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RESEARCH

Prognostic value of blood urea nitrogen-to-albumin ratio in critically ill lung cancer patients

Yoğun bakımda izlenen akciğer kanseri hastalarında kan üre azotu/albumin oranının prognostik değeri

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Abstract

Purpose: This study aimed to investigate factors influencing mortality in intensive care units (ICUs)-treated lung cancer patients, focusing on the prognostic value of the blood urea nitrogen-to-serum albumin ratio (BAR).

Materials and Methods: This retrospective study included lung cancer patients treated in the ICU between 2020 and 2024. Clinical and laboratory data were collected, including demographics, reasons for ICU admission, and scores from BAR, Acute Physiology and Chronic Health Evaluation II (APACHE-II), and Sepsis-related Organ Failure Assessment (SOFA). BAR levels at admission, 24 hours, and 72 hours were analyzed for their predictive value on 30-day mortality using ROC analysis.

Results: Among 110 patients, the 30-day mortality rate was 21.8%. Increasing BAR values over time were significantly associated with mortality. The 72-hour BAR had the highest predictive power (AUC=0.783), surpassing APACHE-II and SOFA scores. Cox regression identified elevated BAR and the need for invasive mechanical ventilation (IMV) as independent predictors of mortality.

Conclusion: BAR is a valuable prognostic biomarker in ICU-managed lung cancer patients. Its dynamic assessment enhances predictive accuracy and may support early clinical decision-making.

Keywords:. Lung Cancer; BAR, Mortality, ICU

Öz

Amaç: Bu çalışmanın amacı, yoğun bakım ünitesinde (YBÜ) takip edilen akciğer kanseri hastalarında mortaliteyi etkileyen faktörleri araştırmak ve kan üre azotu/serum albümin oranının (BAR) prognostik değerini incelemektir.

Gereç ve Yöntem: Bu retrospektif çalışmaya, 2020 ile 2024 yılları arasında YBÜ'de tedavi edilen akciğer kanseri hastaları dahil edilmiştir. Demografik veriler, YBÜ'ye yatış nedenleri ve BAR, Akut Fizyoloji ve Kronik Sağlık Değerlendirmesi II (APACHE-II) ve Sepsis İlişkili Organ Yetmezliği Değerlendirmesi (SOFA) skorları gibi klinik ve laboratuvar verileri toplanmıştır. Yatışta, 24. saatte ve 72. saatte ölçülen BAR düzeylerinin 30 günlük mortaliteyi öngörmedeki değeri ROC analizi ile değerlendirilmiştir.

Bulgular: Toplam 110 hasta incelenmiş olup, 30 günlük mortalite oranı %21,8 bulunmuştur. Zamanla artan BAR değerleri mortalite ile anlamlı şekilde ilişkili bulunmuştur. 72. saatteki BAR değeri, en yüksek öngörü gücüne sahipti (EAA=0,783) ve APACHE-II ile SOFA skorlarını geride bırakmıştır. Cox regresyon analizinde yüksek BAR düzeyi ve invaziv mekanik ventilasyon (İMV) ihtiyacı mortalitenin bağımsız belirleyicileri olarak saptanmıştır.

Sonuç: BAR, YBÜ'de izlenen akciğer kanseri hastalarında değerli bir prognostik biyobelirteçtir. Dinamik değerlendirmesi, öngörü gücünü artırmakta ve erken klinik karar alma süreçlerini destekleyebilmektedir.

Anahtar kelimeler: Akciğer kanseri, BAR; mortalite, YBÜ

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INTRODUCTION

Lung cancer is the most common malignancy worldwide and remains the leading cause of cancer-related deaths[1]. The progressive course of the disease and the aggressive treatment strategies often required lead to the development of critical conditions, increasing the need for intensive care. Lung cancer is not only among the most frequent malignancies admitted to intensive care units but also one of those associated with the highest in-hospital mortality rates[2]. Reliable prognostic markers are therefore needed to improve the prognosis and strengthen the clinical management of this patient group.

Recent studies have shown that nitrogen metabolism products may play a significant role in predicting mortality in critically ill patients. In particular, blood urea nitrogen (BUN) is recognized as a valuable parameter reflecting renal function and nutritional status, and has been reported to be associated with intensive care unit (ICU) length of stay and mortality[3]. Yıldız et al. indicated that elevated serum uric acid levels are significantly associated with mortality in elderly patients with respiratory failure[4]. Similarly, Çelik et al. reported that high BUN levels are related to poor prognosis in patients in respiratory intensive care units[5]. BUN levels not only reflect renal function but may also serve as indirect indicators of systemic inflammation, hypoperfusion, and increased neurohormonal activity[6]. Enhanced protein catabolism and impaired renal perfusion, which are common in critical illness, can lead to a marked elevation in BUN levels. Studies by Giri et al. have demonstrated that elevated BUN levels are independently associated with in-hospital mortality among patients presenting with severe respiratory conditions[7]. These findings suggest that BUN is a multifaceted biomarker that reflects not only renal function but also the overall physiological stress and prognosis. In clinical scenarios such as lung cancer, where systemic inflammation and metabolic dysfunction are prominent, rising BUN levels may provide valuable prognostic insight into disease progression and clinical outcomes[8] . On the other hand, low serum albumin levels have emerged as a strong indicator of poor prognosis in various types of cancer[9]. In addition to its fundamental role in maintaining plasma oncotic pressure, albumin possesses anti-inflammatory, antioxidant, and immunomodulatory properties. Systemic inflammation, catabolic stress, and malnutrition associated with malignancy can suppress albumin synthesis, leading to decreased serum levels, which may negatively impact prognosis[10]. In the presence of malignancy, factors such as inflammation, catabolic processes, and malnutrition affect both nitrogen metabolism parameters and albumin levels, thereby altering the systemic response. Therefore, evaluating these two parameters together may contribute to a more accurate prediction of tumor-related systemic stress and disease course.

Indeed, the blood urea nitrogen-to-albumin ratio (BAR), calculated by dividing BUN by serum albumin levels, has been identified by Dundar et al. as a marker significantly associated with mortality in ICU patients[11]. Peng et al. also demonstrated that BAR is a valuable indicator for predicting in-hospital mortality in patients admitted to the ICU due to lung cancer[12]. This parameter is increasingly recognized as a practical and easily accessible indicator of both metabolic stress and systemic inflammation in critically ill patients. BAR has been shown to outperform some traditional severity scores in certain clinical populations, particularly in settings where rapid prognostic assessment is essential[13]. Its strength lies in combining two routinely measured biomarkers-BUN, which reflects renal perfusion and catabolic state, and albumin, which indicates nutritional and inflammatory status-thus providing a more integrated assessment of the patient's physiologic reserve. In light of these findings, the present study aimed to evaluate the prognostic value of BAR in lung cancer patients managed in the intensive care unit. By separately analyzing BAR levels at admission, 24 hours, and 72 hours, this study investigated the association between the biomarker's temporal dynamics and mortality. In this respect, it represents one of the few studies in the literature to evaluate the time-dependent prognostic role of BAR in malignancy-related critical illness.

MATERIALS AND METHODS

Procedure

The study was performed retrospectively on lung cancer patients who were treated in the Pulmonary Intensive Care Unit of the Department of Pulmonology at Ankara Atatürk Sanatorium Training and Research Hospital between April 15, 2020, and January 15, 2024. Ethical approval was obtained from the Clinical Research Ethics Committee of Ankara Atatürk Sanatorium Training and Research Hospital

(Decision No: 62, dated April 24, 2024). All procedures were conducted in accordance with the principles outlined in the Declaration of Helsinki.

ICU admission reasons were classified into categories including pneumonia, pulmonary embolism, sepsis, respiratory failure, cardiac causes, and cancer-related complications. Collected data comprised lung cancer subtypes, date of diagnosis, disease stage, presence of targetable mutations, cancer-specific treatments, demographic information, laboratory parameters measured during the initial 24 hours following ICU admission, imaging findings, treatment modalities, requirement for renal replacement therapy, respiratory and vasopressor support, as well as patient outcomes.

Patient data were obtained from both the electronic medical record system and physical patient files at Ankara Atatürk Sanatorium Training and Research Hospital. These sources ensure data reliability through standardized documentation and regular internal audits. The hospital is a tertiary referral center equipped with a dedicated pulmonary intensive care unit, managed by experienced pulmonologists and critical care specialists. ICU admissions, treatment protocols, and follow-up procedures are conducted in accordance with national and institutional clinical care guidelines. All clinical and biochemical data were independently verified by two pulmonology and intensive care physicians to ensure consistency and reliability.

An a priori power analysis was performed using G*Power software (version 3.1.9.7) for the primary comparison between two independent groups. Assuming a medium effect size (Cohen's d = 0.5), a significance level of 0.05, and a desired power of 0.80, the required total sample size was calculated as 106 patients. The final study cohort comprised 110 patients, thereby exceeding the calculated requirement and meeting the planned statistical power, upon which patient screening was concluded.

Biochemical analysis

Biochemical analyses were carried out using the Beckman Coulter AU5800 analyzer (Brea, California, United States). BUN levels were measured using a urease-glutamate dehydrogenase -based enzymatic method, with results expressed in mg/dL. Serum albumin levels were measured using the Bromocresol Green spectrophotometric method, with results expressed in g/dL. The BAR was calculated by dividing BUN by serum albumin levels.

Definitions and scoring systems

In this study, sepsis was diagnosed based on the Sepsis-3 definitions[14]. Assessment of organ dysfunction was conducted using the Sepsis-related Organ Failure Assessment (SOFA) scoring system[15]. Sepsis was defined as life-threatening organ dysfunction represented by an acute increase of ≥2 points in the SOFA score, in the presence of a suspected or documented infection, in accordance with the Sepsis-3 criteria. Septic shock was identified as a more severe form of sepsis, characterized by the need for vasopressor support to maintain a mean arterial pressure of 65 mmHg or higher following adequate fluid resuscitation, accompanied by a sustained elevation in serum lactate levels exceeding 2 mmol/L.

The severity of illness and mortality risk among ICU patients were assessed using the Acute Physiology and Chronic Health Evaluation II (APACHE-II) scoring system, which is broadly recognized for its predictive accuracy in critically ill populations[16].

APACHE-II score is a multiparametric system developed to assess disease severity and predict hospital mortality in critically ill patients. It incorporates patient age, chronic health status, and 12 physiological variables recorded within the first 24 hours of ICU admission. The total score ranges from 0 to 71, with higher values indicating a greater risk of mortality[16]. In this study, the APACHE-II score was used to evaluate the baseline severity of illness at the time of ICU admission.

The Tumor, Node, Metastasis (TNM) classification system is a universally accepted framework used to stage lung cancer. The T component reflects the size and local invasion of the primary tumor, N indicates regional lymph node involvement, and M denotes the presence of distant metastasis. In this study, staging was determined according to the 8th edition of the TNM classification[17]. Advanced-stage disease was defined as stage IV for non-small cell lung cancer and extensive-stage disease for small cell lung cancer.

Patients

Patients diagnosed with lung cancer and hospitalized in the ICU during the defined study period were included. Recurrent ICU admissions were excluded

from the analysis. Additional exclusion criteria included the following: incomplete clinical data, individuals younger than 18 years, ICU stays of less than 72 hours, elective postoperative ICU admissions, presence of non-pulmonary malignancies, severe hepatic or renal dysfunction, administration of albumin-containing intravenous fluids before blood sampling, and conditions associated with hypoalbuminemia, such as nephrotic syndrome.

Histopathological classification was performed, categorizing patients as having non-small cell lung cancer (NSCLC) or small cell lung cancer (SCLC). Staging was determined according to the TNM-8 classification system. Advanced-stage disease was defined as stage IV for NSCLC and extensive disease for SCLC. Detailed medical histories, including prior chemotherapy, radiotherapy, and surgical interventions related to lung cancer, were systematically recorded.

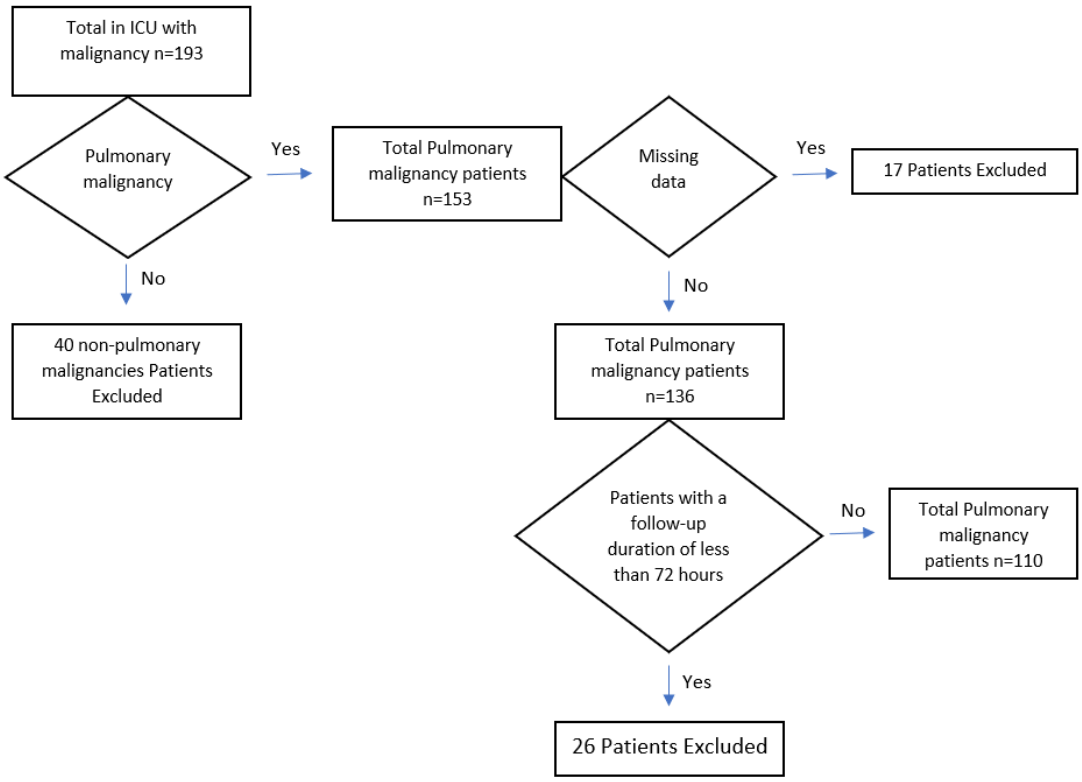

Figure 1. Flowchart of patients included in and excluded from this study

Statistical analysis

The data were analyzed with SPSS software version 27 (SPSS Inc., Chicago, IL). Patients were divided into two groups- survivors and non-survivors- based on 72-hour mortality status and were compared accordingly. To evaluate the distribution of continuous variables, the Kolmogorov-Smirnov test was applied. Data with a normal distribution were represented as mean values along with standard deviations, whereas non-normally distributed data were described using median values and interquartile ranges (25th–75th percentiles). Categorical variables were reported as frequencies and corresponding percentages. Group comparisons for continuous variables were analyzed using the Independent Samples t-test for normally distributed data, while the Mann-Whitney U test was applied for non-normally distributed variables. The analysis of categorical

variables was performed using the chi-square test. The ability of BAR, APACHE-II, and SOFA scores to predict mortality was assessed using Receiver Operating Characteristic (ROC) curve analysis, with the area under the curve (AUC) calculated to determine discrimination ability. Optimal cutoff points were identified, and corresponding sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) were reported. Univariate and multivariate Cox regression analyses were performed to identify independent factors associated with mortality. A p-value of less than 0.05 was considered indicative of statistical significance for all analyses. Variables with a p-value <0.1 in the univariate analysis were considered for inclusion in the multivariate Cox regression model, provided that their inclusion did not compromise model fit or stability.

RESULTS

A total of 193 patients with malignancies were initially screened for inclusion. Among them, 40 patients with non-pulmonary malignancies and 17 patients referred from external centers with incomplete clinical or laboratory data were excluded. Of the remaining 136 patients, 26 were excluded due to an ICU stay of less than 72 hours. Finally, 110 patients with histologically confirmed lung cancer and complete data were included in the study.

The inclusion criteria were being 18 years or older, admission to the ICU due to acute complications of lung cancer, and availability of BAR measurements at admission, 24, and 72 hours.

The exclusion criteria were ICU stays shorter than 72 hours, presence of non-pulmonary malignancies, severe hepatic or renal dysfunction, prior administration of albumin-containing intravenous fluids, and conditions associated with hypoalbuminemia such as nephrotic syndrome.

The demographic and clinical characteristics of the study population, along with the primary reasons for ICU admission, are summarized in Table 1.

Table 1. Demographic features, cancer stage, treatment modalities, and reasons for icu admission*

Variable	All Patients N=110 (100%) Mean±SD
Comorbidities	76 (69%)
Chronic Obstructive Pulmonary Disease	47 (42.7%)
SCLC**	10 (9.1%)
SCLC-Limited Stage	4 (40%)
SCLC-Extensive Stage	6 (60%)
NSCLC***	100 (90.9%)
NSCLC-Stage 1 and 2	26 (26%)
NSCLC-Stage 3	28 (28%)
NSCLC-Stage 4	46 (46%)
Time from Lung Cancer Diagnosis to ICU Admission (days)	617
Patients Receiving Immunotherapy	19 (17.3%)
Patients Receiving Targeted Therapy	2 (1.8%)
Patients Receiving Chemotherapy Only	74 (67.2%)
Patients Receiving Radiotherapy	50 (45.5%)
Operable Patients	12 (10.9%)
Patients Receiving Supportive Care Only	8 (7.3%)
Pneumonia	80 (72.7%)
Sepsis	44 (40%)
Septic Shock	14 (12.7%)
Respiratory Failure	110 (100%)
Hypercapnic Respiratory Failure	38 (34.5%)
Cancer Treatment-Related	8 (7.2%)
Cardiac Causes	12 (10.9%)
Need for Hemodialysis	20 (18.2%)

*ICU: Intensive Care Unit, **SCLC: Small Cell Lung Cancer, ***NSCLC: Non-Small Cell Lung Cancer

Table 2. Demographic and clinical characteristics of surviving and deceased patients

Variable	All Patients N=110 (100%) N (%), Mean±SD	Surviving Patients N=86 (78.2%) N (%), Mean±SD	Deceased Patients N=24 (21.8%) N (%), Mean±SD	p-value
Age, years	65.31±8.86	65.38±8.47	65.08±10.30	0.772
Male Gender	92 (83.6%)	73 (84.9%)	19 (79.2%)	0.505
SCLC*	10 (9.1%)	7 (8.1%)	3 (12.5%)	0.513
NSCLC**	100 (90.9%)	79 (91.9%)	21 (87.5%)	
Presence of Advanced Stage Disease	52 (47.2%)	39 (45.3%)	13 (54.2%)	0.446
Use of Immunotherapy	19 (17.3%)	16 (18.6%)	3 (12.5%)	0.486
Operable Malignancy	12 (10.9%)	10 (11.6%)	2 (8.3%)	0.482
SOFA Score***	5.14±3.61	4.66±3.57	6.83±3.27	<0.001
APACHE-II Score****	15.21±8.56	13.76±8.32	20.42±7.46	<0.001
Invasive Mechanical Ventilation Requirement	54 (49.1%)	33 (38.4%)	21 (87.5%)	<0.001
Vasopressor Requirement	26 (23.6%)	12 (14%)	14 (58.3%)	<0.001
Need for Renal Replacement Therapy	20 (18.2%)	12 (14%)	8 (33.3%)	0.030

*SCLC: Small Cell Lung Cancer, **NSCLC: Non-Small Cell Lung Cancer, ***SOFA: Sepsis-related Organ Failure Assessment, ****APACHE-II: Acute Physiology and Chronic Health Evaluation II

Table 3. Comparison of laboratory parameters and blood urea nitrogen to serum albumin ratio values at intensive care unit admission between surviving and deceased patients

Laboratory Findings	All Patients (N=110) Median (IQR*)	Surviving Patients (N=86) Median (IQR)	Deceased Patients (N=24) Median (IQR)	p-value
Blood Urea Nitrogen (mg/dL)	40 (25–61)	37 (23–52)	59 (34–190)	<0.001
Creatinine (mg/dL)	0.95 (0.75–1.27)	0.93 (0.72–1.15)	1.09 (0.80–1.79)	0.050
Albumin (g/dL)	3.30 (2.90–3.52)	3.30 (3.10–3.60)	3.00 (2.32–3.27)	<0.001
BAR** at Admission	14.18 (7.87–21.49)	12.22 (6.74–17.44)	20.57 (10.39–34.96)	0.002
BAR at 24 Hours	15.33 (8.89–24.56)	13.18 (8.04–21.77)	24.17 (16.27–46.39)	<0.001
BAR at 72 Hours	15.89 (9.70–28.16)	13.19 (9.00–23.58)	35.14 (17.16–56.29)	<0.001

*IQR: Interquartile range, ** BAR: Blood Urea Nitrogen to Serum Albumin Ratio

BAR values were measured at admission, 24 hours, and 72 hours, and comparisons were made based on mortality status (Table 3). The analysis showed that BAR levels were markedly higher at all time points in non-survivors compared to survivors.

A detailed comparison of age, gender, cancer type, treatment modalities, and clinical scores according to mortality status is provided in Table 2, highlighting key differences and clinical implications.

The blood test results obtained at admission were compared based on mortality status and are presented in Table 3. Elevated blood urea nitrogen levels, along with decreased albumin levels, were significantly associated with mortality (p<001).

The ROC curve displaying the ability of BAR monitoring to estimate death risk is presented in Figure 2.

The findings of the ROC analysis are detailed in Table 4, where the sensitivity, specificity, and AUC values of BAR at different time intervals (admission, 24 hours, and 72 hours) were assessed. The analysis indicated significant predictive capabilities for mortality at each time point.

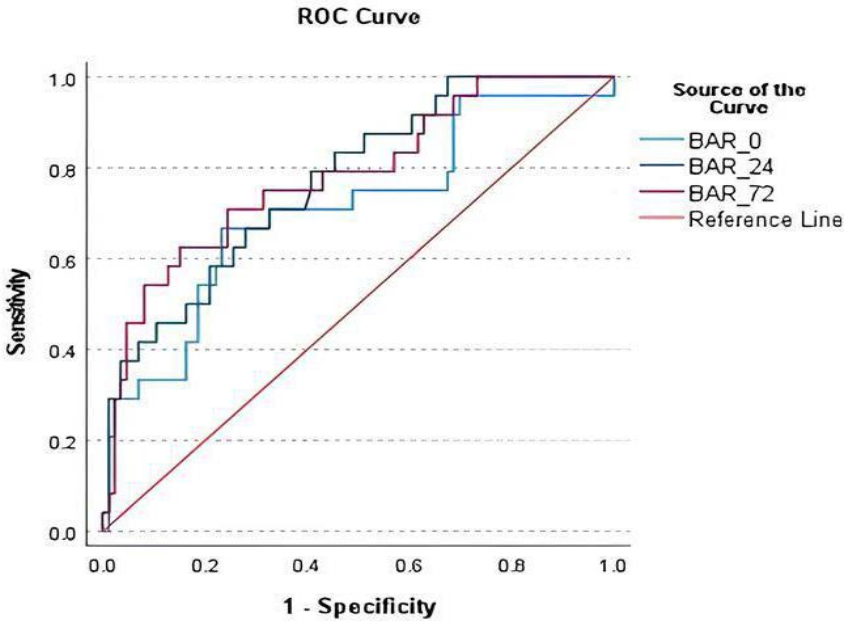

Figure 2. ROC curve analysis of BAR measurements for mortality prediction

Table 4. Comparative ROC analysis of SOFA, APACHE-II, and time-dependent BAR measurements for mortality prediction*

Parameter**	AUC (95% CI)	Cut-Off Value	Sensitivity (%)	Specificity (%)	PPV	NPV	LR +	LR -	p
SOFA Score	0.709 (0.595–0.822)	5.50	66.67	68.60	37.2	88.1	2.12	0.49	<0.001
APACHE-II	0.742 (0.642–0.841)	15.50	75.0	65.12	37.5	90.3	2.15	0.38	<0.001
BAR at Admission	0.709 (0.583–0.834)	18	66.67	76.74	44.4	89.2	2.87	0.63	0.002
BAR at 24 Hours	0.773 (0.671–0.874)	20	66.67	72.09	40	88.6	2.39	0.46	<0.001
BAR at 72 Hours	0.783 (0.675–0.891)	27	62.50	84.88	53.6	89.0	4.13	0.44	<0.001

*ROC: Receiver Operating Characteristic, SOFA: Sepsis-related Organ Failure Assessment, APACHE-II: Acute Physiology and Chronic Health Evaluation II, BAR: Blood Urea Nitrogen to Serum Albumin Ratio **AUC: Area Under the Curve, CI: Confidence Interval, PPV: Positive Predictive Value, NPV: Negative Predictive Value, LR+: Positive Likelihood Ratio, LR-: Negative Likelihood Ratio

The APACHE-II score, SOFA score, and BAR were assessed to estimate mortality risk among the included patients, and the corresponding ROC analysis curve is presented (Figure 3).

The predictive performance of the APACHE-II score, SOFA score, and the 72-hour BAR value for mortality was evaluated through ROC analysis, with the findings summarized in Table 4.

For the APACHE-II score, the optimal threshold for predicting mortality was identified as 15.50, demonstrating an AUC of 0.742, which was statistically significant ($p<0.001$). Similarly, the SOFA score exhibited an optimal cutoff value of 5.50, achieving an AUC of 0.709, indicating a significant predictive capability for mortality ($p<0.001$). The optimal cut-off for the 72-hour BAR value was

identified as 27, with an AUC of 0.783, as demonstrated by the ROC analysis. This indicates that the 72-hour BAR measurement is a strong predictor of mortality.

Univariate and multivariate Cox regression models were applied to identify clinical and laboratory factors associated with mortality. The findings from these analyses are summarized in Table 5, highlighting the significant parameters influencing patient outcomes. Although SOFA and APACHE-II scores met the statistical threshold for inclusion ($p<0.1$), they were not incorporated into the final multivariate model due to their negative impact on model stability and overall fit. Therefore, these variables were excluded to preserve the validity and interpretability of the final model.

Table 5. Results of cox regression analysis to identify factors associated with mortality

Variable	Univariate Cox Regression		Multivariate Cox Regression	
	HR (95%CI) *	p-value	HR (95%CI)	p-value
Disease stage	1.223(0.730-2.048)	0.445		
Renal Replacement Therapy	2.250 (0.963-5.257)	0.061		
SOFA Score	1.093 (1.014-1.179)	0.021		
APACHE-II Score	1.062 (1.020-1.105)	0.003		
BAR at 72 Hours**	1.022 (1.011-1.033)	<0.001	1.014 (1.002-1.027)	0.026
Need for IMV**	7.000 (2.088-23.468)	0.002	4.174 (1.113-15.652)	0.034
Vasopressor Therapy	4.523 (2.009-10.183)	<0.001	1.958 (0.773-4.960)	0.156

*HR: Hazard Ratio, CI: Confidence Interval **BAR: Blood Urea Nitrogen to Serum Albumin Ratio ***IMV: Invasive Mechanical Ventilation

According to the results of the univariate analysis, while disease stage was not associated with mortality, both SOFA and APACHE II scores showed a significant association with mortality. Moreover, requiring invasive mechanical ventilation (IMV) and vasopressor support was linked to an increased risk of mortality. A notable relationship was also observed between elevated BAR levels and mortality. Conversely, the requirement for hemodialysis did not demonstrate a notable statistical effect on mortality outcomes.

The multivariate Cox regression model included the two parameters that demonstrated the greatest impact in the univariate analysis. The purpose of this model was to evaluate the independent predictive significance of BAR in conjunction with other clinical factors. Multivariate analysis confirmed that elevated BAR levels and the necessity for IMV emerged as independent risk factors for mortality, underscoring their critical role in patient prognosis.

DISCUSSION

In this study, we investigated clinical and biochemical predictors of mortality in lung cancer patients admitted to the intensive care unit, with a particular focus on the time-dependent prognostic value of the BAR. Our findings demonstrated that elevated BAR levels-especially at 72 hours-were significantly associated with 30-day mortality, and that this parameter may have meaningful predictive potential when compared to traditional scoring systems such as APACHE II and SOFA. This suggests that assessing not only the baseline value of BAR but also its dynamic trajectory over time may provide a more refined understanding of patient prognosis. Previous studies have reported an association between BAR and mortality in various critical illness contexts, including sepsis, pneumonia, and acute exacerbations of COPD[7,18,19]. However, data addressing this association in the setting of malignancy-related organ dysfunction remain limited. Our study contributes to this gap by evaluating the prognostic significance of BAR at multiple time points in a population of critically ill lung cancer patients. Given that APACHE II and SOFA scores were excluded from the final multivariate model due to their negative impact on model stability, the integration of easily obtainable biomarkers such as BAR into clinical decision-making may offer practical advantages, particularly in resource-limited settings. Moreover, the finding that the need for invasive mechanical ventilation was an independent predictor of mortality aligns with previous research and highlights the dominant role of acute physiological deterioration in driving outcomes in this population[20]. These results underscore the importance of considering not only

tumor burden but also the severity of systemic dysfunction in the ICU management of patients with lung cancer. The need for prospective, multicenter studies with larger sample sizes persists in order to validate these findings and further clarify the clinical utility of BAR in oncology-focused critical care.

With the emergence of targeted therapies and advances in supportive care, survival rates among ICU patients admitted for cancer-related acute medical conditions have significantly increased globally. Over the past decade, this increase in survival rates has been demonstrated in numerous studies[21]. Currently, approximately 10-20% of ICU admissions involve cancer patients[21,22]. Consequently, the management of these patients has become a major public health concern. Research on lung cancer indicates that short-term mortality in the ICU is more closely related to the severity of organ dysfunction compared to the characteristics of the malignancy[23]. Aligned with these observations, our study likewise demonstrated that the primary determinants of in-hospital mortality were acute illness severity rather than the cancer stage.

Indeed, our multivariate analysis results indicate that when disease stage is included in the model, acute clinical conditions (such as APACHE II and SOFA scores, as well as the need for invasive mechanical ventilation) remain independently more decisive predictors of mortality. In our study cohort, 21.8% of patients experienced mortality within 30 days, and a significant association was identified particularly between the need for organ support (e.g., mechanical ventilation, vasopressor use) and mortality. These findings further highlight that in the intensive care management of patients with malignancies, it is crucial to focus not only on tumor burden but also on the severity of accompanying physiological derangements.

In the study by Özpınar et al., which focused on prognostic factors in lung cancer patients receiving intensive care, mechanical ventilation and APACHE-II scores were determined to be significant predictors of survival[20]. Similarly, Park et al. found that the requirement for mechanical ventilation served as an independent predictor of mortality risk in lung cancer patients[24]. In alignment with these findings, our study demonstrated that SOFA and APACHE-II scores, as well as the necessity for IMV, were significantly correlated with mortality risk.

Multivariate analysis further confirmed that IMV was an independent predictor of mortality. Although vasopressor therapy showed statistical significance in univariate analysis, it did not remain an independent predictor in multivariate analysis. This suggests that the requirement for vasopressor support may be influenced by intricate interactions with other clinical parameters. These results highlight the complexity of managing lung cancer patients in critical care settings. BUN is widely recognized not only as a marker of renal function but also as an indicator of neurohormonal activity. Elevated BUN levels have been linked to impaired cardiorenal function and heightened neurohormonal activation, both of which contribute to increased mortality risk across various medical conditions[7,25]. Previous studies have demonstrated that elevated BUN is associated with higher in-hospital mortality rates among ICU patients hospitalized due to acute exacerbations of chronic obstructive pulmonary disease (AECOPD)[7]. Aligned with these results, our study likewise demonstrated a strong correlation between higher BUN levels and mortality among lung cancer patients receiving intensive care.

Albumin is essential for preserving intravascular oncotic pressure and plays a pivotal role in regulating inflammation, apoptosis, and oxidative stress[26,27]. Its involvement in cancer pathogenesis is multifaceted. Research focusing on NSCLC has indicated that albumin-based inflammatory markers may serve as useful prognostic indicators[27]. Furthermore, recent findings have demonstrated an inverse relationship between albumin levels and lung cancer risk[26]. Hypoalbuminemia is also well-established as an independent predictor of mortality across various clinical conditions[28,29]. Consistent with these observations, our study identified a significant association between low albumin levels and mortality in lung cancer patients admitted to the ICU.

BAR has recently gained recognition as a prognostic marker in cardiovascular diseases[30,31] and is increasingly recognized for its utility in assessing critically ill patients[32,33]. Zeng et al.'s study highlighted that elevated BAR functions as a reliable and independent marker for predicting mortality during hospitalization and within 90 days in patients with AECOPD[34]. Similarly, Wang et al. demonstrated that BAR serves as a valuable prognostic marker in ICU patients diagnosed with sepsis[35].

In our study, BAR proved to be a significant biomarker for predicting mortality among the individuals with lung cancer receiving intensive care.

Assessing BAR at admission, 24 hours, and 72 hours allowed for a more nuanced understanding of its temporal relationship with mortality. Our results showed that BAR values fluctuated over time, consistently correlating with mortality outcomes. ROC analysis revealed that the 72-hour BAR value offered the highest predictive accuracy, underscoring its potential as a dynamic and reliable tool for mortality risk assessment in later stages of critical illness. This dynamic nature of BAR highlights its usefulness for ongoing monitoring rather than being merely a static measurement.

The retrospective design of this study may have introduced certain limitations, particularly in terms of data collection, as access to some clinical details was restricted. Moreover, the single-center design limits the generalizability of the findings to wider patient populations. The study sample was relatively small, owing to specific inclusion and exclusion criteria. Additionally, the exclusion of patients with a follow-up period of less than 72 hours might have contributed to an underestimation of overall mortality rates. To achieve greater robustness and consistency, further studies with larger, multi-center cohorts are needed to validate these findings.

In conclusion, this study demonstrated that BAR serves as a robust biomarker for predicting mortality in lung cancer patients admitted to the ICU. The strong prognostic value of the 72-hour BAR measurement highlights its potential as a practical and dynamic tool for clinical monitoring and decision-making. Its simplicity in calculation and application further supports its utility in intensive care settings. Nevertheless, larger multicenter studies are warranted to validate these findings and to solidify the role of BAR in critical care management. Future research should explore the integration of BAR into composite prognostic models, evaluate its temporal dynamics in relation to other inflammatory and nutritional biomarkers, and determine its impact on early therapeutic decision-making in critically ill oncology patients.

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