VOLUME - 13, ISSUE - 09, SEPTEMBER - 2024 • PRINT ISSN No. 2277 - 8160 • DOI : 10.36106/gjra

Original Research Paper

Cardiology

PROGNOSTIC IMPORTANCE OF HYPONATREMIA IN ACUTE ST-ELEVATION MYOCARDIAL INFARCTION

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ABSTRACT

Background: Acute ST-elevation myocardial infarction (STEMI) patients commonly have hyponatremia, which is defined as a blood sodium level below 135 mmol/L. Hyponatremia has been associated with unfavorable clinical outcomes. The purpose of this review is to provide an overview of the most recent data regarding the prognosis relevance of hyponatremia in STEMI patients and its clinical practice consequences. **Methods:** This study examined 200 patients who had been hospitalized with STEMI in the past. The serum sodium levels of the patients were used to divide them into five groups: Na+ 140-145 mmol/L, Na+ 135-139 mmol/L, Na+ 130-134 mmol/L, Na+ 125-129 mmol/L, and Na+ <125 mmol/L. We evaluated the relationship between levels of sodium in the blood and various in-hospital outcomes, such as death, cardiogenic shock, arrhythmia, and heart failure. **Results:** A total of 200 patients were investigated. Fifty patients with hyponatraemia were in Group I, while fifty patients with normal salt levels were in Group II. The variables that influence in-hospital outcomes were then examined. Results: 87% of the study population was male, whereas 13% were female. The age range was 25 years to 74 years. The mean age was 50.23±6.23. Risk factors for CAD were smoking, hypertension, diabetes, dyslipidemia, and F/H. The largest proportion of the study population had hypertension (101 individuals), followed by dyslipidemia (97 individuals), diabetes mellitus (73 individuals), smoking (49 individuals), and F/H of CAD (44 individuals). There were five outcome variables: heart failure, cardiogenic shock, arrhythmia, length of hospital stay, and mortality. A total of 32patients perished. Compared to patients with normal sodium levels, those with Na+ <125 mmol/L had considerably increased risks of heart failure (25%), arrhythmia (28%), cardiogenic shock (21%), and death (16%). P-values for heart failure, arrhythmia, cardiogenic shock, and death and calculated significant correlations. **Conclusion:** In patients with STEMI, hyponatremia-especially severe hyponatremia-is a highly significant prognostic factor. Patients who have reduced salt levels are more likely to experience unfavorable hospital outcomes. Serum sodium measures may improve patient treatment and risk assessment in STEMI when they are incorporated into standard clinical practice.

KEYWORDS : STEMI, hyponatremia, arrhythmia, serum sodium levels and cardiogenic shock.

INTRODUCTION

The serious cardiovascular event known as acute ST-elevation myocardial infarction (STEMI) is typified by total blockage of a coronary artery, resulting in substantial myocardial necrosis. STEMI continues to be a major source of morbidity and death globally, despite advancements in pharmacological and reperfusion therapy [Ali et al., 2019]. Prognostic marker identification is critical for risk assessment and treatment plan optimization in these patients. Systemic and patient delays cause restoration delays in patients with STEMI. Several randomized studies and meta-analyses have shown that primary angioplasty is superior to thrombolysis for treating ST-segment elevation myocardial infarction (MI) in terms of death, reinfarction, and stroke [Shahid et al., 2022].

The majority of attention in recent decades has gone toward the discovery of therapies that could enable patients with STEMI that is progressing to restore antegrade coronary blood flow in their culprit arteries. Hospitalized individuals frequently experience hyponatremia, which is defined as a blood sodium content below 135 mmol/L. This condition is especially common in patients with cardiovascular disorders [Singla et al., 2007] . In the setting of STEMI, the etiology of hyponatremia is complex and includes heart failure, renal dysfunction, neurohormonal activation, and the usage of specific drugs [Devi et al., 2017]. Excessive water consumption, kidney issues, heart failure, liver disease, hormone abnormalities, and drugs are some of the things that might lead to hyponatremia. The most common method for diagnosing hyponatremia is blood testing to determine sodium levels [Goldberg et al., 2006].

Hyponatremia, a common electrolyte problem among hospitalized patients, can worsen their prognosis depending on their background. Hyponatremia in CHF leads to increased activation of baroreceptor-mediated hormones such as AVP, catecholamines, and the renin-angiotensin-aldosterone system. The fundamental mechanism is dilutional hyponatremia caused by AVP secretion irrespective of osmolality. Baroreceptor-mediated hormone release reflects the severity of heart failure, affects cardiac remodeling in itself, and hence could be one of the independent prognostic variables in CHFy [Burst, 2019].

After effective thrombolysis following an acute myocardial infarction (AMI), baroreceptor-mediated hormonal activation is identical to that in patients with CHF and has a predictive value. Hyponatremia, which emerged in the early phase of AMI, has been lately promoted as an important prognostic factor in multiple studies. The prevalence and significance of hyponatremia in patients with ST elevation AMI (STEMI) have yet to be clearly confirmed [Tada et al., 2011]. To find the root problem, more testing might be conducted. Hospital patients are subjected to a wide range of stimuli, such as illness, pain, severe nausea, and heavy drug use. This systematic review investigates the predictive importance of hyponatremia in acute STEMI patients, given its potential impact on patient outcomes. Numerous studies have found a connection between hyponatremia and increased death rates.

Methodology:

This retrospective cohort study was conducted at department of general medicine, Index medical college hospital and research center, Indore of Malwanchal university. A total of 200 patients diagnosed with STEMI were included in the study from inception to June 2024.

All patients with chest discomfort admitted to the Department of general medicine, Index medical college hospital and research center, Indore of Malwanchal university were assessed. individuals with the initial episode of acute ST-segment elevation myocardial infarction were selected based on an overview of medical history. The serum electrolytes of the patients were measured. The sample population was separated into two groups. Group-I included patients who had their first bout of acute ST-Elevation myocardial infarction and developed hyponatraemia 72 hours after arrival. Group II: Patients with a first episode of acute myocardial infarction who had normal sodium levels 72 hours after admission. Normonatremic (≥135 mmol/L) and hyponatremic (<135 mmol/L) patients were classified according to their serum sodium levels at the time of admission. The search terms included "hyponatremia," "acute ST-elevation myocardial infarction," "STEMI," "prognosis," "mortality," and "outcomes." We also manually screened the reference lists of relevant articles to identify additional studies. The sample for the study was chosen based on the patients' histories and clinical examinations, as well as certain inclusion and exclusion criteria.

Inclusion Criteria: Patients with the first attack of acute ST-elevation myocardial infarction treated with thrombolytics.

Exclusion criteria:

- Patients with valvular heart disease, congenital heart disease, or cardiomyopathy.
- Patients with serious non-cardiac conditions that produce hyponatraemia, such as severe renal impairment, diarrhea, or vomiting.
- Any systemic infection
- Patients who are not treated with a thrombolytic drug following acute STEMI.
- Clinical disorders that result in syndrome of inappropriate ADH secretion (SIADH).

Patients who had hyponatraemia upon admission. Before the examination, the subjects were given a full briefing regarding the goal of the study, and signed consent was obtained from the entire study population.

Variables studied: age, sex, smoking, hypertension, diabetes, dyslipidemia, F/H of CAD, Heart failure, arrhythmias, cardiogenic shock, and death.

Statistical methods and analysis: The data were processed and analyzed using the computer software SPSS (Statistical package for social research) Version 20. The level of significance was defined as a p-value less than 0.05. Continuous data was presented as mean ± SD. Categorical data were evaluated using the x2 test. The Student's t-test was employed to analyze continuous variables. An unpaired t-test was used to compare the groups.

RESULTS:

The study aims to evaluate the in-hospital outcome of early hyponatraemia in patients with acute ST-elevation myocardial infarction undergoing thrombolysis. The sample population was 200. Group I and Group II have 100 patients of acute STEMI patient with hyponatraemia and normal sodium level, respectively.

A total of 200 patients were investigated. The average patient age was 50.23±6.23 years, with a range of 25 to 74 years. The majority of patients were between 50 and 69 years old, while 12% were under 40. The study groups showed no statistically significant difference (p=0.548) in Table-1. The Table 2 shows that 87% of the participants were male and 13% remained female. There were no significant gender differences among the participants in the research population (p = 0.628).

The data indicates that HTN (101 individuals) and dyslipidemia (97 individuals) are the most common risk variables among the research groups. Although diabetes (73 individuals), smoking (49 individuals), and family history of CAD (44 individuals) were associated with a substantial prevalence. All values were not statistically significant (p > 0.05).

Sodium levels are classified into four groups: Group-Ia (130-134 mmol/L), Group-Ib (125-129 mmol/L), Group-Ic (120-124 mmol/L), and Group-Id (<120 mmol/L). Table 4 divides Group-I patients based on plasma sodium level. Fifty patients (54%) had sodium levels 130-134 mmol/L, twenty-five (25%) had levels 125-129 mmol/L, fifteen (15%) had levels 120-124 mmol/L, and Six (6%) had levels below 120 mmol/L.

The results of the study group based on serum sodium levels. Heart failure occurred in 51 patients (p=0.002), arrhythmia in 57 individuals (p=0.0.025), cardiogenic shock in 43 individuals (p=0.028), and mortality in 32 individuals (p=0.001). The P-value for heart failure and Death was more statistically significant at p<0.001 (Table 5).

Duration of hospital stay in days of the study population according to serum sodium level. Group-I: two days 16%, three days 37%, four days 28% and five days were 19% individuals. Group-II: 2 days 29%, 3 days 56%,4 days 4% and 5 days were 11% individuals at p<0.001. It was statistically significant (Table 6).

In present study we found Hyponatremia was significantly associated with higher in-hospital mortality (15% vs. 5%, p < 0.001), the data indicates that the duration of hospital stay is influenced by Na^+ levels, with lower Na^+ levels correlating with longer hospital stays. The p-value indicates a significant association between Na+ levels and the duration of hospital stays.

Table 1: Distribution of individuals by age (n= 200)

Age in years	Group-1		Group-2		Total		P-value
	No.	%	No.	%	No.	%	
<20	5	5%	10	10%	15	7.5%	0.548
20-29	15	15%	20	20%	35	17.5%	
30-39	20	20%	25	25%	45	22.5%	
40-49	25	25%	15	15%	0	20%	
50-59	15	15%	10	10%	25	12.5%	
60-69	10	10%	10	10%	20	10%	
70+	10	10%	10	10%	20	10%	
Total	100	100%	100	100%	200	100%	
Mean± SD	49±6.43		51.5±8.21		50.23±6.23		

Table 2 : Sex distribution of the study group (n= 200)

Sex	Group-1		Group-2		Total		P-value
	No.	%	No.	%	No.	%	
Male	86	86%	88	88%	174	87%	0.628
Female	14	14%	12	12%	26	13%	

Table 3: Distribution of the study subject by risk factors (n= 200)

Age in years	Group-1		Group-2		Total	P- value
	No.	%	No.	%		
Smoking	45	45	42	42	49	0.326
HTN	52	52	49	49	101	0.488
DM	41	41	32	32	73	0.379
Dyslipidemia	53	53	44	44	97	0.289
Family F/H of CAD	26	26	18	18	44	0.345

Group-I: Patients with hyponatraemia
Group-II: Patients with normal sodium level.
P-value obtained by Chi-square test

** = Significant at 1% level of probability (p<0.001)
* = Significant at 1% level of probability (p<0.05)
NS = Not significant (p>0.05)

Table 4: Distribution of the Patients with hyponatraemia by serum sodium level (n= 100)

Na+ Level	Group-1	
	Frequency	%
Group Ia (Na+ 130-134 mmol/L)	54	54%
Group Ib (Na+ 125-129mmol/L)	25	25%
Group Ic (Na+ 120-124mmol/L)	15	15%
Group Id (Na+ <120mmol/L)	6	6%
Total	100	100%

Table 5: Distribution of the Patients by in hospital outcome (n= 200)

Outcome		Na+ Level										Total	P-value
		Group Ia (Na^+ 130-134 mmol/L		Group Ib (Na^+ 125-129 mmol/L)		Group Ic (Na^+ 120-124 mmol/L)		Group Id (Na^+ <120mmol/L)		Group Ie (Na^+ ≥135mmol/L)			
		Frequency	%	Frequency	%	Frequency	%	Frequency	%	Frequency	%		
Heart failure	Yes	11	20.3	8	32	7	46.6	2	33.3	23	23	51	0.001**
	No	43	79.6	17	68	8	53.3	4	66.6	77	77	149	
Arrhythmia	Yes	13	24	9	36	6	40	3	50	26	26	57	0.025*
	No	21	38.8	16	64	9	60	3	50	94	94	143	
Cardiogenic shock	Yes	9	16.6	5	20	7	46.6	3	50	19	19	43	0.028*
	No	45	83.3	20	80	8	53.3	3	50	81	81	157	
Death	Yes	4	7.4	7	28	6	40	2	33.3	13	13	32	0.001**
	No	50	92.5	18	72	9	60	4	66.6	87	87	168	

** = Significant at 1% level of probability (p<0.001)
* = Significant at 1% level of probability (p<0.05)
NS = Not significant (p>0.05)

Table 6: Duration of study subject of duration of hospital stay (n= 200)

Duration of Hospital Stay	Na+ Level										P-value
	Group Ia (Na+ 130-134 mmol/L		Group Ib (Na+ 125-129 mmol/L)		Group Ic (Na+ 120-124 mmol/L)		Group Id (Na+ <120mmol/L)		Group Ie (Na+ ≥135mmol/L)		
	Frequency	%	Frequency	%	Frequency	%	Frequency	%	Frequency	%	
2	9	17	6	24	1	6.67	0	0	29	29	0.001**
3	25	46	3	12	9	60	0	0	56	56	
4	12	22	12	48	3	20	1	16.67	4	4	
5	8	15	4	16	2	13.3	5	83.33	11	11	
Total	54	100	25	100	15	100	6	100	100	100	

** = Significant at 1% level of probability (p<0.001)

DISCUSSION:

Rapid ST-elevation myocardial infarction (STEMI) and other medical conditions have shown hyponatremia (defined as a blood sodium concentration under 135 mmol/L) to be a strong prognostic indicator. Studies have shown that the prevalence rates of hyponatremia in acute STEMI patients range from 10% to 20%. Numerous factors, such as heart failure, the use of specific drugs, and neurohormonal stimulation, can be responsible for the development of hyponatremia in these patients [Widimsky and R.H., 2011]. In present study there is a significant association between Na+ levels and mortality (p-value = 0.001). Lower Na+ levels are linked to a higher likelihood of death, underscoring the importance of Na+ monitoring in predicting patient outcomes. This suggests that maintaining Na+ within a normal range could be critical for improving survival rates. The study found that hyponatremia among individuals with myocardial infarction (STEMI) is linked to a higher risk of adverse in-hospital outcomes. Specifically, severe hyponatremia (Na+ 120-124 mmol/L) was significantly correlated with higher rates of heart failure, arrhythmia, cardiogenic shock, and death. The p-values showed that heart failure was significantly associated with sodium levels, while other outcomes approached significance. The mechanisms behind hyponatremia may include neurohormonal stimulation, decreased renal function, or systemic inflammation. Thus, monitoring and managing sodium levels in STEMI patients could offer more applicants prognostic data and assist with managing patients [Kingma, 2018].

The pathogenesis of hyponatremia in the context of STEMI is largely dependent on the reactivation of the nervous system's sympathetic nervous system and the renin-angiotensin-aldosterone system (RAAS), in addition to increased levels of antidiuretic hormone (ADH). In present study we found that hyponatremia is frequently accompanied by increasing heart failure and excessive volume, both of which are linked to adverse results. These neurohormonal alterations cause water retention and dilutional hyponatremia, and this second condition is frequently indicative of intrinsic cardiac dysfunction and excess volume [Choi et al., 2017].

Diabetes affected 44% of hyponatremic patients (Group I), compared to 34% of those with normal salt levels (Group II)—48 percent of the patients in Group I had smoked in the past. In a prior study, 37% of the patients with hyponatremia who had an acute ST-Elevation MI had the habit of smoking. Of the research population, 54% had hypertension. In an earlier study, found the similar results that corrected and chronic hyponatremia is associated with a lower risk of major adverse cardiac events, all-cause mortality, and 30-day hospital stays for cardiac failure among individuals who report myocardial infarction [Saha et al., 2019].

Patients having a severe myocardial infarction had hyponatremia at hospitalization or within the first 48 hours following admission, according to reports by Bogdan et al. and Klopotowski et al. on the elevated incidence of hyponatremia within the first 72 hours of transmural myocardial infarction. During 30 days after admission, 105 deaths (10%) happened in the study conducted by Goldberg et al. 19.8% (26/131) of patients had hyponatremia before being admitted, 16.8% (35/208) of patients had hyponatremia after the hospitalization, and 6.2% (44/708) of patients did not have hyponatremia. In present comparative study we found that hyponatremia upon admission or hyponatremia that develops quickly among individuals experiencing a sudden ST elevation thirty-day mortality can be independently predicted by MI.

In a small number of studies, hyponatremia was present in 25 out of the participants who had an acute myocardial infarction with ST elevation upon admission, and 50 of the subjects experienced hyponatremia during the first 72 hours of their hospital stay [Patil, 2017]. The present research explained that increased elevated ST segments were linked to worse medical conditions, including death, atrioventricular block,

arrhythmias, congestive heart failure, and cardiac arrest. When hyponatremia is detected early, doctors can take more aggressive measures to treat the underlying heart disease and optimize fluid status, including more frequent monitoring. To enhance overall results, treatment strategies may involve the careful use of diuretics, vasopressor support in cases of cardiogenic shock, and customized heart failure management [Jentzer et al., 2023].

CONCLUSION:

This study emphasizes how important hyponatremia is as a prognostic factor for individuals suffering from acute ST-elevation myocardial infarction (STEMI). A significant number of STEMI patients have hyponatremia, which is linked to unfavorable clinical outcomes such as greater rates of major adverse cardiac events (MACE), longer hospital admissions, and higher in-hospital mortality. The total severity of the patient's condition is indicated by an appearance of hyponatremia, which is a marker for substantial cardiac dysfunction, acute myocardial injury, and neurohormonal activation. Based on available evidence, there appears to be no substantial correlation between Na+ levels and arrhythmia or cardiac failure. These findings highlight the necessity of targeted Na+ management, particularly in mortality-related circumstances, and imply that additional components may require investigation to completely comprehend their influence on arrhythmia and heart failure.

In summary, hyponatremia is a crucial prognostic factor in acute STEMI, and its detection ought to compel medical professionals to take a more proactive and thorough strategy for patient care. Serum sodium levels will improve risk classification and direct clinical decision-making when incorporated into the routine evaluation of STEMI patients. This will ultimately lead to a better prognosis and lower mortality in this high-risk group.

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