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The role of the Lactate-to-Albumin ratio in predicting ICU admission and mortality in patients with UGIB presenting to the ED: a prospective observational study

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Abstract

Background Upper gastrointestinal bleeding (UGIB) remains a common and potentially life-threatening condition frequently encountered in emergency departments (EDs). Early risk stratification tools are essential for predicting outcomes such as intensive care unit (ICU) admission and in-hospital mortality.

Objectives To evaluate the predictive performance of the serum lactate-to-albumin ratio (LAR) for ICU admission and in-hospital mortality in patients presenting to the ED with UGIB.

Methods This prospective observational study included 181 patients who presented to a university hospital ED with UGIB. Demographic characteristics, laboratory parameters, medication use, and clinical outcomes were recorded. The diagnostic performance of LAR, blood urea nitrogen (BUN) -to-albumin ratio (BAR), and AIMS65 scores for ICU admission and mortality was assessed using ROC analysis and multivariate logistic regression.

Results LAR was significantly elevated in patients requiring ICU admission ($p < 0.001$). LAR showed a similar predictive value to AIM65 and a superior predictive value to BAR for both ICU admission and in-hospital mortality, compared to BAR and AIM65. The area under the curve (AUC) for LAR was 0.789 for ICU admission and 0.858 for mortality. Multivariate analysis identified LAR, underlying liver disease, and high AIMS65 score as independent predictors of in-hospital mortality.

Conclusion The lactate-to-albumin ratio is a simple, readily available, and effective biomarker for predicting adverse outcomes in UGIB patients. It may serve as a rapid and practical decision-making tool in emergency settings, complementing or potentially replacing existing scoring systems.

Clinical trial number not applicable.

Keywords Upper gastrointestinal bleeding, Lactate-to-albumin ratio, Mortality, Emergency department, Intensive care

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Introduction

Upper Gastrointestinal bleeding (UGIB) is a common condition associated with significant morbidity and mortality among patients presenting to the emergency department (ED) [1, 2]. Despite advancements in endoscopic and radiologic diagnostic and therapeutic modalities, mortality rates remain between 5 and 10%, and the condition continues to demand substantial healthcare resources [3, 4]. Whilst observation and pharmacological treatment may be adequate for minor bleeding, severe bleeding may necessitate more aggressive and interventional procedural treatment. Consequently, risk stratification based on clinical parameters in the emergency department (ED) is imperative to guide management decisions and facilitate the identification of patients at higher risk of adverse outcomes [5].

Several scoring systems, such as the Glasgow-Blatchford Score (GBS), the Rockall Score, and the AIMS65 score, have been developed to predict prognosis in patients with UGIB. However, these systems often involve multiple variables and complex calculations, which limit their utility in the fast-paced ED setting [6, 7]. As a result, there is a growing need for simpler, more practical biomarkers to assist in risk assessment and clinical decision-making.

A study from Korea demonstrated that a high blood urea nitrogen (BUN)-to-serum albumin ratio was associated with increased ICU admission and mortality in elderly patients with UGIB [8]. However, BUN levels can be influenced by dehydration and may be confounded in patients with pre-existing renal disease, making it difficult to isolate the effect of acute UGIB [9]. Serum lactate, a widely accessible biomarker, reflects tissue hypoxia and hypoperfusion and has been shown in previous studies to predict mortality in UGIB [10, 11]. However, lactate levels may be elevated in a range of other conditions such as sepsis, septic shock, trauma, renal, or hepatic dysfunction, potentially limiting its specificity.

In this context, the lactate-to-albumin ratio (LAR) has recently emerged as a promising prognostic marker. LAR is a simple and effective biomarker for predicting the risk of in-hospital death in patients with liver failure [12]. LAR is a powerful, independent biomarker that can be used to predict in-hospital and 30- and 90-day mortality rates in patients with sepsis-associated acute kidney injury [13]. LAR is a powerful and independent biomarker which predicts death rates in intensive care patients with heart failure and type 2 diabetes [14]. A retrospective study in 2024 suggested that LAR may be valuable in predicting outcomes in patients with GIB [15]. The objective of this prospective cohort study is to evaluate the role of LAR in predicting prognosis, as evidenced by the retrospective findings. Given that lactate increases with tissue hypoperfusion and albumin decreases as a negative acute-phase reactant, LAR may provide a more balanced reflection of disease severity.

The aim of this study was to evaluate the role of the LAR in predicting ICU admission and in-hospital mortality in patients presenting to the ED with upper gastrointestinal bleeding.

Materials and methods

Study design and population

This prospective observational study was conducted in the emergency department (ED) of a tertiary academic university hospital between November 1, 2024, and March 31, 2025. Patients aged 18 years or older who presented with symptoms suggestive of gastrointestinal bleeding (hematemesis, melena, or hematochezia) and who provided informed consent were included. Clinical data were recorded at the time of presentation. Diagnoses of upper gastrointestinal bleeding (UGIB) were confirmed by a gastroenterologist following initial suspicion in the ED. The study population comprised all patients with suspected GI bleeding. In accordance with the protocol of our institution, patients who undergo intervention are hospitalised and undergo subsequent follow-up. The decision for admission to the intensive care unit was made by the gastroenterologist. The selection criteria for admission to the intensive care unit were determined by the gastroenterologist on the basis of the patients' unstable condition and the risk of rebleeding, and approved by the ICU specialist. The decision to admit these patients to the intensive care unit (ICU) was made by the gastroenterologist and the ICU specialist in accordance with the current ICU hospitalization criteria. Given that the necessity for ICU care emerged subsequent to hospitalization in the ward, scenarios involving ICU transfer were not given due consideration. Consequently, the initial hospitalization decision from the ED served as the foundation for the subsequent analysis. The nonparametric Mann-Whitney U test had a medium effect size of $d = 0.61$ (119 in the ward admission group and 62 in the ICU group) and a high effect size of $d = 0.88$ (158 in the alive group and 23 in the died group). It was concluded that reliable results could be obtained in this study with a total of 181 cases [16, 17]. Reliable findings were obtained with 181 cases total. Power analysis was evaluated with GPower 3.1 [18].

Patients who declined participation, requested discharge against medical advice, or were transferred to another hospital were excluded. The study was approved by the Ethics Committee of Hitit University Faculty of Medicine (approval number: 2024 – 110; date: October 15, 2024), and conducted in accordance with the Declaration of Helsinki.

Data collection and outcome measurement

Collected data included demographic characteristics such as age, sex, systolic and diastolic blood pressure, heart rate, mental status, comorbidities, etiology of bleeding, and use of medications (e.g., antiplatelets, direct oral anticoagulants). Laboratory values obtained at ED presentation included blood urea nitrogen (BUN), serum lactate, albumin, and other routine parameters. The calculation of the scores and parameters was based on the initial blood values obtained at the time of admission to the emergency department.

Outcomes were classified into two main categories: hospitalization location (general ward vs. intensive care unit) and in-hospital mortality. Patients admitted to the general ward were categorized as the "ward group," while those admitted to the ICU were categorized as the "ICU group." Patients who died during ED stay or hospitalization were assigned to the "died group," and those who survived comprised the "alive group."

Statistical analysis

Normality of distribution was assessed using the Kolmogorov-Smirnov test when sample size was >50, and the Shapiro-Wilk test when ≤ 50. Continuous variables were compared using the independent samples t-test for normally distributed data and the Mann-Whitney U test for non-normally distributed data. Categorical variables were compared using the chi-square test when all expected frequencies were >5, and Fisher's exact test when any expected value was <5. Multiple comparisons of proportions were performed using the Bonferroni-corrected Z-test.

To determine variables associated with mortality and clinical outcomes, logistic regression analyses were conducted. In the multivariate logistic regression model, the Wald backward stepwise method was applied to eliminate confounding and non-significant variables, and to achieve the most optimal model. The diagnostic performance of BUN/albumin ratio, lactate/albumin ratio (LAR), and AIMS65 score in predicting outcomes was assessed using receiver operating characteristic (ROC) analysis, based on the method of Hanley and McNeil [5, 19, 20]. Youden's index was used to determine the optimal cut-off point in the ROC analysis [21, 22].

Results were presented as mean ± standard deviation, median (minimum–maximum), or frequency and percentage, as appropriate. A p-value of <0.05 was considered statistically significant. All analyses were performed using IBM SPSS Statistics for Windows, Version 26.0 (IBM Corp., Armonk, NY, USA).

Results

A total of 181 patients were included in the study (Fig. 1). Among them, 119 were admitted to the general ward and 62 to the intensive care unit (ICU). Liver disease was present in 9.2% of patients admitted to the ward and in 32.3% of those admitted to the ICU ($p<0.001$). A previous history of GIB was identified in 25.2% of ward patients and 48.4% of ICU patients ($p=0.002$). Direct oral anticoagulant (DOAC) use was reported in 13.4% of ward patients and in 25.8% of ICU patients ($p=0.039$). Malignancy was present in 11.4% of survivors and 30.4% of non-survivors ($p=0.022$). Among survivors, 13.9% were using DOACs, compared to 43.5% in the non-survivor group ($p=0.002$). Systolic and diastolic blood pressure values were significantly higher in ward patients compared to ICU patients ($p<0.001$ and $p=0.001$, respectively). The mean albumin level was 3.6 g/dL in the ward group and 3.06 g/dL in the ICU group. Median lactate levels were 2.0 mmol/L in ward patients and 3.86 mmol/L in ICU patients ($p<0.001$). Base excess values were significantly higher in ward patients ($p=0.001$). Among survivors, the median lactate level was 2.21 mmol/L, while in non-survivors it was 4.39 mmol/L ($p<0.001$). Base excess was also significantly higher in survivors ($p=0.002$). A detailed comparison of demographic, clinical variables and laboratory parameters between groups is presented in Table 1.

Median BAR was 8.68 in the ward group and 11.64 in the ICU group ($p=0.010$). Median LAR was 0.59 in ward patients and 1.16 in ICU patients ($p<0.001$). Median BAR was 8.61 in survivors and 13.7 in non-survivors ($p=0.001$). The median LAR was 0.62 in survivors and 1.6 in non-survivors ($p<0.001$). The comparison between the mean scores of BAR, LAR and AIM65 is demonstrated explicitly in Table 2.

Liver disease, malignancy, prior GIB history, and DOAC use were identified as independent risk factors significantly associated with ICU admission. Similarly, increased LAR and AIMS65 scores were associated with a significantly higher risk of ICU admission, while increases in the BUN/albumin ratio were associated with a modest increase in ICU risk. Multivariate analysis revealed that liver disease, LAR, and AIMS65 score were strong independent predictors of ICU admission. Prior history of GIB did not show a statistically significant effect in the combined model ($p=0.092$) (Table 3).

Malignancy, DOAC use, and impaired mental status (non-alert) were significantly associated with increased in-hospital mortality. Higher LAR and AIMS65 scores were also significantly associated with mortality risk, while the BUN/albumin ratio showed only a modest association. Multivariate analysis demonstrated that elevated CRP levels and high LAR were strong independent predictors of mortality. However, age and DOAC use

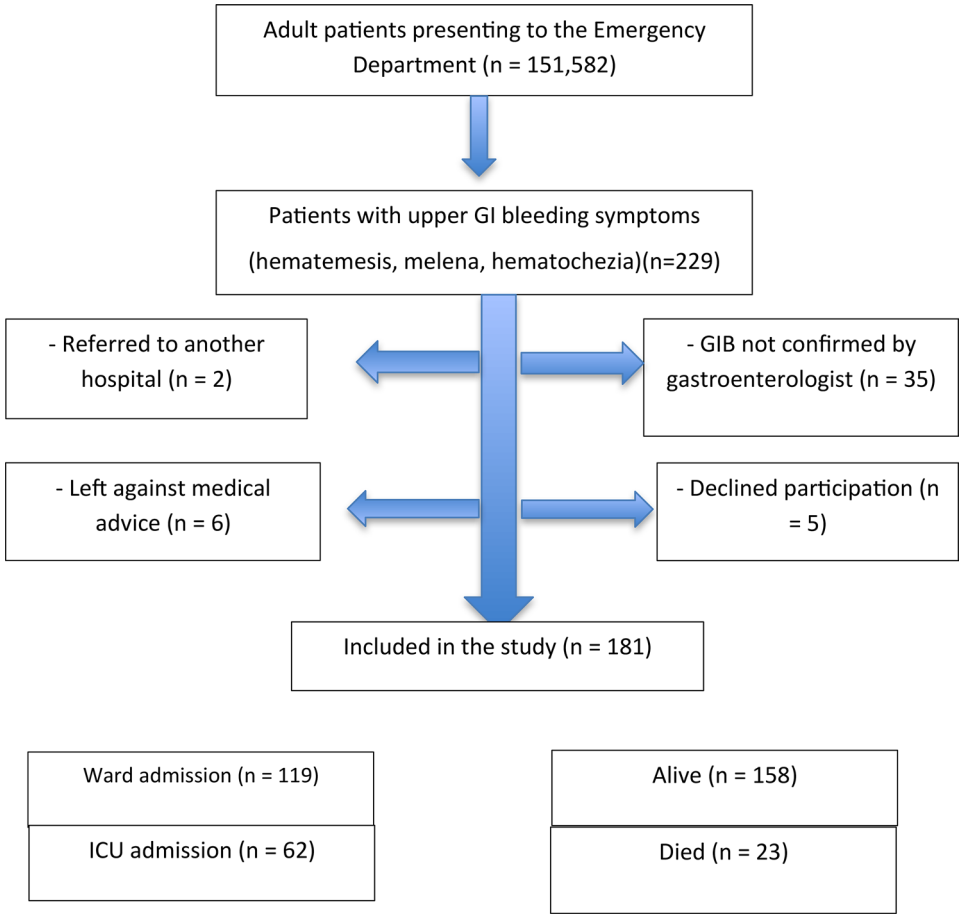

Fig. 1 Study flowchart

were not statistically significant in the combined model ($p > 0.05$) (Table 4).

In predicting ICU admission, the optimal cut-off value for BUN/albumin ratio was ≤ 14.07, with an AUC of 0.616 (95% CI: 0.529–0.704), sensitivity of 40.32%, and specificity of 82.35% ($p = 0.010$). For LAR, the optimal cut-off was ≤ 0.82, with an AUC of 0.789 (95% CI: 0.715–0.864), sensitivity of 69.35%, and specificity of 82.35% ($p < 0.001$). For AIMS65 score, the cut-off was ≤ 3, with an AUC of 0.730 (95% CI: 0.649–0.812), sensitivity of 41.94%, and specificity of 94.96% ($p < 0.001$).

In predicting mortality, the BUN/albumin cut-off value was ≤ 9.31, with an AUC of 0.720 (95% CI: 0.612–0.829), sensitivity of 82.61%, and specificity of 54.43% ($p = 0.001$). For LAR, the optimal cut-off was ≤ 0.85, with an AUC of 0.858 (95% CI: 0.768–0.948), sensitivity of 91.3%, and specificity of 74.05% ($p < 0.001$). For AIMS65, the cut-off was ≤ 2, with an AUC of 0.883 (95% CI: 0.823–0.942), sensitivity of 95.65%, and specificity of 68.35% ($p < 0.001$) (Table 5).

Among all outcome predictors, LAR demonstrated the highest AUC value for ICU admission, indicating superior diagnostic performance compared to other parameters (Hanley & McNeil, 1982) (Fig. 2). For in-hospital mortality, AIMS65 score yielded the highest AUC value, demonstrating the strongest diagnostic power among the evaluated metrics (Hanley & McNeil, 1982) (Fig. 3). Forest plots of factors affecting ICU admission and in hospital mortality according to multivariate logistic regression analysis are given in Figs. 4 and 5.

Discussion

Presently, Glasgow-Blackford score (GBS), Rockall, and AIM65 scores are the scoring systems most frequently utilized in patients with gastrointestinal bleeding who present to emergency departments. These scoring systems have been demonstrated to be effective tools for predicting patient mortality and ascertaining the safety of discharge for patients with low GBS scores [5, 20]. Given the extensive range of parameters encompassed by these scoring systems, there is a persistent interest in identifying more streamlined and complementary parameters to expedite prognosis prediction in EDs. In this context, easily calculable indicators such as LAR and BAR may offer potential advantages in clinical practice. To the best of our knowledge, this is the first prospective study

Table 1 Comparison of demographic, clinical variables and laboratory results by ICU admission and In-Hospital mortality

	Disposition		*p*	Mortality		*p*
	Ward admission (*n* = 119)	ICU (*n* = 62)		Alive (*n* = 158)	Died (*n* = 23)	
Age, year	72 (20–97)	69 (35–100)	0.863[m]	70 (20–97)	77 (46–100)	**0.006[m]**
Gender						
Female	45 (37.8)	30 (48.4)	0.171[x]	60 (38)	15 (65.2)	**0.013[x]**
Male	74 (62.2)	32 (51.6)		98 (62)	8 (34.8)	
Liver Disease	11 (9.2)	20 (32.3)	**< 0.001[x]**	25 (15.8)	6 (26.1)	0.239[f]
Ischemic Heart Disease	44 (37)	18 (29)	0.285[x]	53 (33.5)	9 (39.1)	0.598[x]
Hypertension	65 (54.6)	27 (43.5)	0.157[x]	82 (51.9)	10 (43.5)	0.450[x]
Heart Failure	11 (9.2)	10 (16.1)	0.170[x]	18 (11.4)	3 (13)	0.734[f]
Diabetes	30 (25.2)	10 (16.1)	0.162[x]	37 (23.4)	3 (13)	0.419[f]
Malignancy	12 (10.1)	13 (21)	**0.044[x]**	18 (11.4)	7 (30.4)	**0.022[f]**
Cerebrovascular Disease	2 (1.7)	2 (3.2)	0.607[f]	3 (1.9)	1 (4.3)	0.422[f]
Use NSAID	58 (48.7)	26 (41.9)	0.384[x]	77 (48.7)	7 (30.4)	0.100[x]
Prior GIB	30 (25.2)	30 (48.4)	**0.002[x]**	50 (31.6)	10 (43.5)	0.260[x]
Use of ASA	38 (31.9)	10 (16.1)	**0.022[x]**	44 (27.8)	4 (17.4)	0.289[x]
Use of Other Antiplatelet	19 (16)	6 (9.7)	0.245[x]	21 (13.3)	4 (17.4)	0.531[f]
Use of Warfarin	4 (3.4)	3 (4.8)	0.692[f]	6 (3.8)	1 (4.3)	1.000[f]
Use of DOAC	16 (13.4)	16 (25.8)	**0.039[x]**	22 (13.9)	10 (43.5)	**0.002[f]**
Melena	83 (69.7)	43 (69.4)	0.956[x]	112 (70.9)	14 (60.9)	0.329[x]
Hematemesis	58 (48.7)	35 (56.5)	0.325[x]	81 (51.3)	12 (52.2)	0.935[x]
Hematochezia	15 (12.6)	10 (16.1)	0.514[x]	19 (12)	6 (26.1)	0.099[f]
other symptoms						
None	106 (89.1)	51 (82.3)	0.053[f]	141 (89.2)[a]	16 (69.6)[b]	**< 0.001[f]**
Syncope	9 (7.6)	6 (9.7)		14 (8.9)[a]	1 (4.3)[a]	
Dyspnea	3 (2.5)	0 (0)		2 (1.3)[a]	1 (4.3)[a]	
Weakness	1 (0.8)	2 (3.2)		1 (0.6)[a]	2 (8.7)[b]	
Confusion	0 (0)	3 (4.8)		0 (0)[a]	3 (13)[b]	
Consciousness						
Alert	119 (100)	51 (82.3)	**< 0.001[f]**	153 (96.8)	17 (73.9)	**0.001[f]**
VPU	0 (0)	11 (17.7)		5 (3.2)	6 (26.1)	
Endoscopy						
Normal	3 (2.5)[a]	1 (1.6)[a]	**0.004[f]**	4 (2.5)	0 (0)	0.458[f]
Gastritis, Oesophagitis, Erosions	46 (38.7)[a]	16 (25.8)[a]		56 (35.4)	6 (26.1)	
Ulcer	42 (35.3)[a]	17 (27.4)[a]		51 (32.3)	8 (34.8)	
Varices	9 (7.6)[a]	19 (30.6)[b]		21 (13.3)	7 (30.4)	
Malignancy	8 (6.7)[a]	6 (9.7)[a]		12 (7.6)	2 (8.7)	
Not Performed	4 (3.4)[a]	1 (1.6)[a]		5 (3.2)	0 (0)	
Mallory Weiss	7 (5.9)[a]	2 (3.2)[a]		9 (5.7)	0 (0)	
Forrest Classification						
1 A	0 (0)[a]	2 (11.1)[b]	**< 0.001[f]**	0 (0)[a]	2 (25)[b]	**0.001[f]**
1B	2 (4.8)[a]	0 (0)[a]		2 (3.8)[a]	0 (0)[a]	
2 A	2 (4.8)[a]	8 (44.4)[b]		6 (11.5)[a]	4 (50)[b]	
2B	3 (7.1)[a]	0 (0)[a]		3 (5.8)[a]	0 (0)[a]	
2 C	4 (9.5)[a]	2 (11.1)[a]		5 (9.6)[a]	1 (12.5)[a]	
3	31 (73.8)[a]	6 (33.3)[b]		36 (69.2)[a]	1 (12.5)[b]	
Erythrocyte Transfusion						
None	52 (43.7)[a]	7 (11.3)[b]	**< 0.001[x]**	59 (37.3)[a]	0 (0)[b]	**< 0.001[f]**
One unit	22 (18.5)[a]	6 (9.7)[a]		27 (17.1)[a]	1 (4.3)[a]	
2 or more unit	45 (37.8)[a]	49 (79)[b]		72 (45.6)[a]	22 (95.7)[b]	
GCS	15 (15–15); 96.5	15 (5–15); 80.4	**< 0.001[m]**	15 (7–15); 93.9	15 (5–15); 71.1	**< 0.001[m]**
LOS, day	3 (1–22)	4.5 (1–24)	**< 0.001[m]**	3 (1–24)	4 (1–22)	0.059[m]
Laboratory Results						

Table 1 (continued)

	Disposition		*p*	Mortality		*p*
	Ward admission (*n* = 119)	ICU (*n* = 62)		Alive (*n* = 158)	Died (*n* = 23)	
SBP, mmHg	122.34 ± 21.1	105.61 ± 24.82	**< 0.001**^{t}	118.68 ± 22.81	102.39 ± 25.67	**0.002**^{t}
DBP, mmHg	70 (40–137)	61.5 (36–99)	**0.001**^{m}	68 (36–137)	60 (40–98)	0.051^{m}
Pulse rate,/min	89.79 ± 16.71	94.82 ± 21.15	0.107^{t}	91.43 ± 18.03	92.09 ± 21.55	0.874^{t}
WBC, *10^{9}/L	8.58 (2.28–25.62)	9.61 (1.25–37.49)	0.255^{m}	8.94 (1.25–37.49)	9.15 (2.88–34.75)	0.380^{m}
Hemoglobin, g/dL	9.1 (3.6–17.1)	7.3 (3.7–12.6)	**0.002**^{m}	9.18 ± 3.3	7.4 ± 2.33	**0.014**^{t}
Platelet, *10^{9}/L	226 (12–505)	202 (4–685)	0.147^{m}	223 (4–505)	199 (12–685)	0.391^{m}
CRP, mg/dL	7.75 (3.06–197)	16.75 (3.06–227)	**0.031**^{m}	8.98 (3.06–197)	59.1 (3.11–227)	**0.002**^{m}
BUN, mg/dL	31 (8–121)	37 (7–151)	0.167^{m}	31 (8–134)	37 (7–151)	**0.035**^{m}
Creatinine, mg/dL	0.94 (0.5–11.6)	1 (0.4–7.2)	0.817^{m}	0.9 (0.4–11.6)	1.2 (0.47–4.1)	0.062^{m}
Albumin, g/dL	3.6 ± 0.65	3.06 ± 0.54	**< 0.001**^{t}	3.52 ± 0.61	2.71 ± 0.54	**< 0.001**^{t}
aPTT, sec	13 (9.8–93.9)	15.85 (11.3–54.4)	**< 0.001**^{m}	13.2 (9.8–93.9)	18 (12.7–45.5)	**< 0.001**^{m}
INR	1.1 (0.82–8.83)	1.38 (0.95–5.25)	**< 0.001**^{m}	1.12 (0.82–8.83)	1.6 (1.08–4.3)	**< 0.001**^{m}
Blood gas pH	7.4 ± 0.06	7.4 ± 0.06	0.951^{t}	7.4 ± 0.06	7.41 ± 0.06	0.348^{t}
Serum lactate level	2 (0.61–6.89)	3.86 (1.01–10.76)	**< 0.001**^{m}	2.21 (0.61–7.11)	4.39 (0.87–10.76)	**< 0.001**^{m}
Base deficit	-0.5 (-19.1–9)	-2.4 (-16.7–13.4)	**0.001**^{m}	-0.8 (-19.1–12.7)	-3.5 (-16.7–13.4)	**0.002**^{m}

t: Independent two sample t test, m: Mann Whitney U test, x: Pearson chi-square test, f: Fisher exact test; ; mean ± s. deviation, median (min.-max.); SO, SO: Rank mean, n (%), a-b: There is no difference between groups with the same letter. ICU: intensive care unit, NSAID: non-steroidal anti-inflammatory drug, GIB: gastrointestinal bleeding, ASA: acetylsalicylic acid, DOAC: direct oral anticoagulant, VPU: Verbal, pain, unresponsive, LOS: length of hospital stay, GCS: Glasgow Coma Scale, SBP: systolic blood pressure, DBP: diastolic blood pressure, WBC: white blood cell, CRP: C-Reactive protein, BUN: blood urea nitrogen, aPTT: activated partial thromboplastin time, INR: International Normalized Ratio, BAR: BUN-to-albumin ratio, LAR: Lactat-to-albumin ratio

Table 2 Comparison of BAR, Lar and AIM65 score by ICU admission and In-Hospital mortality

	Disposition		*p*	Mortality		p^{m}
	Ward admission (*n* = 119)	ICU (*n* = 62)		Alive (*n* = 158)	Died (*n* = 23)	
BAR	8.68 (1.74–28.81)	11.64 (2.73–55.93)	**0.010**^{m}	8.61 (1.74–49.63)	13.7 (3.89–55.93)	**0.001**
LAR	0.59 (0.16–2.55)	1.16 (0.27–3.99)	**< 0.001**^{m}	0.62 (0.16–2.78)	1.6 (0.26–3.99)	**< 0.001**
AIM65 Score	1 (0–4)	2 (0–5)	**< 0.001**^{m}	1 (0–4)	3 (1–5)	**< 0.001**

m: Mann Whitney U test, median (min.-max.), a-b: There is no difference between groups with the same letter. ICU: intensive care unit, BAR: BUN-to-albumin ratio, LAR: Lactat-to-albumin ratio

to evaluate the relationship between the lactate/albumin ratio (LAR) and clinical outcomes in patients admitted to the emergency department for UGIB. The findings of this study indicate that LAR is a significant prognostic marker in this patient population.

To assess the performance of LAR in this population, we compared it with previously established prognostic tools, namely the AIMS65 score and the BAR. LAR was found to be the strongest predictor of ICU admission, while it showed similar accuracy to the AIMS65 score in predicting in-hospital mortality. A recent study from Korea also reported that LAR is a valuable marker for predicting both ICU admission and in-hospital mortality in GIB patients [15]. Prior studies have also identified LAR as a useful prognostic marker in other critical illnesses such as sepsis and heart failure [23–25], supporting the findings of the current study.

Prognostic scoring systems in GIB were originally developed to estimate risks of mortality, transfusion, and the need for endoscopy [26]. Over time, due to the complexity and impracticality of some of these tools, simpler models have gained favor. Among them, AIMS65 has emerged as a relatively simple and widely used system. This score incorporates five factors: serum albumin < 3.0 g/dL, international normalized ratio (INR) > 1.5, systolic blood pressure < 90 mmHg, age ≥ 65 years, and altered mental status, the latter being a subjective parameter [27]. The reliance on physician-assessed mental status may be a limitation of this score.

BAR has also been suggested as a practical parameter for outcome prediction in UGIB patients. However, most studies have examined its utility in identifying the bleeding source rather than predicting prognosis [28, 29]. Moreover, BAR may be affected by baseline renal function, limiting its specificity for acute UGIB [9, 30]. In contrast, LAR reflects both tissue perfusion (via lactate) and chronic systemic status (via albumin), and may thus offer a more comprehensive picture of patient status in UGIB.

In our logistic regression analysis, male sex, older age, malignancy, and DOAC use were identified as factors associated with increased mortality. A study by Kudu et al. found that malignancy was one of the most significant predictors of recurrent GIB presentations in the ED [31].

Table 3 Evaluation of factors associated with ICU admission

	Univariate		Multivariate[bw]	
	OR (%95 CI)	*p*	OR (%95 CI)	*p*
Liver Disease (Ref.: None)	4.675 (2.064–10.589)	**< 0.001**	5.676 (1.506–21.389)	**0.010**
Malignancy (Ref.: None)	2.366 (1.007–5.559)	**0.048**		
Prior GIB (Ref.: None)	2.781 (1.456–5.314)	**0.002**	2.450 (0.865–6.939)	0.092
Use of ASA (Ref.: None)	0.410 (0.188–0.893)	**0.025**		
Use of DOAC (Ref.: None)	2.239 (1.031–4.861)	**0.042**		
SBP	0.965 (0.949–0.981)	**< 0.001**		
DBP	0.964 (0.941–0.988)	**0.003**		
Hemoglobin	0.831 (0.745–0.927)	**0.001**		
CRP	1.011 (1.002–1.019)	**0.012**		
aPTT	1.065 (1.013–1.119)	**0.014**		
INR	1.751 (1.092–2.809)	**0.020**		
Base deficit	0.894 (0.832–0.961)	**0.002**		
BAR	1.070 (1.024–1.118)	**0.002**		
LAR	11.555 (4.841–27.578)	**< 0.001**	6.505 (1.850–22.873)	**0.004**
AIM65 Score	2.35 (1.703–3.242)	**< 0.001**	2.301 (1.397–3.791)	**0.001**

OR: Odds ratio, CI: Confidence interval, bw: Backward Stepwise Wald, chi-square = 61.118, $p < 0.001$, Nagelkerke $R^2 = 0.526$, ICU: intensive care unit, GIB: gastrointestinal bleeding, ASA: acetylsalicylic acid, DOAC: direct oral anticoagulant, SBP: systolic blood pressure, DBP: diastolic blood pressure, CRP: C-Reactive protein, aPTT: activated partial thromboplastin time, INR: International Normalized Ratio, BAR: BUN-to-albumin ratio, LAR: Lactat-to-albumin ratio

Table 5 ROC curve analysis of BAR, LAR, and AIMS65 score for predicting ICU admission and mortality

	AUC (%95 CI)	*p*	Cut-off	Sensitivity (%)	Specificity (%)
ICU Admission					
BAR	0.616 (0.529–0.704)	**0.010**	≤ 14.07	40.32	82.35
LAR	0.789 (0.715–0.864)	**< 0.001**	≤ 0.82	69.35	82.35
AIM65 Score	0.730 (0.649–0.812)	**< 0.001**	≤ 3	41.94	94.96
Mortality					
BAR	0.720 (0.612–0.829)	**0.001**	≤ 9.31	82.61	54.43
LAR	0.858 (0.768–0.948)	**< 0.001**	≤ 0.85	91.30	74.05
AIM65 Score	0.883 (0.823–0.942)	**< 0.001**	≤ 2	95.65	68.35

AUC: Area under curve, CI: Confidence interval, BAR: BUN-to-albumin ratio, LAR: Lactat-to-albumin ratio, ICU: intensive care unit

Table 4 Analysis of factors associated with In-Hospital mortality

	Univariate		Multivariate[bw]	
	OR (%95 CI)	*p*	OR (%95 CI)	*p*
Age	1.050 (1.013–1.089)	**0.008**	1.073 (0.996–1.157)	0.064
Gender (Ref.: Female)	0.327 (0.131–0.816)	**0.017**		
Malignancy (Ref.: None)	3.403 (1.233–9.387)	**0.018**		
Use of DOAC (Ref.: None)	4.755 (1.859–12.166)	**0.001**	4.582 (0.996–21.073)	0.051
Consciousness (Ref.: Alert)	10.800 (2.978–39.166)	**< 0.001**		
GCS	0.610 (0.420–0.887)	**0.010**		
SBP	0.965 (0.943–0.988)	**0.003**		
DBP	0.971 (0.938–1.004)	0.082		
Hemoglobin	0.816 (0.690–0.964)	**0.017**		
CRP	1.020 (1.010–1.030)	**< 0.001**	1.016 (1.002–1.031)	**0.030**
aPTT	1.033 (0.995–1.072)	0.088		
INR	1.369 (0.946–1.980)	0.095		
Base deficit	0.871 (0.794–0.956)	**0.004**		
BAR	1.087 (1.034–1.143)	**0.001**		
LAR	7.072 (3.388–14.763)	**< 0.001**	6.372 (2.135–19.013)	**0.001**
AIM65 Score	4.327 (2.476–7.562)	**< 0.001**		

OR: Odds ratio, CI: Confidence interval, ki-kare = 43.112, $p < 0.001$, Nagelkerke $R^2 = 0.560$, DOAC: direct oral anticoagulant, GCS: Glasgow Coma Scale SBP: systolic blood pressure, DBP: diastolic blood pressure, CRP: C-Reactive protein, aPTT: activated partial thromboplastin time, INR: International Normalized Ratio, BAR: BUN-to-albumin ratio, LAR: Lactate-to-albumin ratio

Similarly, He et al. reported a direct correlation between increasing age and mortality in GIB patients [32]. A recent review also emphasized that prior GIB, older age, male sex, and anticoagulant use are risk factors for severe bleeding episodes [33].

Endoscopic findings in our cohort showed ulcers in 32.5% of patients and esophagitis, gastritis, or erosions in 34.3%. These results are consistent with observational studies from the United States and the United Kingdom, where ulcers were found in 32–36% and erosive disease in approximately 42% of UGIB patients [34, 35].

This study has several limitations. First, it was conducted at a single tertiary academic center, which may limit the generalizability of the results. Our patient population may also have included a relatively higher proportion of severely ill individuals compared to the general population. Second, the number of deaths in the study was relatively small, which may reduce the power to detect all contributing factors. Future multicenter studies with larger sample sizes are needed to validate our findings.

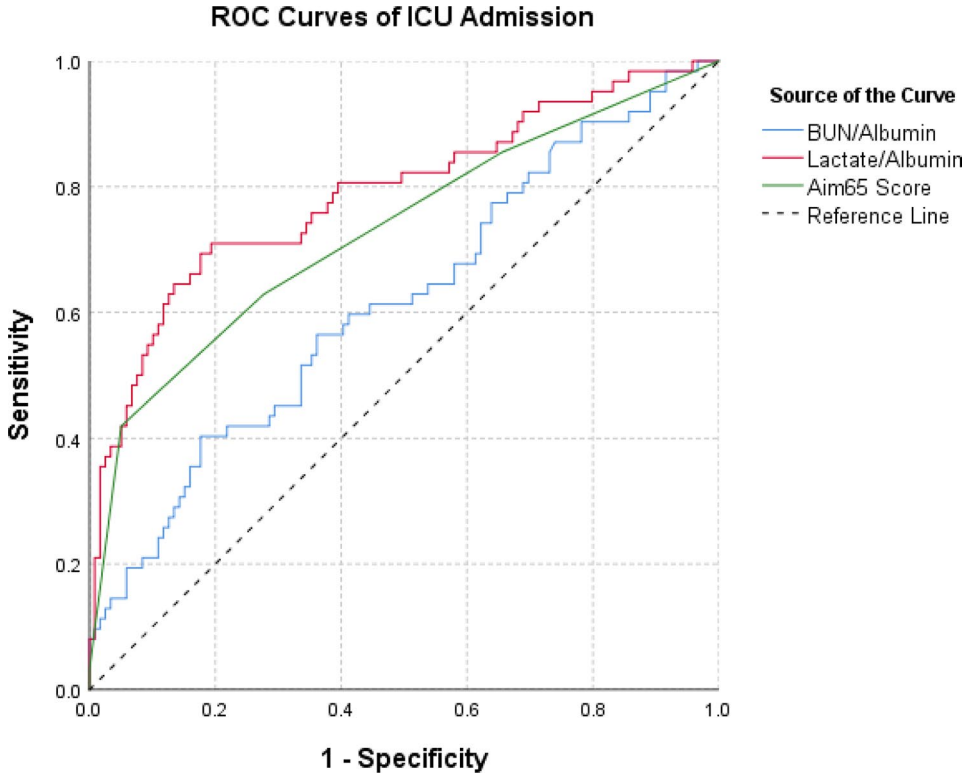

Fig. 2 ROC curves demonstrating AUC values for prediction of ICU admission

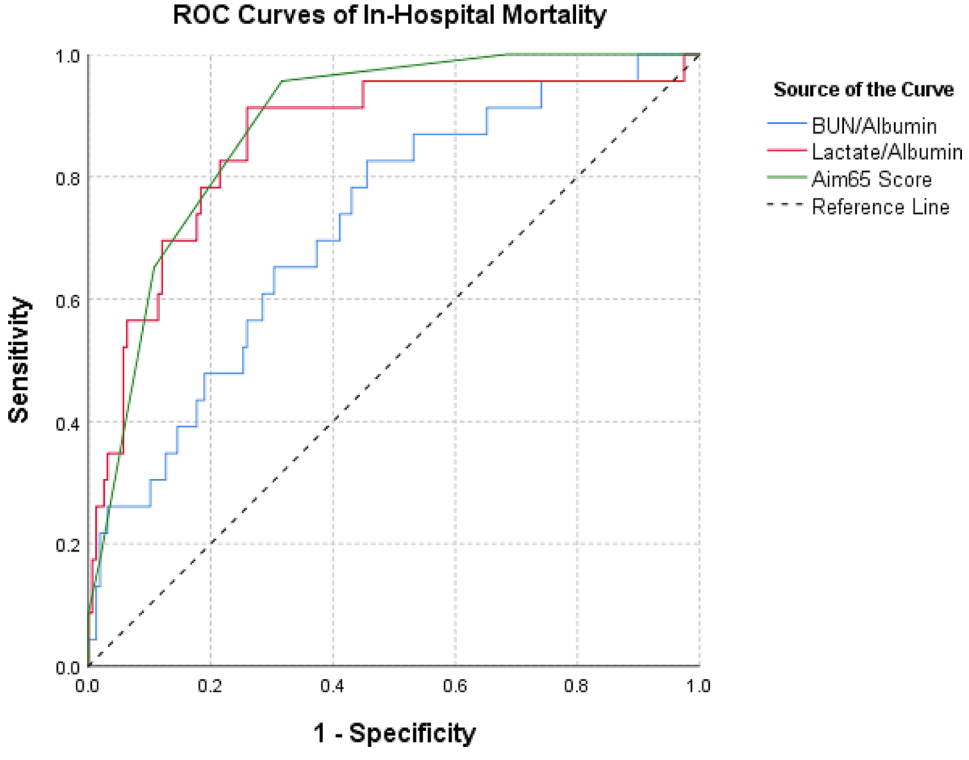

Fig. 3 ROC Curves and AUC values for predicting in-hospital mortality

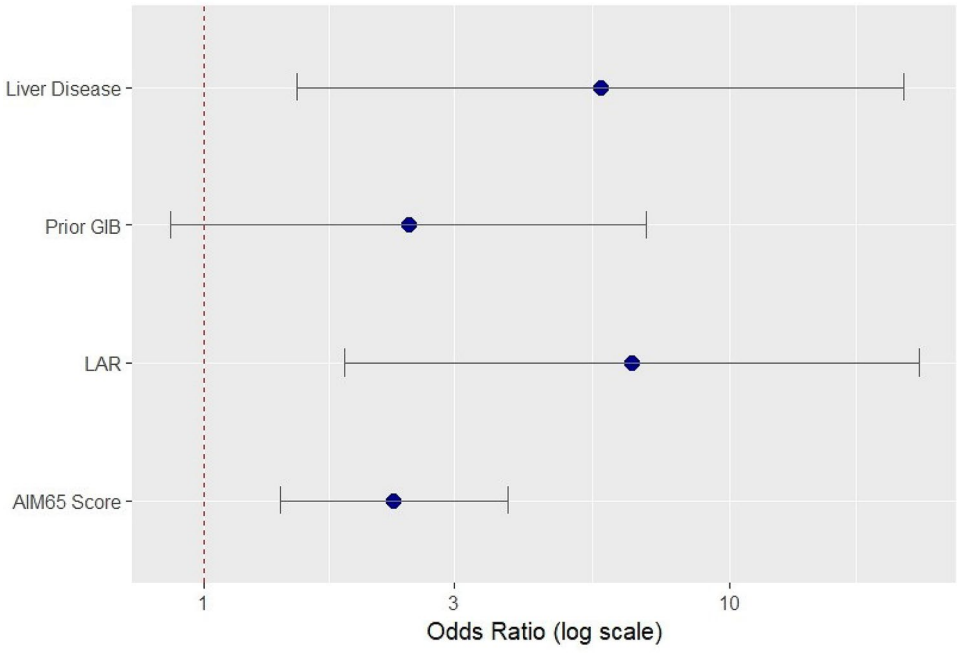

Fig. 4 Forest plot of multivariate logistic regression analysis for ICU Admission. Horizontal axis: odds ratio, odds ratios (points), and 95% CI (whiskers)

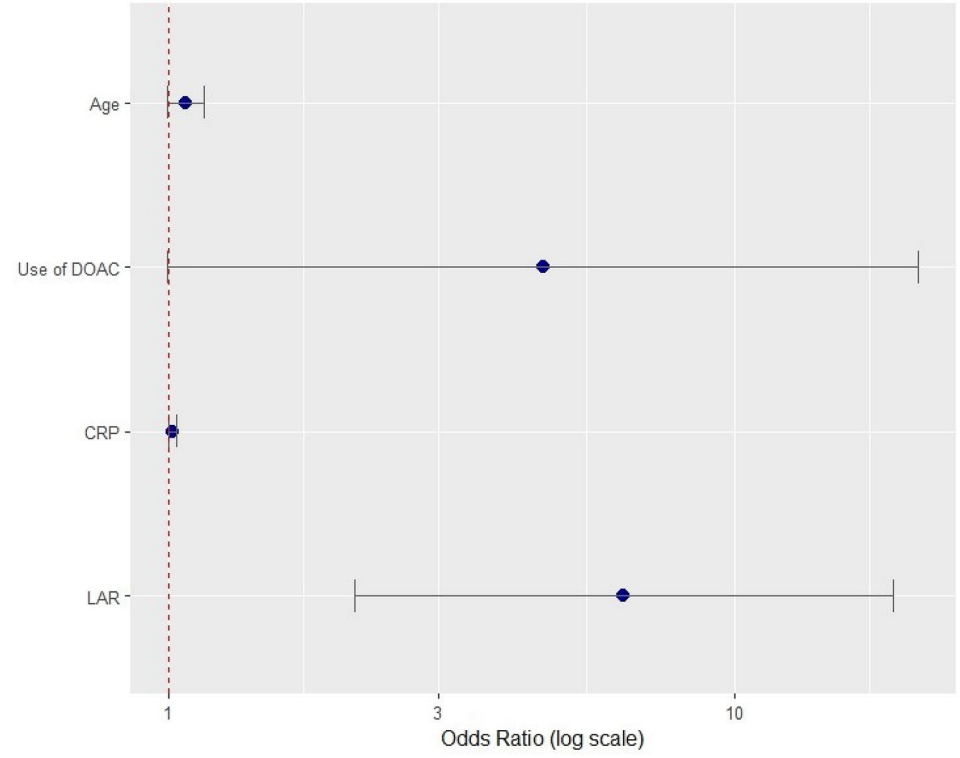

Fig. 5 Forest plot of multivariate logistic regression analysis for In-Hospital Mortality. Horizontal axis: odds ratio, odds ratios (points), and 95% CI (whiskers)

Conclusion

The lactate-to-albumin ratio (LAR), calculated by dividing serum lactate by serum albumin levels, demonstrated superior performance compared to both the blood urea nitrogen-to-albumin ratio (BAR) and the AIMS65 score in predicting ICU admission among patients with upper gastrointestinal bleeding (UGIB). While LAR showed comparable performance to AIMS65 in predicting in-hospital mortality, it outperformed BAR. In addition, LAR is simpler and more practical to use than AIMS65,

making it a feasible tool in the emergency department setting. Therefore, LAR may assist emergency physicians in identifying UGIB patients who require more intensive monitoring or early ICU admission.

Abbreviations

UGIB	Upper Gastrointestinal bleeding
ICU	Intensive care unit
ED	Emergency Department
LAR	Lactate-to-albumin ratio
BUN	Blood urea nitrogen
BAR	BUN-to-albumin ratio
GBS	Glasgow-Blatchford Score
DOAC	Direct oral anticoagulant
CRP	c-reactive protein
GIB	Gastrointestinal bleeding
NSAID	Non-steroidal anti-inflammatory drug
ASA	Acetylsalicylic acid
VPU	Verbal, pain, unresponsive
LOS	Length of hospital stay
GCS	Glasgow Coma Scale
SBP	Systolic blood pressure
DBP	Diastolic blood pressure
WBC	White blood cell
aPTT	Activated partial thromboplastin time
INR	International Normalized Ratio

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None.

Author contributions
İ.A and M.A designed the study. İ.A and M.A analysed and interpreted the data and was the main contributor in writing the manuscript. İ.A and M.A proved the statistical analysis and the correctness of the given information about the project details. İ.A and M.A was a major contributor in writing the manuscript and developing the research question. All authors read and approved the final manuscript.

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Data availability
The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethical approval
This study was approved by the Hitit University Faculty of Medicine Research Ethics Committee on October 15, 2024 (No. 2024 – 110). Since this was a prospective study, participants were informed and included in the study by signing an informed consent form. Patients who did not consent were not included in the study. The informed consent form was evaluated by the Ethics Committee and found appropriate.

Consent to participate
Each patient participating in the study was informed, and informed consent was obtained from the patient or their relative on the informed consent form. Patients who did not consent were excluded from the study. The informed consent form was approved by the Ethics Committee before starting the study.

Competing interests
The authors declare no competing interests.

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