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Hyponatremia in Acute Coronary Syndrome: Prevalence, Severity and Clinical Phenotype in a Tertiary-Care Cohort

Dr Panchala Siva Krishna[1], Preethi Perumalsamy[2], Vinay Prasad. C[3], Nagarajan K[4], Dr. Nirmala Devi Chandrasekaran[5]*

[1]MBBS, MD, Senior Resident, Department of Internal Medicine, Shri Sathya Sai Medical College and Research Institute, Sri Balaji Vidyapeeth Deemed University, Chengalpattu, Tamil Nadu, India
[2]MBBS, MD, Senior Resident, Department of Internal Medicine, Shri Sathya Sai Medical College and Research Institute, Sri Balaji Vidyapeeth Deemed University, Chengalpattu, Tamil Nadu, India
[3]MBBS, MD General Medicine Senior Resident, Department of Internal Medicine Shri Sathya Sai Medical College and Research Institute, Sri Balaji Vidyapeeth Deemed University, Chengalpattu, Tamil Nadu, India
[4]MBBS, MD., Professor, Department of Internal Medicine, Shri Sathya Sai Medical College and Research Institute, Sri Balaji Vidyapeeth Deemed University, Puducherry, India
[5]*Professor and HOD of General Medicine, Shri Sathya Sai medical college and research institute ,Sri Balaji Vidyapeeth deemed to be university, Chengalpattu, Phone number: 86107 54098
Corresponding Author: nirmaladevi@sssmcri.ac.in

ABSTRACT: **Background**: Hyponatremia is frequently encountered during acute coronary syndromes (ACS), but its clinical importance may be under-recognized when sodium abnormalities are mild. We characterized the burden and clinical phenotype of hyponatremia among adults presenting with ACS at a tertiary-care teaching hospital.

Methods: This cross-sectional observational study included 143 adults presenting within 12 hours of symptom onset with STEMI, NSTEMI or unstable angina. Patients with previous coronary artery disease, arrhythmia, cardiomyopathy/heart failure, or prior diuretic use were excluded. Serum sodium was measured at admission, 48 hours and discharge. Demographic characteristics, cardiovascular risk factors, presenting symptoms, ACS subtype, cardiac biomarkers, lipid profile and left ventricular ejection fraction (LVEF) were recorded.

Results: The cohort was predominantly male (94/143, 65.7%), with the largest age group being 51–60 years (42/143, 29.4%). Hypertension, diabetes and smoking were present in 56.6%, 44.8% and 38.4%, respectively. STEMI accounted for 56.6% of ACS presentations. Hyponatremia (<135 mmol/L) was present in 93/143 patients (65.0%). Mild hyponatremia (130–134 mmol/L) was most common (48.3%), followed by moderate (11.9%) and severe hyponatremia (4.9%). Mean sodium increased from 132.2±3.7 mmol/L at admission to 134.6±3.2 mmol/L at discharge. Severe LV systolic dysfunction (LVEF <40%) was present in 28.7% of the cohort.

Conclusions: Hyponatremia affected nearly two-thirds of this selected ACS cohort and was predominantly mild. The high frequency of sodium disturbance across a population with substantial cardiometabolic risk and LV dysfunction supports routine electrolyte

assessment during the initial evaluation and hospitalization of ACS patients. Prospective studies should determine whether sodium trajectories add prognostic information beyond established clinical risk scores.

1. INTRODUCTION

Acute coronary syndrome encompasses a spectrum of acute myocardial ischemic presentations, principally ST-elevation myocardial infarction (STEMI), non-ST-elevation myocardial infarction (NSTEMI), and unstable angina. Contemporary ACS care emphasizes rapid diagnosis, risk stratification and treatment of both the ischemic event and its systemic consequences. [1,2] Electrolyte abnormalities are clinically relevant in this setting because they may reflect neurohormonal activation, altered renal handling of water and sodium, hemodynamic compromise, concomitant metabolic disease, or treatment-related effects.

Hyponatremia, generally defined as a serum sodium concentration below 135 mmol/L, has repeatedly been associated with adverse cardiovascular outcomes. Early studies in acute myocardial infarction reported associations between low sodium concentrations and mortality, heart failure and more severe clinical presentations. [3–6] A systematic review and meta-analysis subsequently found that hyponatremia was associated with increased short- and long-term mortality after ACS, supporting the concept that serum sodium may function as a readily available marker of illness severity.[7]

Despite this evidence, the reported prevalence of hyponatremia varies according to the definition used, timing of measurement and characteristics of the study population. Indian tertiary-care populations may also differ from Western cohorts in the distribution of diabetes, hypertension, smoking, delayed presentation and ACS subtype. The present study therefore sought to quantify the burden and severity of hyponatremia and describe the clinical phenotype of patients presenting with ACS in a tertiary-care hospital.

The primary objective was to assess the proportion of ACS patients with serum sodium <135 mmol/L. Secondary objectives were to describe sodium severity categories and characterize associated demographic, cardiovascular, biochemical and echocardiographic features.

2. MATERIALS AND METHODS

2.1 Study design and setting

This was a cross-sectional observational study conducted over 18 months in the Department of General Medicine, Shri Sathya Sai Medical College and Research Institute, Ammapettai, Chengalpattu District, Tamil Nadu, a tertiary-care teaching hospital. The dissertation reports Institutional Ethics Committee approval, written informed consent and anonymized research data. [Source dissertation]

2.2 Participants and sample size

The planned sample size was 143, calculated using an expected hyponatremia prevalence of 29.4%, 8% absolute precision and a 10% allowance for non-response. Adults presenting within 12 hours of symptom onset with ECG evidence of STEMI, NSTEMI or unstable angina and willing to provide informed consent were eligible. Patients with previous coronary artery disease, previous arrhythmia, cardiomyopathy or heart failure, or prior diuretic therapy were excluded.

2.3 Data collection

A structured proforma captured demographic characteristics, presenting symptoms, medical history, smoking status, examination findings and laboratory investigations. Serum sodium and potassium, lipid profile, cardiac biomarkers (troponin I/T and CK-MB), ECG findings and 2-dimensional echocardiography with LVEF were recorded. Serum sodium was assessed at admission, 48 hours and discharge. Hyponatremia was defined as sodium <135 mmol/L and categorized as mild (130–134), moderate (125–129) or severe (<125 mmol/L), consistent with the study protocol.

2.4 Statistical analysis

Data were entered in Microsoft Excel and analyzed using SPSS version 23. Continuous variables were summarized as mean±standard deviation and categorical variables as counts and percentages. Chi-square and t-tests were used as appropriate,

with a two-sided significance threshold of $p<0.05$ and 95% confidence intervals. Because the present manuscript focuses on prevalence and phenotype, no causal inference is made from the cross-sectional associations.

3. RESULTS

3.1 Demographic profile

A total of 143 participants were analyzed. Men constituted 65.7% of the cohort and women 34.3%. The largest age category was 51–60 years (29.4%), followed by 61–70 years (25.2%).

Age group	Male	Female	Total	%
≤40	11	3	14	9.8
41–50	25	8	33	23.1
51–60	28	14	42	29.4
61–70	21	15	36	25.2
>70	9	9	18	12.6
Total	94	49	143	100

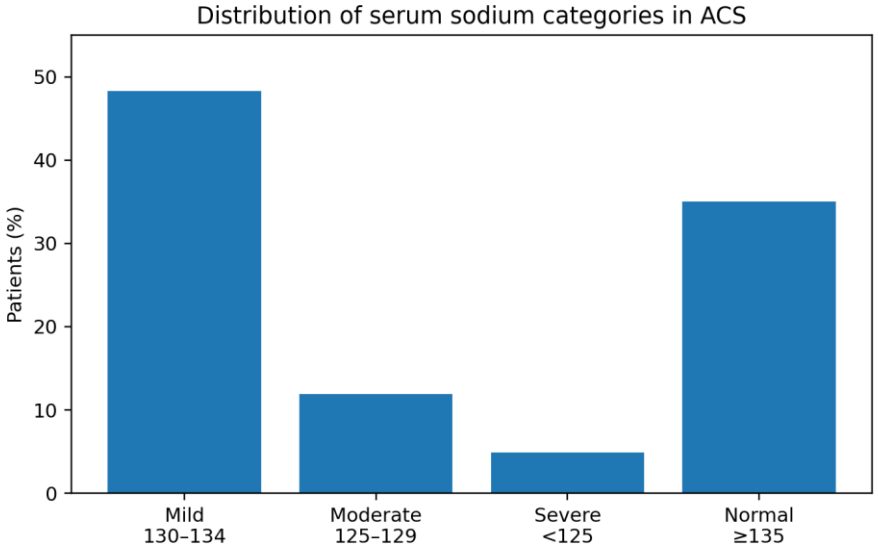


Figure 1. Severity distribution of serum sodium abnormalities in the study cohort.

3.2 Cardiovascular risk profile

Hypertension was the most frequent recorded risk factor, followed by diabetes mellitus and smoking.

Risk factor	Present (n)	Absent (n)	Present (%)
Hypertension	81	62	56.6
Diabetes mellitus	64	79	44.8
Smoking	55	88	38.4

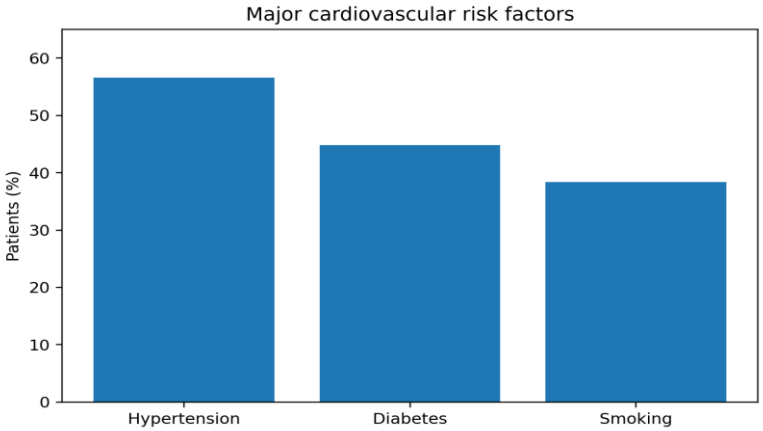


Figure 2. Major cardiovascular risk factors among ACS participants.

3.3 Presenting clinical features

Presenting symptom	N	%
Chest pain	131	91.6
Sweating	86	60.1
Dyspnea	39	27.3
Nausea/vomiting	22	15.4
Palpitations	14	9.8
Syncope	8	5.6

Chest pain was reported by 91.6% of participants. Sweating and dyspnea were the next most frequent symptoms. Less frequent presentations included syncope, palpitations and nausea/vomiting.

3.4 Lipid profile and ACS phenotype

Lipid parameter	Mean ± SD (mg/dL)	Reference
Total cholesterol	189.2 ± 32.1	<200
LDL-C	124.3 ± 28.6	<100
HDL-C	39.5 ± 9.2	>40
Triglycerides	172.6 ± 46.7	<150
ACS subtype	**N**	**%**
STEMI	81	56.6
NSTEMI	38	26.6
Unstable angina	24	16.8

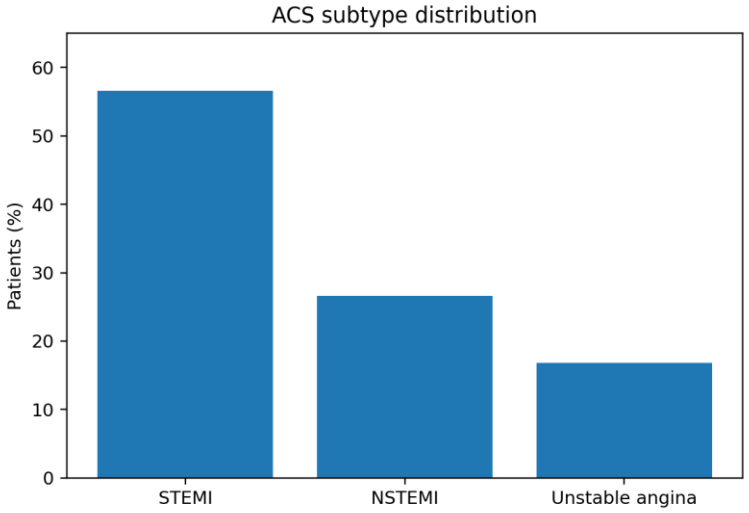


Figure 3. Distribution of STEMI, NSTEMI and unstable angina.

3.5 Cardiac biomarkers and ventricular function

Variable	Positive/Category n	%
Troponin I	102	71.3
CK-MB	86	60.1
LVEF <40%	41	28.7
LVEF 40–54%	58	40.6
LVEF ≥55%	44	30.8

3.6 Sodium profile

Time point	Mean sodium ± SD (mmol/L)	
Admission	132.2 ± 3.7	
48 hours	133.9 ± 3.4	
Discharge	134.6 ± 3.2	
Sodium category	**N**	**%**
Mild, 130–134	69	48.3
Moderate, 125–129	17	11.9
Severe, <125	7	4.9
Normonatremia, ≥135	50	35.0

Hyponatremia was present in 93 of 143 participants (65.0%), while 50 (35.0%) were normonatremic. Mild hyponatremia represented the largest subgroup.

4. DISCUSSION

The principal finding of this study was the high burden of hyponatremia among patients presenting with ACS: 65% had sodium

<135 mmol/L at the study assessment. This proportion is higher than that reported in several earlier myocardial infarction cohorts, where prevalence depended strongly on whether admission, nadir or later sodium values were used.[3–8] The difference should not be interpreted as evidence of a higher population prevalence without accounting for the study's inclusion criteria, timing of sampling and tertiary-care case mix.

The predominance of mild hyponatremia is clinically relevant. Nearly half of the cohort had sodium 130–134 mmol/L, while moderate and severe categories were less common. Low sodium in ACS may represent a composite signal of neurohormonal activation, altered free-water handling and hemodynamic stress rather than an isolated electrolyte problem. Prior studies have linked early hyponatremia with higher Killip class, heart failure and mortality, supporting the use of sodium as a marker of overall physiological stress.[3–6]

The cohort also showed a substantial burden of conventional cardiovascular risk factors: hypertension was present in 56.6%, diabetes in 44.8% and smoking in 38.4%. STEMI represented 56.6% of presentations and almost three in ten patients had LVEF <40%. These findings provide an important clinical context for interpreting the sodium burden. Hyponatremia should not be considered in isolation; it may coexist with ventricular dysfunction and a high-risk ACS phenotype.

Mean sodium increased from 132.2 mmol/L at admission to 134.6 mmol/L at discharge. The observed trajectory is compatible with improvement during hospitalization, although the cross-sectional design and lack of treatment-level data prevent attribution of this change to any specific intervention. Importantly, contemporary literature indicates that sodium measured at different time points can carry different prognostic information, making serial measurement a potentially useful clinical strategy.[8]

5. STRENGTHS AND LIMITATIONS

Strengths include a prospectively structured clinical assessment, standardized sodium measurements at multiple time points, echocardiographic assessment and explicit exclusion of patients with prior heart failure, cardiomyopathy, arrhythmia, coronary disease and pre-admission diuretic use. Limitations include the single-centre design, modest sample size, observational cross-sectional framework, absence of long-term follow-up, and inability to establish causality. The manuscript also does not have sufficient individual-level data to construct a fully adjusted multivariable model for risk factors.

6. CONCLUSION

Hyponatremia was common in this tertiary-care ACS cohort, affecting 65% of participants, with mild hyponatremia accounting for the majority. The findings support routine serum sodium measurement as part of the initial and serial assessment of ACS. Future multicentre prospective studies should determine whether sodium trajectories improve established ACS risk prediction and whether targeted management changes outcomes.

Declarations

Ethics approval: Institutional Ethics Committee approval was reported in the dissertation. Written informed consent was obtained. Participants' data were anonymized.

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