [8]and Lazzeri et al[52]

Higher Troponin T values(3- 6) were more often found in hyponatremic cases.(significant p value 0.001)

Hyponatremic cases more often had anterior infarction similar to studies by Goldberg et al[8] and Prashant et al[45]

After studying the baseline characteristics in cases, impact of hyponatremia was assessed in terms of 30 days survival, and various baseline characteristics were studied in survivors and nonsurvivors.

In our study, 25 deaths (12.5%) occurred within 30 days of admission, 0.75 % (1/132) in patients without hyponatremia, 75% (21/28) in patients with hyponatremia on admission, 7.5% (3/40) in patients who developed hyponatremia within 72 hour of admission.

In study done by Goldberg et al,[8] a total of 105 deaths (10%) occurred within 30 days of admission. 6.2% (44/708) of patients without hyponatremia, 19.8%(26/131) of patients with hyponatremia on admission and 16.8% (35/208) of patients who developed hyponatremia after admission.

In comparison with the above study, our study had higher mortality in patients with hyponatremia .

In our study, we found a trend of increasing mortality with the severity of hyponatremia. We stratified patients into two groups depending on the mean sodium level. 16.6%(7/42) of total death occurred in those with sodium 131-134 mmol/L and 65.38% (17/26) of total death occurred in sodium <130mmol/l. This was in concordance with the study conducted by Goldberg[8] et al., who showed increasing mortality with severity of hyponatremia.

Comparison of various risk factors and other variables among survivor and non survivor cases was done. Apart from sex , hypertension, infarct site, Killipclass on admission, ejection fraction and troponin levels, hyponatremia was significant risk factor in determining mortality. All the variables among the survivors and non survivors that were significantly associated with mortality were included in the multivariate logistic regression analysis. Hyponatremia remained a significant independent predictor of mortality. This is in concordance to similar study conducted by Goldberg[8]et al., they found that hyponatremia was independently associated with 30 day mortality.

Thus, this study concluded that in patients with acute ST elevation MI, hyponatremia on admission or within 72 hrs after admission, is an independent predictor of 30 day mortality.

Summary

Hyponatremia has been shown to be a predictor of cardiovascular mortality among patients with heart failure. In fact, the neurohormonal activation that accompanies acute myocardial infarction is similar to that which accompanies heart failure. Hence we aimed to investigate the prognostic importance of hyponatremia in the setting of acute ST elevation MI and to determine its usefulness in predicting short term survival.

In our study, substantial proportion of patients who presented with acute ST elevation myocardial infarction were hyponatremic on admission or developed hyponatremia shortly after admission. Univariate analysis of the several variables among survivors and nonsurvivors identified hyponatremia as significant risk factor in determining mortality. We also found a significant linear relationship between severity of hyponatremia and mortality.

Other factors like Killip class on admission, male sex, hypertension, anterior infarction, ejection fraction, troponin levels were also found to play a significant role in mortality.

Multivariate analysis was performed which identified hyponatremia on admission or early development of hyponatremia as a significant independent predictor of 30 day mortality

Conclusion

In our study, we concluded that hyponatremia on admission or early development of hyponatremia in patients with acute ST elevation myocardial infarction is an independent predictor of 30-day mortality. Plasma sodium levels may serve as a simple marker to identify patients at risk.

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