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Prognostic Value of CRP-to-Albumin Ratio in Elderly ICU Patients: A Retrospective Study

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Abstract

Background: Systemic inflammation and malnutrition are key contributors to adverse outcomes among older adults admitted to the ICU. The prognostic relevance of CRP-to-albumin ratio (CAR), reflecting combined inflammatory and nutritional status, was evaluated in relation to 28-day mortality.

Methods: A retrospective cohort of 207 older adults (≥65 years) admitted to the ICU between December 2024 and June 2025 was analyzed. Demographic variables, clinical features, and laboratory parameters were extracted from electronic health records. All-cause mortality at 28 days served as the primary outcome, while prognostic assessment was performed using ROC analysis alongside multivariable logistic regression models.

Results: A 28-day all-cause mortality of 26.1% was observed. Non-survivors exhibited significantly higher CAR, CRP, APACHE II, and SOFA scores ($p < 0.001$). In multivariable models, CAR remained independently associated with mortality (OR 1.14, 95% CI 1.01–1.28, $p = 0.034$). An AUC of 0.77 (95% CI 0.70–0.84) was observed for CAR, indicating good discriminatory ability.

Conclusions: The CAR independently associated with short-term mortality in geriatric ICU patients and may serve as a simple, inexpensive biomarker for early risk stratification and outcome prediction.

Keywords: Aged, Biomarkers, C-Reactive Protein, Critical Care, Serum Albumin

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Yoğun Bakım Hastalarında C-Reaktif Protein/Albümin Oranının Prognostik Değeri: Geriatrik Hasta Grubunda Retrospektif Bir Çalışma

Öz

Amaç: Sistemik inflamasyon ve malnütrisyon, yaşlı yoğun bakım hastalarında olumsuz klinik sonuçların temel belirleyicileridir. Bu çalışmada, inflamatuvar yanıt ile beslenme durumunu bütüncül biçimde yansıtan entegre bir biyobelirteç olan C-reaktif protein/albumin oranının (CAR), 28 günlük mortaliteyi öngörmedeki prognostik değerinin değerlendirilmesi amaçlandı.

Yöntemler: Bu retrospektif kohort çalışmasına Aralık 2024 – Haziran 2025 arasında yoğun bakım ünitesinde takip edilen, yaşları ≥65 olan toplam 207 hasta dâhil edildi. Demografik, klinik ve laboratuvar veriler elektronik kayıt sisteminden elde edildi. Yoğun bakıma yatıştan sonraki 28 gün içinde gelişen tüm nedenlere bağlı mortalite, birincil sonlanım ölçütü olarak kabul edildi. Bağımsız mortalite belirleyicilerini ortaya koymak için ROC eğrisi analizi ile çok değişkenli lojistik regresyon analizlerinden yararlanıldı.

Bulgular: Toplam 28 günlük mortalite oranı %26,1 olarak saptandı. Kaybedilen hastalarda CAR, CRP, APACHE II ve SOFA skorları daha yüksekti ($p < 0,001$). Çok değişkenli analizde, CAR mortalitenin bağımsız bir öngördürücüsü olarak kaldı (OR: 1,14; %95 GA: 1,01–1,28; $p = 0,034$). CAR için ROC eğrisi altında kalan alan 0,77 (%95 GA: 0,70–0,84) olarak hesaplandı.

Sonuç: CAR, yaşlı yoğun bakım hastalarında kısa dönem mortalite açısından bağımsız bir öngörü değeri taşımaktadır. Bu oran, erken risk sınıflandırması ve prognoz tahmininde kolay erişilebilir, düşük maliyetli ve klinik pratikte kullanılabilir bir biyobelirteçtir.

Anahtar kelimeler: Yaşlı, Biyobelirteçler, C-Reaktif Protein, Yoğun Bakım, Serum Albümini.

INTRODUCTION

Over the past decade, population aging worldwide has driven a notable expansion in intensive care admissions among older adults. Older adults exhibit markedly higher mortality rates compared with younger patients[1]. Large-scale epidemiologic studies indicate that ICU mortality in geriatric patients is approximately 27.5%, while short-term mortality within 30 days has been reported to vary substantially according to disease severity and comorbidity profiles, reaching levels as high as 40%[2]. Taken together, these observations highlight the importance of identifying reliable and easily accessible biomarkers for outcome prediction in this high-risk population.

Aging is accompanied by physiological decline, impaired immune response, and a persistent state of low-level systemic inflammation known as inflammaging[3]. Concomitantly, protein-energy malnutrition occurs frequently in older adult populations, contributing to reduced serum albumin levels and impaired recovery from critical illness. In the ICU setting, the interplay between systemic inflammation and nutritional depletion has a profound impact on outcomes[4]. C-reactive protein (CRP) and albumin are routinely measured biomarkers representing these two interconnected pathophysiological pathways, with CRP indicating inflammatory activity and albumin reflecting nutritional and hepatic status[5]. The CRP-to-albumin ratio (CAR), therefore, integrates these two dimensions into a single composite index that may better reflect the global inflammatory–nutritional balance of critically ill patients[6].

The prognostic relevance of the CAR has been reported in diverse disease contexts, such as sepsis, acute kidney injury, and traumatic brain injury[7–9]. Among critically ill patients, increased CAR values are linked to an elevated probability of short-term mortality and worse clinical

trajectories. However, most available evidence originates from heterogeneous adult cohorts, while data specifically focusing on geriatric ICU patients remain scarce, with limited studies addressing broader hospitalized elderly populations[10]. Commonly applied ICU severity scores—specifically APACHE II and SOFA—have limited capacity to account for temporal patterns in physiologic data, which may constrain their predictive performance in elderly critically ill patients with unique metabolic and physiologic characteristics[11].

In this context, CAR may complement existing prognostic models by integrating inflammatory and nutritional information derived from routinely obtained laboratory parameters.

In this context, the association between admission CAR values and 28-day mortality was investigated in a geriatric ICU population, with additional analyses assessing the incremental prognostic contribution of CAR beyond APACHE II and SOFA scores.

METHODS

Study Design and Setting

The study employed a retrospective observational design within a tertiary adult intensive care unit (ICU) of the Gazi Yaşargil Training and Research Hospital, Turkey. All eligible ICU admissions occurring between December 2024 and June 2025 were evaluated. The Institutional Ethics Committee of the Gazi Yaşargil Training and Research Hospital approved the study protocol (Approval No: 632, September 19, 2025), and all study-related procedures adhered to the principles of the Declaration of Helsinki and subsequent revisions.

Study Population

Eligibility was defined as ICU admission in patients aged ≥65 years with a minimum stay of 24 hours. Based on these criteria, 207 patients were ultimately included in the analysis. Exclusion criteria comprised the presence of chronic liver failure, active malignancy, hematologic disease, or incomplete baseline laboratory data. When multiple ICU admissions occurred within the study timeframe, only the first admission was included in the analysis to preserve the independence of observations and to avoid potential clustering effects related to repeated measurements. Information regarding demographics, comorbid conditions, disease severity scores, and laboratory findings was retrieved from the institutional electronic medical record system.

Data Collection and Variables

Patient-level information was retrieved on demographics (age and sex), coexisting illnesses (diabetes mellitus, hypertension, coronary artery disease, heart failure, chronic kidney disease, and chronic obstructive pulmonary disease), and the principal indications for ICU admission.

APACHE II and SOFA scores obtained during the initial 24 hours after ICU admission were used to evaluate disease severity.

Baseline laboratory measurements obtained at admission included CRP, serum albumin, lactate, arterial pH, white blood cell count, hemoglobin concentration, and platelet count. CAR was calculated by dividing serum CRP levels (mg/L) by serum albumin concentrations (g/dL).

Outcomes

All-cause mortality within 28 days following ICU admission was designated as the primary outcome. Secondary outcomes included ICU length of stay and mechanical ventilation duration, calculated in days until discharge or death.

Statistical Analysis

All statistical analyses were performed with IBM SPSS Statistics (version 25.0; IBM Corp., Armonk, NY, USA). The distributional

properties of continuous variables were examined with the Shapiro–Wilk test. Continuous variables are summarized using medians and interquartile ranges (IQRs), whereas categorical data are reported as frequencies and percentages.

Given the retrospective design of the study, no a priori sample size calculation was performed, and all consecutive eligible patients during the study period were included in the analysis.

Comparisons between survivor and non-survivor groups were performed using the Mann–Whitney U test for continuous variables, while categorical data were evaluated with the chi-square test or Fisher's exact test, as appropriate.

The ability of the CAR to discriminate 28-day mortality was assessed through ROC curve analysis. Optimal cut-off values were determined using Youden's index, and discriminatory performance was summarized by the AUC with corresponding 95% confidence intervals (CIs).

Factors yielding p-values below 0.10 in univariate analyses were incorporated into a multivariable logistic regression framework to determine independent associations with mortality. Effect estimates are expressed as odds ratios (ORs) with corresponding 95% confidence intervals, with a two-sided p-value below 0.05 used to indicate statistical significance.

RESULTS

The analysis included 207 geriatric patients admitted to the ICU, all aged 65 years or older. The median age of the cohort was 77 years (IQR 71–86), and 52.7% of patients were male. Twenty-eight–day all-cause mortality occurred in 54 patients (26.1%). Baseline demographic, clinical, and laboratory characteristics stratified by survival status are summarized in Table I.

Table I: Baseline characteristics of the study population according to 28-day mortality

Variables	All patients (n = 207)	Survivors (n = 153)	Non-survivors (n = 54)	p-value
Age (years)	77 (71–86)	76 (70–85)	78 (72–87)	0.28
Male sex, n (%)	109 (52.7)	80 (52.3)	29 (53.7)	0.87
APACHE II score	15 (10–22)	13 (9–18)	22 (17–29)	<0.001
SOFA score	5 (3–8)	4 (2–7)	9 (6–13)	<0.001
CRP (mg/L)	85 (36–154)	65 (28–121)	158 (102–229)	<0.001
Albumin (g/dL)	3.1 (2.7–3.7)	3.3 (2.9–3.9)	2.6 (2.2–3.0)	<0.001
CAR (CRP/Albumin)	1.47 (0.36–4.22)	0.99 (0.22–2.87)	4.36 (2.21–8.72)	<0.001
Lactate (mmol/L)	2.2 (1.4–3.7)	2.0 (1.2–3.0)	3.5 (2.3–5.2)	<0.001
Arterial pH	7.35 (7.29–7.42)	7.37 (7.32–7.43)	7.29 (7.22–7.36)	<0.001
ICU stay (days)	9 (6–13)	9 (6–13)	10 (7–15)	0.21
Mechanical ventilation (days)	5 (2–9)	4 (2–8)	7 (4–12)	0.02

Data are presented as median (interquartile range) or number (%), as appropriate. p-values are based on the Mann–Whitney U test or chi-square test, where applicable. Abbreviations: APACHE II, Acute Physiology and Chronic Health Evaluation II; SOFA, Sequential Organ Failure Assessment; CRP, C-reactive protein; CAR, CRP-to-albumin ratio.

Baseline Characteristics

Non-survivors exhibited significantly higher disease severity scores compared with survivors. Non-survivors exhibited higher median APACHE II and SOFA scores [22 (IQR 17–29) and 9 (IQR 6–13), respectively] compared with survivors [13 (IQR 9–18) and 4 (IQR 2–7); both $p < 0.001$]. Regarding inflammatory markers, CRP and CAR values were markedly elevated in non-survivors, while

albumin levels were lower (p < 0.001 for all). The median CAR was 4.36 (IQR 2.21–8.72) in non-survivors and 0.99 (IQR 0.22–2.87) in survivors (p < 0.001; Table I).

ICU Stay and Ventilatory Support

The duration of ICU stay did not differ significantly between non-survivors [median 10 days (IQR 7–15)] and survivors [median 9 days (IQR 6–13); p = 0.21].

Non-survivors required longer mechanical ventilation than survivors [7 days (IQR 4–12) vs. 4 days (IQR 2–8); p = 0.02; Table I].

Predictive Value of CAR for 28-Day Mortality

The ability of the CAR to predict 28-day mortality was supported by ROC analysis, with an AUC of 0.77 (95% CI 0.70–0.84, p < 0.001).

The optimal cut-off value, determined by Youden's index, was 3.1, yielding a sensitivity of 68.5% and specificity of 77.8%.

The ROC is shown in Figure 1, and the comparison of predictive performance among CAR, CRP, and albumin is summarized in Table II.

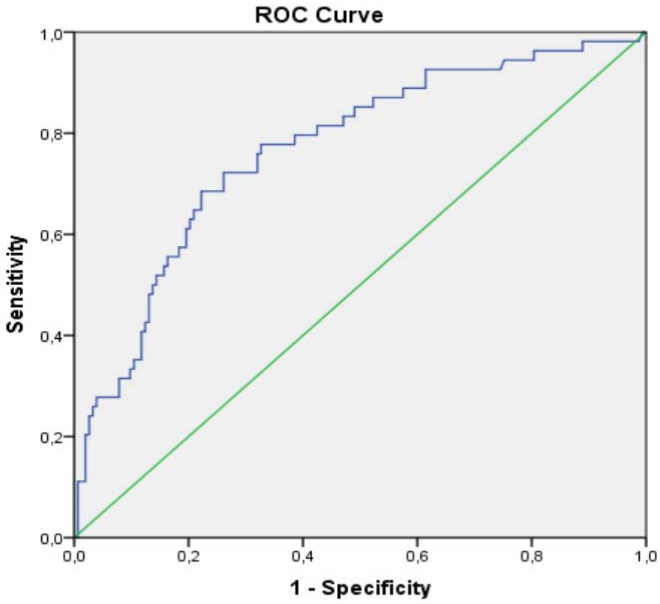

Figure 1. ROC curve of CAR for predicting 28-day mortality

Figure 1 illustrates ROC demonstrating the predictive performance of CAR for 28-day mortality in geriatric ICU patients. AUC was 0.77, indicating a moderate-to-high discriminatory ability. Sensitivity and 1–specificity values across thresholds reflect the overall accuracy of the biomarker.

Table II: Comparison of predictive performance of inflammatory markers for 28-day mortality

Biomarker	AUC (95% CI)	Cut-off	Sensitivity (%)	Specificity (%)	p-value
CAR	0.77 (0.70–0.84)	3.1	68.5	77.8	<0.001
CRP	0.69 (0.61–0.76)	94 mg/L	65.4	68.2	<0.001
Albumin	0.63 (0.55–0.71)	2.9 g/dL	61.2	66.0	<0.001

AUC, area under the curve; CI, confidence interval; CAR, C-reactive protein/albumin ratio; CRP, C-reactive protein.

CAR demonstrated superior discrimination compared with CRP (AUC 0.69) and albumin (AUC 0.63) for predicting 28-day mortality.

Multivariable Logistic Regression Analysis Factors with p-values < 0.10 on univariate analysis—namely age, APACHE II, SOFA, lactate, and CAR—were entered into the multivariable logistic regression analysis. Results of the univariate and adjusted analyses are reported in Table III.

Table III: Univariable and multivariable logistic regression analyses of factors associated with 28-day mortality

Variables	Univariable OR (95% CI)	p-value	Multivariable OR (95% CI)	p-value
Age (years)	1.02 (0.99–1.06)	0.11	1.01 (0.97–1.05)	0.48
Male sex	1.08 (0.62–1.89)	0.78	—	—
APACHE II score	1.15 (1.09–1.22)	<0.001	1.12 (1.05–1.21)	<0.001
SOFA score	1.21 (1.11–1.34)	<0.001	1.18 (1.07–1.32)	0.002
Lactate (mmol/L)	1.31 (1.09–1.56)	0.004	1.19 (0.97–1.47)	0.09
CAR	1.17 (1.05–1.30)	0.003	1.14 (1.01–1.28)	0.034

OR, odds ratio; CI, confidence interval; CAR, C-reactive protein/albumin ratio; APACHE II, Acute Physiology and Chronic Health Evaluation II; SOFA, Sequential Organ Failure Assessment. Variables with p < 0.10 in univariate analysis were included in the multivariable model.

After adjustment for clinical covariates, In the adjusted analysis, CAR was independently associated with 28-day mortality (odds ratio [OR] = 1.14; 95% confidence interval [CI] 1.01–1.28; p = 0.034), together with APACHE II (OR = 1.12; 95% CI 1.05–1.21; p < 0.001) and SOFA (OR = 1.18; 95% CI 1.07–1.32; p = 0.002).

The final regression model demonstrated good discrimination (AUC = 0.82) and calibration (Hosmer–Lemeshow p = 0.46).

DISCUSSION

Among geriatric ICU patients, CAR was independently associated with 28-day mortality after controlling for established severity scores such as APACHE II and SOFA. These findings suggest that CAR, a simple and readily available biomarker, may provide additional prognostic information beyond traditional scoring systems in elderly critically ill patients.

These findings support the growing literature indicating that CAR has prognostic relevance in critically ill populations[6,7,10,12–13,16].

Oh et al.6 reported that higher CAR values retained independent prognostic relevance for short-term mortality among ICU patients., supporting our observation that CAR reflects the combined burden of inflammation and nutritional decline.

Evidence from ICU-based studies indicates that CAR is associated with mortality risk, as shown by Park et al.[12], whereas Ranzani et al.[13] validated its prognostic performance in sepsis using 90-day mortality as an outcome measure. More recently, in a cohort of older hospitalized patients, Capurso et al.[10] reported a significant relationship between CAR and in-hospital mortality, supporting its potential relevance to ICU settings.

Furthermore, Uluç et al.[16] showed that CAR was significantly associated with mortality in elderly ICU patients.

An AUC value of 0.77 observed here supports earlier evidence and highlights CAR as a clinically reliable prognostic marker.

The prognostic power of CAR likely arises from its capacity to integrate two key determinants of critical illness outcomes: systemic inflammation and nutritional status.

CRP is an interleukin-6–regulated acute-phase reactant that sensitively reflects systemic inflammatory activity[3,15], while hypoalbuminemia reflects chronic inflammation, malnutrition, and capillary leakage[4,5].

In older adults, these biological processes are closely linked to reduced physiological reserve and vulnerability, core components of the frailty phenotype. In this context, CAR may be interpreted as a biochemical surrogate reflecting frailty-related biological burden rather than a direct measure of clinical frailty.

Consequently, a high CAR reflects both acute inflammatory stress and poor nutritional reserves—two synergistic processes that are closely associated with unfavorable clinical outcomes among older adults[1,2,14,17].

Recent studies further highlight the interplay between inflammation and malnutrition in determining survival in older ICU patients[17,18].

Therefore, CAR serves as a composite biomarker integrating these biological dimensions, providing a holistic indicator of physiologic resilience in the geriatric critical care setting.

Given its simplicity and low cost, CAR can be easily implemented in routine ICU workflows.

Unlike complex scores requiring numerous variables, CAR relies solely on two widely available parameters—CRP and albumin—measured at admission.

This makes CAR an attractive adjunct for early risk stratification and treatment prioritization in older adults.

The objective nature of this measure may also enhance clinician–family communication and support shared decision-making regarding expected outcomes and care intensity.

As highlighted by Flaatten et al.[14] the combination of biological and functional vulnerability defines outcomes in elderly ICU patients, and CAR may serve as an objective biochemical representation of this vulnerability.

Although survivor–non-survivor comparisons are inherently outcome-driven, the prognostic relevance of CAR in this study was further supported by ROC and multivariable regression analyses, emphasizing its discriminatory capacity rather than a deterministic predictive role.

Our analysis revealed that CAR retained independent prognostic significance even after adjustment for APACHE II and SOFA scores.

This indicates that CAR captures additional biological domains—particularly inflammation and nutrition—not represented in traditional physiologic scoring systems.

The integration of CAR with existing tools could therefore improve risk prediction and support individualized management strategies in geriatric ICU populations.

Strengths and Limitations

A notable strength of the present analysis lies in its relatively large sample size, the exclusive focus on a geriatric ICU population, and the integration of real-world clinical and biochemical data, enhancing the clinical relevance of the findings.

Several methodological limitations should be considered when interpreting these results. First, the retrospective, single-center design may limit the generalizability of the findings to other settings or patient populations. Second, only baseline laboratory parameters were analyzed; therefore, dynamic changes in CAR over time could not be assessed, and serial measurements might provide additional insight into disease progression and risk stratification.

Third, although APACHE II, SOFA, and CAR represent distinct clinical and biological domains, their inclusion within the same multivariable model may introduce potential multicollinearity, which should be taken into account when interpreting the adjusted effect estimates.

Fourth, frailty indices and functional outcome measures—recognized as important determinants of prognosis in older ICU patients—were not available and could not be incorporated into the analysis.

Finally, given the observational nature of the study, causal inferences cannot be established, and the findings should be regarded as hypothesis-generating. Multicenter prospective studies are warranted to validate these results and further clarify the prognostic role of CAR in geriatric critical care populations.

CONCLUSIONS

In summary, CAR retained independent prognostic significance for 28-day mortality among geriatric ICU patients.

By integrating inflammation and nutritional status into a single parameter, CAR offers a robust, inexpensive, and practical marker for mortality risk stratification.

Future prospective and multicenter studies should assess whether incorporating CAR into existing prognostic models can enhance outcome prediction and clinical decision-making in critically ill elderly populations.

Ethical Approval: The Institutional Ethics Committee of the Gazi Yaşargil Training and Research Hospital approved the study protocol

(Approval No: 632, September 19, 2025), and all study-related procedures adhered to the principles of the Declaration of Helsinki and subsequent revisions.

Conflict of Interest: The authors declared no conflicts of interest.

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REFERENCES

1. Vallet H, Schwarz GL, Flaatten H, et al. A. Mortality of older patients admitted to an ICU: a systematic review. Crit Care Med. 2021;49(2):324-34.

2. Guidet B, de Lange DW, Boumendil A, et al. The contribution of frailty, cognition, activity of daily life and comorbidities on outcome in acutely admitted patients over 80 years in European ICUs: the VIP2 study. Intensive Care Med. 2020;46(1):57-69.

3. Franceschi C, Garagnani P, Parini P, et al. Inflammaging: a new immune-metabolic viewpoint for age-related diseases. Nat Rev Endocrinol. 2018;14(10):576-90.

4. Volkert D, Beck AM, Cederholm T, et al. ESPEN guideline on clinical nutrition and hydration in geriatrics. Geriatr Psychol Neuropsychiatr Vieil. 2024;22(3):273-315.

5. Soeters PB, Wolfe RR, Shenkin A. Hypoalbuminemia: pathogenesis and clinical significance. JPEN J Parenter Enteral Nutr. 2019;43(2):181-93.

6. Oh TK, Song IA, Lee JH. Clinical usefulness of C-reactive protein to albumin ratio in predicting 30-day mortality in critically ill patients: a retrospective analysis. Sci Rep. 2018;8(1):14977.

7. Liu Y, Gao Y, Liang B, et al. The prognostic value of C-reactive protein to albumin ratio in patients with sepsis: a systematic review and meta-analysis. Aging Male. 2023;26(1):2261540.

8. Liu B, Lv D. Prognostic value of C-reactive protein to albumin ratio for mortality in acute kidney injury. BMC Nephrol. 2023;24(1):44.

9. Wang Y, Gong Y, Chen D, et al. C-reactive protein/albumin ratio is associated with mortality in patients with moderate to severe traumatic brain injury. World Neurosurg. 2023; 173: e234-40.

10. Capurso C, Lo Buglio A, Bellanti F, et al. C-reactive protein to albumin ratio predicts early mortality in hospitalized older patients, independent of the admission diagnosis. Nutrients. 2025;17(12):1984.

11. Deng Y, Li S, Li J, et al. Enhancing mortality prediction in intensive care units: improving APACHE II, SOFA, and SAPS II scoring systems using long short-term memory. Intern Emerg Med. 2025.

12. Park JE, Chung KS, Song JH, et al. The C-reactive protein/albumin ratio as a predictor of mortality in critically ill patients. J Clin Med. 2018;7(10):333.

13. Ranzani OT, Zampieri FG, Forte DN, et al. C-reactive protein/albumin ratio predicts 90-day mortality of septic patients. PLoS One. 2013;8(3): e59321.

14. Flaatten H, de Lange DW, Morandi A, et al. The impact of frailty on ICU and 30-day mortality and the level of care in very elderly patients (≥80 years). Intensive Care Med. 2017;43(12):1820-8.

15. Humble C, Schønemann-Lund M, Bruun-Rasmussen P, et al. Pro- and anti-inflammatory responses and clinical outcomes in critically ill patients with endotheliopathy: a cohort study. Acta Anaesthesiol Scand. 2025;69(9): e70117.

16. Uluç K, Akkütük Öngel E, Çolakoğlu ŞM, et al. Effects of HALP score, C-reactive protein/albumin ratio, and platelet/lymphocyte ratio on predicting mortality in geriatric patients in the respiratory intensive care unit. Clin Interv Aging. 2025; 20:815-23.

17. Heyland DK, Dhaliwal R, Jiang X, et al. Identifying critically ill patients who benefit the most from nutrition therapy: the development and initial validation of a novel risk assessment tool. Crit Care. 2011;15(6): R268.

18. Stoppe C, Wendt S, Mehta NM, et al. Biomarkers in critical care nutrition. Crit Care. 2020;24(1):499.