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Hyponatremia in Acute Myocardial Infarction as a Prognostic Indicator - A Retrospective Observational Study

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ABSTRACT

Background: *Hyponatremia, a common electrolyte disturbance in hospitalized patients, has been linked to worse outcomes in acute cardiac diseases. Its value as a prognostic marker in acute myocardial infarction (AMI) is still being investigated.*

Objectives:

1. *To find out the prevalence of hyponatremia among patients with acute myocardial infarction.*
2. *To evaluate hyponatremia as a prognostic marker for acute myocardial infarction.*

Methods: *A retrospective observational study of 100 individuals admitted with acute myocardial infarction. Patients were divided into hyponatremic (serum sodium < 135 mEq/L) and normonatremic groups. Demographic information, clinical characteristics, type of STEMI, ejection fraction, and duration of stay were examined. To measure the strength and significance of relationships, statistical analysis used odds ratios and p-values.*

Results: *Hyponatremia was detected in 25% of AMI patients. It was more likely in older people and those with anterior, inferior, and lateral STEMI, though not statistically significant. Hyponatremia prevalence increased with decreasing ejection fraction (38.5% for EF <40%) and Hyponatremic patients had a substantially higher average hospital stay (6.88 ± 2.1 days vs. 5.11 ± 2.18 days; p = 0.030).*

Conclusion: *Hyponatremia is a common finding in AMI patients, and it is linked to increased severity and longer hospital stay. It may be used as a simple but effective prognostic indicator to identify high-risk patients and guide more intense surveillance and intervention efforts.*

Keywords: *Hyponatremia, Acute Myocardial Infarction, Prognostic Indicator, ejection fraction, electrolyte imbalance.*

INTRODUCTION

Coronary artery disease (CAD) remains the third biggest cause of death worldwide, accounting for nearly 17.5 million deaths each year.[1] Over the last two to three decades, both the incidence and prevalence of CAD have increased, greatly adding to the global health burden, according to research undertaken both internationally and in India.[2] A large amount of research has investigated the link between hyponatremia and myocardial infarction (MI), emphasizing the influence on clinical outcomes.[3] Previous studies have shown that neurohumoral activation after acute MI and heart failure contributes to the development of hyponatremia, which is associated with a worse prognosis.[4]

Hyponatremia in Acute Coronary Syndrome (ACS) is caused by a variety of complex mechanisms, including increased secretion of antidiuretic hormone (ADH), fluid redistribution, and dilutional effects from fluid resuscitation.[5, 6] Hyponatremia in ACS is frequently interpreted as a sign of more extensive myocardial damage and reduced heart function. It has been related to an increased risk of arrhythmia, cardiac failure, and death.[7] Although the clinical significance of hyponatremia in ACS is well acknowledged, there is insufficient evidence to support focused therapy methods in this scenario. Nonetheless, timely and adequate correction of hyponatremia is critical, with therapeutic options tailored to the severity of the salt imbalance and the patient's overall clinical condition. Additional research is needed to better understand how hyponatremia affects the prognosis of patients with Acute Coronary Syndrome. Hence, the present study intends to understand the relationship between Hyponatremia and STEMI and its use as a prognostic indicator.

OBJECTIVES

1. To find out the prevalence of hyponatremia among patients with acute myocardial infarction.
2. To evaluate hyponatremia as a prognostic marker for acute myocardial infarction.

MATERIALS AND METHODS

This is a Retrospective Observational study conducted in a Tertiary Care Hospital at Puducherry and data was collected for a period of one year (Ref no: 43/SVMCH/IEC-Cert/May.25). All the patients above 18 years of age, with classical chest pain lasting for more than 20 minutes, diagnosed of myocardial infarction (STEMI and NSTEMI) through Electrocardiogram (ECG) or Elevated Troponin I (>0.06 ng/ml) were included in the study. Patients with Infective endocarditis, past history of rheumatic heart disease, Cardiomyopathy, previous history of MI, using medication that causes hyponatremia or with Endocrine causes of hyponatremia were excluded from the study.

STATISTICAL ANALYSIS

The Collected Data was entered in MS Excel and analyzed using SPSS software version 23.0. Frequency Analysis, Descriptives, Cross Tabulation, Odds ratio and Independent sample 't' test was applied for appropriate variables and the results were interpreted. A significance level of $p < 0.05$ was considered to indicate a significant relationship between variables.

RESULTS

The study comprised 100 patients with acute myocardial infarction, 25% had hyponatremia (serum sodium <135 mEq/L) and 75% had normal Seum Sodium levels (serum sodium ≥135 mEq/L). The sodium concentrations ranged between 127 to 143 mEq/L, with a mean of 135.64 mEq/L and a standard deviation of 3.125. (Figure 1)

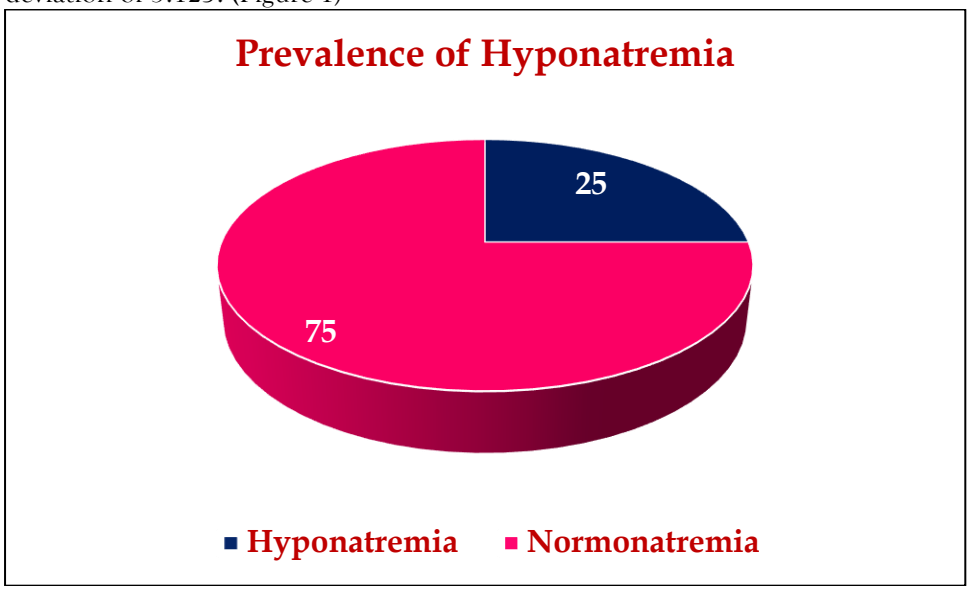

Figure 1: Prevalence of Hyponatremia

Table 1: Prevalence of Hyponatremia based on Demographics

Demographics	Hyponatremia (Na <135 mEq/L)	Normonatremia (Na>135 mEq/L)
Gender		
Male	14 (24.6%)	43 (75.4%)
Female	11 (25.6%)	32 (74.4%)
Total	**25 (25%)**	**75 (100%)**
Age		
<=40 years	0 (0%)	4 (100%)
41-50 years	4 (40%)	6 (60%)
51-60 years	7 (19.4%)	29 (80.6%)
>60 years	14 (28.0%)	36 (72.0%)
Total	**25 (25%)**	**75 (100%)**

In this study, approximately 25% of patients had hyponatremia (serum sodium <135 mEq/L). The gender distribution revealed that 14 of 57 (24.6%) males were hyponatremic, while 43 (75.4%) had normonatremia. Similarly, 11 of 43 females (25.6%) exhibited hyponatremia, whereas 32 (74.4%) had normal sodium levels. Age-wise analysis revealed that none of the patients aged 40 or younger had

hyponatremia. However, in the 41-50 year age range, 4 out of 10 patients (40%) were hyponatremic, the highest percentage of any age group. In the 51-60 age range, 7 out of 36 patients (19.4%) had hyponatremia, whereas in the >60 age group, 14 out of 50 patients (28.0%) were affected. Although the proportion was highest in the 41-50 age group, the absolute number of hyponatremic cases was higher in patients over 60, indicating that hyponatremia is becoming more common as people get older. (Table 1, figure 2, figure 3)

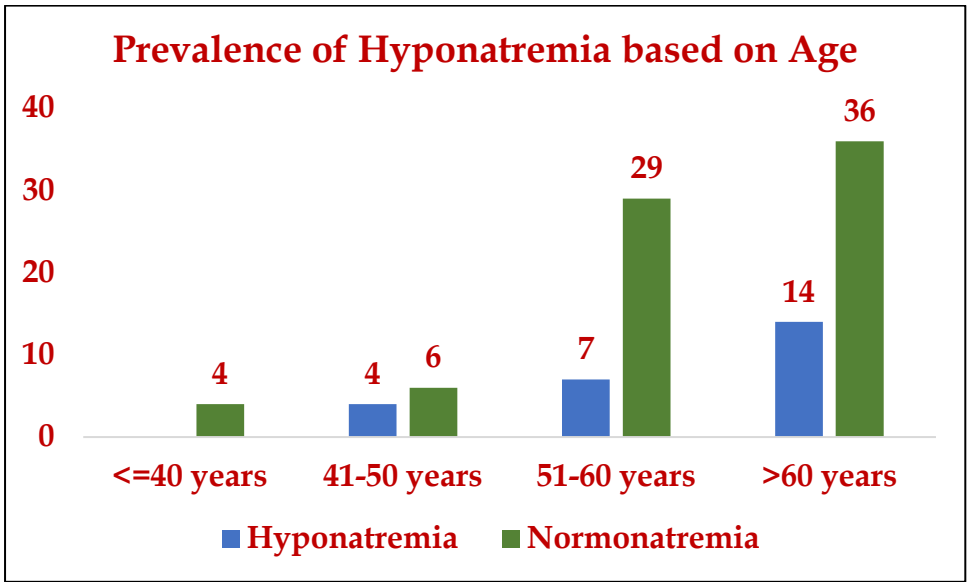

Figure 2: Prevalence of Hyponatremia based on Age

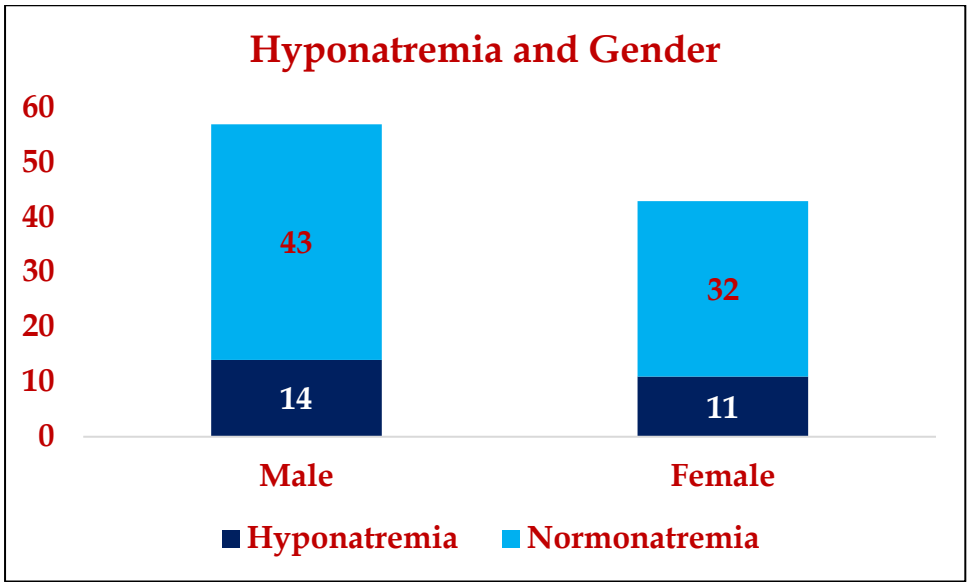

Figure 3: Prevalence of Hyponatremia based on gender

Table 2: Prevalence of Hyponatremia and symptoms of acute Myocardial Infarction

Symptoms	Hyponatremia (Na <135 mEq/L)	Normonatremia (Na>135 mEq/L)
Chest Pain		
Yes	21 (23.6%)	68 (76.4%)
No	4 (36.4%)	7 (63.6%)
Total	25 (25%)	75 (100%)
Breathlessness		
Yes	24 (25.5%)	70 (74.5%)
No	1(16.7%)	5 (83.3%)
Total	25 (25%)	75 (100%)

Palpitations		
Yes	7 (33.3%)	14 (66.7%)
No	18 (22.8%)	61 (77.2%)
Total	25 (25%)	75 (100%)
Profuse Sweating		
Yes	5 (22.7%)	17 (77.3%)
No	20 (25.6%)	58 (74.4%)
Total	25 (25%)	75 (100%)

Hyponatremia was present in 23.6% of patients with acute myocardial infarction and not in 36.4% of those without chest pain. Patients with dyspnea had a slightly higher prevalence of hyponatremia (25.5%) compared to those without (16.7%). Those who experienced palpitations had a greater rate of hyponatremia (33.3%) compared to those who did not (22.8%). On the other hand, hyponatremia was marginally less prevalent in people who perspired a lot (22.7%) compared to people who didn't (25.6%).(Table 2)

Table 3: Type of ST-elevation myocardial infarction and Hyponatremia

Type of STEMI	Hyponatremia	Normonatremia	OR (95% CI)	'p' value
Anterior	8 (29.6%)	19 (70.4%)	1.272 (0.622 – 2.601)	0.516
Inferior	9 (27.3%)	24 (72.7%)	1.142 (0.566 – 2.305)	0.713
Lateral	4 (36.4%)	7 (63.6%)	1.541 (0.648 – 3.666)	0.356
Others	4 (13.8%)	25 (86.2%)	0.466 (0.175 – 1.240)	0.098

Hyponatremia was more common in anterior (29.6%), inferior (27.3%), and lateral (36.4%) STEMI types than in other types of STEMI (13.8%). The odds ratios for anterior (OR = 1.272, p = 0.516), inferior (OR = 1.142, p = 0.713), and lateral (OR = 1.541, p = 0.356) infarctions all showed a tendency toward greater odds of hyponatremia, although with broad confidence ranges that crossed 1. In contrast, the "other" group had a lower risk of hyponatremia (OR = 0.466, p = 0.098), which was not statistically significant. As none of these correlations were statistically significant, the data do not indicate a substantial or statistically significant relationship between the kind of STEMI and the presence of hyponatremia.(Table 3)

Table 4: Ejection Fraction and Hyponatremia

Ejection fraction		Hyponatremia	Normonatremia	Total	'p' value
<40%	**Frequency**	5	8	13	0.334
	%	38.5%	61.5%	100.0%	Not Significant
40-40%	**Frequency**	10	26	36	
	%	27.8%	72.2%	100.0%	
>50%	**Frequency**	10	41	51	
	%	19.6%	80.4%	100.0%	
Total	**Frequency**	25	75	100	
	%	25.0%	75.0%	100.0%	

In the current investigation, individuals with lower ejection fraction (<40%) had the highest rate of hyponatremia (38.5%). This was followed by 27.8% in the mid-range ejection fraction group (40-50%), and 19.6% in those with intact ejection fraction (>50%). Although there appeared to be a trend towards increased hyponatremia with decreasing ejection fraction, the relationship was not statistically significant (p = 0.334). (Table 4)

Table 5: Killip Class and Hyponatremia

Killip Class		Hyponatremia	Normonatremia	Total	'p' value
I	**Frequency**	12	62	74	0.003
	%	16.2%	83.8%	100.0%	Highly Significant
II	**Frequency**	12	10	22	

	%	54.5%	45.5%	100.0%
III	**Frequency**	1	2	3
	%	33.3%	66.7%	100.0%
IV	**Frequency**	0	1	1
	%	0.0%	100.0%	100.0%
Total	**Frequency**	25	75	100
	%	25.0%	75.0%	100.0%

There was a significant correlation between Killip class and hyponatremia (p = 0.003). Only 16.2% of patients in Killip Class I had hyponatremia, while the proportion climbed significantly in higher classes—54.5% in Class II and 33.3% in Class III. There was no hyponatremia among Class IV patients. These data demonstrate that hyponatremia is more common in patients with severe heart failure (higher Killip class), implying that it may serve as a marker of worse clinical condition in acute myocardial infarction. (Table 5)

Table 6: Correlation between Sodium level and Duration of Hospital stay

		Duration of Hospital stay (days)
Sodium level mEq/L	Pearson Correlation	-0.493**
	Sig. (2-tailed)	0.000
	N	100

There is a significant negative association (p < 0.001) between serum sodium levels and duration of hospital stay duration in patients with acute myocardial infarction. The Pearson correlation coefficient is -0.493 which suggests that decreased sodium levels are significantly related with an extended hospital stay. The significance level (p = 0.000) indicates that this association is highly significant, emphasizing the prognostic importance of hyponatremia in AMI patients. (Table 6, Figure 4)

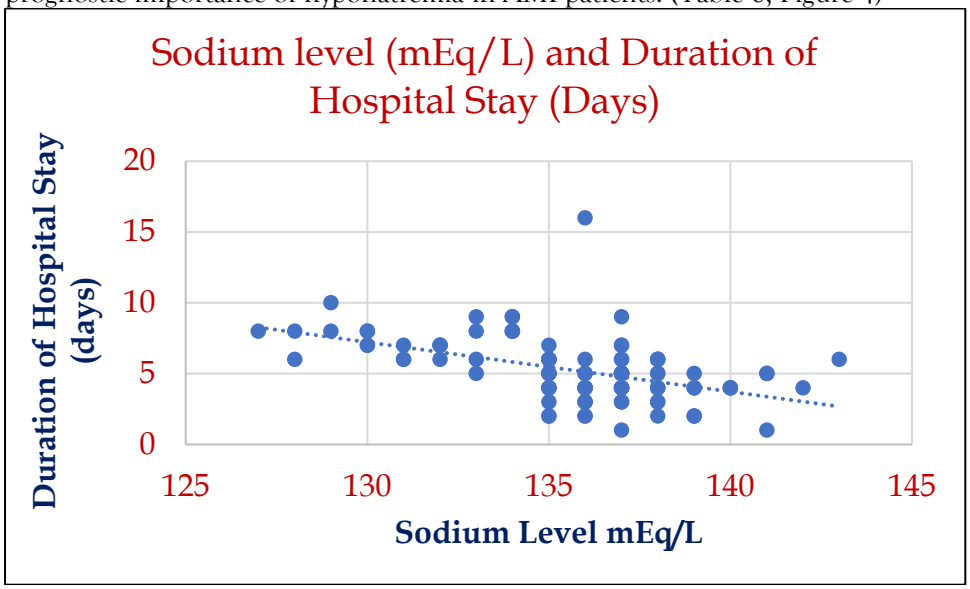

Figure 4: Correlation between Sodium level (mEq/L) and Duration of Hospital Stay (Days)

Table 7: Prognostic value of Hyponatremia for Acute Myocardial Infarction

Outcome	Hyponatremia		OR (95% CI)	'p' value
	Yes	No		
Duration of Hospital Stay (Days)	6.88±2.1	5.11±2.181	-	0.030

The hyponatremic group had a substantially longer average hospital stay (6.88 ± 2.1 days) than the normonatremic group (5.11 ± 2.18 days; p = 0.030). These data indicate that hyponatremia is related with poorer clinical outcomes in patients with acute myocardial infarction. (Table 7)

DISCUSSION

A blood sodium level of less than 135 mmol/L is known as hyponatremia, and it is a common electrolyte imbalance that is observed in hospitalized patients, especially those who have cardiovascular disease. It is

becoming more well acknowledged that hyponatremia during acute myocardial infarction (AMI) may be a sign of a poor prognosis.

Hyponatremia

In the current study, 25% of patients admitted with acute myocardial infarction (AMI) exhibited hyponatremia (serum sodium <135 mEq/L), while 75% had normal serum sodium levels (≥135 mEq/L). These findings are consistent with prior research, however the incidence of hyponatremia varies. For instance, Goldberg et al. found a lower incidence of 12.5% among AMI patients, whereas Pramila and Anuja revealed a greater frequency of 30% at admission.[8,9] The difference in the prevalence in the various studies is contributed to the variation in population.

Age

Patients under the age of 40 in this study did not have hyponatremia. 40% of individuals in the 41–50 age range had the highest prevalence of hyponatremic symptoms. While 28% of people over 60 had hyponatremia, 19.4% of people in the 51–60 age range were affected. These results suggest that as people age, the prevalence of hyponatremia rises. In the study by Naveen Kumar et al. discovered a very high prevalence (86%) of hyponatremia in people over 60, supports this pattern.[10]

Type of STEMI

In the current study, hyponatremia was more common in patients with anterior wall myocardial infarction (29.6%). This finding is consistent with the data of Sanket and Sharanabasavaraj, who similarly found a higher prevalence of hyponatremia in anterior infarctions.[11] This connection may be due to the larger level of myocardial injury and hemodynamic stress found in anterior wall involvement.

Hyponatremia and Ejection Fraction

The present study indicated that hyponatremia was most prevalent among patients with reduced ejection fraction (<40%), impacting 38.5% of these people. The mid-range ejection fraction group (40-50%) had a hyponatremia rate of 27.8%, whilst those with intact ejection fraction (>50%) had the lowest frequency of 19.6%. These findings are comparable with those of Sanket and Sharanabasavaraj, who also found reduced ejection fractions in individuals with hyponatremia, implying a probable relationship between impaired cardiac performance and sodium balance disruption.[11]

Hyponatremia and Killip Class

Killip class and the prevalence of hyponatremia were found to be significantly correlated ($p = 0.003$), suggesting a potential link between serum sodium levels and the severity of heart failure. Only 16.2% of patients in Killip Class I were hyponatremic in our study; in contrast, the incidence rose sharply in Class II and Class III, reaching 54.5% and 33.3%, respectively. Remarkably, there were no documented cases of hyponatremia among Class IV patients. These findings suggest that advanced heart failure and poor clinical state are more frequently associated with hyponatremia. This trend suggests that hyponatremia may be a useful predictor of disease severity in patients with acute myocardial infarction, which is in line with the findings of Sanket and Sharanabasavaraj.[11]

Prognostic value

Patients with hyponatremia in the study had significantly longer hospital admissions, with an average of 6.88 ± 2.1 days compared to 5.11 ± 2.18 days in the normonatremic group ($p = 0.030$). This finding strengthens the link between hyponatremia and poor clinical outcomes in acute myocardial infarction. Tada et al., confirmed a similar tendency, finding that hyponatremic patients had considerably longer hospital stays than those with normal sodium levels.[12] These findings imply that hyponatremia may represent not only the severity of the underlying illness, but also lead to higher healthcare consumption and resource burden.

Overall, these findings validate the association between hyponatremia and poor outcomes in AMI, highlighting its potential as a simple but powerful prognostic indicator.

CONCLUSION

The present study found that hyponatremia is a very prevalent electrolyte abnormality in individuals with acute myocardial infarction, involving 25% of the study group. Although not substantially linked with age, gender, or STEMI type, hyponatremia was more common in patients with lower ejection fractions. The strong association between hyponatremia and length of hospital stay ($p = 0.030$), as well as the negative correlation between Sodium levels and duration of hospital stay suggests that hyponatremia may be a useful prognostic indicator in acute myocardial infarction. Routine monitoring and early detection of hyponatremia in these individuals may aid in risk stratification and clinical management, ultimately improving outcomes.

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