Original Article

Blood urea nitrogen-to-albumin ratio independently predicts 30-day mortality in acute respiratory failure patients: a retrospective cohort study

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Background: It is crucial to identify patients at high risk for acute respiratory failure (ARF) to provide appropriate and optimal clinical treatment. While previous studies have explored the use of prognostic biomarkers based on a combination of blood urea nitrogen (BUN) and albumin levels, no reports to date have evaluated its utility across a wide range of ARF etiologies in a large and diverse critical care population. Therefore, we aimed to ascertain the association between the BUN-to-albumin ratio (BAR) and mortality in these patients.

Methods: Data recorded in the first 24 h following intensive care unit (ICU) admission, including demographics, vital signs, laboratory test results, comorbidities, and score systems were retrieved from the Medical Information Mart for Intensive Care IV (MIMIC-IV) database. A general additive model was used to determine whether there was a non-linear relationship between BAR and 30-day mortality. A multivariate Cox analysis was performed to measure the association between them.

Results: The study enrolled 9,734 patients with ARF. In comparison to survivors, non-survivors exhibited higher BAR [10.79 (6.25–18.81) *vs.* 7.35 (4.48–13.62), P<0.001]. The correlation between baseline BAR and 30-day all-cause mortality in patients with ARF was non-linear, with a significant inflection point (11.76 mg/g). The Kaplan-Meier curve demonstrated that ARF patients had higher 30-day all-cause mortality rates when they had higher BAR levels (>11.76 mg/g) with hazard ratio (HR) 1.54 [95% confidence interval (CI): 1.39–1.70].

Conclusions: A high BAR was linked to a higher risk of mortality in ARF patients. BAR is a straightforward and possibly useful prognostic biomarker for ARF.

Keywords: Blood urea nitrogen and albumin ratio; acute respiratory failure (ARF); Medical Information Mart for Intensive Care (MIMIC); mortality

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Introduction

Acute respiratory failure (ARF) is a common and prevalent life-threatening medical condition (1). More than 50% of severely ill patients admitted to the intensive care unit (ICU) suffer from ARF due to respiratory disease or pulmonary vascular disease (2). There are several other etiologies of ARF, including sepsis, congestive heart failure, and central nervous system depression (3). The in-hospital mortality rate of ARF patients who require invasive mechanical ventilation is 33–37% (4). The precise prediction of ARF severity may facilitate the early identification of patients approaching critical condition, enabling timely interventions that could potentially reduce the duration of their ICU stay and enhance their probability of survival with reduced morbidity (5). Therefore, biomarkers that can accurately and rapidly predict ARF mortality are needed.

However, predictive biomarkers for therapeutic decisions are critically deficient. Interleukin-1 (IL-1), IL-6, IL-8, tumor necrosis factor alpha (TNF-α), and Galectin-3 have all been linked to the prognosis of ARF patients (6,7); however, these biomarkers are not included in routine laboratory tests and results cannot be obtained immediately. Previous studies have shown that blood urea nitrogen (BUN) and albumin, two routinely used laboratory indicators, can predict the severity of disease-related mortality (8,9). BUN is a significant indicator of dehydration status and is typically used to evaluate renal function and hypovolemia. It is an important parameter for several types of severity assessment scores in community acquired pneumonia, such as SMARTCOP (10), REA-ICU (11), and CURB-65 (12). Elevated BUN levels are associated with poor clinical results in patients with community-acquired pneumonia (CAP) and heart failure (13,14). Albumin is an acute-phase reactant that is usually used to assess malnutrition (15) and plays many physiological roles, such as regulating osmotic pressure (16), acid-base balance (17) and vascular permeability (18). In addition, it is an antioxidant involved in the process of destroying oxygen radicals produced during oxidative stress (18).

Recent researches have shown that BUN-to-albumin ratio (BAR) can be used as a predictor of in-hospital mortality in corona virus disease 2019 (COVID-19) patients in the emergency department and aspiration pneumonia patients (19,20). Additionally, BAR is found to be a more accurate predictor than BUN or albumin levels alone. However, there is no research that employs the BAR to forecast ARF patient mortality and its applicability to a broader spectrum of ARF etiologies remains underexplored. Therefore, this study aimed to explore how BAR may be used to predict in-hospital and 30-day mortality in patients with ARF. We present this article in accordance with the STROBE reporting checklist (available at https://jtd.amegroups.com/article/view/10.21037/jtd-24-298/rc).

Highlight box

Key findings

- The study finds out that the correlation between baseline blood urea nitrogen-to-albumin ratio (BAR) and 30-day all-cause mortality in patients with acute respiratory failure (ARF) was non-linear, with a significant inflection point (11.76 mg/g). The Kaplan-Meier curve demonstrated that ARF patients had higher 30-day all-cause mortality rates when they had higher BAR levels (>11.76 mg/g).

What is known and what is new?

- Previous studies have explored the use of prognostic biomarkers based on a combination of blood urea nitrogen (BUN) and albumin levels in patient with respiratory disease.
- We are the first to investigate the combined use of BUN and albumin as a prognostic indicator for ARF patients across a diverse range of etiologies within a large-scale dataset.

What is the implication, and what should change now?

- A high BAR was linked to a higher risk of mortality in ARF patients, indicating that BAR could serve as a straightforward and possibly useful prognostic biomarker for ARF. Additional studies are warranted to evaluate this biomarker panel and to further elucidate the underlying biological mechanisms involved.

Methods

Study design

The Medical Information Mart for Intensive Care IV (MIMIC-IV) databases, built by the Massachusetts Institute of Technology and provided by Beth Israel Deaconess Medical Center (BIDMC), are large-scale, retrospective resources for critical care research. Patient

data were anonymized in accordance with the Health Insurance Portability and Accountability Act (HIPAA) Safe Harbor Provision. This study utilized data retrieved from the MIMIC database (https://physionet.org/content/mimiciv/2.2/). After finishing the web-based training courses and the Protecting Human Research Participants examination (No. 36208651), we obtained permission to extract data from MIMIC-IV database. Because the study had a retrospective design, the need for patient consent was waived. The study was approved by the Medical Research Ethics Committee of Changde Hospital, Xiangya School of Medicine, Central South University (The First People's Hospital of Changde City) (No. 2022-048-1). The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013).

Patients

The analysis included all patients (≥18 years old) in the database diagnosed with ARF using the International Classification of Disease, Ninth Revision (ICD-9) and ICD-10 codes. The detailed ICD-9 codes were "51881," and the detailed ICD-10 codes were "J960", "J9600", "J9601, and "J9602". Patients who met any of the following criteria were excluded: (I) repeated hospital or ICU admissions, (II) ICU stays of less than 24 h, and (III) missing variables.

Data extraction

The following information was extracted for each patient: age at admission, sex, ethnicity, body mass index (BMI), comorbidities (including atrial fibrillation, myocardial infarction, congestive heart failure, chronic pulmonary disease, diabetes, renal disease, severe liver disease, malignant cancer, and metastatic solid tumor), first 24-hour Sequential Organ Failure Assessment (SOFA) score, Acute Physiology Score III (APSIII), and Oxford Acute Severity of Illness Score (OASIS) after admission to the ICU, vital signs [including temperature, pondus hydrogenii (PH), oxygen saturation (SO_2), partial pressure of oxygen (PO_2), and partial pressure of carbon dioxide (PCO_2)], laboratory tests, mechanical ventilation (including non-invasive ventilation, invasive ventilation, high flow, and oxygen), vasopressor use, and 30-day mortality.

Statistical analysis

Continuous variables were presented as the mean (SD) or median [interquartile range (IQR)], and categorical variables were expressed as percentages. In two groups, when the baseline characteristics were continuous variables, Student's *t*-test (normal distribution) or Mann-Whitney test (non-normal distribution) was used to compare them, and when the baseline characteristics were categorical variables, the Chi-squared test was used. For multiple groups, continuous variables were compared using the analysis of variance (ANOVA) and Kruskal Wallis rank sum test.

A generalized additive model was used to evaluate whether there was a non-linear association between BAR and 30-day mortality. Segmented regression, also known as piecewise regression, was applied. This method fits each interval with a different line segment by identifying one or more breakpoints where the slope of the relationship changes, thereby providing a better fit to the data. To ascertain whether a threshold exists, the log-likelihood ratio test was employed to compare the one-line (non-segmented) model to the segmented regression model. To investigate the independent effects of BAR on in-hospital and 30-day mortality, multivariate Cox analysis was used with crude and full models. Age, ethnicity, sex, severe liver disease, white blood cell (WBC) count, creatine level, platelet count, malignant cancer, SOFA score, vasoactive use, and mechanical ventilation were included as adjusting variables. Kaplan-Meier (K-M) methods and log-rank tests were used to assess the differences in survival rates between each group of patients with varied BAR at admission. Receiver operating characteristic (ROC) analysis was performed to determine the 30-day mortality predictive power of the BUN, albumin, and BAR levels. Subgroup analysis was conducted to determine whether there were any differences among the subgroups, and their interactions were examined.

The statistical software packages R (http://www.R-project.org) and Empower Stats (http://www.empowerstats.com version R.4.3.2) were used for data analyses. Statistical significance was considered when P value was <0.05.

Results

Characteristics of patients

A total of 9,734 patients with ARF were included in the study cohort according to the inclusion and exclusion criteria, with 7,153 survivors and 2,581 non-survivors stratified by 30-day mortality (*Table 1*). A flowchart for selecting the study participants is presented in *Figure 1*. The BAR in the survivor group was significantly higher

Table 1 Baseline characteristics between survivors and no-survivors

Characteristics	Survivor (n=7,153)	Non-survivor (n=2,581)	P
Age (years)	64.77±16.82	70.51±14.98	<0.001
Gender			0.40
Male	3,936 (55.03)	1,445 (55.99)	
Female	3,217 (44.97)	1,136 (44.01)	
Ethnicity			<0.001
White	4,807 (67.20)	1,687 (65.36)	
Black/African American	810 (11.32)	209 (8.10)	
Asian	194 (2.71)	76 (2.94)	
Unknown	1,342 (18.76)	609 (23.60)	
BMI* (kg/m^2)	28.01 (24.06–33.23)	27.14 (23.43–32.37)	<0.001
Comorbidity			
Atrial fibrillation	2,166 (30.28)	977 (37.85)	<0.001
Myocardial infarct	1,262 (17.64)	563 (21.81)	<0.001
Congestive heart failure	2,707 (37.84)	941 (36.46)	0.21
Chronic pulmonary disease	2,393 (33.45)	782 (30.30)	0.003
Renal disease	1,744 (24.38)	693 (26.85)	0.01
Diabetes	1,739 (24.31)	599 (23.21)	0.26
Malignant cancer	988 (13.81)	584 (22.63)	<0.001
Severe liver disease	461 (6.44)	329 (12.75)	<0.001
Metastatic solid tumor	377 (5.27)	362 (14.03)	<0.001
Charlson comorbidity	5.93 (4.00–8.00)	7.23 (5.00–9.00)	<0.001
Severity scores			
APSIII*	48.00 (36.00–64.00)	70.00 (51.00–91.00)	<0.001
SOFA*	6.00 (4.00–9.00)	9.00 (6.00–13.00)	<0.001
OASIS	36.91±8.96	42.35±9.19	<0.001
Vital signs			
PH*	7.32 (7.24–7.38)	7.28 (7.18–7.37)	<0.001
SO_2 (%)	82.79±17.95	79.54±19.97	<0.001
Temperature (℃)	36.84±0.92	36.58±1.09	<0.001
PO_2min* (mmHg)	61.00 (40.00–89.00)	55.00 (38.00–81.00)	<0.001
PCO_2max* (mmHg)	47.00 (40.00–57.00)	47.00 (39.00–58.00)	0.23
Albumin (g/dL)	3.23±0.70	2.99±0.74	<0.001
BUN* (mg/dL)	22.00 (14.00–36.00)	28.00 (18.00–47.00)	<0.001
WBC* (10^9 cells/L)	11.60 (8.20–16.10)	12.40 (8.40–17.70)	<0.001
Platelets* (10^9 cells/L)	212.00 (150.00–282.00)	192.00 (119.00–276.75)	<0.001

Table 1 *(continued)*

Table 1 *(continued)*

Characteristics	Survivor (n=7,153)	Non-survivor (n=2,581)	P
Glucose* (mg/dL)	135.00 (109.00–178.00)	140.00 (109.00–189.00)	0.25
LDH* (U/mL)	300.00 (225.00–448.00)	373.50 (259.00–641.75)	<0.001
Lactate* (mmol/L)	2.00 (1.30–3.30)	2.80 (1.70–5.45)	<0.001
Creatinine* (mg/dL)	1.10 (0.80–1.70)	1.30 (0.90–2.10)	<0.001
BAR* (mg/g)	7.35 (4.48–13.62)	10.79 (6.25–18.81)	<0.001
Mechanical ventilation			<0.001
Non-invasive ventilation	219 (3.15)	37 (1.49)	
Invasive ventilation	4,316 (62.11)	1,766 (71.21)	
High flow	876 (12.61)	294 (11.85)	
Oxygen	1,538 (22.13)	383 (15.44)	
Vasopressor use	313 (4.38)	223 (8.64)	<0.001

Continuous variables conforming to normal distribution are expressed as mean ± standard deviation, whereas those not adhering to normal distribution are presented as median (interquartile range). Categorical variables are expressed as n (percentage). Skewed variables are marked with an asterisk. BMI, body mass index; ASPSIII, acute physiology score III; SOFA, sequential organ failure assessment; OASIS, Oxford Acute Severity of Illness Score; PH, pondus hydrogenii; SO_2, oxygen saturation; PO_2, partial pressure of oxygen; PCO_2, partial pressure of carbon dioxide; BUN, blood urea nitrogen; WBC, white blood cell; LDH, lactate dehydrogenase; BAR, blood urea nitrogen-to-albumin ratio.

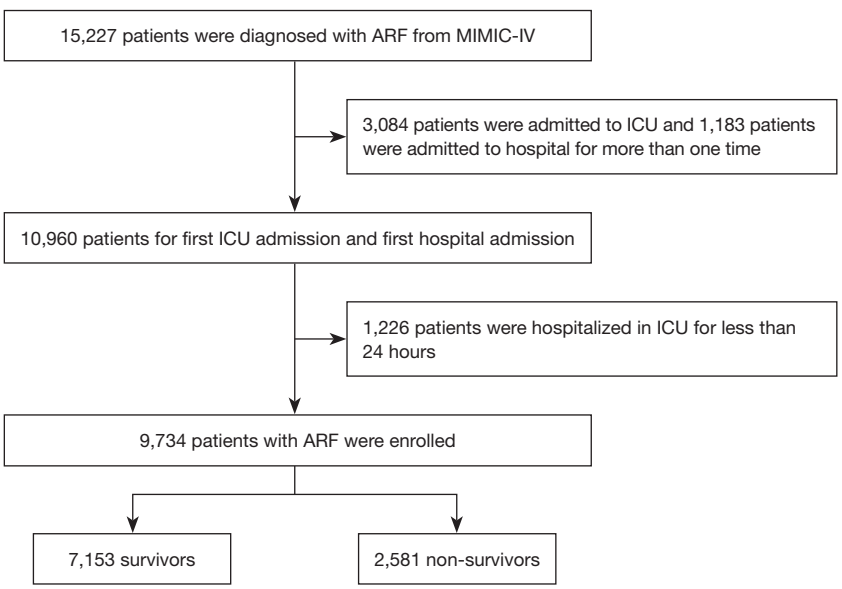

Figure 1 Flow chart of the current study. ARF, acute respiratory failure; MIMIC-IV, Medical Information Mart for Intensive Care IV; ICU, intensive care unit.

than that in the non-survivor group [10.79 (6.25–18.81) *vs.* 7.35 (4.48–13.62), P<0.001]. In addition, age, ethnicity, BMI, comorbidities including atrial fibrillation, myocardial infarction, chronic pulmonary disease, renal disease, malignant cancer, severe liver disease, and metastatic solid tumor; severity scores including APSIII, SOFA, and OASIS; vital signs including PH, SO_2, and temperature; laboratory tests including albumin, BUN, WBC, platelets, lactate

Table 2 Outcomes of the patients with ARF across different grouping methods of the baseline BAR

Exposure	Time in hospital (days)		Time in ICU (days)		In-hospital mortality		30-day mortality	
	Median (IQR)	P value	Median (IQR)	P value	n (%)	P value	n (%)	P value
BAR tertile		0.001		<0.001		<0.001		<0.001
Low	9.82 (5.35–17.71)		4.30 (2.26–9.05)		360 (19.81)		259 (14.25)	
Middle	10.78 (5.90–18.80)		4.64 (2.44–9.08)		529 (29.08)		356 (19.57)	
High	11.45 (5.99–19.80)		4.98 (2.69–9.77)		693 (38.08)		500 (27.47)	
BAR categorical		0.02		<0.001		<0.001		<0.001
≤11.76 mg/g	10.28 (5.70–18.21)		4.49 (2.31–9.07)		857 (23.99)		594 (16.63)	
>11.76 mg/g	11.42 (5.92–19.77)		4.97 (2.69–9.76)		725 (38.48)		521 (27.65)	

ARF, acute respiratory failure; BAR, blood urea nitrogen-to-albumin ratio; ICU, intensive care unit; IQR, interquartile range.

dehydrogenase (LDH), lactate, creatinine, and PO_2; and treatment received (mechanical ventilation and vasopressor use) were significantly different between the two groups.

Association between BAR and clinical outcome in ARF patients

Table S1 displays the results of univariate Cox regression analysis for 30-day mortality. Age, comorbidities including malignant cancer and severe liver disease, albumin, BUN, creatinine, WBC, SOFA, platelets, vasopressor use, and BAR were significantly associated with 30-day mortality in patients with ARF.

We divided all patients into several groups based on the tertile of BAR and the threshold determined from the segmented regression model (results of threshold analysis are provided in Table S2). *Table 2* displays the clinical outcomes of the subjects with different BAR values. Patients with high BAR had longer in-hospital and ICU stays and higher in-hospital and 30-day mortality rates.

We demonstrated the relationship between baseline BAR and the risk of 30-day mortality using smooth curve fitting (*Figure 2*). Taking BAR as a continuous variable, the association between baseline BAR and the risk of 30-day mortality was non-linear with a significant inflection point (11.76); after adjusting for age, sex, ethnicity, SOFA score, and other variables, the tendency still existed.

This finding was further evaluated using multivariable Cox regression analysis, which is displayed in *Table 3*. The unadjusted hazard ratio (HR) [95% confidence interval (CI)] of BAR as a continuous variable was 1.02 (95% CI: 1.01–1.02). After model I was adjusted for age, sex, and ethnicity, the hazard ratio was 1.02 (95% CI: 1.01–1.02). After model II was adjusted for age, sex, ethnicity, comorbidities including malignant cancer and severe liver disease, creatine, WBC, platelets, SOFA score, mechanical ventilation, and vasoactive use, the hazard ratio was 1.01 (95% CI: 1.01–1.02). When BAR was assessed as tertiles, the unadjusted hazard ratio of the middle group (1.39; 95% CI: 1.22–1.59) and the high group (1.79; 95% CI: 1.57–2.03) was higher than that of patients in the low BAR group. After model I, the hazard ratio of the middle group (1.24; 95% CI: 1.08–1.42) and the high group (1.60; 95% CI: 1.40–1.82) was higher than that of the low BAR group. After model II, the hazard ratio of the middle group (1.03; 95% CI: 0.89–1.18) and the high group (1.28; 95% CI: 1.10–1.49) was higher than that of the low BAR group. When BAR was categorized to two groups according to threshold determined from segmented regression model, patients in the high BAR group (>11.76 mg/g) had significantly higher risk of 30-day mortality than those in the low BAR group (≤11.76 mg/g), with the unadjusted model (HR 1.54, 95% CI: 1.39–1.70), adjusted model I (HR 1.45, 95% CI: 1.31–1.60) and adjusted model II (HR 1.29, 95% CI: 1.15–1.45).

The ROC curve for predicting 30-day mortality of ARF patients is provided in Table S3 and Figure S1. The area under the receiver operating characteristic curve (AUC) for the BAR was 0.704 (95% CI: 0.692–0.714) with 61.8% sensitivity and 69.2% specificity. As for BUN, its AUC value was found to be 0.647 (95% CI: 0.634–0.659) with 59.4% sensitivity and 61.9% specificity. For Albumin, its AUC was found to be 0.641 (95% CI: 0.629–0.653) with 58.2% sensitivity and 62.9% specificity.

The Kaplan-Meier curve demonstrated that ARF patients had higher 30-day all-cause mortality rates when they had higher BAR levels (>11.76 mg/g). The log-rank

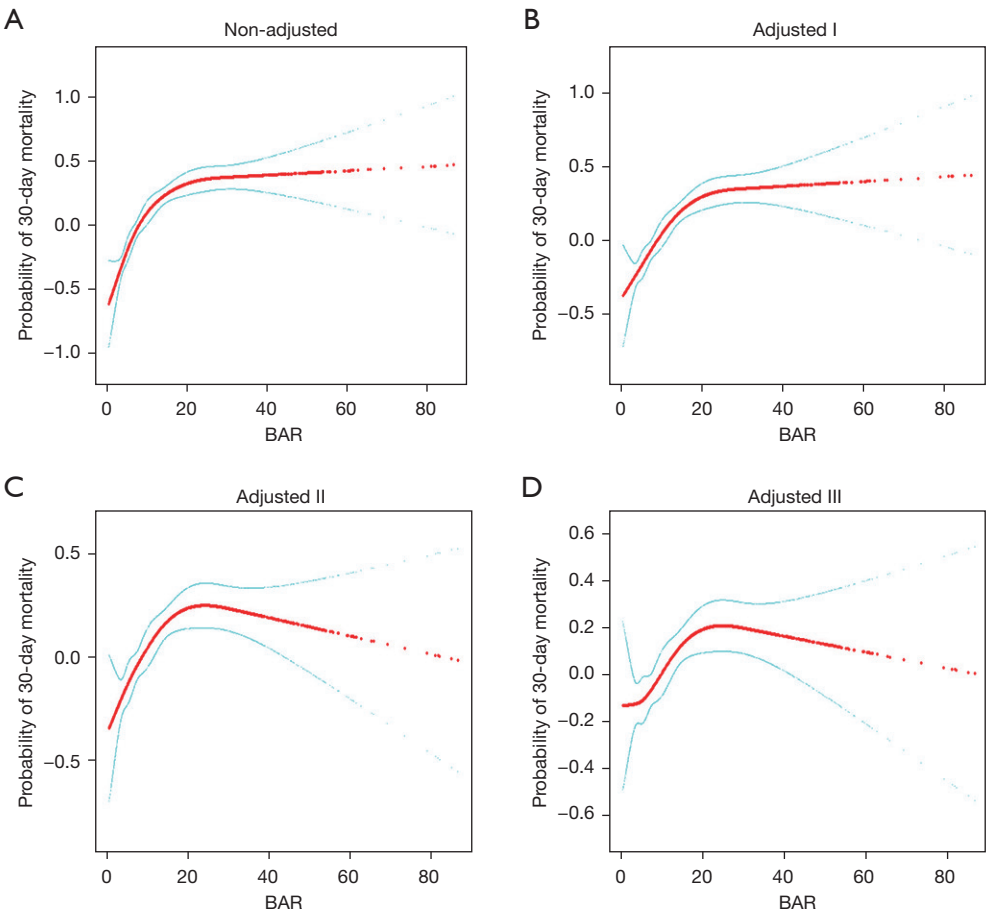

Figure 2 Association between BAR and clinical outcomes for patients with ARF. (A) Non-adjusted model; (B) adjusted I model: adjusted for age, gender and ethnicity; (C) adjusted II model: adjusted for age, gender, ethnicity, mild and severe liver disease, renal disease, congestive heart fail, chronic pulmonary disease and SOFA; (D) adjusted III model: adjusted for age, gender, ethnicity, mild and severe liver disease, renal disease, congestive heart fail, chronic pulmonary disease, SOFA, vasopressor use, mechanical ventilation, WBC, platelets, PH, PCO_2 and PO_2. BAR, blood urea nitrogen-to-albumin ratio; ARF, acute respiratory failure; SOFA, Sequential Organ Failure Assessment; WBC, white blood cell; PH, pondus hydrogenii; PCO_2, partial pressure of carbon dioxide; PO_2, partial pressure of oxygen.

Chi-square was 74.051, with a highly significant P value <0.001. Furthermore, a significant difference was found when the BAR was divided into tertiles (low, middle, and high groups), yielding a log-rank Chi-square of 82.513 and a P value <0.001, as shown in *Figure 3*.

Subgroup analysis and interaction

Subgroup analyses for the relationship between BAR and 30-day all-cause mortality were performed according to age, sex, ethnicity, and comorbidities including malignant cancer, severe liver disease, renal disease, chronic pulmonary disease, congestive heart failure, vasopressor use, and mechanical ventilation. The association between BAR and 30-day mortality in patients with ARF was not observed in the severe liver disease group [odds ratio (OR) 1.01, 95% CI: 0.99–1.02, P=0.27] and vasopressor use group (OR 1.00, 95% CI: 0.98–1.02, P=0.91). In addition, no significant interactions were found for age, sex, ethnicity, comorbidities, mechanical ventilation, or vasopressor use (*Table 4*).

Discussion

The findings of this study indicate a significant positive association between BAR and 30-day mortality in patients

Table 3 Association of BAR with 30-day mortality

Exposure	Non-adjusted		Adjust I		Adjust II	
	HR (95% CI)	P value	HR (95% CI)	P value	HR (95% CI)	P value
BUN	1.01 (1.01, 1.01)	<0.001	1.01 (1.00, 1.01)	<0.0001	1.00 (1.00, 1.01)	<0.001
Albumin	0.77 (0.72, 0.82)	<0.001	0.76 (0.71, 0.81)	<0.0001	0.87 (0.81, 0.94)	<0.001
BAR per 1sd	1.02 (1.01, 1.02)	<0.001	1.02 (1.01, 1.02)	<0.0001	1.01 (1.01, 1.02)	<0.001
BAR tertile						
Low (ref)	1.0		1.0		1.0	
Middle	1.39 (1.22, 1.59)	<0.001	1.24 (1.08, 1.42)	0.0024	1.03 (0.89, 1.18)	0.71
High	1.79 (1.57, 2.03)	<0.001	1.60 (1.40, 1.82)	<0.0001	1.28 (1.10, 1.49)	0.002
BAR categorical						
≤11.76 mg/g (ref)	1.0		1.0		1.0	
>11.76 mg/g	1.54 (1.39, 1.70)	<0.001	1.45 (1.31, 1.60)	<0.0001	1.29 (1.15, 1.45)	<0.001

Adjusted I for age, gender and ethnicity. Adjusted II for age, gender and ethnicity, malignant cancer, severe liver disease, creatine, WBC, platelets, SOFA, mechanical ventilation and vasoactive use. BAR, blood urea nitrogen-to-albumin ratio; HR, hazard ratio; CI, confidence interval; BUN, blood urea nitrogen; ref, reference; WBC, white blood cell; SOFA, sequential organ failure assessment.

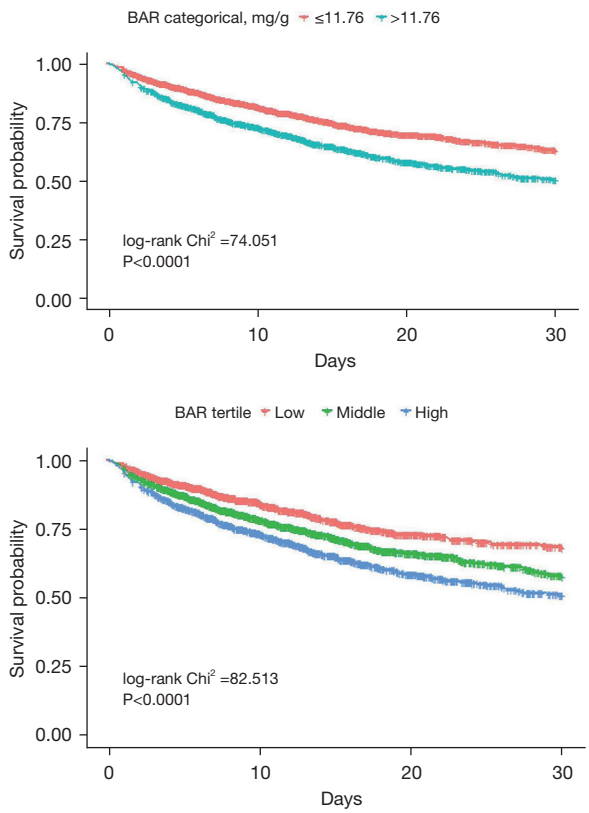

Figure 3 Kaplan-Meier curves of 30-day all-cause mortality for patients with ARF. BAR, blood urea nitrogen-to-albumin ratio; ARF, acute respiratory failure.

with ARF across various etiologies, underscoring its potential as a universal biomarker in critically ill patients. This correlation persisted after adjusting for confounding factors using multivariate Cox regression analysis. Compared with patients with low BAR, those with high BAR showed a significantly higher risk of 30-day mortality.

Common indicators used to evaluate renal function include estimation of glomerular filtration rate, blood creatinine, and BUN (21). In critically ill patients, who are in a state of high protein catabolism (22), the increase in BUN is more pronounced than that in serum creatinine, suggesting that BUN has additional predictive value over serum creatinine (23). High BUN, indicating unfavorable neurohormonal activation and impaired cardiorenal function, is generally considered an ominous sign in various diseases (24,25). Patients with sepsis (26,27) and *Escherichia coli* bacteremia (28) have a higher risk of death when they have higher BUN levels. In addition, it performed well as one of the parameters in the BAP65 (29) and CURB65 (30) models, which are frequently used to predict the probability of CAP mortality.

The significance of albumin in clinical practice is often limited to that of an oncotic agent and a presumptive sign of undernutrition. However, serum albumin demonstrates more clinical significance by binding with bilirubin, bile acids, fatty acids, tryptophan, calcium and medicines (31).

Table 4 Subgroup analysis of the associations between BAR and 30-day all-cause mortality by multivariable Cox regression. Adjusted for age, gender and ethnicity, malignant cancer, severe liver disease, creatine, WBC, platelets, SOFA, mechanical ventilation and vasoactive use

Subgroups	No. of patients	HR (95% CI)	P value	P value for interaction
Age (years)				0.89
<65	2,595	1.01 (1.00, 1.02)	0.04	
≥65	2,861	1.02 (1.01, 1.03)	<0.001	
Gender				0.83
Male	3,133	1.02 (1.01, 1.03)	<0.001	
Female	2,323	1.02 (1.01, 1.03)	<0.001	
Ethnicity				0.78
White	3,516	1.01 (1.01, 1.02)	<0.001	
Black/African American	551	1.02 (1.00, 1.04)	0.03	
Asian	158	1.03 (1.00, 1.06)	0.07	
Unknown	1,231	1.01 (1.00, 1.02)	0.02	
Congestive heart failure				0.40
No	3,506	1.02 (1.01, 1.02)	<0.001	
Yes	1,950	1.01 (1.00, 1.02)	0.003	
Renal disease				0.12
No	4,083	1.01 (1.01, 1.02)	<0.001	
Yes	1,373	1.01 (1.00, 1.02)	0.003	
Severe liver disease				0.57
No	4,813	1.02 (1.01, 1.02)	<0.001	
Yes	643	1.01 (0.99, 1.02)	0.27	
Malignant cancer				0.19
No	4,596	1.02 (1.01, 1.02)	<0.001	
Yes	860	1.01 (1.00, 1.02)	0.007	
Chronic pulmonary disease				0.48
No	3,870	1.01 (1.01, 1.02)	<0.001	
Yes	1,586	1.02 (1.01, 1.03)	<0.001	
Mechanical ventilation				0.09
No	1,801	1.03 (1.02, 1.04)	<0.001	
Yes	3,655	1.01 (1.00, 1.02)	0.01	
Vasopressor use				0.06
No	5,104	1.02 (1.01, 1.02)	<0.001	
Yes	352	1.00 (0.98, 1.02)	0.91	

BAR, blood urea nitrogen-to-albumin ratio; WBC, white blood cell; SOFA, sequential organ failure assessment; HR, hazard risk; CI, confidence interval.

Additionally, it accounts for approximately three-quarters of the antioxidant capacity of plasma, making it the most significant extracellular antioxidant in terms of quantity (32). Spontaneous increases or decreases in serum albumin levels, together with an associated shrinkage of rising total body water, are useful indicators of recovery or worsening health in critical illness, respectively. Elderly people with hypoalbuminemia have a higher chance of developing pneumonia outside hospitals (33) and there are more CAP patients who need intensive care (34).

Recent researches have shown that BAR, rather than serum albumin or BUN levels alone, can predict mortality and illness severity more precisely in individuals with CAP and aspiration pneumonia (20,35). Furthermore, studies revealed that BAR was related to survival outcomes in hospital-acquired pneumonia (36), elderly patients who visited the emergency department (37), moderate-to-severe COVID-19 pneumonia (38), acute pulmonary embolism (39), and chronic heart failure (40), among various other diseases. However, no study has focused on the predictive role of the BAR in ARF. Consistent with previous studies, in this study we found that elevated BAR was independently linked to higher in-hospital and 30-day mortality rates in patients with ARF. However, the cut-off point was different. In our study we found that BAR >11.76 mg/g was an independent predictor of mortality in ARF patients while Dundar ZD and colleagues revealed that elderly patients in the emergency department had a higher risk of in-hospital mortality when BAR >6.25 mg/g (37). This might be due to the difference of oxidative stress state and the severity of the disease between them.

Nevertheless, there are some limitations in this study. First, as a retrospective cohort study, it was impossible to account for every confounder. Although we accounted for known confounders, some unmeasured factors may still have an impact on our findings. Second, we only included BUN and albumin records of patients at their first admission, so that the prognostic impact of dynamic changes in BAR was still unclear. Third, because this was a single-center study, caution should be exercised when extrapolating the findings to other populations and areas since racial differences may have an impact on the result.

Conclusions

In conclusion, after controlling for the potential confounding variables, a high BAR was found to be linked to a higher risk of in-hospital and 30-day mortality. In patients with ARF, BAR is a straightforward and possibly useful prognostic biomarker.

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Footnote

Reporting Checklist: The authors have completed the STROBE reporting checklist. Available at https://jtd.amegroups.com/article/view/10.21037/jtd-24-298/rc

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Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at https://jtd.amegroups.com/article/view/10.21037/jtd-24-298/coif). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by the Medical Research Ethics Committee of Changde Hospital, Xiangya School of Medicine, Central South University (The First People's Hospital of Changde City) (No. 2022-048-1). Informed consent was waived because of the retrospective design of the study.

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