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Comparison of the new risk score (ABL) with the Glasgow Blatchford Score, AIMS65, and pre-endoscopic Rockall Score in patients with upper gastrointestinal bleeding admitted to the emergency department

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Abstract

Background Upper gastrointestinal bleeding (UGIB) continues to be a major global health concern, contributing substantially to both morbidity and mortality. This highlights the need for efficient and reliable risk assessment methods, particularly in emergency care settings. The primary objective of this study was to create a new risk scoring system that is easier to apply, more practical in clinical workflows, and highly effective for evaluating patients presenting to the emergency department with UGIB.

Methods This retrospective observational study was conducted at a single center by analyzing records of patients aged 18 years and older who presented to the Emergency Medicine Department of Sakarya Training and Research Hospital with clinical signs and symptoms suggestive of upper gastrointestinal bleeding (UGIB) between January 2022 and June 2023. For analytical purposes, patients were categorized into six distinct subgroups. Those assigned to transfusion, intervention, intensive care unit (ICU), readmission, or mortality groups were collectively defined as high-risk patients. Based on the collected clinical data, a novel scoring system—referred to as the ABL score—was developed. The diagnostic performance of this new score in identifying high-risk patients and each outcome subgroup was then evaluated and compared to existing scoring tools: the Glasgow Blatchford Score (GBS), AIMS65, and the pre-endoscopic Rockall Score (Pre-RS).

Results A total of 589 patients were included, with a median age of 67 years, with a male ratio of 66.2%. ABL score, which includes **A**ge, systolic **B**lood pressure, **L**aboratory parameters (hemoglobin, BUN/creatinine ratio, and international normalized ratio/albümin) was found to be more effective in predicting high-risk groups compared to the GBS, AIMS65, and Pre-RS scores ([AUROC]: 0.86, 0.806, 0.71, and 0.704, respectively; $p < 0.05$). The ABL score also performed better in predicting transfusion and readmission subgroups. (AUROC: 0.886 and 0.719, respectively).

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Conclusion The ABL scoring system demonstrated higher predictive performance than GBS, AIMS65, and Pre-RS, particularly in identifying high-risk patients, transfusion requirements, and the likelihood of readmission. However, confirmation of these findings requires validation through larger, prospective studies.

Keywords Emergency department, Gastrointestinal bleeding, Risk score

Background

Upper gastrointestinal bleeding (UGIB) is one of the most common reasons for emergency department (ED) visits. The annual incidence has been reported in the literature to range between 50 and 170 per 100,000 person-years, with mortality rates reported between 4% and 40% [1, 2]. Patients may present with hematemesis, melena, or hematochezia and can be either hemodynamically stable or unstable. After initial evaluation and hemodynamic stabilization, risk classification using scoring systems is recommended to triage patients for in-hospital or out-of-hospital management. This approach allows the discharge of low-risk patients, preventing unnecessary hospitalizations and ensuring the efficient use of public health resources, while contributing to improved prognosis in high-risk groups. The most commonly used risk scoring systems for UGIB in current practice are the Glasgow Blatchford Score (GBS), AIMS65, and pre-endoscopic Rockall Score (Pre-RS) [3, 4].

The GBS, developed by Blatchford et al., is used to predict the need for intervention (e.g., transfusion, endoscopy, surgery) in adult UGIB patients, based on variables like melena, syncope, heart failure, liver disease, hemoglobin, urea, systolic blood pressure, gender, and pulse rate [5]. The American College of Gastroenterology and the European Society of Gastrointestinal Endoscopy recommend outpatient follow-up for patients with a GBS of 0–1 [3, 6]. The AIMS65 score, by Saltzman et al., predicts in-hospital mortality, length of stay, and cost using albumin, INR, mental status, systolic blood pressure, and age, classifying patients as low risk (< 2) or high risk (≥ 2) [7]. The Rockall Score, developed by Rockall et al., estimates rebleeding and mortality risk based on endoscopic findings, age, shock, and comorbidities; its pre-endoscopic version (Pre-RS) excludes endoscopy and is more suited for ED use [8, 9].

Numerous studies in the literature have demonstrated the effectiveness of these scoring systems (GBS, AIMS65, and Pre-RS) in predicting the risk levels of UGIB patients [1–4]. However, the large number of variables in the scoring systems, and the inclusion of comorbidities like heart failure and liver disease—which lack clear definitions—limits the use of GBS in ED settings. Similarly, the AIMS65 and Pre-RS systems are limited by their sole focus on predicting adverse outcomes, such as mortality and rebleeding [10–12]. For these reasons, there is a clear need for a new risk score that overcomes these limitations, is easy to use in ED settings, and can effectively predict adverse outcomes, particularly in high-risk groups.

Therefore, the aim of this study was to develop a new, simpler, more practical and highly effective risk scoring system to predict the need for transfusion, endoscopic, radiological or surgical intervention, ICU admission status, rehospitalization due to UGIB and in-hospital mortality in patients presenting to the emergency department with a preliminary diagnosis of UGIB.

Methods

Study design and population

This retrospective, single-center observational study was carried out in the Emergency Medicine Department of Sakarya Training and Research Hospital. Ethical approval was obtained from the local institutional review board (IRB No: 43012747-050.04-438096) before the initiation of the study, which adhered to the ethical standards outlined in the Declaration of Helsinki. The study was also registered at ClinicalTrials.gov under the identifier NCT06878183.

The study population consisted of patients aged 18 and above who were admitted to the emergency department between January 1, 2022, and June 1, 2023, with clinical manifestations of upper gastrointestinal bleeding (UGIB), such as hematemesis, melena, or hematochezia, and who were subsequently hospitalized. Individuals with incomplete clinical records, those diagnosed with lower gastrointestinal bleeding, or those who did not undergo endoscopy due to death or refusal of medical intervention were excluded.

Data collection

Demographic characteristics, presenting complaints, comorbidities, regularly used medications, mental status, vital signs, laboratory values, hospitalization locations, blood transfusion needs, endoscopic hemostasis, radiological interventions, surgical procedures, LOS, recurrent admissions, and in-hospital mortality data were retrieved from the electronic database and recorded by a single physician on a pre-prepared data form. Using this data, patients' GBS, AIMS65, and Pre-RS scores were calculated as described in their original studies [5, 7, 8]. Patients were categorized into six groups.

Patient groups:

- **High risk**: Patients included in any of the transfusion, intervention, intensive care unit (ICU), readmission, or mortality groups.
- **Transfusion**: Patients requiring blood transfusion at any time during hospitalization.
- **Intervention**: Patients undergoing any of the following: endoscopic hemostasis (thermal coagulation, adrenaline injection, hypertonic injection, hemoclips, band ligation), radiological intervention, or surgical procedures.
- **ICU**: Patients requiring ICU admission at any time during hospitalization.
- **Readmission**: Patients readmitted to the hospital within one month due to UGIB.
- **Mortality**: Patients who experienced in-hospital mortality.

Study outcomes

The primary outcome was to develop a new risk score capable of predicting the high-risk group. The secondary outcome was to compare the effectiveness of the newly developed risk score with GBS, AIMS65, and Pre-RS in predicting high risk, transfusion, intervention, ICU, readmission, and mortality groups.

Statistical analysis

All statistical evaluations were conducted using SPSS software version 26 (IBM Corp., Armonk, NY, USA) and Jamovi version 2.5.3, which is based on the R statistical environment. Continuous data were summarized as median values along with interquartile ranges (IQR) and assessed using the Mann–Whitney U test due to non-normal distribution. Categorical variables were expressed as counts and percentages, with comparisons made using either the chi-square test or Fisher's exact test when appropriate.

Univariate logistic regression analysis was initially performed to explore potential risk factors. Subsequently, binary logistic regression was applied to determine variables independently associated with the newly developed risk score. A p-value less than 0.05 was accepted as statistically significant. To control for multicollinearity, variables with a variance inflation factor (VIF) greater than three were excluded from the model [13]. Model performance was tested using the Omnibus test for overall model significance and the Hosmer–Lemeshow test to assess calibration. The discriminative ability of each risk scoring system was evaluated by calculating the area under the receiver operating characteristic (ROC) curve (AUROC), including 95% confidence intervals. Comparisons between AUROCs were performed using the DeLong method [14].

The most appropriate cut-off values for each score were determined based on Youden's index. Diagnostic performance metrics including sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), positive likelihood ratio (+LR), and negative likelihood ratio (–LR) were calculated using contingency table analysis. All hypothesis tests were two-tailed with a significance level set at 0.05. In accordance with the recommendations by Altman et al. [15], absolute and relative effect sizes for clinical outcomes were reported alongside their respective 95% confidence intervals.

Results

Baseline characteristics

Data from 823 patients hospitalized with a preliminary diagnosis of UGIB were retrospectively reviewed and recorded. Patients diagnosed with lower gastrointestinal bleeding based on endoscopy results ($n = 113$), those with insufficient data ($n = 41$), and those who did not undergo endoscopy ($n = 80$) were excluded, leaving 589 patients included in the study. The included patients were divided into two groups: high-risk ($n = 421$) and non-high-risk ($n = 168$) (Fig. 1).

The demographic data, presenting complaints, regularly used medications, vital signs, and laboratory values of the patients are shown in Table 1. The median age of the patients was 67 years (IQR = 24), with males comprising 66.2% ($n = 390$) of the cohort. The most common presenting complaints were melena (79.5%) and hematemesis (37.7%). Hypertension (49.1%) was identified as the most frequent comorbidity, and antiplatelet agents (28.5%) were the most commonly used regular medications. The median length of hospital stay was four days (IQR = 3).

Primary study outcome

Identification of independent risk variables for high risk

Univariate logistic regression analysis was used to identify independent risk variables for high risk (Table 1). Among the variables identified through this analysis, age, systolic blood pressure (SBP), hemoglobin, INR/albumin, and blood urea nitrogen (BUN)/creatinine ratio were selected as independent risk variables based on the relevant literature and our clinical experience [16–18].

Sample size adequacy for binary logistic regression analysis

The required minimum sample size for conducting a binary logistic regression analysis was estimated based on the formula $\boldsymbol{N = 10 \times k / p}$, as recommended by Peduzzi and colleagues [19]. In this formula, N represents the minimum sample size, k denotes the number of independent variables included in the model, and p refers to the proportion of cases with the outcome of interest. For the current model, which incorporated five predictors ($k = 5$) and had an observed high-risk group frequency of approximately 71% ($p = 421/589$), the calculated

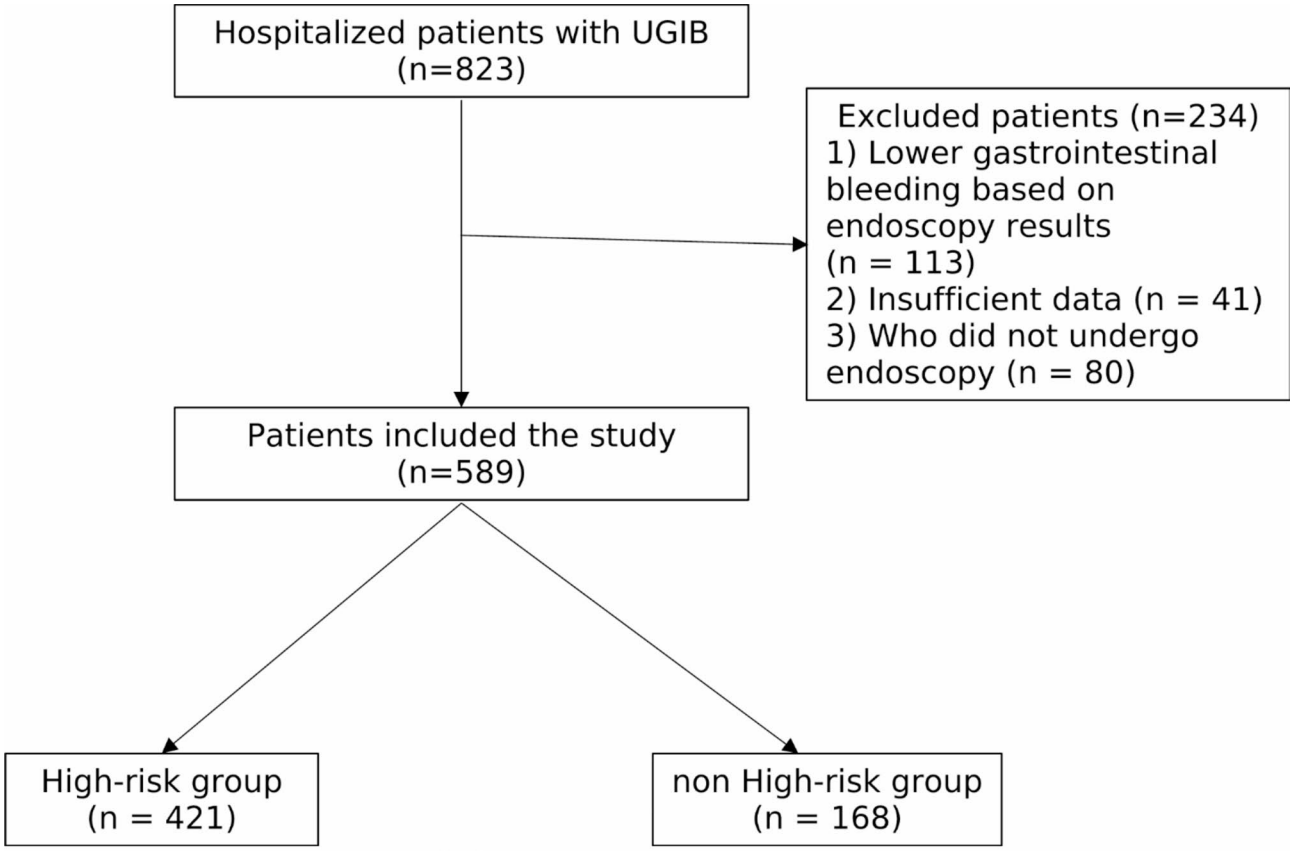

Fig. 1 Flow chart

minimum sample size was 70. This confirmed that the number of subjects included in the study was sufficient for the planned regression analysis.

Development of a new risk score for high risk

The selected independent risk variables were categorized based on the optimal cut-off values determined via ROC analysis. The cut-off values were calculated as follows: age ≥ 53 years, SBP < 110 mmHg, hemoglobin < 8.6 mg/dL, BUN/creatinine ratio ≥ 30, and INR/albumin ratio ≥ 0.4. The effects of these categorized risk variables on the high-risk group were analyzed using binary logistic regression (Table 2). Independent risk variables were scored according to the β-coefficients obtained from binary logistic regression analysis. The new risk score (ABL score) was developed as follows: age ≥ 53 (1 point), SBP < 110 (1 point), hemoglobin < 8.6 (3 points), BUN/creatinine ratio ≥ 30 (1 point), and INR/albumin ratio ≥ 0.4 (1 point) (Table 2). The score points were allocated based on the beta coefficients obtained from multivariate logistic regression analysis.

Secondary study outcome

Comparison of the new risk score with GBS, AIMS65, and Pre-RS scores in predicting high risk

The median values, sensitivity, specificity, PPV, NPV, AUROC (95% CI), +LR, and − LR values of all risk scores for the high-risk group are shown in Tables 3, 4 and 5. A statistically significant difference was observed in the median values of all risk scores among high-risk groups ($p < 0.001$). The ABL score had the highest AUROC value for predicting the high-risk group (AUROC = 0.86, 95% CI = 0.83–0.89). Furthermore, the AUROC value of the ABL score was significantly higher than those of the other risk scores ($p < 0.05$). In the high-risk group, the + LR and − LR values of the new risk score were 4.77 and 0.31, respectively.

Comparison of the new risk score with GBS, AIMS65, and pre-RS scores in predicting transfusion, intervention, ICU, readmission, and mortality groups

The median values of risk scores, along with sensitivity, specificity, PPV and NPV, AUROC with 95% CI, and + LR and − LR, for all scoring systems across the transfusion, intervention, ICU admission, readmission, and mortality outcomes are summarized in Tables 3 and 4.

Table 1 Baseline characteristics and univarity logistic regression analysis of the high risk group

	Total (*n* = 589)	**High risk**					
		No (*n* = 168)	**Yes (*n* = 421)**				
Variables	***n* (%) or Median (IQR)**	***n* (%) or Median (IQR)**	***n* (%) or Median (IQR)**	***p***	**OR**	**95% CI**	
Age (year)	67 (24)	59 (30.2)	69 (20)	< 0.001	1.033	1.023	1.044
Sex							
Female	199 (33.8)	54 (27.1)	145 (72.9)	0.594	1.11	0.758	1.62
Male	390 (66.2)	114 (29.2)	276 (70.8)				
Presentation							
Fatigue	79 (13.4)	11 (6.5)	68 (16.2)	0.003	2.75	1.42	5.34
Altered Mental Status	68 (11.5)	13 (7.7)	55 (13.1)	0.071	1.79	0.951	3.37
Haematemesis	222 (37.7)	45 (12.3)	23 (10.4)	0.285	1.22	0.847	1.76
Melena	439 (79.5)	121 (72)	318 (75.5)	0.378	1.20	0.801	1.80
Haematochezia	58 (9.8)	13 (7.7)	45 (10.7)	0.280	1.43	0.749	2.72
Abdominal Pain	39 (6.6)	16 (9.5)	23 (5.5)	0.077	1.82	0.937	3.54
Comorbidities							
Coronary Artery Disease	141 (23.9)	30 (17.9)	111 (26.4)	0.030	1.65	1.05	2.58
Hypertension	289 (49.1)	66 (39.3)	223 (53)	0.003	1.74	1.21	2.50
Diabetes Mellitus	145 (24.6)	34 (20.2)	111 (26.4)	0.120	1.41	0.914	2.18
Chronic Pulmonary Disease	26 (4.4)	3 (1.8)	23 (5.5)	0.062	3.18	0.941	10.73
Cerebrovascular Disease	40 (6.8)	9 (5.4)	31 (7.4)	0.384	1.40	0.654	3.02
Chronic Kidney Disease	59 (10)	5 (3)	54 (12.8)	0.001	4.80	1.88	12.21
Cirrhosis	38 (6.5)	4 (2.4)	34 (8.1)	0.017	3.60	1.26	10.31
Medication							
Antiplatelets	168 (28.5)	44 (26.2)	124 (29.5)	0.429	1.18	0.787	1.76
Anticoagulants	87 (14.8)	13 (7.7)	74 (17.6)	0.003	2.54	1.37	4.72
NSAID	42 (7.1)	15 (8.9)	27 (6.4)	0.286	1.43	0.741	2.76
Proton Pump Inhibitors	45 (7.6)	10 (6)	35 (8.3)	0.332	1.43	0.693	2.96
Vital Signs							
Glaskow Coma Scale	15 (0)	15 (0)	15 (0)	0.006	0.518	0.324	0.829
SBP (mmHg)	120 (17)	120 (20)	120 (15)	0.024	0.989	0.980	0.999
DBP (mm/Hg)	70 (20)	72 (10)	70 (20)	< 0.001	0.969	0.953	0.985
HR (pulse/min)	86 (18)	85 (11.3)	88 (20)	0.003	1.019	1.007	1.03
SpO2 (%)	98 (3)	98 (2)	97 (2)	< 0.001	0.823	0.740	0.916
Laboratory Parameters							
WBC (10^3/µl)	9.32 (5.35)	9.28 (3.42)	10.46 (5.29)	0.008	1.06	1.016	1.11
Hemoglobin (mg/dl)	9 (4.2)	11.52 (1.97)	8.06 (2.47)	< 0.001	0.550	0.495	0.611
Hematocrit (%)	27.8 (11.9)	35.27 (5.62)	25.2 (7.18)	< 0.001	0.811	0.782	0.842
Platelet (10^3/µl)	231 (106)	242.4 (80.8)	240.69 (109.4)	0.854	1.000	0.998	1.00
Neutrophil (10^3/µl)	6.54 (4.66)	5.63 (3.76)	6.94 (8.59)	0.002	1.09	1.032	1.14
Lymphocyte (10^3/µl)	1.74 (1.31)	1.89 (1.18)	1.66 (1.43)	0.536	0.964	0.859	1.08
BUN (mg/dl)	29.91 (21.5)	22.66 (17.41)	33.18 (23.36)	< 0.001	1.046	1.032	1.061
Creatinine (mg/dl)	0.85 (0.44)	0.82 (0.31)	0.87 (0.59)	< 0.001	2.631	1.657	4.18
eGFR (ml/min/1.73 m^2)	87.15 (47.09)	95.24 (31.22)	81.72 (52.93)	< 0.001	0.982	0.975	0.988
ALT (U/L)	14 (11)	16 (10)	14 (11)	0.437	0.997	0.989	1.00
AST (U/L)	18 (11)	29 (9)	18 (13)	0.476	1.00	0.996	1.01
PT (sec)	12.5 (2.9)	12.25 (2.4)	12.6 (3.3)	0.026	1.02	1.00	1.04
INR	1.22 (0.28)	1.21 (0.21)	1.23 (0.32)	0.024	1.29	1.03	1.60
APTT (sec)	28.4 (7.8)	28.1 (5.4)	28.5 (8.6)	0.032	1.02	1.002	1.04
Albumin (g/dl)	3.5 (0.75)	3.8 (0.51)	3.34 (0.75)	< 0.001	0.801	0.763	0.841
C-reactive protein (mg/L)	5.73 (16.69)	3.34 (5.07)	7.94 (24.2)	< 0.001	1.02	1.01	1.03
INR/albumin	0.36 (0.17)	0.32 (0.08)	0.39 (0.2)	< 0.001	21.384	4.892	93.47
BUN/creatinine	32.42 (24.23)	26.58 (22.07)	35.12 (23.49)	< 0.001	1.028	1.015	1.04

Table 1 (continued)

	Total (*n* = 589)	High risk					
		No (*n* = 168)	Yes (*n* = 421)				
Variables	***n* (%) or Median (IQR)**	***n* (%) or Median (IQR)**	***n* (%) or Median (IQR)**	***p***	**OR**	**95% CI**	
AST/ALT	1.25 (0.67)	1.14 (0.55)	1.31 (0.75)	< 0.001	1.73	1.252	2.39
LOS (day)	4 (3)	3 (1)	4 (4)	< 0.001	1.777	1.544	2.047

*NSAID: non-steroidal anti-inflammatory drug, SBP: systolic blood pressure, DBP: diastolic blood pressure, HR: heart rate, SpO2: oxygen saturation, WBC: White blood cell, BUN: blood urea nitrogen, eGFR: estimated glomerular filtration rate, ALT: alanine aminotransferase, AST: aspartate aminotransferase, PT: prothrombin time, APTT: activated partial thromboplastin time, INR: international normalized ratio, LOS: length of stay IQR: Interquartile range

Table 2 Optimum cutpoint values obtained by ROC analysis of independent risk variables

Variables	Optimum cutpoint	Sensitivity (%)	Specifity (%)	PPV (%)	NPV (%)	AUC (95% CI)	+LR	-LR
Age	53	82.66	42.86	78.38	49.66	0.66 (0.61–0.71)	1.45	0.4
SBP	110	84.52	28.27	31.98	82.07	0.56 (0.51–0.61)	1.18	0.55
Hemoglobin	8.6	95.83	60.57	49.24	97.33	0.86 (0.83–0.9)	2.43	0.07
BUN/Creatinine	30	62	60.71	79.82	38.93	0.63 (0.58–0.68)	1.58	0.63
INR/Albumin	0.4	46.32	82.14	86.67	37.91	0.71 (0.67–0.76)	2.59	0.65

*PPV: positive predictive value, NPV: negative predictive value, LR: likelihood ratio, SBP: systolic blood pressure, BUN: blood urea nitrogen, INR: international normalized ratio

Table 3 Binary logistic regression analysis of the high risk group for new risk score and scoring of the new risk score

						95% CI		
Variables	**B**	**SE**	**Wald**	***p***	**OR**	**Lower**	**Upper**	**Score**
Constant	1.964	0.236	69.019	0.000	7.125			
Age								
< 53								0
≥ 53	0.860	0.251	11.767	0.001	2.363	1.446	3.864	1
SBP								
≥ 110								0
< 110	0.655	0.285	5.299	0.021	1.925	1.102	3.363	1
Hemoglobin								
≥ 8.6								0
< 8.6	3.428	0.407	71.011	0.000	30.811	13.882	68.386	3
BUN/creatinine								
< 30								0
≥ 30	0.668	0.229	8.517	0.004	1.951	1.245	3.055	1
INR/albumin								
< 0.4								0
≥ 0.4	0.869	0.264	10.808	0.001	2.385	1.420	4.004	1

In the transfusion groups, all risk scores showed a statistically significant difference in median values ($p < 0.001$). Among them, the ABL score demonstrated superior predictive performance, with an AUROC of 0.886 (95% CI: 0.86–0.91), significantly outperforming the other scoring systems in transfusion prediction ($p < 0.001$). For the ABL score, the calculated positive and negative likelihood ratios in this group were 16.99 and 0.36, respectively.

Regarding the intervention group, only the AIMS65 score showed a statistically significant difference in median values ($p = 0.007$), and therefore, diagnostic accuracy analyses were not conducted for the other scoring models. The AUROC of the AIMS65 score in this context was 0.579 (95% CI: 0.52–0.64).

In the ICU admission group, all scoring systems revealed significant differences in median values ($p < 0.001$). The AIMS65 score provided the most accurate prediction, with an AUROC of 0.78 (95% CI:

Table 4 Comparison of median values of new risk score, GBS, AIMS65 and Pre-RS scores in all patient groups

Risk scores	Patient groups		*n*	Median	IQR*	*p*
New Risk Score						
	High Risk	No	168	1	1–2	**< 0.001**
		Yes	421	4	2–6	
	Transfusion	No	208	1	1–2	**< 0.001**
		Yes	381	5	3–6	
	Intervention	No	478	3	1–5	0.062
		Yes	111	4	2–6	
	ICU	No	433	2	1–5	**< 0.001**
		Yes	156	5	3–6	
	Readmission	No	569	3	1–5	**< 0.001**
		Yes	20	6	3.5-6	
	Mortality	No	560	3	1–5	**< 0.001**
		Yes	29	5	3–6	
GBS						
	High Risk	No	168	5	2–8	**< 0.001**
		Yes	421	10	7–12	
	Transfusion	No	208	5	3–8	**< 0.001**
		Yes	381	11	8–12	
	Intervention	No	478	8.5	6–11	0.083
		Yes	111	10	7–12	
	ICU	No	433	8	5–11	**< 0.001**
		Yes	156	11	8–13	
	Readmission	No	569	9	6–11	**0.045**
		Yes	20	10.5	10.5–11.3	
	Mortality	No	560	8	6–11	**< 0.001**
		Yes	29	11	9–13	
AIMS65						
	High Risk	No	168	1	0–1	**< 0.001**
		Yes	421	1	1–2	
	Transfusion	No	208	1	0–1	**< 0.001**
		Yes	381	1	1–2	
	Intervention	No	478	1	0–2	**0.007**
		Yes	111	1	1–2	
	ICU	No	433	1	0–1	**< 0.001**
		Yes	156	2	1–3	
	Readmission	No	569	1	0–2	**0.018**
		Yes	20	2	1–3	
	Mortality	No	560	1	0–2	**< 0.001**
		Yes	29	2	2–3	
Pre-RS						
	High Risk	No	168	2	0–3	**< 0.001**
		Yes	421	3	3–4	
	Transfusion	No	208	2	0–3	**< 0.001**
		Yes	381	3	3–4	
	Intervention	No	478	3	2–4	0.169
		Yes	111	3	2–4	
	ICU	No	433	3	2–4	**< 0.001**
		Yes	156	4	3–5	
	Readmission	No	569	3	2–4	0.07
		Yes	20	4	3-4.25	
	Mortality	No	560	3	2–4	**< 0.001**
		Yes	29	4	4–5	

*IQR: Interquartile range (25th–75th percentile)

Table 5 Comparison of the efficacy of ABL, GBS, AIMS65 and Pre-RS scores in predicting all patient groups

Patient groups	Risk scores	Cutpoint	Sens. (%)	Spec. (%)	PPV (%)	NPV (%)	AUC (95% CI)	*p*	+LR	-LR
High risk										
	ABL Score	4	73.87	84.52	92.28	56.35	0.86 (0.83–0.89)	0.002[1] <0.001[2,3,4,5] 0.739[6]	4.77	0.31
	GBS	10	66.03	84.52	91.45	49.82	0.806 (0.77–0.84)		4.27	0.4
	AIMS65	3	43.47	89.88	91.5	38.82	0.71 (0.67–0.75)		4.3	0.63
	Pre-RS	5	47.27	83.33	87.67	38.67	0.704 (0.66–0.75)		2.84	0.63
Transfusion										
	ABL Score	5	65.35	96.15	96.89	60.24	0.886 (0.86–0.91)	<0.001[1,2,3,4,5] 0.959[6]	16.99	0.36
	GBS	10	70.6	83.17	88.49	60.7	0.828 (0.79–0.86)		4.2	0.35
	AIMS65	3	45.93	87.98	87.5	47.04	0.709 (0.67–0.75)		3.82	0.61
	Pre-RS	5	49.87	82.21	83.7	47.24	0.710 (0.67–0.75)		2.8	0.61
Intervention										
	ABL Score									
	GBS									
	AIMS65	2	81.08	32.22	21.74	88	0.579 (0.52–0.64)		1.2	0.59
	Pre-RS									
ICU										
	ABL Score	4	86.54	53.35	40.06	91.67	0.764 (0.72–0.81)	0.018[1] 0.46[2]	1.86	0.25
	GBS	10	74.36	56.58	38.16	85.96	0.713 (0.67–0.76)	0.253[3] 0.013[4]	1.71	0.45
	AIMS65	3	69.23	78.75	54	87.66	0.78 (0.74–0.82)	0.357[5] 0.03[6]	3.26	0.39
	Pre-RS	5	66.67	71.59	45.81	85.64	0.736 (0.69–0.78)		2.35	0.47
Readmission										
	ABL Score	6	70	66.43	6.83	98.44	0.719 (0.6–0.84)	0.103[1] 0.293[2]	2.09	0.45
	GBS	11	75	56.77	5.75	98.48	0.631 (0.53–0.73)	0.806[4]	1.73	0.44
	AIMS65	3	60	66.96	6	97.94	0.649 (0.51–0.79)		1.82	0.6
	Pre-RS									
Mortality										
	ABL Score	4	89.66	44.46	7.72	98.81	0.714 (0.63–0.8)	0.676[1] 0.005[2]	1.61	0.23
	GBS	9	96.55	41.96	7.93	99.58	0.732 (0.65–0.81)	0.146[3] 0.036[4]	1.73	0.27
	AIMS65	3	89.66	68.93	13	99.23	0.834 (0.78–0.90)	0.207[5] 0.184[6]	2.89	0.15
	Pre-RS	5	82.76	63.75	10.57	98.62	0.787 (0.72–0.85)		2.28	0.27

[1]ABL score and GBS score; [2]ABL score and AIMS65 score; [3]ABL and Pre-RS score; [4]GBS score and AIMS65 score; [5]GBS score and Pre-RS score; [6]AIMS65 score and Pre-RS score

0.74–0.82). This performance was comparable to that of the new ABL score, while both outperformed the other risk models ($p < 0.05$).

For the readmission outcome, all risk scores except for the Pre-RS showed significant differences in median values ($p < 0.05$). The ABL score yielded the best predictive ability, with an AUROC of 0.719 (95% CI: 0.6–0.84). However, no significant difference was found among the AUROC values of the various scoring systems in this group ($p > 0.05$).

In the mortality groups, median values of all risk scores differed significantly ($p < 0.001$). The AIMS65 score demonstrated the highest discriminative performance, with an AUROC of 0.834 (95% CI: 0.78–0.90). When comparing AUROC values for mortality prediction, the AIMS65 score was found to be significantly more effective than both the ABL and GBS ($p = 0.005$ and $p = 0.036$, respectively).

Discussion

In this study, a new scoring system was developed for use in patients presenting to the ED with UGIB. This newly developed scoring system was compared with the current GBS, AIMS65, and Pre-RS scores in predicting high risk, transfusion, intervention, ICU, readmission, and mortality in UGIB patients and was found to be more successful in predicting high risk, transfusion, and readmission.

Strengths and weaknesses of GBS, AIMS65, Pre-RS, and the new risk score

An ideal risk score should be simple, easy to use, and highly effective. The variables evaluated by the score should consist of data that can be easily obtained from patients in the acute phase. Additionally, the score should have been prospectively applied and externally validated in different patient populations [20].

The GBS, AIMS65, and Pre-RS scores, developed to predict adverse outcomes in UGIB patients, have strengths and weaknesses. A strength of the GBS score is its high sensitivity in detecting the need for treatment (98.6%). However, the GBS score is not as successful in predicting mortality and the risk of rebleeding as it is in predicting the need for treatment. Furthermore, the large number of variables included, as well as the questioning of melena history and poorly defined variables like liver disease and heart failure, represent some of its other weaknesses [10, 21]. The AIMS65 score is easy to use and shows high effectiveness in predicting mortality. However, it is not sufficiently effective in identifying low-risk patient groups or in making discharge decisions from the ED [21, 22]. The strengths of the Pre-RS score include the small number of variables and its high effectiveness in predicting mortality. However, its assessment of poorly defined comorbidities, such as heart failure, kidney failure, and liver disease, represents a weakness of the score [9, 21]. The ABL score includes few variables, is easy to calculate, and is based on objective data that can be obtained from patients in the acute period. These strengths facilitate its use in the ED. However, it has not been prospectively validated in a large patient population.

Effectiveness of the new risk score and other risk scores in predicting high-risk groups

To the best of our knowledge, there are no studies in the literature on GBS, AIMS65, and Pre-RS scores that include transfusion, intervention, ICU, readmission, and mortality to assess high risk. This study, therefore, makes valuable contributions to the literature. The ABL score was found to be more effective than GBS, AIMS65, and Pre-RS scores in predicting the high-risk group in UGIB patients (AUROC values; ABL score: 0.86, GBS: 0.81, AIMS65: 0.71, Pre-RS: 0.70).

Effectiveness of the new risk score and other risk scores in predicting the transfusion group

In the literature, Robertson et al. and Gonçalves et al. reported that GBS outperformed AIMS65 and Pre-RS in predicting the need for transfusion, while Bryant et al. reported that Pre-RS outperformed and Yaka et al. reported that AIMS65 outperformed [12, 23–25]. In the present study, it was found that GBS outperformed AIMS65 and Pre-RS in predicting the need for transfusion, and the new risk score outperformed GBS. This finding not only supports the existing literature but also makes important contributions. This result may be due to the fact that both GBS and the new risk score use hemoglobin levels as a parameter. The higher AUROC of the ABL score may be attributed to the inclusion of continuous laboratory ratios, which offer improved sensitivity to the severity of acute bleeding. The poorer performance of AIMS65 in predicting intervention may be due to its design, which focuses on mortality rather than immediate treatment needs.

Effectiveness of the new risk score and other risk scores in predicting the readmission group

There is a scarcity of studies in the existing literature that specifically assess the predictive value of risk scoring systems for readmission among patients with UGIB. In one such study, Strömdahl et al. observed that the median Pre-RS score was elevated in patients who experienced 30-day readmission; however, their analysis did not include an evaluation of the GBS or AIMS65 scores [26]. Contrary to the findings of Strömdahl et al., the current study did not reveal a statistically significant difference in median Pre-RS scores between the readmitted and non-readmitted groups. This inconsistency may stem from variations in patient selection criteria across

studies. Nonetheless, the present analysis showed that GBS, AIMS65, and ABL scores were all useful for predicting readmission, with the ABL score demonstrating the strongest predictive performance.

Effectiveness of the new risk score and other risk scores in predicting ICU, intervention, and mortality groups

In the present study, the AUROC values for predicting ICU for ABL score, GBS, AIMS65, and Pre-RS were 0.76, 0.71, 0.78, and 0.74, respectively. A review of the literature revealed that Kim et al. and Robertson et al. reported that AIMS65 outperformed Pre-RS and GBS in predicting ICU admission, and similarly, Hyett et al. also found that AIMS65 was superior to GBS [12, 27, 28]. In another study, Choi et al. compared all three scores and reported that the AIMS65 score performed similarly to the Pre-RS score and outperformed the GBS score [29]. In the present study, AIMS65 was found to be the most effective score in predicting ICU admission, which is consistent with the literature. Additionally, since ABL score had similar AUROC values to AIMS65, it can be suggested that the new risk score could be used alongside AIMS65 in predicting ICU admission.

Previous research in the literature regarding interventions in UGIB patients has largely concentrated on the prediction of endoscopic and surgical procedures. Jimenez-Rosales et al. and Shafaghi et al. examined the utility of GBS and AIMS65 scores for forecasting the need for endoscopic intervention, finding that both scores had limited predictive capacity, as reflected in their low and comparable AUROC values [30, 31]. In contrast, Stanley et al. reported that GBS offered better performance in identifying patients requiring endoscopic intervention, while AIMS65 and Pre-RS scores demonstrated weaker predictive ability [32].

Similarly, studies by Yaka et al. and Zhong et al. indicated that GBS was superior to AIMS65 in predicting both endoscopic and surgical interventions [10, 25]. In surgical intervention prediction specifically, Bryant et al. noted the superiority of GBS over Pre-RS, and Gonçalves et al. found GBS to be more accurate than both AIMS65 and Pre-RS; however, despite these findings, none of the scoring systems were considered adequately reliable for predicting the need for endoscopic intervention due to their low AUROC values [23, 24].

In the current study, only the AIMS65 score showed a statistically significant difference between groups regarding intervention prediction; however, its diagnostic accuracy remained limited. Although these findings align with prior literature, the clinical applicability of AIMS65 in this context appears to be restricted.

Numerous studies in the literature have compared the effectiveness of GBS, AIMS65, and Pre-RS scores in predicting in-hospital mortality in UGIB patients [12, 33–36]. Robertson et al., Fouad & Shabaan, and Morarasu et al. reported that AIMS65 had higher diagnostic effectiveness than GBS and Pre-RS in predicting in-hospital mortality among UGIB patients [12, 35, 37]. Conversely, Renukaprasad et al. found that GBS was superior to Pre-RS and AIMS65 in predicting in-hospital mortality [38]. In the present study, all scores were effective in predicting the mortality group, and consistent with other studies in the literature, AIMS65 was the most effective scoring system for predicting mortality. Considering that this is the only study conducted for ABL score, the results obtained in the present study should be supported by additional clinical studies.

Limitations

This study has several inherent limitations. Foremost among them is its retrospective design, which naturally restricts the ability to establish causality. Another important limitation stems from the exclusion of patients who did not undergo endoscopy; however, this decision was made to ensure diagnostic confirmation of UGIB, thus focusing the analysis on confirmed cases. Additionally, the findings of this study require validation through future prospective research to confirm their reproducibility and generalizability. Furthermore, since this is a single-center retrospective study, the external validity of the ABL score is limited. Prospective multicenter validation is necessary before clinical implementation. The last limititaion is that patients who developed rebleeding during hospitalization were not included in the study.

Conclusion

Accurately identifying patients at high risk for transfusion, intervention, intensive care admission, readmission, and mortality in the emergency department setting due to UGIB is essential for guiding timely clinical decisions and optimizing patient care. In this study, the ABL score outperformed the GBS, AIMS65, and Pre-RS scores in terms of diagnostic accuracy, particularly in predicting high-risk status, transfusion needs, and likelihood of readmission. Additionally, the ABL score may serve as a complementary tool alongside the AIMS65 score in assessing the need for ICU admission. Nevertheless, these results require confirmation through larger-scale, prospective studies to establish broader clinical applicability.

Abbreviatons

AUROC	Area under the receiver operating characteristic
BUN	Blood urea nitrogen
ED	Emergency department
GBS	Glaskow Blatchford Score
ICU	Intensive care unit
INR	International normalized ratio
IQR	Interquartile range
LOS	Length of stay

NPV	Negative predictive value
PPV	Positive predictive value
Pre-RS	Pre-endoscopic Rockall Score
ROC	Receiver operating characteristic
SBP	Systolic blood pressure
SPSS	Statistical Package for the Social Sciences
UGIB	Upper gastrointestinal bleeding

Author contributions
N.G.G.; Conceptualization, Data curation, Formal analysis, Methodology, Writing – original draft, Writing – review & editing F.C.; Conceptualization, Data curation, Formal analysis, Writing – original draft, Writing – review & editing Y.Y.; Methodology Visualization, Writing – review & editing F.G.; Investigation, Visualization, Writing – review & editing F.B.; Data curation and resources, Writing – review & editing. All authors reviewed the manuscript.

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

Declarations

Ethics approval and patient consent
Ethical approval for the study was granted by the Ethics Committee of Sakarya University (IRB No: 43012747-050.04-438096), and all procedures were carried out in compliance with the ethical standards outlined in the Declaration of Helsinki. As this was a retrospective study based on the review of medical records, the requirement for informed consent was waived by the Ethics Committee of Sakarya University. All patient records were anonymized and de-identified, and the Ethics Committee waived the need for informed consent before analysis due to the retrospective nature of the data.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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References

1. Dicu D, Pop F, Ionescu D, Dicu T. Comparison of risk scoring systems in predicting clinical outcome at upper Gastrointestinal bleeding patients in an emergency unit. Am J Emerg Med. 2013;31(1):94–9.
2. Thanapirom K, Ridtitid W, Rerknimitr R, Thungsuk R, Noophun P, Wongjitrat C, et al. Prospective comparison of three risk scoring systems in non-variceal and variceal upper Gastrointestinal bleeding. J Gastro Hepatol. 2016;31(4):761–7.
3. Gralnek IM, Stanley AJ, Morris AJ, Camus M, Lau J, Lanas A, et al. Endoscopic diagnosis and management of nonvariceal upper Gastrointestinal hemorrhage (NVUGIH): European society of Gastrointestinal endoscopy (ESGE) Guideline – Update 2021. Endoscopy. 2021;53(03):300–32.
4. Ramaekers R, Mukarram M, Smith CAM, Thiruganasambandamoorthy V. The predictive value of preendoscopic risk scores to predict adverse outcomes in emergency department patients with upper gastrointestinal bleeding: a systematic review. Gerhardt RT, editor. Academic rmergency medicine. 2016;23(11):1218–27.
5. Blatchford O, Murray WR, Blatchford M. A risk score to predict need for treatment for uppergastrointestinal haemorrhage. Lancet. 2000;356(9238):1318–21.
6. Laine L, Barkun AN, Saltzman JR, Martel M, Leontiadis GI. ACG clinical guideline: upper Gastrointestinal and ulcer bleeding. Am J Gastroenterol. 2021;116(5):899–917.
7. Saltzman JR, Tabak YP, Hyett BH, Sun X, Travis AC, Johannes RS. A simple risk score accurately predicts in-hospital mortality, length of stay, and cost in acute upper GI bleeding. Gastrointest Endosc. 2011;74(6):1215–24.
8. Rockall TA, Logan RF, Devlin HB, Northfield TC. Risk assessment after acute upper Gastrointestinal haemorrhage. Gut. 1996;38(3):316–21.
9. Meltzer AC, Burnett S, Pinchbeck C, Brown AL, Choudhri T, Yadav K, et al. Pre-Endoscopic Rockall and Blatchford scores to identify which emergency department patients with suspected Gastrointestinal bleed do not need endoscopic hemostasis. J Emerg Med. 2013;44(6):1083–7.
10. Zhong M, Chen WJ, Lu XY, Qian J, Zhu CQ. Comparison of three scoring systems in predicting clinical outcomes in patients with acute upper Gastrointestinal bleeding: a prospective observational study. J Digest Dis. 2016;17(12):820–8.
11. Choe JW, Kim SY, Hyun JJ, Jung SW, Jung YK, Koo JS, et al. Is the AIMS 65 score useful in Prepdicting clinical outcomes in Korean patients with variceal and nonvariceal upper Gastrointestinal bleeding?? Gut Liver. 2017;11(6):813–20.
12. Robertson M, Majumdar A, Boyapati R, Chung W, Worland T, Terbah R, et al. Risk stratification in acute upper GI bleeding: comparison of the AIMS65 score with the Glasgow-Blatchford and Rockall scoring systems. Gastrointest Endosc. 2016;83(6):1151–60.
13. Zuur AF, Ieno EN, Elphick CS. A protocol for data exploration to avoid common statistical problems. Methods Ecol Evol. 2010;1(1):3–14.
14. DeLong ER, DeLong DM, Clarke-Pearson DL. Comparing the areas under two or more correlated receiver operating characteristic curves: a nonparametric approach. Biometrics. 1988;44(3):837–45.
15. Robert G, Newcombe DGA. In: Altman D, Machin D, Bryant T11.GM, Ed. Statistics with Confidence: Confidence Intervals and Statistical Guidelines. 2nd edition. London: Wiley; 2000;45– 7. In.
16. Alali AA, Barkun AN. An update on the management of non-variceal upper Gastrointestinal bleeding. Gastroenterol Rep. 2022;11:goad011.
17. Kim MS, Moon HS, Kwon IS, Park JH, Kim JS, Kang SH, et al. Validation of a new risk score system for non-variceal upper Gastrointestinal bleeding. BMC Gastroenterol. 2020;20(1):193.
18. Wilkins T, Wheeler B, Carpenter M. Up Gastrointest Bleeding Adults:Evaluation Manage. 2020;101(5).
19. Peduzzi P, Concato J, Kemper E, Holford TR, Feinstein AR. A simulation study of the number of events per variable in logistic regression analysis. J Clin Epidemiol. 1996;49(12):1373–9.
20. Kim BJ, Park MK, Kim SJ, Kim ER, Min BH, Son HJ, et al. Comparison of scoring systems for the prediction of outcomes in patients with nonvariceal upper Gastrointestinal bleeding: A prospective study. Dig Dis Sci. 2009;54(11):2523–9.
21. Alali AA, Boustany A, Martel M, Barkun AN. Strengths and limitations of risk stratification tools for patients with upper Gastrointestinal bleeding: a narrative review. Expert Rev Gastroenterol Hepatol. 2023;17(8):795–803.
22. Abougergi MS, Charpentier JP, Bethea E, Rupawala A, Kheder J, Nompleggi D, et al. A prospective, multicenter study of the AIMS65 score compared with the Glasgow-Blatchford score in predicting upper Gastrointestinal hemorrhage outcomes. J Clin Gastroenterol. 2016;50(6):464–9.
23. Cúrdia Gonçalves T, Barbosa M, Xavier S, Boal Carvalho P, Firmino Machado J, Magalhães J, et al. Optimizing the risk assessment in upper Gastrointestinal bleeding: comparison of 5 scores predicting 7 outcomes. GE Port J Gastroenterol. 2018;25(6):299–307.
24. Bryant RV, Kuo P, Williamson K, Yam C, Schoeman MN, Holloway RH, et al. Performance of the Glasgow-Blatchford score in predicting clinical outcomes and intervention in hospitalized patients with upper GI bleeding. Gastrointest Endosc. 2013;78(4):576–83.
25. Yaka E, Yılmaz S, Özgür Doğan N, Pekdemir M. Comparison of the Glasgow-Blatchford and AIMS65 scoring systems for risk stratification in upper Gastrointestinal bleeding in the emergency department. Acad Emerg Med. 2015;22(1):22–30.
26. Strömdahl M, Helgeson J, Kalaitzakis E. Emergency readmission following acute upper Gastrointestinal bleeding. Eur J Gastroenterol Hepatol. 2017;29(1):73–7.
27. Kim D, Jo S, Lee JB, Jin Y, Jeong T, Yoon J, et al. Comparison of the National early warning Score + Lactate score with the pre-endoscopic rockall,

Glasgow-Blatchford, and AIMS65 scores in patients with upper Gastrointestinal bleeding. Clin Exp Emerg Med. 2018;5(4):219–29.
28. Hyett BH, Abougergi MS, Charpentier JP, Kumar NL, Brozovic S, Claggett BL, et al. The AIMS65 score compared with the Glasgow-Blatchford score in predicting outcomes in upper GI bleeding. Gastrointest Endosc. 2013;77(4):551–7.
29. Choi J, Lee JS, Lee S, Kim YW, Lee Y, Kim TY. International Normalized Ratio-to-Albumin Ratio as a Novel Marker of Upper Gastrointestinal Bleeding Severity. Quach DT, editor. Gastroenterology Research and Practice. 2022;2022:1–7.
30. Jimenez-Rosales R, Lopez-Tobaruela JM, Lopez-Vico M, Ortega-Suazo EJ, Martinez-Cara JG, Redondo-Cerezo E. Performance of the new ABC and MAP(ASH) scores in the prediction of relevant outcomes in upper Gastrointestinal bleeding. JCM. 2023;12(3):1085.
31. Shafaghi A, Gharibpoor F, Mahdipour Z, Samadani AA. Comparison of three risk scores to predict outcomes in upper Gastrointestinal bleeding; modifying Glasgow-Blatchford with albumin. Rom J Intern Med. 2019;57(4):322–33.
32. Stanley AJ, Laine L, Dalton HR, Ngu JH, Schultz M, Abazi R et al. Comparison of risk scoring systems for patients presenting with upper Gastrointestinal bleeding: international multicentre prospective study. BMJ. 2017;356:i6432.
33. Akhila Arya PV, Thulaseedharan NK, Raj R, Unnikrishnan DC, Jacob A. AIMS65, Glasgow-Blatchford bleeding score and modified Glasgow-Blatchford bleeding score in predicting outcomes of upper Gastrointestinal bleeding: an accuracy and calibration study. Indian J Gastroenterol. 2023;42(4):496–504.
34. Gu L, Xu F, Yuan J. Comparison of AIMS65, Glasgow–Blatchford and Rockall scoring approaches in predicting the risk of in-hospital death among emergency hospitalized patients with upper Gastrointestinal bleeding: a retrospective observational study in nanjing, China. BMC Gastroenterol. 2018;18(1):98.
35. Fouad T, Shabaan ES. Comparison of AIMS65, Glasgow-Blatchford, and pre-endoscopy Rockall scoring systems for risk stratification in Egyptian patients with upper Gastrointestinal bleeding. J Med Sci Res. 2020;3(4):270.
36. Martínez-Cara JG, Jiménez-Rosales R, Úbeda-Muñoz M, De Hierro ML, De Teresa J, Redondo-Cerezo E. Comparison of AIMS65, Glasgow–Blatchford score, and Rockall score in a European series of patients with upper Gastrointestinal bleeding: performance when predicting in-hospital and delayed mortality. United Eur Gastroenterol J. 2016;4(3):371–9.
37. Morarasu BC, Sorodoc V, Haisan A, Morarasu S, Bologa C, Haliga RE, et al. Age, blood tests and comorbidities and AIMS65 risk scores outperform Glasgow-Blatchford and pre-endoscopic Rockall score in patients with upper Gastrointestinal bleeding. World J Clin Cases. 2023;11(19):4513–30.
38. Renukaprasad AK, Narayanaswamy S. R V. A comparative analysis of risk scoring systems in predicting clinical outcomes in upper Gastrointestinal bleed. Cureus. 2022;14(7):e26669.

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