Journal of
Cardio - Thoracic Medicine

http://jctm.mums.ac.ir

Utility of Serum Urea-to-Albumin Ratio in Predicting Length of Stay in Patients with Myocardial Infarction: A Retrospective Cohort Study

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ARTICLEINFO

Article type:
Original Article

Article history:
Received: 05 July 2025
Accepted: 29 July 2025

Keywords:
Length of Stay
Myocardial Infarction
Prognostic Marker
Risk Stratification
Serum Urea-to-Albumin Ratio

ABSTRACT

Introduction: This study aimed to assess the effectiveness of the Serum Urea-to-Albumin Ratio (UAR) as a predictor of prolonged Length of Stay (LOS) in patients admitted with Myocardial Infarction (MI).

Materials and Methods: This retrospective study analyzed data from 195 patients admitted with MI. LOS was recorded and categorized as Short Stay (≤6 days) or long stay (>6 days). Statistical analyses included comparative tests, correlation, linear and binary logistic regression, and Receiver Operating Characteristic (ROC) curve analysis. A p-value of <0.05 was considered statistically significant.

Results: The mean age of patients was 51 years, with 67.7% being male. UAR was significantly higher in the long stay group (median 7) compared to the short stay group (median 5.4) (p<0.001). Spearman correlation showed a significant positive correlation between UAR and LOS (r=0.37, p<0.001). In binary logistic regression, UAR was a significant predictor of long stay (OR 1.2077, 95% CI 1.0947-1.3323, p<0.001). ROC analysis for UAR predicting long stay yielded an Area Under the Curve (AUC) of 0.6648, with an optimal cut-off of 6.4848 (Sensitivity 55.10%, Specificity 72.16%).

Conclusions: The Serum UAR demonstrates a significant association with LOS in MI patients and can be a useful, easily calculated adjunct tool for early risk stratification of MI patients for prolonged LOS.

► *Niranjan, K., Sujatha Rani, A. Utility of Serum Urea-to-Albumin Ratio in Predicting Length of Stay in Patients with Myocardial Infarction: A Retrospective Cohort Study. J Cardiothorac Med. 2025; 13(3): 1571-1577.* ***Doi : 10.22038/jctm.2025.89313.1494***

Introduction

Myocardial infarction (MI) remains a leading cause of morbidity and mortality worldwide. The length of hospital stay (LOS) following an MI is a critical outcome measure, reflecting the patient's clinical course and the burden on healthcare resources (1). Critically ill patients in the ICU necessitate careful attention. Therefore, the early identification of patients at risk for prolonged LOS is paramount for optimizing patient management, resource allocation, and implementing targeted intervention (2).

Various clinical and biochemical markers have been investigated for their prognostic value in MI patients (3,4). In the specific scenario of acute myocardial infarction

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(AMI), the kidney's response to hemodynamic shifts and neurohormonal activation can lead to decreased renal urea excretion. This phenomenon results in an elevated blood urea nitrogen (BUN) level that does not solely stem from a reduction in the glomerular filtration rate (5). Serum albumin the primary protein in human plasma and the most abundant in the extracellular compartment, plays vital physiological roles, including maintaining osmotic pressure and acting as a ligand for numerous compounds, also influencing drug pharmacokinetics. Importantly, low serum albumin (hypoalbuminemia) is linked to adverse clinical outcomes across various conditions such as cancer, heart failure, stroke, and stable coronary artery disease. In acute coronary syndromes (ACS), specifically, hypoalbuminemia is associated with increased coronary lesion severity, no-reflow, elevated in-hospital and long-term mortality, and a higher risk of heart failure development (6).

The Serum Urea-to-Albumin Ratio (UAR) is a calculated index that aims to provide a composite measure of these physiological states. Given that both elevated urea and low albumin are individually associated with poorer outcomes in MI, their ratio may identify patients with greater physiological stress or vulnerability (7). This study aims to investigate the association between UAR at admission and LOS in patients with MI, seeking to determine if it can serve as an independent predictor of prolonged LOS.

Materials and Methods

Study Design and population

This retrospective analysis was conducted on a cohort of 195 patients admitted with a diagnosis of Myocardial Infarction. Patients were categorized based on their Length of Stay (LOS): Short Stay (LOS ≤6 days, n=97) and Long Stay (LOS >6 days, n=98). All adult patients (age > 18 years) with a confirmed diagnosis of acute Myocardial Infarction based on clinical symptoms and ECG findings were included. Patients with pre-existing renal disease, chronic liver failure, thyroid abnormalities, previous cases of MI, active malignancy, or those with incomplete admission data for serum urea or serum albumin were excluded from the analysis.

Data Collection

Data for each patient included demographic variables (Age, Gender); clinical variables (Diabetes Mellitus, Hypertension, MI Severity status); and laboratory parameters (Serum Urea (mg/dL), Serum Albumin (g/dL)). The Serum UAR was calculated from these values. The primary outcome was LOS in days, analyzed as both a continuous and categorical variable.

Statistical Analysis

The Shapiro-Wilk test was used to assess normality. Continuous variables were summarized as mean ± standard deviation (SD) or median and interquartile range (IQR), while categorical variables were presented as frequencies and percentages. Group comparisons were made using Welch's t-test or the Mann-Whitney U test, and associations were assessed with the Chi-square test. Spearman correlation was used to assess the relationship between variables and LOS. Simple and multiple linear regression were used for continuous LOS, while binary logistic regression was used for categorical LOS. Receiver Operating Characteristic (ROC) curve analysis was performed to evaluate the predictive ability and determine optimal cut-off values. Statistical analyses were performed using SPSS Statistics 29.0 (IBM, Chicago, IL). The ROC curve analysis and figure generation were performed using Python (version 3.9) with the Scikit-learn and Matplotlib libraries. A p-value <0.05 was considered statistically significant for all tests.

Results

Patients in the Long Stay group were significantly older and had significantly higher median Serum Urea and UAR, and lower mean Serum Albumin compared to the Short Stay group ($p<0.05$ for all). Diabetes and higher MI severity were also significantly associated with a longer LOS ($p=0.04$ for both). Spearman correlation analysis showed a significant positive correlation between UAR and continuous LOS ($r=0.37$, $p<0.001$) in overall analysis.

Table 1. Baseline demographic and biochemical parameters.

Variables	Values
Demographics	
Age[a]	51 ± 11.55
Number of males[c]	132 (67.7%)
Number of females[c]	63 (32.3%)
Laboratory Parameters	
Urea[b]	23.54 (19.2 – 34.2)
Albumin[a]	4.06 ± 0.46
Urea-Albumin Ratio (UAR)[b]	7 (5 – 9)
Length of Stay (LOS)	6.1 (4.75 – 8.45)
Number of patients with Short LOS	97 (49.7%)
Number of patients with Longer LOS	98 (50.3%)
Comorbidities	
Number of patients with Diabetes[c]	59 (30.3%)
Number of patients without Diabetes[c]	136 (69.7%)
Number of patients with Hypertension[c]	85 (43.6%)
Number of patients without Hypertension[c]	110 (56.4%)
Severity of MI	
Mild MI[c]	102 (52.3%)
Moderate MI[c]	53 (27.2%)
Severe MI[c]	40 (20.5%)

[a]: Data are presented as mean ± standard deviation;
[b]: Data are presented as median (Interquartile Range);
[c]: Data are presented as frequency (percentage);

Table 2. Comparison of baseline demographic and biochemical parameters.

Variables	Group-1 (LOS<6) (n=97)	Group-2 (LOS >7) (n=98)	p-value
Demographics			
Age[a]	49 ± 10.79	53 ± 12.03	0.01*
Number of males[c]	68 (70.1%)	64 (65.3%)	0.473
Number of females[c]	29 (29.9%)	34 (34.7%)	
Laboratory Parameters			
Urea[b]	21.4 (21.4-29.1)	27.8 (21.4 – 36.38)	<0.001*
Albumin[a]	4.12 ± 0.46	3.98 ± 0.46	0.03*
Urea-Albumin Ratio (UAR)[b]	5.4 (4.2 – 7)	7 (5.2 – 9.8)	<0.001*
Length of Stay (LOS)	5 (4 – 6)	9 (7 – 11)	
Comorbidities			
Number of patients with Diabetes[c]	23 (23.7%)	36 (36.7%)	0.04*
Number of patients without Diabetes[c]	74 (76.3%)	62 (63.3%)	
Number of patients with Hypertension[c]	42 (43.2%)	43 (43.9%)	0.93
Number of patients without Hypertension[c]	55 (56.8%)	55 (56.1%)	
Severity of MI			
Mild MI[c]	57 (58.7%)	45 (45.9%)	0.04*
Moderate MI[c]	27 (27.8%)	26 (26.5%)	
Severe MI[c]	13 (13.5%)	27 (27.6%)	

*p-value <0.05 indicates a significant difference between the Short Stay and Long Stay groups.
[a]: Data are presented as mean ± standard deviation; p-value derived from Welch's t-test.
[b]: Data are presented as median (Interquartile Range); p-value derived from Mann-Whitney U test.
[c]: Data are presented as frequency (percentage); p-value derived from Chi-square test.

In Group-2, a significant positive correlation between UAR and continuous LOS (r=0.40, p<0.001) was found. However, in Group-1, a non-significant correlation was found between UAR and continuous LOS (r=0.09, p=0.39) Simple linear regression analysis for the entire cohort revealed that the Serum UAR was a highly significant predictor of LOS. Overall, for each one-unit increase in UAR, the LOS increased by 0.4014 days (β = 0.4014, 95% CI 0.2712–0.5315, p < 0.001). However, when stratified by subgroups, a key difference emerged. In the Short Stay group (Group-1), UAR was not a significant predictor of LOS (β = 0.0556, p = 0.2758). In contrast, within the Long Stay group (Group-2), UAR remained a strong and significant predictor, where each unit increase corresponded to a 0.2561-day increase in LOS (β = 0.2561, 95% CI 0.1026–0.4095, p < 0.001).

In the multiple linear regression model for predicting continuous LOS, UAR was excluded due to significant multicollinearity with its components. The final, stable model retained Serum Urea and Serum Albumin as significant independent predictors explaining approximately 18% of the variance in LOS (R^2=0.177, p<0.001).

Table 3. Binary linear regression analysis between variables and LOS (n=195).

Variable	Coefficient (B)	Standard Error (SE)	Wald $\chi 2$	p-value	Odds Ratio (OR)	95% Confidence Interval (CI) for OR
Age (years)	0.029	0.0128	4.95	0.02*	1.0290	1.0034 - 1.0553
Urea (mg/dL)	0.047	0.0130	13.17	<0.001*	1.0484	1.0220 - 1.0755
Albumin (g/dL)	-0.633	0.3201	3.92	0.04*	0.5307	0.2834 - 0.9938
UAR	0.189	0.0501	14.19	<0.001*	1.2077	1.0947 - 1.3323
Gender	-0.219	0.307	0.51	0.47	0.8028	0.4398 - 1.4650
Diabetes Status	0.625	0.318	3.87	0.04*	1.8682	1.0024 - 3.4816
Hypertension Status	0.024	0.289	0.0066	0.93	1.0238	0.5812 - 1.8032
MI Severity	0.438	0.187	5.56	0.01*	1.5508	1.0768 - 2.2334

*p-value < 0.05 indicates a significant predictor of LOS.

In binary logistic regression analysis for predicting categorical Long Stay, UAR emerged as a significant predictor (OR 1.2077, 95% CI 1.0947-1.3323, p<0.001). Age, Serum Urea, lower Serum Albumin, Diabetes status, and MI Severity were also significant predictors.

Table 4. ROC Analysis for predicting prolonged length of stay.

Bio-marker	Optimal cut-off	Youden's Index	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	AUC	95% CI for AUC
Age (years)	56.0	0.2322	47.96	75.26	66.2	58.8	0.593	0.50-0.67
Urea (mg/dL)	22.4	0.2506	69.39	55.67	61.2	64.3	0.655	0.57-0.73
Albumin (g/dL)	2.90	0.0103	100	1.03	50.5	100	0.414	0.34-0.49
UAR	6.48	0.2727	55.10	72.16	66.7	61.4	0.664	0.58-0.73

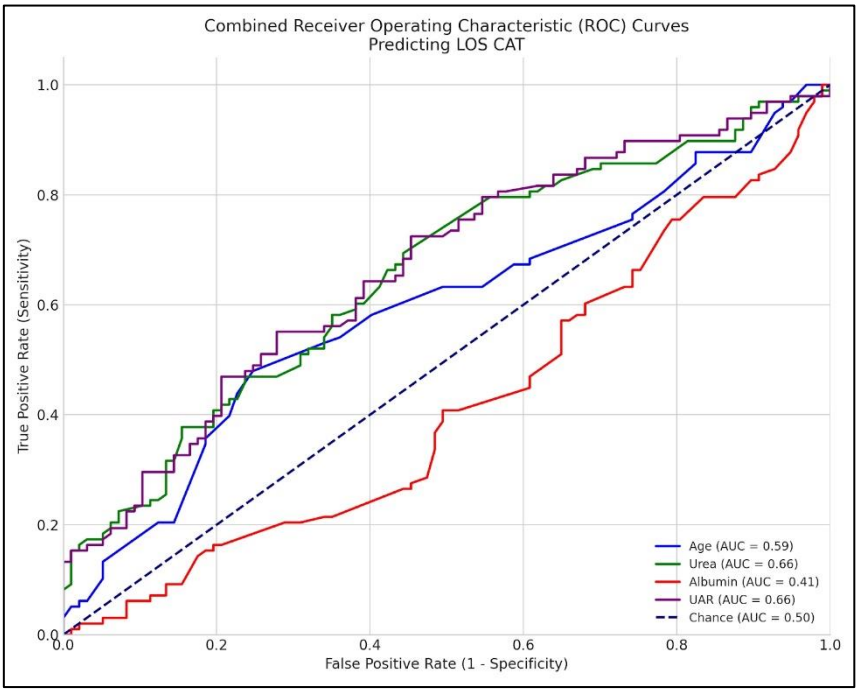

Figure 1. Comparative ROC curves for predicting prolonged LOS.

The figure 1 displays the ROC curves for Serum UAR, Serum Urea, Serum Albumin, and Age. The diagonal dashed line represents the line of no-discrimination (AUC = 0.50). The Area Under the Curve (AUC) for each variable was: UAR (0.664), Serum Urea (0.655), Age (0.593), and Serum Albumin (0.414).

Discussion

This study investigated the utility of the Serum UAR as a predictor of LOS in 195 patients hospitalized with MI. The findings indicate that UAR is significantly associated with prolonged hospitalization, with a higher UAR conferring a 21% increased odds of a long stay. Patients with long stay had a significantly higher median UAR compared to those with a short stay (7 vs 5.4, $p<0.001$). This was supported by Spearman correlation analysis, which demonstrated a significant positive correlation between UAR and continuous LOS ($r=0.37$, $p<0.001$). In simple linear regression, UAR alone accounted for 16% of the variance in LOS ($R2=0.16$). A key finding was the exclusion of UAR from the multivariate model for continuous LOS due to multicollinearity, suggesting its prognostic information is captured by its individual components in that context.

When evaluating UAR for predicting categorical long stay, binary logistic regression showed that UAR was a significant independent predictor, with each unit increase in UAR associated with approximately a 21% increased odds of having a long stay (OR 1.2077). Other factors found to be significantly associated with long stay in binary logistic regression included older age, higher serum urea, lower serum albumin, presence of diabetes, and higher MI severity. These findings are consistent with existing literature on predictors of poorer outcomes post-MI.

The ROC curve analysis for UAR yielded an AUC of 0.6648, suggesting fair discriminatory power. An optimal cut-off for UAR was identified as 6.4848, providing a specificity of 72.16% but a modest sensitivity of 55.10%. This indicates that while a high UAR is fairly specific for long stay, a low UAR does not reliably rule it out. Serum Urea demonstrated a similar AUC (0.6550), suggesting comparable individual utility in predicting categorical LOS. Our results are consistent with several published studies that evaluated UAR or the closely related Blood Urea Nitrogen-to-Albumin Ratio (BAR) as prognostic markers. A study in patients with septic shock reported that UAR independently predicted ICU mortality (OR = 1.011–1.014) with a modest AUC of 0.617, supporting the notion of UAR as a moderately effective predictor in critical illness (8). Similarly, in neurosurgical ICU patients with intracerebral hemorrhage, UAR significantly predicted in-hospital mortality with an OR of 1.9 ($p = 0.005$), indicating its robust predictive value even in neurologically critical cohorts (9). In acute

pancreatitis, the BAR (a close surrogate of UAR) showed a significant association with both short- and long-term mortality, achieving AUCs of 0.78 and 0.70 for 28-day and 360-day outcomes respectively, demonstrating a similar utility in non-renal ICU conditions (10). Likewise, in patients with coronary heart disease, increasing BAR values correlated with longer hospital stays and increased mortality risk (HR = 1.11 per SD increase), further emphasizing the prognostic potential of urea-albumin indices across diverse clinical populations (11). Taken together, these findings validate UAR as a moderately powerful but clinically useful predictor of adverse outcomes such as prolonged hospitalization, particularly in critical care and high-risk settings.

The subgroup analyses showed that UAR's correlation with LOS was stronger and significant in the long LOS group ($r=0.40$, $p<0.001$) compared to the short LOS group where it was non-significant ($r=0.09$, $p=0.39$). The finding that UAR's correlation with LOS was significant only in the long stay subgroup suggests that its prognostic utility is most pronounced in higher-risk patients. This principle, where a biomarker's influence is magnified in a more vulnerable population, has also been observed in a few studies. In a large retrospective analysis of 3,962 ICU patients with diabetic ketoacidosis, the association between BAR and in-hospital mortality was significantly stronger in patients without kidney insufficiency (HR = 2.88) compared to those with renal impairment (HR = 1.35), suggesting that BAR may carry greater prognostic value when not confounded by pre-existing renal dysfunction (12). Similarly, in a cardiac surgery cohort, elevated BAR levels predicted both prolonged ICU stay and in-hospital mortality, with subgroup analysis revealing that BAR retained prognostic significance across most strata except in those with chronic kidney disease (CKD), where its predictive utility was attenuated (13). This might imply that the imbalances reflected by UAR (e.g., higher catabolism/renal issues relative to nutritional status) become more influential in determining LOS for patients already on a trajectory for a longer, more complicated hospital stay. Ultimately, UAR acts as an integrated biomarker, with a high ratio indicating a combination of increased catabolic stress or renal dysfunction (high urea) and decreased anabolic capacity or inflammation (low albumin), reflecting overall patient vulnerability.

However, this study has limitations. The study is retrospective and relies on previously collected data. The precise timing of laboratory measurements in relation to the onset of MI symptoms was not available. The socioeconomic status and baseline nutritional state of the patient beyond the serum albumin level were not available. The data were sourced from a single cohort of 195 patients at one institution. This may limit the generalizability of our findings to other populations, healthcare systems, or geographic locations with different patient demographics and clinical practices. The definition of "long LOS" (>6 days) is specific to this study's context and was based on our cohort's median length of stay. This binary cut-off may not be applicable universally.

Conclusion

The Serum UAR demonstrates a statistically significant association with LOS in patients admitted with MI when assessed through bivariate correlations and logistic regression for predicting long stay (>6 days). It serves as a fair predictor for long stay, with an AUC of 0.6648 and an optimal cut-off of 6.4848. Patients with a UAR above this cut-off are more likely to have a prolonged hospital stay. As an easily calculated index from commonly available blood tests, UAR can still serve as a useful adjunct tool for initial risk stratification, particularly in identifying MI patients who may be at higher risk for a prolonged hospitalization. Its value may lie in its simplicity as a single metric combining aspects of metabolic stress, renal function, and nutritional/inflammatory status, especially for categorical risk assessment.

Acknowledgement

The authors would like to thank the Department of Biochemistry at Osmania Medical College, for providing the necessary support and facilities to conduct this study.

References

1. Amin AP, Spertus JA, Reid KJ, Lan X, Buchanan DM, Decker C, Masoudi FA. The prognostic

importance of worsening renal function during an acute myocardial infarction on long-term mortality. American heart journal. 2010 Dec 1;160(6):1065-71.
2. Gundpatil DB, Somani BL, Saha TK, Banerjee M. Serum urea: albumin ratio as a prognostic marker in critical patients with non-chronic kidney disease. Indian Journal of Clinical Biochemistry. 2014 Jan;29(1):97-100.
3. D'Ascenzo F, Biondi-Zoccai G, Moretti C, Bollati M, Omedè P, Sciuto F, et al. TIMI, GRACE and alternative risk scores in Acute Coronary Syndromes: a meta-analysis of 40 derivation studies on 216,552 patients and of 42 validation studies on 31,625 patients. Contemporary clinical trials. 2012 May 1;33(3):507-14.
4. Vasan RS. Biomarkers of cardiovascular disease: molecular basis and practical considerations. Circulation. 2006 May 16;113(19):2335-62.
5. Aronson D, Hammerman H, Beyar R, Yalonetsky S, Kapeliovich M, Markiewicz W, et al. Serum blood urea nitrogen and long-term mortality in acute ST-elevation myocardial infarction. International journal of cardiology. 2008 Jul 21;127(3):380-5.
6. Polat N, Oylumlu M, Işik MA, Arslan B, Özbek M, Demir M, et al. Prognostic significance of serum albumin in patients with acute coronary syndrome. Angiology. 2020 Nov;71(10):903-8.
7. Zhang K, Yang L, Wu X, Zheng X, Zhao Y. Urea nitrogen-to-albumin ratio predicts ventricular aneurysm formation in ST-segment elevation myocardial infarction. ESC Heart failure. 2024 Apr;11(2):974-85.
8. Pereira AG, Costa NA, Gut AL, Azevedo PS, Tanni SE, Zornoff LA, et al. Urea to albumin ratio is a predictor of mortality in patients with septic shock. Clinical Nutrition ESPEN. 2021 Apr 1;42:361-5.
9. Bender M, Haferkorn K, Tajmiri-Gondai S, Stein M, Uhl E. Serum urea-to-albumin ratio is an independent predictor of Intra-hospital Mortality in Neurosurgical Intensive Care Unit patients with spontaneous intracerebral hemorrhage. Journal of Clinical Medicine. 2023 May 18;12(10):3538.
10. Huang Y, Zhang C, Li M, Mei J, Wu Y, Xiang X. Increased blood urea nitrogen to serum albumin ratio is associated with poor prognosis in patients with acute pancreatitis: a retrospective cohort study. Archives of Medical Science. 2025.
11. Zhang L, Xing M, Yu Q, Li Z, Tong Y, Li W. Blood urea nitrogen to serum albumin ratio: a novel mortality indicator in intensive care unit patients with coronary heart disease. Scientific Reports. 2024 Mar 29;14(1):7466.
12. Chen H, Wang Y, Ji R, Li M. Association between blood urea nitrogen to serum albumin ratio and in-hospital mortality in critical patients with diabetic ketoacidosis: a retrospective analysis of the eICU database. Frontiers in Endocrinology. 2024 Jun 27;15:1411891.
13. Zhao D, Chen S, Liu Y, Xu Z, Shen H, Zhang S, et al. Blood urea nitrogen-to-albumin ratio in predicting long-term mortality in patients following coronary artery bypass grafting: an analysis of the MIMIC-III database. Frontiers in surgery. 2022 Feb 18;9:801708.