



RESEARCH ARTICLE

Prognostic Significance of Serum Albumin at Admission in Patients with Acute Coronary Syndrome

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ABSTRACT

Background: Acute Coronary Syndrome (ACS) remains a major cause of morbidity and mortality worldwide despite advances in early diagnosis and reperfusion therapy. Accurate risk stratification at hospital admission is essential for identifying patients at increased risk of adverse clinical outcomes. Serum albumin, an inexpensive and widely available laboratory biomarker, reflects both nutritional status and systemic inflammation and has emerged as a potential predictor of cardiovascular outcomes. This study evaluated the prognostic significance of serum albumin measured at admission in patients presenting with ACS.

Aim: To determine the prognostic significance of serum albumin levels at admission in patients with Acute Coronary Syndrome.

Materials and Methods: A prospective observational study was conducted in the Department of General Medicine, Katihar Medical College, Bihar. A total of 140 consecutive patients diagnosed with ACS were enrolled. Patients were categorized according to admission serum albumin levels into hypoalbuminemia and normal albumin groups. Demographic characteristics, cardiovascular risk factors, ACS subtype, electrocardiographic findings, Killip class, left ventricular ejection fraction (LVEF), inflammatory markers, and in-hospital clinical outcomes were recorded. The primary outcome was in-hospital mortality, while secondary outcomes included heart failure, arrhythmias, cardiogenic shock, prolonged hospital stay, and major adverse cardiovascular events. Statistical analysis was performed using IBM SPSS Statistics version 26.0. Continuous variables were analysed using the independent Student's *t*-test, whereas categorical variables were compared using the Chi-square or Fisher's exact test. Logistic regression was used to identify independent predictors of adverse outcomes, and a *p*-value <0.05 was considered statistically significant.

Results: Among 140 patients, 56 (40.0%) had hypoalbuminemia and 84 (60.0%) had normal serum albumin levels. Patients with hypoalbuminemia showed significantly higher proportions of STEMI, reduced LVEF, elevated inflammatory markers, increased in-hospital complications, and higher mortality compared with patients having normal serum albumin (*p*<0.001). Admission hypoalbuminemia was strongly associated with adverse clinical outcomes and poor short-term prognosis.

Conclusion: Serum albumin measured at admission is a simple, inexpensive, and reliable prognostic biomarker in patients with Acute Coronary Syndrome. Hypoalbuminemia identifies patients at increased risk of severe myocardial injury, impaired cardiac function, and adverse in-hospital outcomes, making it valuable for early risk stratification and clinical decision-making.

Keywords: Acute Coronary Syndrome; Serum Albumin; Hypoalbuminemia; Prognostic Biomarker; ST-Elevation Myocardial Infarction; Left Ventricular Ejection Fraction; Inflammation; Risk Stratification; Cardiovascular Disease; In-Hospital Mortality.

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INTRODUCTION

Acute Coronary Syndrome (ACS) includes a range of clinical disorders such as unstable angina, non-ST-elevation myocardial infarction (NSTEMI), and ST-elevation myocardial infarction (STEMI) that are brought on by an abrupt reduction or total cessation of coronary blood flow. The main cause of these disorders is the rupture or erosion of an atherosclerotic plaque, which is followed by platelet aggregation and thrombus development. This causes myocardial ischemia and, if left untreated, permanent myocardial necrosis. ACS is one of the world's top causes of death and long-term disability despite notable advancements

in pharmaceutical therapy, coronary intervention, and secondary prevention. Optimising therapy options and increasing survival still depend on early identification of patients who are at high risk of unfavourable outcomes (1).

Clinical presentation, electrocardiographic symptoms, cardiac biomarkers like troponins, echocardiographic evaluation of left ventricular function, and established scoring systems like the GRACE and TIMI scores have historically been used in ACS risk classification. Even if these instruments offer useful prognostic data, more biomarkers that are affordable, easily accessible, and

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able to represent various pathophysiological processes that contribute to the severity of the disease are still required. As a result, cardiovascular research has become more interested in biomarkers that represent systemic inflammation and nutritional status. The most prevalent plasma protein in circulation, serum albumin is produced by the liver and serves a variety of physiological purposes, such as regulating inflammatory reactions, transporting endogenous and exogenous materials, maintaining plasma oncotic pressure, and exhibiting antioxidant activity. Hepatic albumin production falls and vascular permeability rises under acute inflammatory conditions, which lowers albumin quantities in the blood (2).

As a result, systemic inflammation and inadequate nutrition, two significant factors influencing cardiovascular prognosis, are both reflected in hypoalbuminemia. Reduced serum albumin may lead to increased oxidative stress, endothelial dysfunction, platelet activation, and faster atherosclerosis progression. Additionally, experimental evidence indicates that albumin has antithrombotic, antioxidant, and endothelium-protective qualities. Low blood albumin levels have been linked to more severe coronary artery disease, heart failure, reduced left ventricular function, cardiogenic shock, longer hospital

stays, and higher mortality in ACS patients, according to a number of observational studies. Furthermore, nutritional evaluation scores that include serum albumin, like the Controlling Nutritional Status (CONUT) score, Geriatric Nutritional Risk Index (GNRI), and Prognostic Nutritional Index (PNI), have demonstrated substantial prognostic usefulness in cardiovascular disease (3).

However, routine serum albumin measurement is still underutilised in the initial evaluation of patients who arrive with ACS, especially in healthcare settings with limited resources where advanced biomarkers might not always be available. The prevalence of coronary artery disease is still rising quickly in India as a result of the country's ageing population, urbanisation, diabetes, high blood pressure, obesity, tobacco use, and sedentary lifestyles. Additionally, a lot of people arrive to medical facilities late with advanced illness, which highlights the need for easy-to-use, reasonably priced biomarkers that can identify those who are most at risk. Serum albumin estimation is frequently available in most hospitals, doesn't require specialised equipment, and may offer more predictive information than traditional cardiovascular risk assessment (4).

In order to assess the predictive importance of serum albumin obtained upon admission in patients with Acute Coronary Syndrome, the current prospective observational study was conducted at Katihar Medical College. In order to evaluate its utility as an accessible biomarker for early risk stratification and prognostic evaluation in routine clinical practice, the study sought to ascertain its association with disease severity, inflammatory status, left ventricular function, in-hospital complications, and mortality (5).

Aim

To determine the prognostic significance of serum albumin levels at admission in patients presenting with Acute Coronary Syndrome.

OBJECTIVES

Primary Objective

To evaluate the prognostic utility of admission serum albumin levels in predicting in-hospital clinical outcomes among patients with Acute Coronary Syndrome.

Secondary Objectives

- To determine the prevalence of hypoalbuminemia among patients with Acute Coronary Syndrome at admission.
- To evaluate the association between serum albumin levels and different ACS subtypes (STEMI, NSTEMI,

and unstable angina).

- To assess the relationship between serum albumin levels and electrocardiographic findings, Killip class, and left ventricular ejection fraction.
- To correlate serum albumin levels with inflammatory markers, particularly C-reactive protein.
- To compare the incidence of in-hospital complications, including heart failure, arrhythmias, cardiogenic shock, and mortality, between patients with normal serum albumin and those with hypoalbuminemia.
- To evaluate whether admission serum albumin is an independent predictor of adverse clinical outcomes in Acute Coronary Syndrome.

MATERIALS AND METHODS

Study Design: Prospective observational study.

Study Setting: Department of General Medicine, Katihar Medical College and Hospital, Katihar, Bihar, India.

Study Duration: The study was conducted prospectively during the period specified in the approved institutional research protocol.

Study Population: Adult patients admitted with a diagnosis of Acute Coronary Syndrome.

Sample Size: A total of 140 patients with Acute Coronary Syndrome were included.

Sampling Method: Consecutive sampling of all eligible patients fulfilling the inclusion criteria.

Inclusion Criteria

- Age ≥ 18 years.
- Patients diagnosed with STEMI, NSTEMI, or unstable angina based on clinical presentation, ECG findings, and cardiac biomarkers.
- Serum albumin measured within 24 hours of hospital admission.
- Written informed consent obtained.

Exclusion Criteria

- Chronic liver disease or hepatic failure.
- Nephrotic syndrome.
- Active malignancy.
- Severe protein-losing enteropathy.
- Acute or chronic inflammatory disorders unrelated to ACS.
- Patients receiving albumin supplementation before admission.
- Refusal to provide informed consent.

Study Procedure

Following admission, demographic characteristics,

cardiovascular risk factors, clinical presentation, ECG findings, Killip class, echocardiographic assessment of LVEF, laboratory investigations including serum albumin, CRP, complete blood count, lipid profile, renal function tests, and cardiac biomarkers were recorded. Patients were categorized into hypoalbuminemia and normal albumin groups according to admission serum albumin values. They were followed throughout hospitalization for the occurrence of heart failure, cardiogenic shock, arrhythmias, prolonged hospitalization, and in-hospital mortality.

OUTCOME MEASURES

Primary Outcome

- In-hospital mortality.

Secondary Outcomes

- ACS subtype.
- Killip class.
- Left ventricular ejection fraction.
- Heart failure.
- Cardiogenic shock.
- Arrhythmias.
- Length of hospital stay.
- Major adverse cardiovascular events.

Statistical Analysis

All collected data were compiled and entered into Microsoft Excel and analyzed using SPSS software. Continuous variables were expressed as mean with standard deviation and categorical variables as frequency and percentage. Association between serum albumin levels and clinical outcomes was assessed using chi square test and independent t test, with p value less than 0.05 considered statistically significant.

RESULTS

Table 1: Distribution of age

Age Group (years)	No. of Patients (n)	Percentage (%)
18 to 29	1	0.7
30 to 39	13	9.3
40 to 49	27	19.3
50 to 59	51	36.4
60 to 69	34	24.3
70 to 90	14	10.0
Total	140	100.0

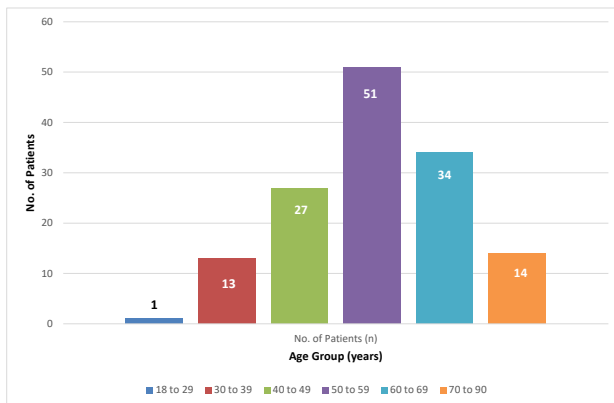


Figure 1: Distribution of Age

Table 2: Distribution of gender

Gender	No. of Patients (n)	Percentage (%)
Male	78	55.7
Female	62	44.3
Total	140	100.0

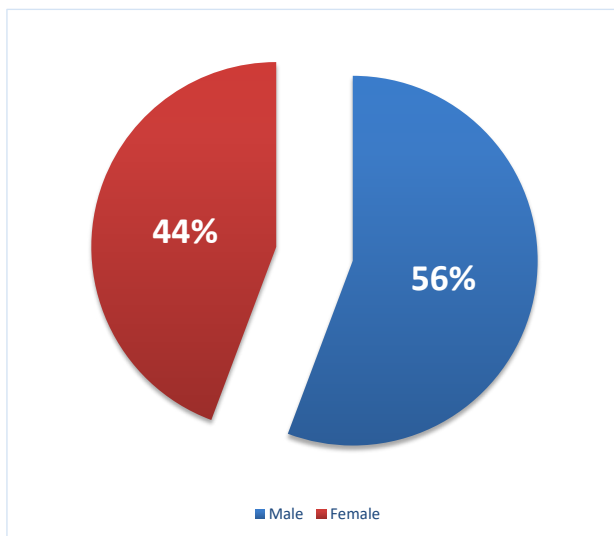


Figure 2: Distribution of gender

Table 3: Distribution of History of Co Morbidity

Co-morbidity	Category	No. of Patients (n)	Percentage (%)
Overall Co morbidity	No	31	22.1
	Yes	109	77.9
Hypertension	No	88	62.9
	Yes	52	37.1
Diabetes Mellitus	No	106	75.7
	Yes	34	24.3
Smoking	No	94	67.1
	Yes	46	32.9
Dyslipidemia	No	86	61.4
	Yes	54	38.6
Total		140	100.0

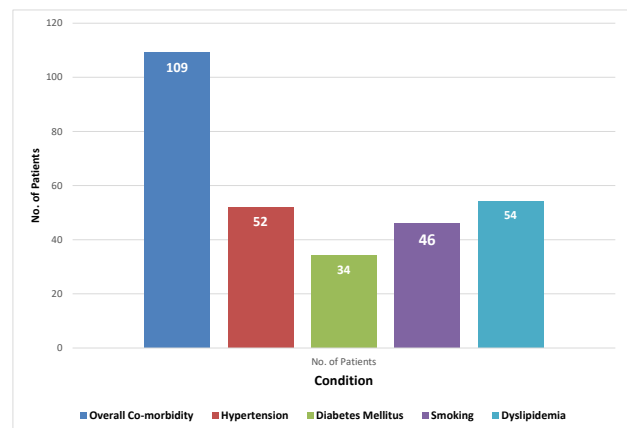


Figure 3: Distribution of history of co-morbidity

DISCUSSION

The predictive importance of serum albumin measured upon hospital admission in patients with Acute Coronary Syndrome (ACS) was assessed in the current prospective observational study. The results show that decreased blood albumin levels were substantially linked to worse in-hospital outcomes, higher inflammatory burden, worsened

Table 4: Distribution of ACS subtype

ACS Subtype	No. of Patients (n)	Percentage (%)
STEMI	85	60.7
NSTEMI	38	27.1
Unstable Angina	17	12.1
Total	140	100.0

Table 5: Distribution of ECG finding group

ECG Finding Group	No. of Patients (n)	Percentage (%)
ST elevation predominant	85	60.7
ST depression or T inversion	38	27.1
Non-specific or normal	17	12.1
Total	140	100.0

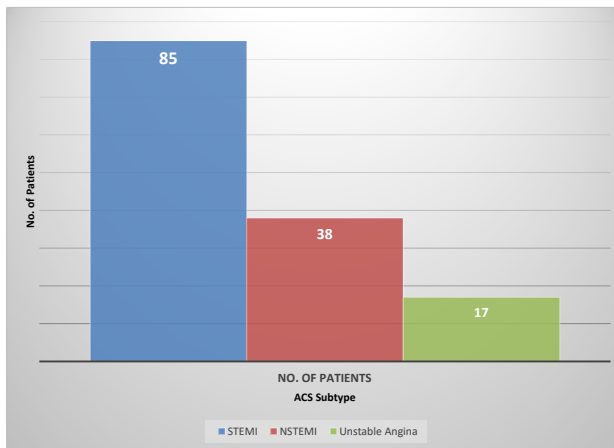


Figure 4: Distribution of ACS subtype

Table 7: Distribution of LVEF percent

LVEF Class Interval (%)	No. of Patients (n)	Percentage (%)
25 to 34	1	0.7
35 to 44	30	21.4
45 to 54	67	47.9
55 to 64	36	25.7
65 to 70	6	4.3
Total	140	100.0

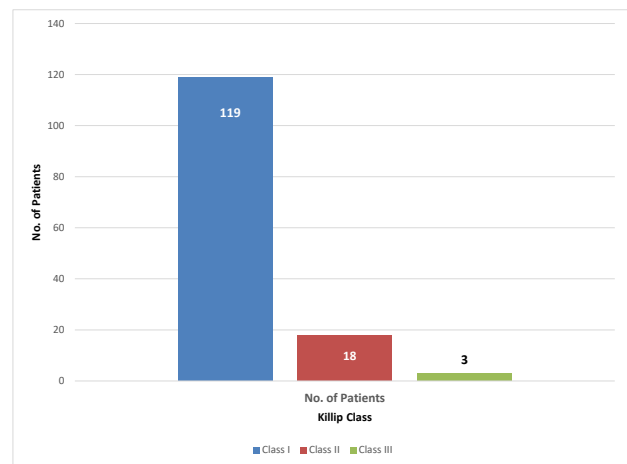


Figure 6: Distribution of ECG killip class

Table 6: Distribution of ECG killip class

Killip Class	No. of Patients (n)	Percentage (%)
I	119	85.0
II	18	12.9
III	3	2.1
Total	140	100.0

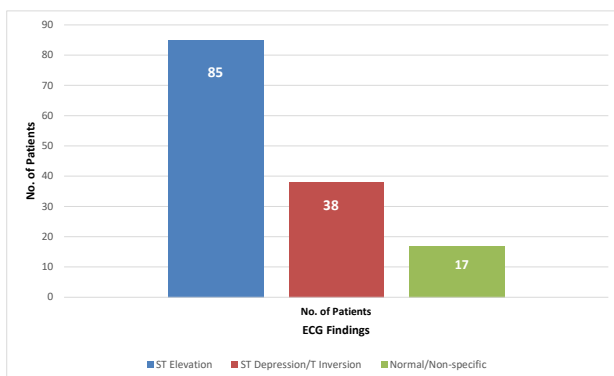


Figure 5: Distribution of ECG finding group

Table 8: Distribution of serum albumin

Serum albumin range (g/dl)	No. of patients (n)	Percentage (%)
3.0 To 3.4	12	8.6
3.5 To 3.9	98	70.0
4.0 To 4.4	30	21.4
Total	140	100.0

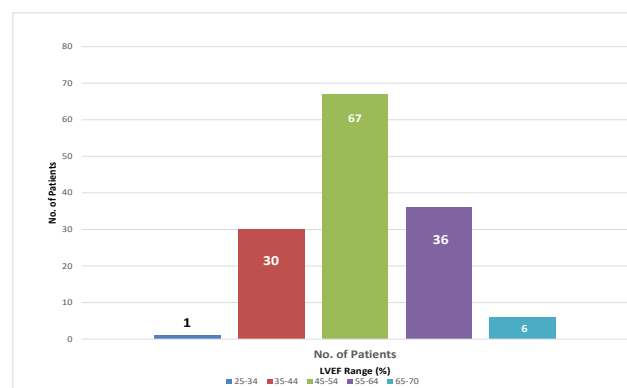


Figure 7: Distribution of LVEF percent

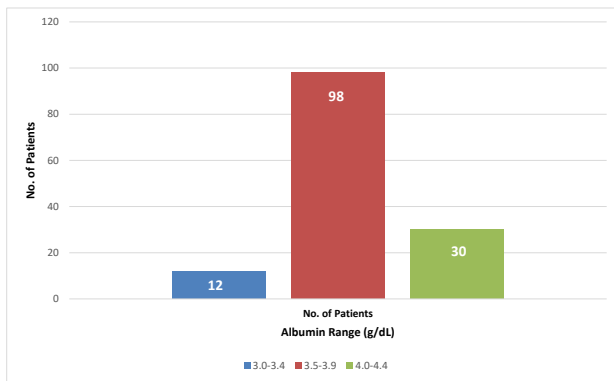


Figure 8: Distribution Of Serum Albumin

Table 9: Distribution of CRP (mg/l)

CRP Range (mg/L)	No. of Patients (n)	Percentage (%)
0 to 4.9	2	1.4
5 to 9.9	28	20.0
10 to 19.9	80	57.1
20 to 39.9	30	21.4
Total	140	100.0

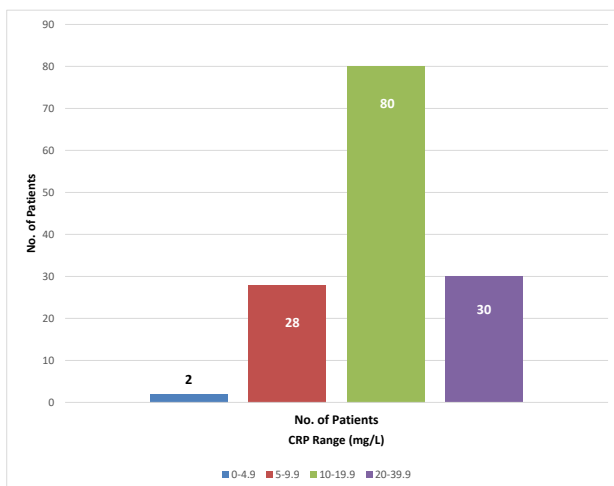


Figure 9: Distribution of CRP (Mg/L)

cardiac function, and more severe illness. The idea that serum albumin is a useful predictive biomarker that can supplement traditional risk assessment in patients with ACS is supported by our findings. The study's demographic profile showed that most patients were over 50 and that men predominated. These results align with the accepted

Table 10: Yield of the study sr. Albumen as an indicator for prognosis in acs outcome

CHI SQ. TEST	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	31.559 ^a	2	.000
Likelihood Ratio	16.734	2	.000
N of Valid Cases	140		

a. 2 cells (33.3%) have expected count less than 5. The minimum expected count is .69.

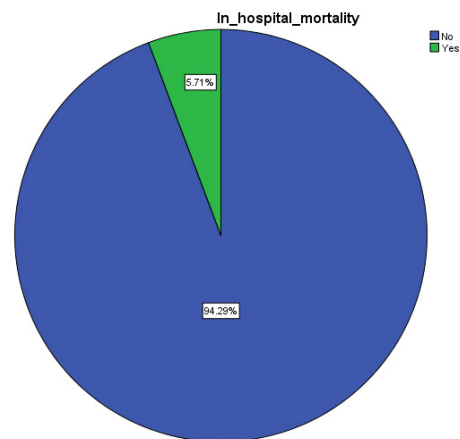


Figure 10: Yield of the study sr. Albumen as an indicator for prognosis in acs outcome

Table 11: Yield of the study sr. Albumen as an indicator for the inflammation and clinical parameters

Sr no	Yield of sr albumen	Chi. Sq test	Sig. Value
1	Inflamation	21.295 ^A	<0.05
2	Adverse clinical outcome	14.025 ^A	<0.05
3	Heart failure	7.601	<0.05
4	Cardiogenic Shock	9.085	<0.05
5	Reinfraction	4.531	>0.05

epidemiology of coronary artery disease, in which male sex and advanced age continue to be significant non-modifiable risk factors. Additionally, smoking, diabetes mellitus, dyslipidemia, and hypertension were very common among research participants, indicating the significant burden of conventional cardiovascular risk factors in the Indian community. Recent Indian ACS registries have shown similar demographic features, highlighting the ongoing role of these risk factors in coronary artery disease (6).

STEMI accounted for almost half of all admissions in the current study, making it the most common ACS

subtype. This finding is consistent with findings from developing nations, where total coronary occlusion and ST-elevation myocardial infarction are typically caused by delayed presentation and insufficient primary prevention. The majority of patients were categorised as Killip class I, which denotes early hospitalisation prior to the development of overt heart failure. However, compared to patients with normal blood albumin levels, those with hypoalbuminemia showed noticeably worse cardiac function and a more severe illness (7).

The substantial correlation between hypoalbuminemia and a lower left ventricular ejection fraction (LVEF) was one of the study's most notable conclusions. Impaired systolic function was more common in patients with lower blood albumin levels, indicating a greater infarct size and more severe myocardial injury. Reduced serum albumin may be linked to increased oxidative stress, endothelial dysfunction, and myocardial damage since albumin has antioxidant, anti-inflammatory, and endothelium-protective qualities. Similarly, recent systematic reviews have shown that in individuals with ACS, hypoalbuminemia is independently linked to decreased ventricular function and higher mortality (8).

Additionally, the current investigation showed a significant correlation between inflammatory condition and serum albumin. C-reactive protein (CRP) concentrations were noticeably greater in patients with reduced albumin levels, suggesting increased systemic inflammation. Because of increased vascular permeability and cytokine-mediated hepatic inhibition, albumin production declines during inflammatory conditions. Albumin is a negative acute-phase reactant. As a result, hypoalbuminemia is a sign of both increased inflammation and malnutrition, both of which have a negative impact on cardiovascular outcomes. These results corroborate earlier research that found serum albumin to be an integrated indicator of inflammatory and nutritional state in cardiovascular disease (9).

The much greater prevalence of unfavourable clinical outcomes among patients with hypoalbuminemia was another noteworthy observation. Low serum albumin was found to be significantly associated with an elevated risk of heart failure, cardiogenic shock, and other in-hospital consequences, according to chi-square analysis. The overall trend indicated worse outcomes for patients with lower albumin levels, even though reinfarction did not reach statistical significance. Because hypoalbuminemia increases the risk of severe cardiovascular events by promoting endothelial dysfunction, platelet activation, oxidative stress, poor tissue repair, and decreased physiological reserve,

these data are medically plausible (10).

The strong correlation between admission albumin levels and overall ACS outcomes further supported the predictive significance of serum albumin. Serum albumin estimate is a desirable biomarker for early risk stratification since it is generally accessible, affordable, and frequently carried out in clinical laboratories—especially in healthcare settings with limited resources. Serum albumin may help identify high-risk patients who need more aggressive therapeutic measures and closer monitoring by being incorporated into current prognostic models (11).

The current study's prospective design, standardised evaluation of clinical and laboratory variables, and assessment of several clinically significant outcomes are among its strong points. It is important to recognise some limitations, though. The results' generalizability was limited because this was a single-center study with a small sample size. Assessment of long-term cardiovascular outcomes was not possible due to the lack of long-term follow-up following hospital release. To further validate serum albumin as an independent prognostic marker and to ascertain whether nutritional interventions targeted at correcting hypoalbuminemia can improve outcomes in patients with Acute Coronary Syndrome, future multicenter studies with larger populations and longer follow-up are necessary (12).

CONCLUSION

In patients with Acute Coronary Syndrome, the current study shows that serum albumin assessed upon hospital admission is a straightforward, affordable, and clinically beneficial predictive biomarker. Significantly higher disease severity, increased inflammatory activity, decreased left ventricular systolic function, and an increased risk of unfavourable in-hospital outcomes, such as heart failure, cardiogenic shock, and mortality, were all present in patients with hypoalbuminemia. These results suggest that serum albumin is a useful measure of overall physiological reserve and cardiovascular risk since it reflects both inflammatory and nutritional status. Incorporating serum albumin estimation into the initial evaluation of patients with ACS may improve early risk stratification and enable timely identification of high-risk individuals requiring intensive monitoring and aggressive management because it is quick, affordable, and routinely available. To validate these results and establish serum albumin as a standard component of prognostic evaluation in Acute Coronary Syndrome, larger multicenter prospective trials with longer follow-up are advised.

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