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Yaşlı Yoğun Bakım Ünitesi Hastalarında 30 Günlük Mortalite Öngörücüsü Olarak Serum Albumin-Kreatinin Oranının Rolü

Role of Serum Albumin-to-Creatinine Ratio as a Predictor of 30-Day Mortality in Geriatric Intensive Care Unit Patients

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ÖZ

Giriş: Geriatrik yoğun bakım hastalarında mortaliteyi öngörmede güvenilir ve uygun maliyetli prognostik belirteçler sınırlıdır. Bu çalışmada, Serum Albümin-Kreatinin Oranı'nın (sACR) mortaliteyi öngörmedeki rolü değerlendirilmiştir.

Yöntem: Bu retrospektif kohort çalışma, 1 Mayıs 2023 ile 1 Mayıs 2024 tarihleri arasında Kocaeli Şehir Hastanesi Yoğun Bakım Ünitesi'nde yürütülmüştür. Dışlama kriterleri uygulandıktan sonra, 65 yaş ve üzeri 485 geriatrik hasta çalışmaya dahil edilmiştir. Demografik veriler, eşlik eden hastalıklar, yoğun bakım ünitesine yatış nedenleri, hastalık şiddet skorları ve laboratuvar parametreleri toplanmıştır. sACR, serum albümin (g/dL) ve kreatinin (mg/dL) oranından hesaplanmıştır. Mortalite risk faktörleri Çok Değişkenli Lojistik Regresyon ile, sACR'nin prognostik performansı ise Alıcı İşletim Karakteristiği (ROC) analizi ile incelenmiştir.

Bulgular: Hastaların %59,4'ü (n=288) sağ kalan, %40,6'sı (n=197) ise sağ kalamayan olarak sınıflandırıldı. Konjestif kalp hastalığı, malignite, kronik böbrek hastalığı, sepsis, akut böbrek hasarı ve invaziv mekanik ventilasyon ihtiyacı sağ kalamayan hastalarda daha yüksekti (p<0,05). Çok değişkenli analizde, sACR'nin mortalitenin bağımsız bir öngörücüsü olduğu bulundu (OR: 0,843, %95 GA: 0,749-0,950, p=0,005). ROC analizinde duyarlılık %74,7, özgüllük %60,4 ve sACR için 2,50 kesme değerinde AUC 0,719 (p<0,001) olarak bulundu.

Sonuç: sACR, geriatrik yoğun bakım hastalarında 30 günlük mortaliteyi öngörmede bağımsız bir prognostik belirteçtir. Bu çalışma, bu popülasyonda sACR'yi değerlendiren ilk çalışma olması nedeniyle literatüre katkıda bulunmaktadır. Düşük sACR, mortalite riski ile ilişkilidir ve klinik uygulamada risk sınıflandırması ve tedavi planlaması için kullanılabilir.

Anahtar Kelimeler: serum albümin-kreatinin oranı, geriatrik hastalar, yoğun bakım ünitesi, mortalite, prognostik belirteç

ABSTRACT

Objective: Reliable and cost-effective prognostic markers for predicting mortality in geriatric intensive care patients are limited. The present study evaluated the role of the Serum Albumin-Creatinine Ratio (sACR) in predicting mortality.

Method: This retrospective cohort study was conducted in Kocaeli City Hospital, Anesthesiology and Reanimation, Intensive Care Unit between May 01, 2023 and May 01, 2024. After exclusion criteria, 485 geriatric patients aged 65 years and over were included. Demographic data, comorbidities, reasons for ICU admission, disease severity scores, and laboratory parameters were collected. sACR was calculated from the ratio of serum albumin (g/dL) and creatinine (mg/dL). Mortality risk factors were examined with Multivariate Logistic Regression, and the prognostic performance of sACR was examined with In Receiver Operating Characteristic (ROC) analysis.

Results: A total of 59.4% (n=288) of the patients were classified as survivors and 40.6% (n=197) as non-survivors. Congestive heart disease, malignancy, chronic kidney disease, sepsis, acute kidney injury and need for invasive mechanical ventilation were higher in non-survivors (p<0.05). In multivariate analysis, sACR was found to be an independent predictor of mortality (OR: 0.843, 95% CI: 0.749-0.950, p=0.005). The ROC analysis, sensitivity was 74.7%, specificity was 60.4% and AUC was 0.719 (p<0.001) at a cut-off value of 2.50 for sACR.

Conclusion: The sACR is an independent prognostic marker for predicting 30-day mortality in geriatric ICU patients. The present study contributes to the literature by being the first study to evaluate sACR in this population. Low sACR is associated with mortality risk and can be employed in clinical practice for risk stratification and treatment planning.

Keywords: serum albumin-creatinine ratio, geriatric patients, intensive care ünit, mortality, prognostic marker

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INTRODUCTION

Geriatric patients treated in Intensive Care Units (ICUs) face a high risk of mortality because of age-related loss of physiological reserve, multiple comorbidities, polypharmacy, and frailty (1, 2). Mortality rates have been reported to reach 27-64% in the elderly population, and the correct use of prognostic markers is of critical importance in the clinical management of these patients (3–5). Identifying reliable, easily applicable, and cost-effective markers that can predict clinical outcomes in geriatric ICU patients is a vital need to optimize patient care, individualize treatment strategies, and improve resource utilization (6, 7).

As a parameter, the Serum Albumin-Creatinine Ratio (sACR) is calculated as the ratio of serum albumin (g/dL) and creatinine (mg/dL) levels and is a marker used to evaluate nutritional status, renal function, and systemic inflammatory response holistically. Serum albumin is known as an indicator of liver synthesis, malnutrition, and inflammation, while low levels are associated with increased morbidity and mortality in ICU patients (8, 9). Serum creatinine reflects renal functions; however, its interpretation might be complicated by age-related muscle mass loss in geriatric patients (10). By combining these two parameters, sACR offers a comprehensive and integrated approach to assessing both renal and systemic health status, providing stronger prognostic information compared to albumin or creatinine measurements alone (11).

The prognostic value of sACR in various clinical conditions has been investigated in the literature (12–14). Elevated sACR has been reported to reduce the risk of 28-day mortality in sepsis patients (13). Also, sACR has been found to be associated with in-hospital mortality in patients with severe acute pancreatitis (14). However, to our knowledge, there are no studies in the literature examining the prognostic role of sACR specific to the geriatric ICU population. This absence indicates an important knowledge gap, considering the unique physiological and clinical characteristics of geriatric patients (e.g., frailty, comorbidity burden, age-related inflammatory changes) (2). Assessing the prognostic potential of sACR in geriatric ICU patients may improve risk stratification in this population and support clinical decision-making processes.

No study systematically evaluates the prognostic value of sACR in the geriatric ICU patient population and analyzes the usability of this biomarker as an effective tool in predicting mortality risk and guiding treatment processes in clinical practice. The present study aimed to investigate the relationship between sACR and 30-day mortality in geriatric ICU patients.

MATERIALS AND METHODS

Study Design

The study had a single-center, retrospective cohort design and was conducted with the approval from the Kocaeli City Hospital Local Ethics Committee (Ethics Committee Approval No: 2025-95, Date: 10/07/2025). All data were collected and analyzed in line with ethical principles protecting patient confidentiality.

Patients

The study included geriatric patients aged 65 years and over who were admitted to the ICU of Kocaeli City Hospital between May 01, 2023 and May 01, 2024. A total of 589 patients were screened. A total of 104 patients who stayed in the ICU for less than 48 hours, had incomplete serum albumin or creatinine measurements, and could not be evaluated because of missing data were excluded from the study. The sample size was calculated as a minimum of 220 (110+110) patients, assuming an effect size of 0.5, an alpha margin of error of 0.05, and a power of 95%. As a result, 485 patients were included in the study and these patients were classified as survivors (n=288, 59.4%) and non-survivors (n=197, 40.6%) based on their 30-day mortality status. The patient selection and exclusion process is presented in detail in the flow chart of the study (Figure 1).

Data Collection

The data were collected retrospectively from the Hospital Electronic Health Record System and patient files. The demographic data (age, gender), comorbidities (Hypertension, Diabetes Mellitus, Congestive Heart Disease, Malignancy, Coronary Artery Disease, Chronic Obstructive Pulmonary Disease [COPD], Cerebrovascular Disease, Chronic Kidney Disease, Liver Disease), reasons for ICU admission (postoperative conditions, sepsis, respiratory reasons, neurological reasons, traumas, other reasons), and first-day diagnosis/treatment data (Acute Kidney Injury, need for Hemodialysis, use of Invasive Mechanical Ventilation [IMV]) were recorded. Disease severity was assessed by using the APACHE-II (Acute Physiologic and Chronic Health Evaluation-II), SOFA (Sequential Organ Failure Assessment), and Charlson Comorbidity Index (CCI) scores. Length of ICU stay, hospital stay, duration of IMV, and 90-day mortality rate were also collected. Laboratory parameters were measured from blood samples taken at the time of admission to the ICU and included Hemoglobin, Leukocyte Count, Platelet Count, INR, aPTT, Glucose, Sodium, Potassium, Chloride, Calcium, Magnesium, Phosphorus, Aspartate Aminotransferase (AST), Alanine Aminotransferase (ALT), total and direct bilirubin, total protein, C-Reactive Protein (CRP), procalcitonin, pH, and lactate levels. sACR was calculated by dividing serum albumin (g/dL) by serum creatinine (mg/dL). All laboratory measurements were made by using hospital-standard calibrated automatic analyzers.

Statistical Analysis

The normal distribution of the continuous variables was assessed by using the Kolmogorov-Smirnov Test. Normally distributed continuous variables were expressed as mean ± standard deviation, and those not normally distributed were expressed as median (interquartile range). Categorical variables were presented as frequency and percentage (%). In the comparison of continuous variables between survivors and non-survivors, an independent samples t-test was used for normal distribution, and Mann-Whitney U-Test was used for data not showing normal distribution. The Chi-Square Test or Fisher's Exact Test was used for the comparison of categorical variables. Multivariate Logistic Regression Analysis was used to determine risk factors associated with mortality and potential predictors such as age, APACHE-II, SOFA, CCI, procalcitonin, lactate, and sACR were included in the model. Odds Ratios (95% Confidence Interval) were calculated and the suitability of the model was evaluated using the Hosmer-Lemeshow Test. The explanatory power of the model was determined by the Nagelkerke R^2 value. The prognostic performance of sACR in predicting mortality was examined by Receiver

Operating Characteristic (ROC) analysis, cut-off value, sensitivity, specificity, and Area Under the Curve (AUC) values were calculated. The statistical significance level was accepted as $p<0.05$. All analyses were performed by using the SPSS 26.0 (IBM Corp., Armonk, NY, USA) software.

RESULTS

A total of 485 geriatric patients who were retrospectively evaluated between May 1, 2023, and May 1, 2024, in Kocaeli City Hospital ICU were included in the study. The patient selection process and exclusion criteria are summarized in Figure 1. A total of 59.4% (n=288) of the patients were classified as survivors and 40.6% (n=197) as non-survivors. Demographic data, comorbidities, reasons for ICU admission, first-day diagnosis/treatment data, disease severity scores, and laboratory parameters are presented in detail in Table 1 and Table 2.

Table 1. Baseline Demographic Data and Clinical Characteristics Comparison Between Survivors and Non-Survivors

	All Patients n:485 (100%)	Survivors n:288 (59.4%)	Non-survivors n:197 (40.6%)	P-value
Age (median-years)	77.74 ± 7.87	77.52 ± 7.94	78.07 ± 7.79	0.436
Gender (n (%))				
Female	191 (39.4%)	110 (38.2%)	81 (41.1%)	
Male	294 (60.6%)	178 (61.8%)	116 (58.1%)	0.290
Comorbidities (n (%))				
Hypertension	249 (51.3%)	141 (49.0%)	108 (54.8%)	0.229
Diabetes Mellitus	160 (33.0%)	86 (29.9%)	74 (37.6%)	0.078
Congestive Heart Disease	142 (29.3%)	74 (25.7%)	68 (34.5%)	**0.042**
Malignancy	119 (24.5%)	60 (20.8%)	59 (29.9%)	**0.024**
Coronary Artery Disease	91 (18.8%)	41 (14.2%)	50 (25.4%)	**0.003**
COPD	81 (16.7%)	43 (14.9%)	38 (19.3%)	0.217
Cerebrovascular Disease	72 (14.8%)	41 (14.2)%	31 (15.7%)	0.697
Chronic Kidney Disease	51 (10.5%)	19 (6.6%)	32 (16.2%)	**0.001**
Liver Disease	6 (1.2%)	2 (0.7%)	4 (2.0%)	0.229
Causes of ICU Admission (n (%))				
Postoperative patients	179 (36.9%)	131 (45.5%)	48 (24.4%)	**<0.001**
Sepsis	128 (26.4%)	51 (17.7%)	77 (39.1%)	**<0.001**
Respiratory causes	71 (14.6%)	32 (11.1%)	39 (19.8%)	**0.009**
Neurological causes	48 (9.9%)	29 (10.1%)	19 (9.6%)	0.504
Trauma	41 (8.5%)	29 (10.1%)	12 (6.1%)	0.137
The other causes	32 (6.6%)	16 (5.6%)	16 (8.1%)	0.270
First-day diagnosis/treatment (n (%))				
Acute Kidney Injury	81 (16.7%)	28 (9.7%)	53 (26.9%)	**<0.001**
Hemodialysis	47 (9.7%)	15 (5.2%)	32 (16.2%)	**<0.001**
IMV treatment	261 (53.8%)	125 (43.3%)	136 (69.0%)	**<0.001**
Severity Scores				
APACHE-II scores	20 (14-27)	16 (12-22)	26 (20-32)	**<0.001**
SOFA scores	6 (3-8)	4 (2-7)	7 (6-10)	**<0.001**
CCI	5 (2-9)	4 (1-8)	6 (3-9)	**<0.001**
Duration of IMV day (day)	10 (4-25)	16.50 (3.00-43.75)	9 (5-16)	**0.004**
Length of stay ICUs (days)	9 (5-20)	8 (5-32)	10 (6-18)	0.653
Length of stay in hospital (days)	15 (9-27)	16 (10-36)	15 (8-22)	**<0.001**
90-day mortality	248 (51.1%)			

Note. IMV: Invasive Mechanical Ventilation, APACHE-II: Acute Physiologic and Chronic Health Evaluation-II, SOFA: Sequential Organ Failure Assessment, CCI: Charlson Comorbidity Index, ICUs: Intensive Care Units, COPD: Chronic Obstructive Pulmonary Disease

Table 2. Laboratory Values of the Patients at Admission Comparison Between Survivors and Non-Survivors				
	All Patients n: (100%)	Survivors n:288 (59.4%)	Non-survivors n:197 (40.6%)	P-value
Hemoglobin (g/dL)	10.80 (9.30-12.70)	11.30 (9.62-13.10)	10.20 (8.95-11.80)	**<0.001**
Leukocyte (10^3/μL)	12.85 (9.07-17.67)	12.04 (8.76-17.11)	14.05 (9.51-18.99)	**0.009**
Platelet (10^3/μL)	229.00 (171.50-305.00)	232.00 (183.25-305.75)	212.00 (145.00-303.00)	**0.011**
INR	1.15 (1.06-1.31)	1.11 (1.04-1.21)	1.22 (1.11-1.46)	**<0.001**
aPTT (second)	29.30 (26.20-35.30)	28.40 (25.60-32.90)	32.20 (27.00-38.80)	**<0.001**
Glucose (mg/dL)	152.50 (120.00-195.50)	149.50 (120.00-188.75)	153.00 (120.50-206.00)	0.349
Sodium (mmol/L)	139.00 (136.00-143.00)	139.00 (137.00-142.00)	139.00 (135.00-143.00)	0.414
Potassium (mmol/L)	4.20 (3.70-4.80)	4.20 (3.80-4.70)	4.20 (3.70-5.00)	0.441
Chlorine (mmol/L)	103.25 (100.00-108.00)	104.00 (100.00-107.52)	103.00 (99.00-109.00)	0.571
Calcium (mg/dL)	8.90 (8.40-9.35)	8.90 (8.40-9.30)	8.90 (8.20-9.40)	0.308
Magnesium (mg/dL)	1.93 (1.71-2.19)	1.91 (1.68-2.14)	1.99 (1.79-2.24)	**0.028**
Phosphorus (mg/dL)	3.70 (2.90-4.60)	3.50 (2.82-4.27)	4.10 (3.10-5.60)	**<0.001**
AST (U/L)	34.00 (23.00-60.60)	32.00 (21.50-54.85)	39.70 (23.40-86.20)	**0.005**
ALT (U/L)	20.00 (12.00-39.50)	19.00 (12.00-35.00)	22.00 (13.00-50.50)	0.089
Total bilirubin (mg/dL)	0.57 (0.36-0.96)	0.57 (0.37-0.90)	0.56 (0.35-1.16)	0.751
Direct bilirubin (mg/dL)	0.27 (0.16-0.49)	0.25 (0.14-0.40)	0.30 (0.18-0.70)	**0.001**
Total Protein (g/dL)	5.61 (4.94-6.41)	5.79 (5.09-6.54)	5.37 (4.71-6.19)	**<0.001**
CRP (mg/L)	68.10 (17.00-156.00)	49.27 (8.17-135.03)	94.70 (26.55-194.10)	**<0.001**
Procalcitonin (μg/L)	0.45 (0.13-1.78)	0.24 (0.09-0.79)	1.06 (0.32-5.03)	**<0.001**
pH	7.38 (7.31-7.44)	7.40 (7.33-7.44)	7.37 (7.27-7.44)	**0.009**
Lactate (mmol/L)	1.78 (1.26-2.55)	1.61 (1.19-2.24)	2.00 (1.44-3.03)	**<0.001**

Note. INR; International Normalized Ratio, aPTT: activated Partial Thromboplastin Time, AST: Aspartate Amino-Transferase, ALT: Alanine Amino-Transferase, CRP: C-Reactive Protein, pH: power of Hydrogen

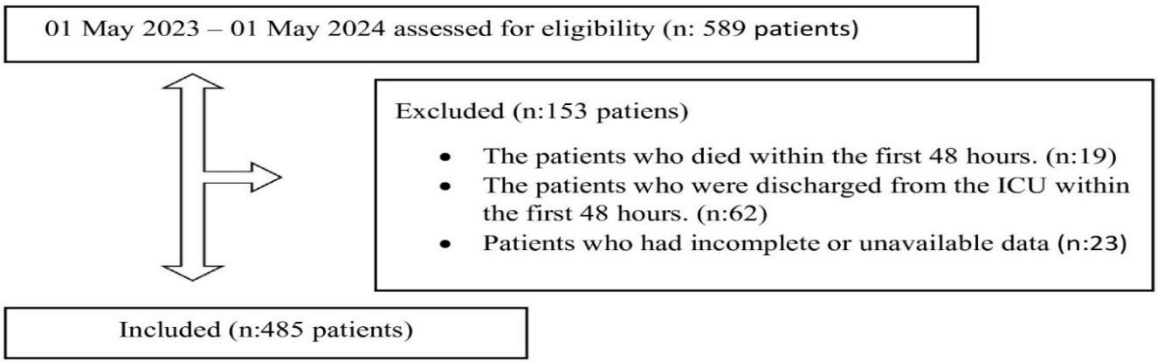

Figure 1. Flowchart of Study

Note. ICU: Intensive Care Unit

The mean age of the patients was found to be 77.74 ± 7.87 years, and no significant differences were detected between survivors (77.52 ± 7.94) and non-survivors (78.07 ± 7.79) (p=0.436). Gender distribution showed that 60.6% of the patients were male (n=294) (p=0.290). Among the comorbidities, congestive heart disease (p=0.042), malignancy (p=0.024), Coronary Artery Disease (p=0.003), and Chronic Kidney Disease (p=0.001) were significantly more common in non-survivors. Among the reasons for ICU admission, postoperative conditions (p<0.001), sepsis (p<0.001), and respiratory reasons (p=0.009) were more common in non-survivors. When the first-day diagnosis and treatment data were examined, Acute Kidney Injury (p<0.001), need for hemodialysis (p<0.001) and use of Invasive Mechanical Ventilation (IMV) (p<0.001) were higher in non-survivors (Table 1).

Disease severity scores were found to be significantly higher in non-survivors (APACHE-II score [median 26 (20-32) vs. 16 (12-22), p<0.001], SOFA score [7 (6-10) vs. 4 (2-7), p<0.001] and Charlson Comorbidity Index (CCI) [6 (3-9) vs. 4 (1-8), p<0.001]). IMV duration was longer in survivors [16.50 days (3.00-43.75) vs. 9 days (5-16), p=0.004], and ICU length of stay (p=0.653) was similar. Hospital length of stay was longer in survivors [16 days (10-36) vs. 15 days (8-22), p<0.001] and the 90-day mortality rate was 51.1% (n=248) (Table 1).

Laboratory parameters showed significant differences between survivors and non-survivors in terms of hemoglobin (p<0.001), leukocyte count (p=0.009), platelet count (p=0.011), INR (p<0.001), aPTT (p<0.001), magnesium (p=0.028), phosphorus (p<0.001), AST (p=0.005), direct bilirubin (p=0.001), total protein (p<0.001), CRP (p<0.001), procalcitonin (p<0.001), pH (p=0.009) and lactate (p<0.001) levels (Table 2). sACR parameters are given in Table 3 (Median sACR value was 3.10 (1.67-4.60) in all patients, 3.83 (2.42-5.00) in survivors, and 2.06 (1.09-3.45) in non-survivors and the difference was statistically significant (p<0.001)). Serum albumin [3.20 g/dL (2.80-3.80) vs. 2.80 g/dL (2.30-3.30), p<0.001] and creatinine [0.87 mg/dL (0.66-1.21) vs. 1.24 mg/dL (0.84-2.41), p<0.001] levels also showed significant differences in non-survivors.

Mortality risk factors were evaluated by multivariate logistic regression analysis. APACHE-II (OR: 1.077, 95% CI: 1.042-1.112, p<0.001), SOFA (OR: 1.165, 95% CI: 1.061-1.279, p=0.001), CCI (OR: 1.077, 95% CI: 1.024-1.113, p=0.004) and sACR (OR: 0.843, 95% CI: 0.749-0.950, p=0.005) were independent predictors of mortality. Procalcitonin (OR: 1.018, p=0.088) and lactate (OR: 1.097, p=0.055) remained at the significance threshold. The Hosmer-Lemeshow Test (χ^2=6.390, df=8, p=0.604) showed the suitability of the model, and Nagelkerke R^2 (0.382) showed a moderate explanatory power (Table 4).

Table 3. Comparison sACR Parameter Among Survivors and Non-Survivors

	All Patients n: (100%)	Survivors n:288 (59.4%)	Non-survivors n:197 (40.6%)	P-value
Albumin (g/dL)	3.10 (2.50-3.60)	3.20 (2.80-3.80)	2.80 (2.30-3.30)	**<0.001**
Creatinine (mg/dL)	0.99 (0.71-1.68)	0.87 (0.66-1.21)	1.24 (0.84-2.41)	**<0.001**
sACR	3.10 (1.67-4.60)	3.83 (2.42-5.00)	2.06 (1.09-3.45)	**<0.001**

Note. sACR: Serum Albumin to Creatinine Ratio

Table 4. Multivariate Logistic Regression Analysis for Risk Factors for Mortality

Risk factors	Odds Ratio	95% Confidence Interval	P value
APACHE II	1,077	1.042-1.112	**<0.001**
SOFA	1,165	1.061-1.279	**0.001**
CCI	1,077	1,024-1,113	**0.004**
Procalcitonin	1,018	0.997-1.039	0.088
Lactate	1,097	0.998-1.206	0.055
sACR	0.843	0.749-0.950	**0.005**

Note. APACHE-II: Acute Physiologic and Chronic Health Evaluation-II, CCI: Charlson Comorbidity Index, SOFA: Sequential Organ Failure Assessment, sACR: Serum Albumin to Creatinine Ratio, The Hosmer and Lemeshow Test (χ^2 = 6.390, df = 8, p = 0.604) indicates a satisfactory model fit. The Nagelkerke R^2 of 0.382 indicates a substantial explanatory power for mortality.

In predicting mortality, the performance of sACR was examined by ROC analysis. The cut-off value was determined as 2.50, at which sensitivity was 74.7%, specificity was 60.4%, and Area Under the Curve (AUC) was 0.719 (p<0.001) (Figure 2, Table 5).

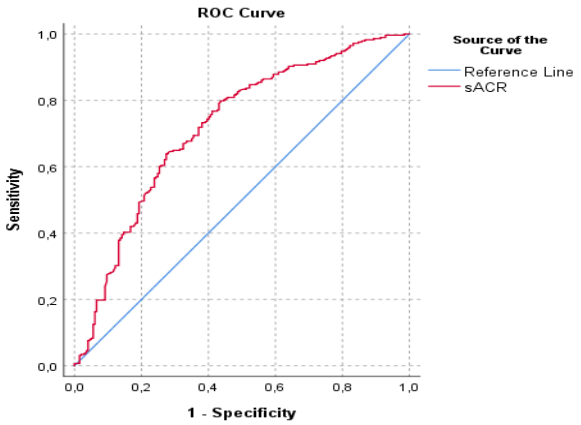

Figure 2. Receiver operating characteristic (ROC) curves to assess the ability of sACR

Table 5. Predictive Performance and ROC Analysis of sACR for Mortality

	Cut off	Sensitivity	Specificity	AUC	P value
sACR	2.50	74.7%	60.4%	0.719	**<0.001**

Note. sACR: Serum Albumin to Creatinine, ROC: Receiver Operating Characteristic, AUC: Area Under Curve

DISCUSSION

The results suggest that low levels of sACR are associated with mortality risk in geriatric ICU patients and may be used as a potential marker for risk stratification in this population. sACR is considered to reflect multiple physiological processes, such as nutritional status, renal function, and systemic inflammatory response, by combining serum albumin and creatinine levels. This characteristic may make sACR a valuable tool for patient management in the ICU setting.

The prognostic value of sACR depends on multifactorial mechanisms based on the physiological roles of albumin and creatinine. Serum albumin, as well as being an indicator of liver function and nutritional status, plays important roles in inflammatory processes (8, 14). Hypoalbuminemia may occur because of the action of proinflammatory cytokines such as interleukin-6 (IL-6) and may impair the capacity to reduce oxidative stress (15). Albumin may balance systemic inflammation by neutralizing free radicals and its antioxidant properties, which may affect the risk of mortality in geriatric patients (16). On the other hand, serum creatinine reflects renal functions; however, it might also be misleading because of the loss of muscle mass in elderly patients. By combining these two parameters, sACR provides a tool that holistically evaluates not only renal function but also systemic stress and loss of physiological reserve (14). For example, Li et al. (2024) reported that low levels of sACR increased the risk of mortality in ICU patients with heart failure (14). Similarly, high sACR was reported to be associated with better clinical outcomes in sepsis patients (13). These results support the prognostic value of sACR in different clinical scenarios, and our study indicates that this parameter is also applicable in the geriatric ICU population.

It is already known that chronic diseases are associated with mortality in geriatric patients (17). In our study, it was determined that concomitant diseases such as congestive heart failure, cancer, and chronic kidney disease were more common in patients who did not survive. As a parameter reflecting nutritional status, inflammation, and renal functions, sACR has the potential to be a marker that evaluates not only the acute condition of the patient but also the general health status and comorbidity burden.

Multivariate Analysis has shown that sACR is an independent predictor of mortality. Also, as previous studies reported, disease severity scores such as APACHE-II and SOFA were found to be independent risk factors for mortality in our study (18). Developed in 1987, the Charlson Comorbidity Index (CCI) has recently begun to be used again in intensive care studies (19). The CCI, which was also used in the present study, was found to be an independent risk factor for mortality. More frequent use of this index in geriatric patients in intensive care units may contribute to cost-effective patient management. Although scores such as APACHE-II and SOFA are standard tools for prognostic assessment in intensive care patients, it has been observed that sACR can provide additional prognostic information to these scores. The most important advantage of sACR is that it is based on easily measured and widely accessible laboratory parameters. This characteristic makes the clinical use of sACR more applicable, especially in resource-limited health systems.

Infection and inflammation cause an increase in mortality in intensive care (20). Although CRP and procalcitonin, which are inflammation markers, were significant in univariate analysis, procalcitonin was not significant in multivariate analysis. New parameters that integrate systemic inflammation parameters into sACR may yield more valuable results in terms of intensive care mortality.

The potential applications of SACR in clinical practice may enable early intervention and development of targeted therapies in patient management. For example, nutritional support, control of the inflammatory response, or renal function supportive treatments can be applied to patients with low sACR values (21). However, studies examining the prognostic value of SACR in different clinical conditions (e.g., acute pancreatitis, bresat cancer) have been increasing recently (12, 13). sACR's ROC analysis with a sensitivity of 74.7% and specificity of 60.4% and a cut-off value of 2.50 demonstrates reasonable prognostic performance; however, the relatively low specificity may limit its use, especially in clinical scenarios where false-positive results may increase. This situation has the potential to result in unnecessary interventions or

resource utilisation, particularly in environments where critical clinical decisions are made, such as in intensive care units. This highlights the importance of using sACR not alone but in combination with other prognostic markers (e.g., APACHE-II, SOFA, procalcitonin, or lactate). Combined use may provide more accurate risk stratification by increasing sensitivity and specificity and may enhance clinical decision-making processes. For example, a model in which sACR is evaluated together with procalcitonin or lactate may better reflect the combined effect of inflammation and metabolic stress and may provide higher accuracy in mortality prediction (22). Also, the impact of the low specificity of sACR in clinical practice should be taken into account in determining early intervention strategies, especially in high-risk geriatric patients. In this context, the potential advantages of integrating sACR with other markers should be systematically investigated in future prospective studies (23). Although sACR was given a cut-off value of 2.50 with a sensitivity of 74.6% and specificity of 60.4% in our study, studies specific to the geriatric population are limited, and further research is needed to close the knowledge gap in this area.

The present study is the first to our knowledge to evaluate the prognostic value of sACR in geriatric ICU patients, which makes a significant contribution to the literature. A large patient cohort (n=485), comprehensive clinical and laboratory data, and robust statistical methods (ROC analysis, multivariate logistic regression) have objectively demonstrated the prognostic role of sACR. Also, the fact that sACR is based on easily measurable parameters increases its applicability in clinical practice. However, our study has some limitations. First, the retrospective design may limit data quality and causality relationships. Second, being a single-center study restricts the generalizability of the results to different patient populations. Third, the dynamic changes (e.g., repeated measurements) of sACR during ICU stay were not evaluated, making it difficult to understand the time-varying effect of the parameter. Finally, studies examining the effect of sACR in combination with other prognostic markers (e.g., lactate, procalcitonin) in predicting mortality may further strengthen the clinical utility of this parameter.

CONCLUSION

The sACR is an independent prognostic marker for predicting 30-day mortality in geriatric ICU patients. Low sACR is associated with mortality risk and provides additional prognostic information in combination with scores such as APACHE-II, SOFA, and CCI. The use of sACR in risk stratification and treatment planning in clinical practice may improve patient outcomes. However, these results must be confirmed by prospective and multicenter studies.

Ethics CommitteeApproval: The Kocaeli City Hospital Local Ethics Committee approved the study protocol (EC number: 2025-95, 10/07/2024). All authors declare that the study was conducted in accordance with the Declaration of Helsinki and followed the ethical standards of the country of origin.

Authors' contributions: All authors contributed at all stages of the study (conceptıon, desıgn, supervısıon, materıals, data collectıon, analysıs, lıterature revıew, crıtıcal revıew). All authors read and approved the final version of the manuscript.

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