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Prognostic scores for predicting clinical outcomes in upper gastrointestinal bleeding

Gaurav Khatana[1*], Sunil Kumar K[2], Sandesh Kolassery[1], Saji Sebastian[1], Deni Joseph[1], Ramu Muraleedharanpillai[1], Tony Joseph[1], Nithya V[1], Lal Krishna Unnikrishnan[1] and Gino Rony[1]

Abstract

Background and aims This study aimed to determine the performance of AIMS65, Rockall score, and Glasgow-Blatchford score (GBS) in patients presenting with upper gastrointestinal bleeding (UGIB) and to compare results between patients with nonvariceal UGIB (NVUGIB) and variceal UGIB (VUGIB).

Methods We conducted a single-center prospective cohort study between December 2021 and December 2022. A total of 400 patients who met the inclusion criteria were included in the study, out of which 232 patients (58%) had NVUGIB and 168 patients (42%) had VUGIB. Receiver operating characteristic curve analysis was performed for all outcomes for comparison.

Results Of the total of 400 patients with UGIB, 232 patients (58%) had NVUGIB, and 168 patients (42%) had VUGIB. The present study showed that GBS (*AUROC* 0.729, 95% *CI*: 0.598–0.859, $p=0.001$) and RS (*AUROC* 0.693, 95% *CI*: 0.579–0.807, $p=0.005$) but not AIMS65 (*AUROC*, 0.545, 95% *CI*: 0.412–0.679, $p=0.500$) predicted in-hospital and overall 6-week mortality in patients with UGIB. All the three scores predicted need for blood transfusion and poor composite outcomes ($p<0.05$). The need for endoscopic intervention was predicted by all the three scores in overall UGIB (OUGIB) patients ($p<0.05$), only GBS and RS in NVUGIB patients ($p<0.05$). Rebleeding was best predicated by RS in both OUGIB and NVUGIB patients ($p<0.05$). None of the scores predicted the need for endoscopic intervention, rebleeding, need for surgical and radiological intervention, and composite outcomes in VUGIB patients ($p>0.05$).

Conclusions GBS and RS were superior to AIMS65 in predicted in-hospital and overall 6-week mortality in all the three categories: OUGIB, NVUGIB, and VUGIB patients.

Keywords AIMS65 score, Glasgow-Blatchford score, Rockall score, Upper gastrointestinal bleeding

*Correspondence:
Gaurav Khatana
gauravkhatana09@gmail.com
[1] Department of Medical Gastroenterology, Government Medical College Kottayam, Gandhinagar, Kerala 686008, India
[2] Department of Medical Gastroenterology, Government Medical College Kozhikode, Kozhikode, Kerala 673008, India

Background

Upper gastrointestinal bleed (UGIB) is one of the most common medical emergencies in clinical practice worldwide. Despite major improvements in the care of patients with UGIB over the years with major advances in endoscopic equipment, practice, therapeutic modalities, radiologic techniques, and ICU care, mortality of UGIB is still high and varies from 6 to 12% [1]. Overall UGIB (OUGIB) is traditionally divided into variceal (VUGIB) and nonvariceal (NVUGIB), and peptic ulcer is the most common, accounting for approximately 40% of cases [2]. Bleeding is self-limited in 80% of patients even without specific therapy. Of the remaining 20% who continue to bleed or rebleed, the mortality rate is 30 to 40% [3].

Therefore, various scoring systems for UGIB were developed and validated with primary aim which was to segregate the patients into low-risk and high-risk groups. These scoring systems allow us to compartmentalize the myriad presentations, risk factors, and outcomes into more or less uniform groups, so as to prioritize management and resource allocation [4]. Due to massive burden of UGIB and wide nonavailability of emergency endoscopic services in India, the role of these scores amplifies in segregating high-risk patients requiring immediate medical care from the low-risk patients who do not need specialized medical care and can be managed with basic supportive care.

There is a lack of universally accepted ideal risk score that is validated in patients with UGIB in India. Therefore, usefulness of these scores in Indian population needs to be assessed. This study aims to compare the performance of AIMS65, Rockall score, and GBS (Table 1) in patients presenting with UGIB, including those with any cause of UGIB and subgroups of patients with NVUGIB and VUGIB.

Study design and population

This was a single-center prospective cohort study conducted at the Department of Gastroenterology and Medicine at Government Medical College, Kottayam, Kerala, India, between December 2021 and December 2022 after taking approval from institutional ethics board. The study was conducted in accordance with the Declaration of Helsinki and good clinical practice guidelines. Consent was obtained from the patient or the nearest relatives of the patient at the time of enrolment. Patients were included if they were > 18 years old and presented to the hospital with evidence of UGIB, defined as hematemesis, coffee-ground vomiting, melena, or hematochezia [5]. Patients with age ≤ 18 years and pregnant females were excluded.

Methods

Definitions and treatment protocols

According to the institutional protocols, all patients with UGIB visiting the emergency or outpatient department were assessed and hemodynamically stabilized and subsequently underwent endoscopy during the study period. The details of endoscopic findings in the whole cohort are shown in Fig. 1. Depending upon the endoscopic findings, overall UGIB patients (OUIB) were be divided into those having variceal UGIB (VUGIB) and nonvariceal UGIB (NVUGIB). VUGIB was be defined by Baveno VI consensus [6]. All other etiologies of UGIB identified on UGIE including cases where the source of bleeding could not be identified were classified as having NVUGIB [7]. Diagnostic and therapeutic UGI endoscopy were done with Olympus GIF-150 endoscopy system. Ulcers (gastric or duodenal) found on UGI endoscopy were designated according to Forrest classification [8].

Acute UGI bleed was defined as a hematemesis or the passage of melena. Hematemesis was defined as vomiting of blood, blood clots, or coffee ground. Melena was defined as passage of dark, tarry stools, or fresh blood. Blood transfusion was done at target hemoglobin ≥ 7 g/dL, with higher hemoglobin target (9 g/dL) in patients with clinical evidence of intravascular volume depletion or comorbidities such as coronary artery disease. Shock was defined as pulse > 100/min and systolic blood pressure < 90 mm Hg. The patients were considered to have altered mental status if the Glasgow Coma Scale score was < 14 or patient's experiencing "disorientation," "lethargy," "stupor," or "coma." Rebleeding was defined as recurrent vomiting of fresh blood, melena, or both with either shock or a decrease in hemoglobin concentration of at least 2 g % after initial successful treatment and after initial stabilization of 24 h. Failure of endoscopic therapy was defined as inability to control active bleeding during endoscopy or fall in hemoglobin > 2 g% and melena within 48 h of endoscopy.

Interventions related to the management of the upper GI hemorrhage were recorded, which included the need for blood transfusion, endoscopic therapy, repeated endoscopy and endoscopic therapy, radiologically guided hemostasis (embolization), and surgery. Endoscopic attempts at hemostasis were carried out according to the institutional protocols. After initial endoscopic control, patients were admitted for monitoring and treatment. Surgery or embolization was considered for patients who failed endoscopic intervention or developed rebleeding despite two adequate endoscopic intervention attempts. Patients were subsequently followed up for 6 weeks to determine rebleeding and mortality [5]. Prognostic scores such as AIMS65, Rockall score, and GBS were calculated as per the standard criteria.

Table 1 Scoring systems

Scoring system	Admission clinical factor	Parameter	Score
AIMS65 score			
	Albumin	< 3.0 mg/dL	1
	INR	> 1.5	1
	Mental status	Altered	1
	SBP, mm Hg	≤ 90	1
	Age, year	≥ 65	1
Rockall score			
	Age, year	< 60	0
		60–79	1
		≥ 80	2
	Shock	Heart rate > 100 bpm	1
		SBP < 100 mm Hg	2
	Comorbidity	No major	0
		CHF, IHD, or major comorbidity	2
		Renal failure, liver failure, metastatic malignancy	3
	Endoscopic finding	Mallory–Weiss tear or no lesion and no stigmata	0
		All other diagnoses	1
		GI malignancy	2
	Stigmata of recent bleeding	No stigmata or pigmented spot on ulcer	0
		Blood in upper GI tract, adherent clot, visible vessel, bleeding	2
Glasgow-Blatchford score			
	BUN, mg/dL	≥ 18.2 to < 22.4	2
		≥ 22.4 to < 28	3
		≥ 28 to < 70	4
		≥ 70	6
	Hemoglobin level, g/dL	Male ≥ 12.0 to < 13.0	1
		Male ≥ 10.0 to < 12.0	3
		Male < 10.0	6
		Female ≥ 10.0 to < 12.0	1
		Female < 10.0	6
	SBP, mm Hg	≥ 100 to < 109	1
		≥ 90 to < 100	2
		< 90	3
	Other markers	Heart rate > 100 bpm	1
		Presented with melena	1
		Presented with syncope	2
		Hepatic disease	2
		Cardiac failure	2

Data collection

Data collection was done on printed case record forms recording clinical and investigational information at initial assessment, during hospitalization, at subsequent outpatient visits, and at end of study period. For each patient, the following data were collected: age, sex, clinical presentation, comorbidities, medications, and laboratory results on admission. In addition, the time to endoscopy, endoscopic findings, type of endoscopic intervention, number of packed red blood cell units received, surgical and radiologic intervention, and subsequent clinical outcomes (including rebleeding and in-hospital death) were assessed. Post-discharge data was gathered during outpatient visits and weekly telephonic interviews for a period of 6 weeks from initial gastrointestinal (GI) bleed. These data forms were securely stored in the office of the principal investigator, and the information was transferred to SPSS statistical package

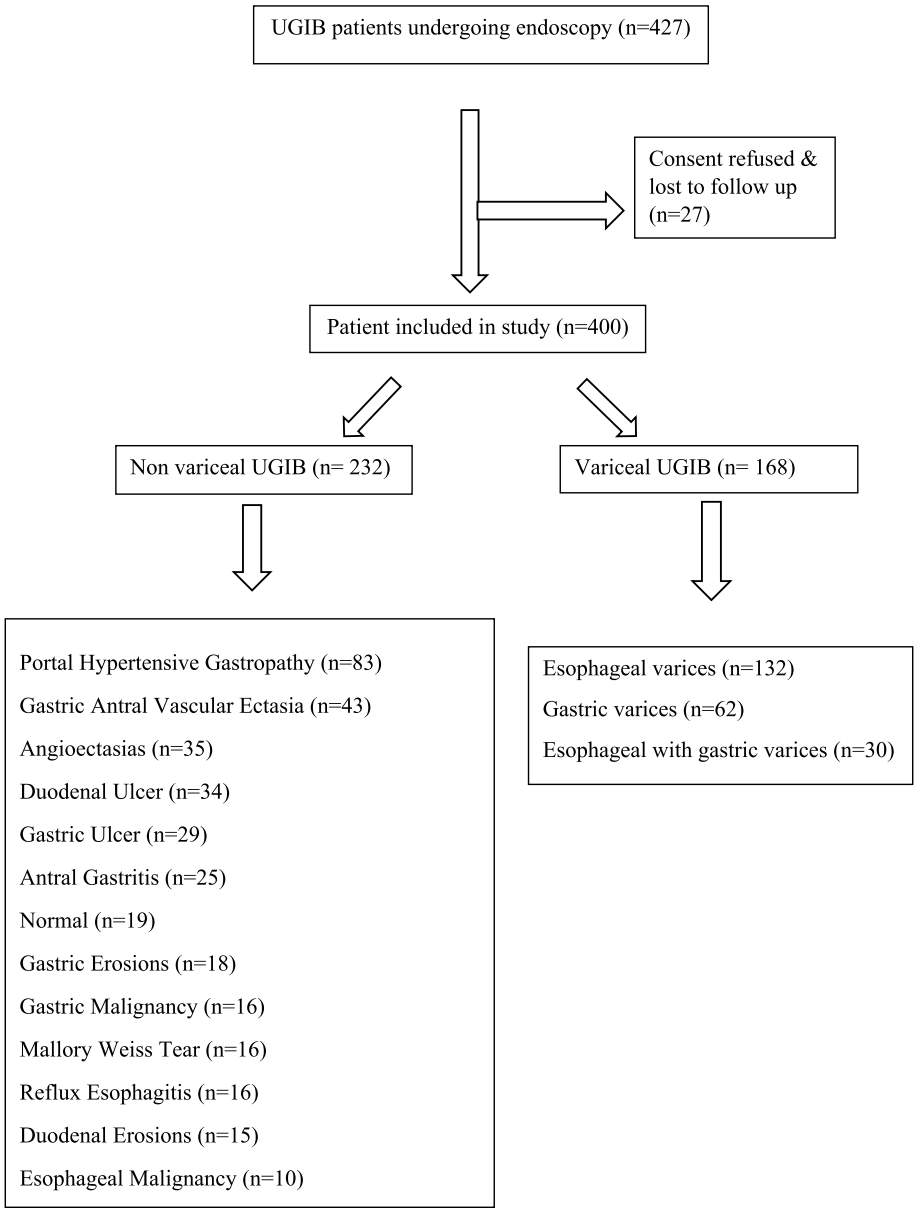


Fig. 1 Flow chart of patients recruited. UGI, upper gastrointestinal; NVUGIB, nonvariceal upper gastrointestinal bleeding; VUGIB, variceal upper gastrointestinal

worksheet (SPSS for Windows, version 21.0. Chicago: SPSS Inc.) on a password-protected computer.

Outcomes

The primary outcome was in-hospital mortality. Secondary outcomes were (1) the need for blood transfusion, (2) endoscopic intervention requirement, (3) in-hospital rebleeding, and (4) the composite endpoint of in-hospital mortality, need for blood transfusion, overall interventions (including endoscopic, radiologic, and surgical interventions), and rebleeding.

Statistical analysis

The study sample size was calculated according to the studies by Hyett et al. and Bryant et al. [9, 10]. Hyett et al. revealed that the in-hospital mortality rate was 6.5%, and the AUROCs of AIMS65 and GBS for predicting in-hospital mortality were 0.93 and 0.68, respectively [9]. Bryant et al. reported that the AUROCs of RS and GBS for predicting in-hospital mortality were 0.71 and 0.72, respectively [10].

Categorical variables were summarized using frequency statistics (e.g., frequencies, percentage) and were

compared between groups using Pearson chi-square test or Fisher's exact test. Descriptive statistics (e.g., mean, standard deviation, median, and range) was used for continuous variables, which was compared using Student's *t*-test, ANOVA, and Wilcoxon rank-sum test. After performing univariate analysis, age, sex, and other variables with *p*-values < 0.1 were included in the multivariate analysis model. Later, receiver operating characteristic (ROC) curves were constructed to assess the relationship between each score and all outcomes. The area under the ROC curves (AUROCs) were assessed with exact binomial confidence intervals (CIs). AUROCs were tested for equality using the Delong χ^2 test. The data analysis was performed using the statistical program Stata version 15.1. A *p*-value of < 0.05 was considered statistically significant.

Results

Patients baseline characteristics

Among 427 patients, 400 patients who met the inclusion criteria were enrolled in study. The mean age (years) was 56.99 ± 13.35. A total of 318 (79.5%) of the participants were male, and 82 (20.5%) of the participants were female. A total of 190 (47.5%) of the participants presented with hematemesis and 97 (24.2%) with melena, and 113 (28.2%) had hematemesis with melena. A total of 151 (37.8%) of the participants had minimal bleeding, 205 (51.2%) had moderate bleeding, and 44 (11.0%) had massive bleeding on presentation. The mean blood pressure (mmHg) was 119.17 ± 17.39. A total of 85 (21.2%) of the participants had syncope, and 4 (1.0%) of the participants had altered mental status. A total of 38 (9.5%) of the participants had prior history of UGIB. A total of 122 (42.1%) of the participants had a history of alcohol, 73 (25.2%) had history of smoking, and 92 (31.7%) had history of both alcohol and smoking.

On the basis of endoscopy results, 232 patients (58%) had NVUGIB, and 168 patients (42%) had VUGIB. The endoscopic findings of patients with VUGIB included esophageal varices in 132 (33%) and gastric varices with or without esophageal varices in 62 (15.5%). A total of 216 (54.0%) of the participants had endoscopy within 24 h, and 184 (46.0%) had endoscopy after 24 h. The causes of UGIB in patients with NVUGIB were peptic ulcer disease in 63 patients (15.75%), including 29 with gastric ulcers, 34 with duodenal ulcers, gastritis/duodenitis in 58 patients (14.5%), Mallory–Weiss tears in 16 patients (4%), reflux esophagitis in 16 patients (4%), portal hypertensive gastropathy in 83 patients (20.8%), and malignancy in 26 patients (6.5%). The patients with NVUGIB had greater mean blood pressure, heart rate, hemoglobin values, platelets count, albumin, and history drugs, i.e., NSAIDS, aspirin, statins, pantoprazole, and corticosteroid intake. The patients with NVUGIB had greater number of participants who had prior history of alcohol with smoking and with presentation of altered mental status and syncope. The patient with VUGIB had greater mean age and INR, BUN, and creatinine values with higher number of patients with history of alcohol intake. In terms of outcomes, patients with VUGIB had higher AIMS65, Glasgow-Blatchford score, and complete Rockall score values. Higher number of patients with VUGIB required endoscopic intervention and had higher incidence of rebleeding. The requirement of blood transfusion, need for surgical and radiological intervention, in-hospital mortality, and overall mortality at 6 weeks were higher in participants with NVUGIB.

The following variables were significantly associated ($p < 0.05$) with the VUGIB: presentation, comorbidities (chronic liver disease, malignancy, hepatitis C virus), lab parameters (hemoglobin, platelet count, S. albumin, INR, BUN, S. creatinine, early endoscopy (within 24 h)), and endoscopic findings (esophageal varices, gastric antral vascular ectasia, portal hypertensive gastropathy, angioectasias, duodenal ulcer, gastric ulcer, antral gastritis, gastric erosions, gastric malignancy, Mallory–Weiss tear, reflux esophagitis, duodenal erosions, requirement of blood transfusion, endoscopic intervention, rebleeding, and composite outcome (Table 2).

Accuracy of scoring systems and comparison between patients with NVUGIB and those with VUGIB

Mortality

GBS and RS were accurate in predicting mortality in patients with OUGIB (AUROC; *GBS* = 0.729, *RS* = 0.693, all $p \leq 0.05$), NVUGIB (AUROC; *GBS* = 0.688, *RS* = 0.675, all $p < 0.05$), and VUGIB patients (AUROC; *GBS* = 0.892, *RS* = 0.745, all $p < 0.05$), whereas AIMS65 was not accurate in predicting mortality in patients with OUGIB (*AUROC*: 0.545, all $p = 0.500$), NVUGIB (*AUROC*: 0.555, all $p = 0.512$), and VUGIB (*AUROC*: 0.642, all $p = 0.175$) (Fig. 2).

Overall 6-week mortality

GBS and RS were accurate in predicting overall 6-week mortality in patients with OUGIB (AUROC; *GBS* = 0.77, *RS* = 0.727, all $p \leq 0.05$), NVUGIB (AUROC; *GBS* = 0.782, *RS* = 0.728, all $p < 0.05$), and VUGIB patients (AUROC; *GBS* = 0.824, *RS* = 0.75, all $p < 0.05$), whereas AIMS65 was not accurate in predicting mortality in patients with OUGIB (*AUROC*: 0.589, all $p = 0.121$), NVUGIB (*AUROC*: 0.617, all $p = 0.093$), and VUGIB (*AUROC*: 0.651, all $p = 0.106$) (Fig. 3).

Table 2 Overall baseline characteristics and outcome comparison between patients with nonvariceal and variceal upper gastrointestinal bleeding

Factors	VUGIB (*n* = 168)	NVUGIB (*n* = 232)	*p*-value
Age (years)	57.15 ± 14.10	56.87 ± 12.80	0.834[1]
Gender			0.106[2]
Male	140 (83.3%)	178 (76.7%)	
Female	28 (16.7%)	54 (23.3%)	
Presentation			0.003[2]
Hematemesis	84 (50.0%)	106 (45.7%)	
Melena	27 (16.1%)	70 (30.2%)	
Severity of bleed			0.521[2]
Minimal	58 (34.5%)	93 (40.1%)	
Moderate	91 (54.2%)	114 (49.1%)	
Massive	19 (11.3%)	25 (10.8%)	
Blood pressure (mmHg)	118.06 ± 17.18	119.97 ± 17.54	0.310[3]
Heart rate (> 90)	18 (10.7%)	23 (9.9%)	0.794[2]
Syncope	37 (22.0%)	48 (20.7%)	0.748[2]
Altered mental status	1 (0.6%)	3 (1.3%)	0.642[4]
Comorbidities			
Chronic liver disease***	132 (78.6%)	63 (27.2%)	< 0.001[2]
Diabetes mellitus	44 (26.2%)	62 (26.7%)	0.905[2]
Coronary artery disease	19 (11.3%)	38 (16.4%)	0.152[2]
Chronic obstructive pulmonary disease	16 (9.5%)	23 (9.9%)	0.897[2]
Hypertension	20 (11.9%)	18 (7.8%)	0.163[2]
Malignancy***	3 (1.8%)	25 (10.8%)	< 0.001[2]
Normal***	1 (0.6%)	24 (10.3%)	< 0.001[2]
Chronic kidney disease	7 (4.2%)	15 (6.5%)	0.320[2]
Thyroid disease	4 (2.4%)	13 (5.6%)	0.115[2]
Dyslipedimia	4 (2.4%)	9 (3.9%)	0.404[2]
Hepatitis B virus infection	8 (4.8%)	4 (1.7%)	0.079[2]
Hepatitis C virus***	7 (4.2%)	2 (0.9%)	0.039[4]
Bronchial asthma	3 (1.8%)	5 (2.2%)	1.000[4]
Cerebrovascular accidents	1 (0.6%)	4 (1.7%)	0.404[4]
Autoimmune hepatitis	2 (1.2%)	2 (0.9%)	1.000[4]
Chronic pancreatitis	3 (1.8%)	0 (0.0%)	0.073[4]
Hepatocellular carcinoma	1 (0.6%)	1 (0.4%)	1.000[4]
Gastrojejunostomy	0 (0.0%)	2 (0.9%)	0.512[4]
Rheumatic heart disease	0 (0.0%)	2 (0.9%)	0.512[4]
Associated factors			0.102[4]
None	2 (1.5%)	1 (0.6%)	
Alcohol	64 (48.9%)	58 (36.5%)	
Smoking	27 (20.6%)	46 (28.9%)	
Alcohol + smoking	38 (29.0%)	54 (34.0%)	
Medications			
Aspirin	23 (17.4%)	38 (21.5%)	0.377[2]
Clopidogrel	6 (4.5%)	6 (3.4%)	0.603[2]
Pantoprazole	99 (75.0%)	119 (67.2%)	0.138[2]
Corticosteroids	13 (9.8%)	21 (11.9%)	0.575[2]
NSAIDS	20 (15.2%)	42 (23.7%)	0.063[2]
Statins	16 (12.1%)	33 (18.6%)	0.120[2]
Laboratory			
Hemoglobin (g/dL)***	7.37 ± 1.94	9.37 ± 1.89	< 0.001[3]
Platelet count (mcL)***	1.02 ± 0.55	2.51 ± 1.02	< 0.001[3]
S. albumin (g/dL)***	2.69 ± 0.48	3.50 ± 0.71	< 0.001[3]
INR***	1.87 ± 0.59	1.32 ± 0.45	< 0.001[3]

Table 2 (continued)

Factors	VUGIB ($n=168$)	NVUGIB ($n=232$)	p-value
BUN (mg/dL)	23.62 ± 10.25	23.53 ± 14.35	0.041[3]
S. creatinine (mg/dL)***	1.45 ± 0.57	1.27 ± 0.72	< 0.001[3]
Endoscopy (24 h)* **	149 (88.7%)	67 (28.9%)	< 0.001[2]
Endoscopy findings			
Esophageal varices***	132 (78.6%)	0 (0.0%)	< 0.001[2]
Gastric antral vascular ectasia***	78 (46.4%)	27 (11.6%)	< 0.001[2]
Portal hypertensive gastropathy***	83 (49.4%)	0 (0.0%)	< 0.001[2]
Angioectasia***	0 (0.0%)	35 (15.1%)	< 0.001[2]
Duodenal ulcer***	0 (0.0%)	34 (14.7%)	< 0.001[2]
Gastric ulcer***	0 (0.0%)	29 (12.5%)	< 0.001[2]
Antral gastritis***	23 (13.7%)	2 (0.9%)	< 0.001[2]
Normal***	0 (0.0%)	19 (8.2%)	< 0.001[2]
Gastric erosions***	1 (0.6%)	17 (7.3%)	0.001[2]
Gastric malignancy***	0 (0.0%)	16 (6.9%)	< 0.001[2]
Mallory–Weiss tear***	0 (0.0%)	16 (6.9%)	< 0.001[2]
Reflux esophagitis***	0 (0.0%)	16 (6.9%)	< 0.001[2]
Duodenal erosions***	0 (0.0%)	15 (6.5%)	< 0.001[2]
Esophageal malignancy	1 (0.6%)	9 (3.9%)	0.050[4]
Post EVL ulcer	3 (1.8%)	4 (1.7%)	1.000[4]
Forrest class			1.000[2]
1A		3 (4.8%)	
1B		6 (9.7%)	
2A		13 (21.0%)	
2B		29 (46.8%)	
2C		3 (4.8%)	
3		8 (12.9%)	
Sarin's classification			0.086[4]
GOV1	9 (14.5%)		
GOV2	17 (27.4%)		
IGV1	36 (58.06%)		
Grade of esophageal varices			1.000[4]
Grade 1	6 (4.5%)		
Grade 2	10 (7.5%)		
Grade 3	116 (87.8%)		
AIMS65 score* **	1.99 ± 0.98	0.83 ± 0.88	< 0.001[3]
Complete Rockall score* **	4.52 ± 1.59	3.68 ± 2.15	< 0.001[3]
Glasgow-Blatchford score* **	11.39 ± 2.99	8.86 ± 3.41	< 0.001[3]
Requirement of blood transfusion* **	63 (37.5%)	65 (28.0%)	0.045[2]
Endoscopic intervention* **	148 (88.1%)	74 (31.9%)	< 0.001[2]
Rebleeding* **	35 (20.8%)	23 (9.9%)	0.002[2]
Surgical or radiological intervention	2 (1.2%)	5 (2.2%)	0.704[4]
In-hospital mortality	7 (4.2%)	11 (4.7%)	0.784[2]
Overall mortality (6 weeks)	9 (5.4%)	16 (6.9%)	0.530[2]
Composite outcome* **			< 0.001[2]
Good	10 (6.0%)	106 (45.7%)	
Poor	158 (94.0%)	126 (54.3%)	

*** Significant at $p < 0.05$

[1] *t*-test

[2] chi-squared test

[3] Wilcoxon-Mann–Whitney *U*-test

[4] Fisher's exact test

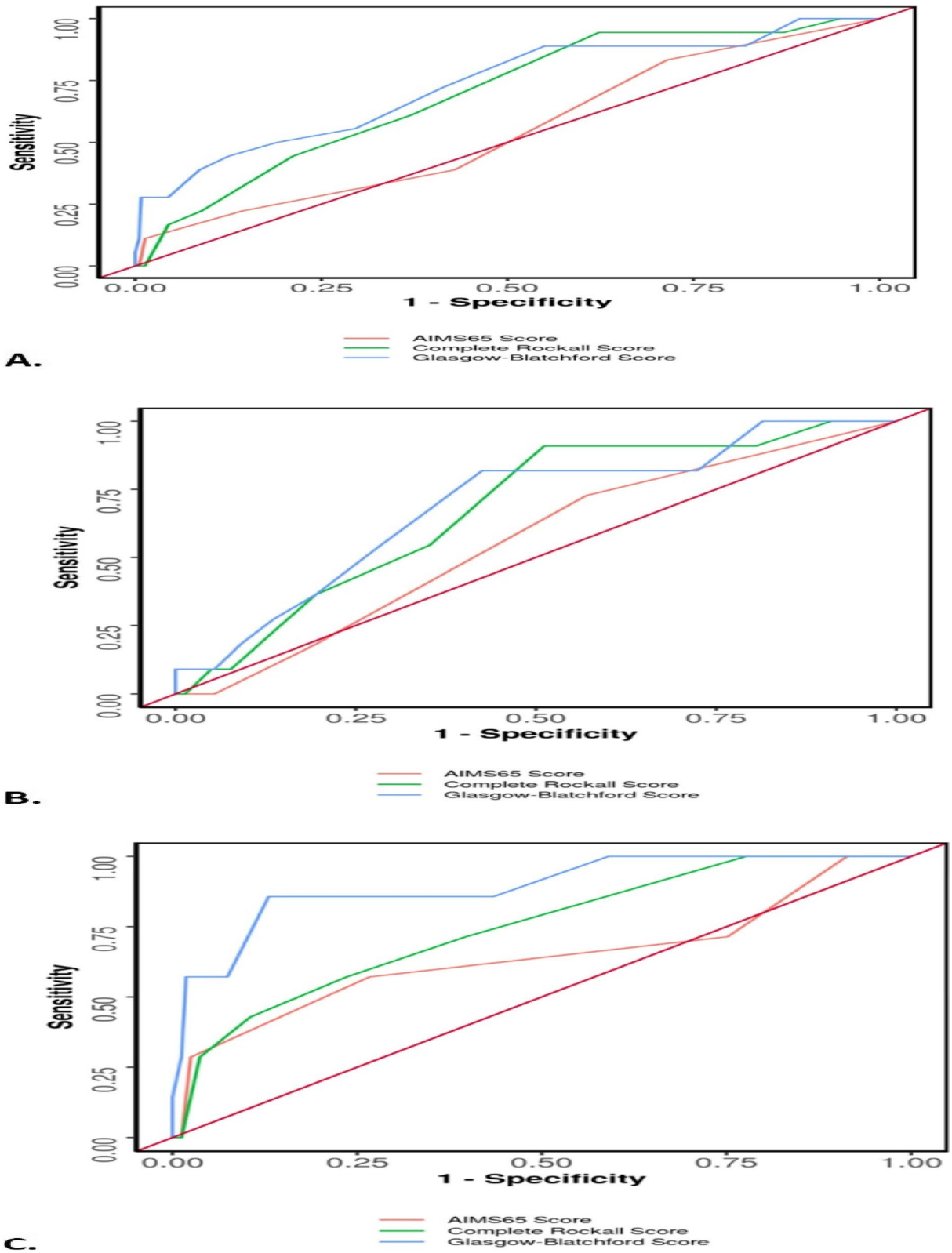
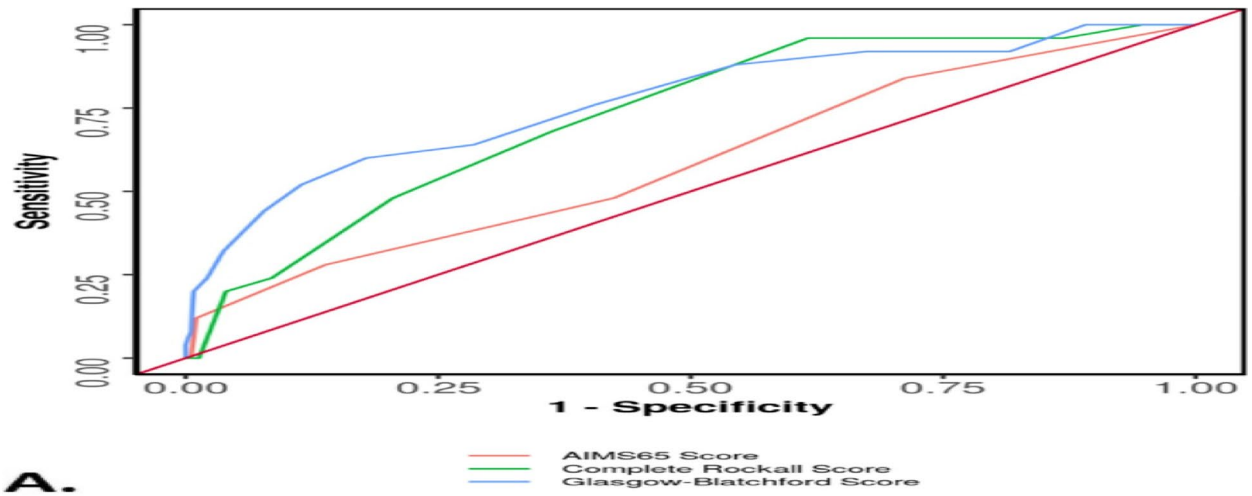
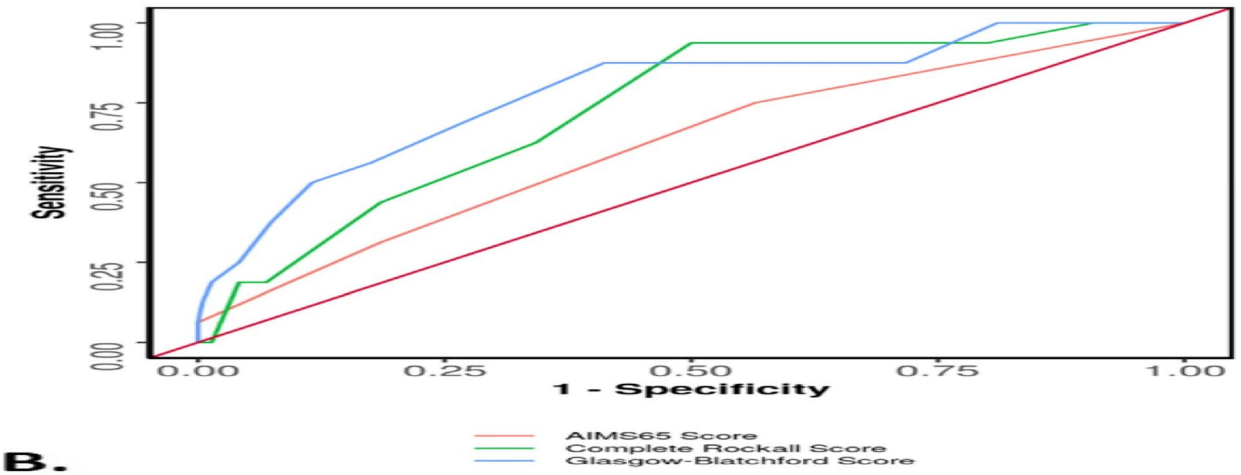


Fig. 2 A comparison of the area under the receiver operating characteristic curve (AUROC) of the AIMS65 score (AIMS65), Glasgow-Blatchford score (GBS), and Rockall score (RS) in predicting in-hospital mortality in **A** overall upper gastrointestinal bleeding (OUGIB) patients, **B** nonvariceal upper gastrointestinal bleeding (NVUGIB), and **C** variceal upper gastrointestinal bleeding (VUGIB)



A.



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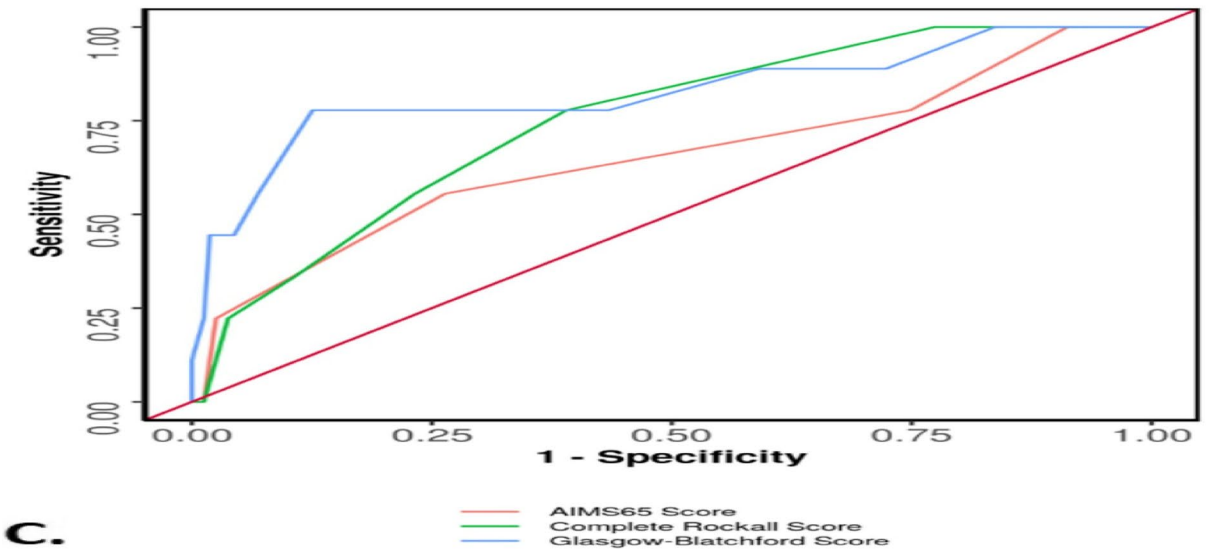


C.

Fig. 3 A comparison of the area under the receiver operating characteristic curve (AUROC) of the AIMS65 score (AIMS65), Glasgow-Blatchford score (GBS), and Rockall score (RS) in predicting overall 6-week mortality in **A** overall upper gastrointestinal bleeding (OUGIB) patients, **B** nonvariceal upper gastrointestinal bleeding (NVUGIB), and **C** variceal upper gastrointestinal bleeding (VUGIB)

Need for blood transfusion

All the studied scores could predict the need for blood transfusion in patients with OUGIB (AUROC; *AIMS65* = 0.632, *GBS* = 0.686, *RS* = 0.671, all $p < 0.001$), NVUGIB (AUROC; *AIMS65* = 0.603, *GBS* = 0.681, *RS* = 0.676, all $p < 0.001$), and VUGIB (AUROC; *AIMS65* = 0.640, *GBS* = 0.671, *RS* = 0.652, all $p < 0.001$) (Fig. 4).

Endoscopic intervention

All the studied scores could predict the need for endoscopic intervention in patients with OUGIB (AUROC; *AIMS65* = 0.632, *GBS* = 0.686, *RS* = 0.671, all $p < 0.001$). In NVUGIB, GBS (AUROC; 0.625, all $p < 0.001$) and RS (AUROC; 0.771, all $p < 0.001$) could predict the need for endoscopic intervention, whereas AIMS65 (AUROC; 0.551, all $p = 0.180$) was not accurate in predicting endoscopic intervention in patients with NVUGIB. In VUGIB patients, none of the studied score (AUROC; *AIMS65* = 0.527, *GBS* = 0.581, *RS* = 0.557, all $p > 0.05$) could predict the need for endoscopic intervention (Fig. 5).

Rebleeding

Only RS could predict rebleeding in patients with OUGIB (*AUROC*: 0.580, $p < 0.001$) and NVUGIB (*AUROC*: 0.554, $p < 0.001$), whereas AIMS65 and GBS could not predict rebleeding in OUGIB (AUROC; *AIMS65* = 0.577, *GBS* = 0.522 all $p > 0.005$) and NVUGIB patients (AUROC; *AIMS65* = 0.501, *GBS* = 0.518 all $p > 0.005$). In VUGIB patients, none of the studied score (AUROC; *AIMS65* = 0.509, *GBS* = 0.510, *RS* = 0.564, all $p > 0.05$) could predict rebleeding (Fig. 6).

Surgical and radiological intervention

Only GBS could predict the need for surgical and radiological intervention in patients with OUGIB (AUROC; 0.757, $p < 0.001$) and NVUGIB (AUROC; 0.733, $p < 0.001$), whereas AIMS65 and RS could not predict the need for surgical and radiological intervention in OUGIB (AUROC; *AIMS65* = 0.650, *RS* = 0.581, all $p > 0.005$) and NVUGIB patients (AUROC; *AIMS65* = 0.686, *GBS* = 0.881, all $p > 0.005$). In VUGIB patients, none of the studied score (AUROC; *AIMS65* = 0.666, *GBS* = 0.601, *RS* = 0.794, all $p > 0.05$) could predict the need for surgical and radiological intervention (Fig. 7).

Composite scores

All the studied scores could predict the composite scores in patients with OUGIB (AUROC; *AIMS65* = 0.690, *GBS* = 0.686, *RS* = 0.762, all $p < 0.001$) and NVUGIB (AUROC; *AIMS65* = 0.582, *GBS* = 0.669, *RS* = 0.763, all $p < 0.001$). In VUGIB patients, none of the studied score (AUROC; *AIMS65* = 0.589, *GBS* = 0.658, *RS* = 0.641, all $p > 0.05$) could predict the composite outcomes (Fig. 8).

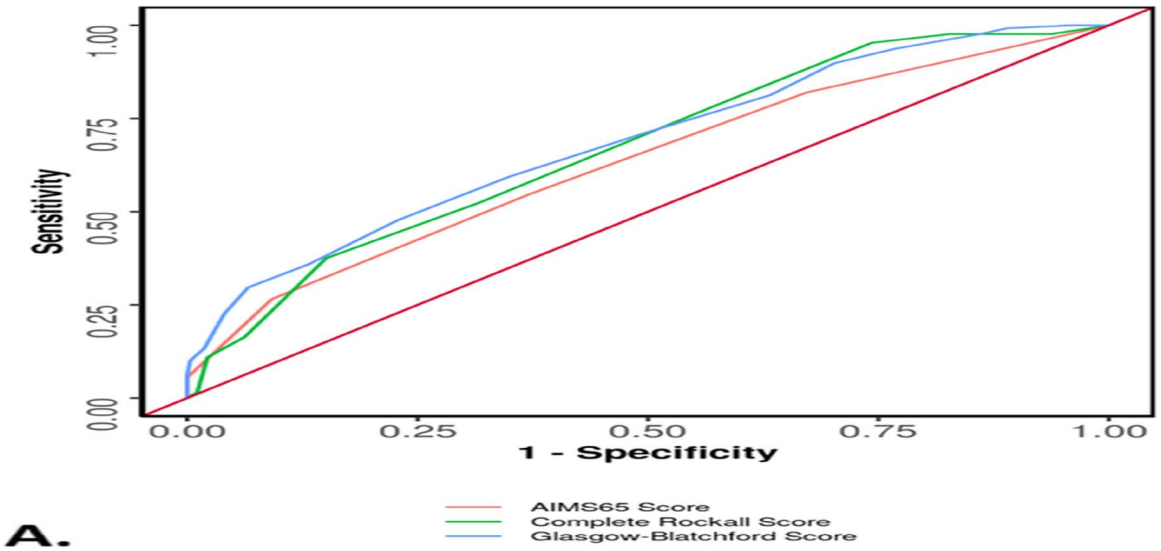
Association of UGIB scores with risk of in-hospital mortality in patients (*N* = 400)

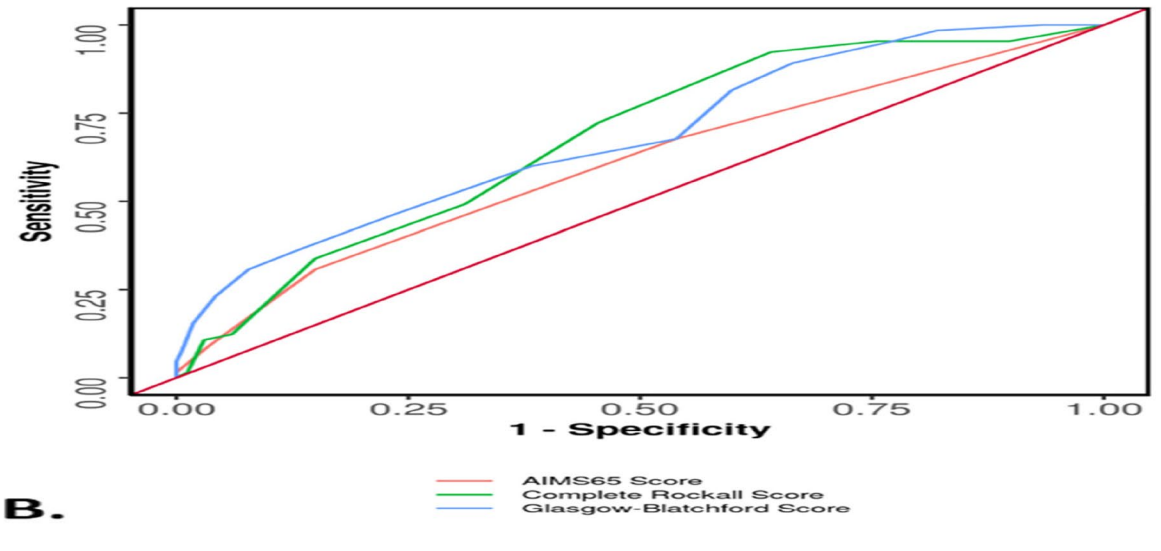
Glasgow-Blatchford score and Rockall score significantly predicted in-hospital mortality in patients with OUGIB. Glasgow-Blatchford score had the best parameter in terms of AUROC, specificity, and diagnostic accuracy. Rockall score had the best sensitivity in determining in hospital mortality in overall upper gastrointestinal bleeding patients regardless of any cause. Both Glasgow-Blatchford score and Rockall score had best positive and negative predictive values (Tables 3, 4 and 5).

Discussion

Due to massive burden and high mortality rates (6–12%) [1] in UGIB patients, various scoring systems were developed and validated with primary aim which was to segregate the patients into low-risk and high-risk groups. Stratification risk systems could reduce the resources and costs without adversely influencing the patients' outcomes [11]. Previous studies supported the accuracies of AIMS65, GBS, and RS in predicting outcomes or disease-related interventions [1, 12, 13].

The present study showed that GBS and RS but not AIMS65 predicted in-hospital and overall 6-week mortality in all the three categories, i.e., OUGIB, NVUGIB, and VUGIB patients. All the three scores, AIMS65, GBS, and RS, predicted need for blood transfusion and poor composite outcomes in all the three categories, i.e., OUGIB, NVUGIB, and VUGIB patients. The need for endoscopic intervention was predicted by all the three scores in OUGIB patients, only GBS and RS in NVUGIB patients. Rebleeding was best predicated by RS in both OUGIB and NVUGIB patients. The need for surgical intervention was best predicted by GBS in both OUGIB and NVUGIB patients. None of the scores predicted the need for endoscopic intervention, rebleeding, need for surgical and radiological intervention, and composite outcomes in VUGIB patients. This comparative study supports the idea that GBS is the most appropriate scoring system for both OUGIB and the NVUGIB patients. This finding was consistent with that of previous studies [14–16]. These studies demonstrated higher sensitivity and specificity of GBS especially in defining high-risk outcomes like requirement of blood transfusions [17]. Stanley et al. [18] and Pang et al. [19] suggested using a GBS of 0 as a low-risk threshold for safe discharge, finding that it had both a sensitivity and a negative predictive value of 100%. On the contrary, Chandra et al. [20] previously suggested sub-optimal performance of the GBS with regard to the classification of patients as low or high risk.





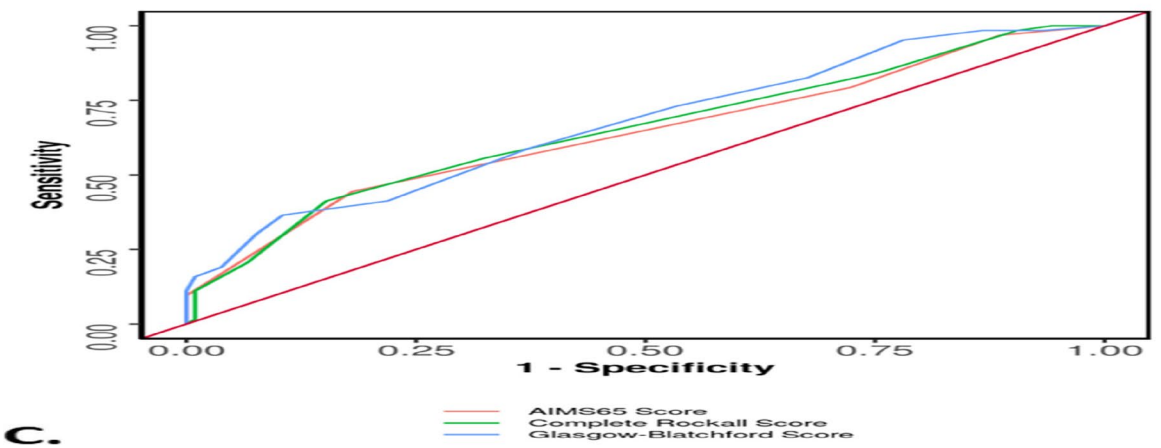


Fig. 4 A comparison of the area under the receiver operating characteristic curve (AUROC) of the AIMS65 score (AIMS65), Glasgow-Blatchford score (GBS), and Rockall score (RS) in predicting need for blood transfusion in **A** overall upper gastrointestinal bleeding (OUGIB) patients, **B** nonvariceal upper gastrointestinal bleeding (NVUGIB), and **C** variceal upper gastrointestinal bleeding (VUGIB)

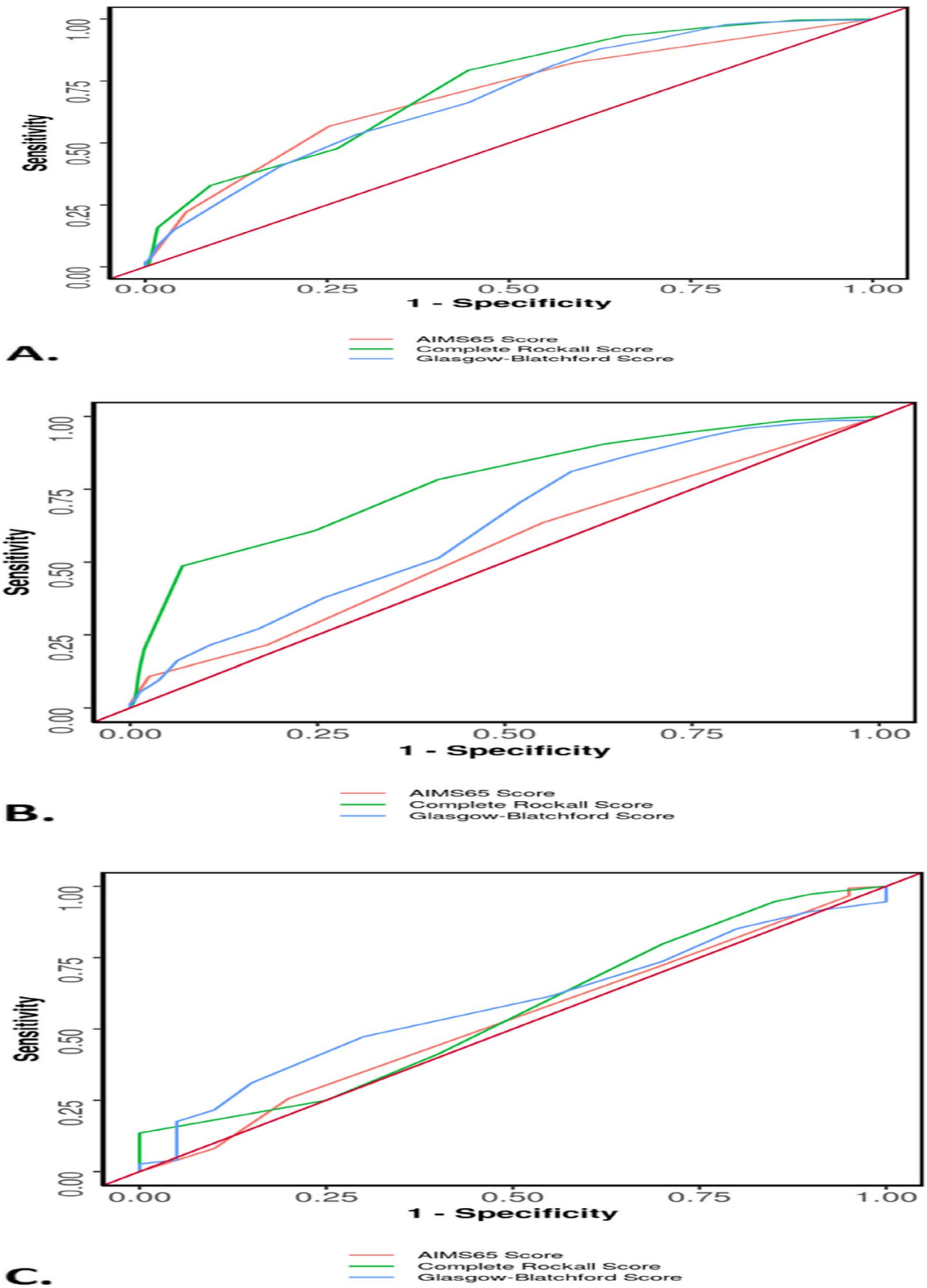
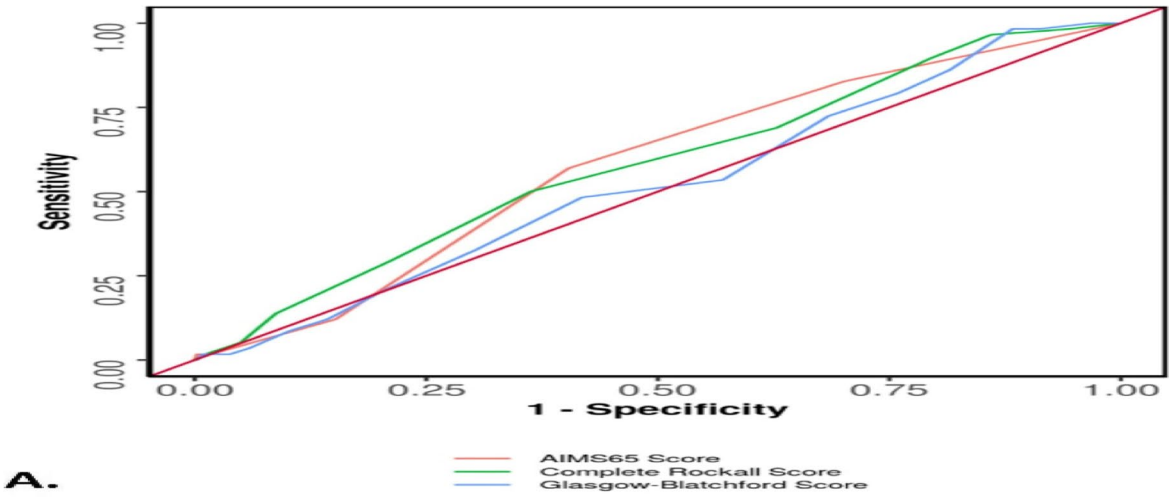


Fig. 5 A comparison of the area under the receiver operating characteristic curve (AUROC) of the AIMS65 score (AIMS65), Glasgow-Blatchford score (GBS), and Rockall score (RS) in predicting need for endoscopic intervention in **A** overall upper gastrointestinal bleeding (OUGIB) patients, **B** nonvariceal upper gastrointestinal bleeding (NVUGIB), and **C** variceal upper gastrointestinal bleeding (VUGIB)



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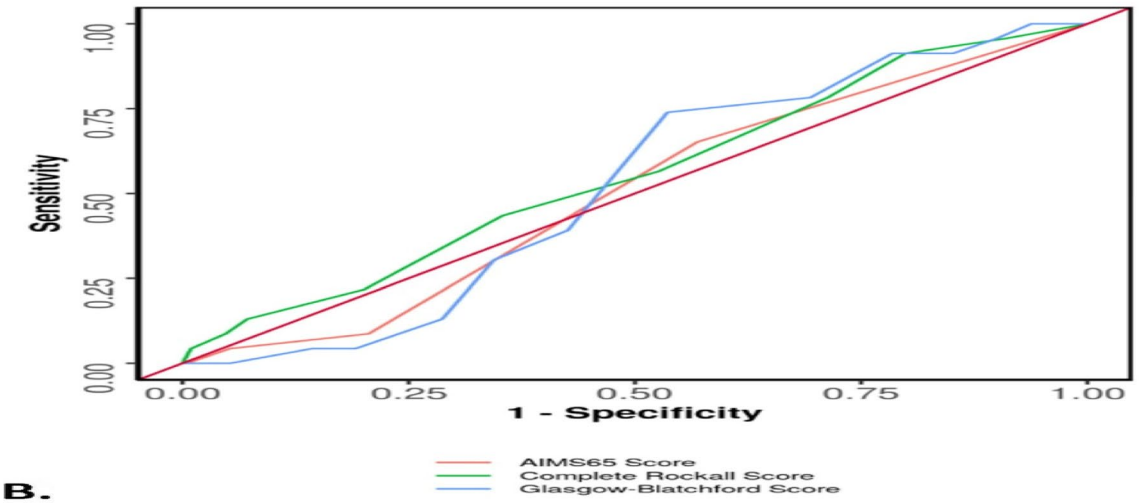

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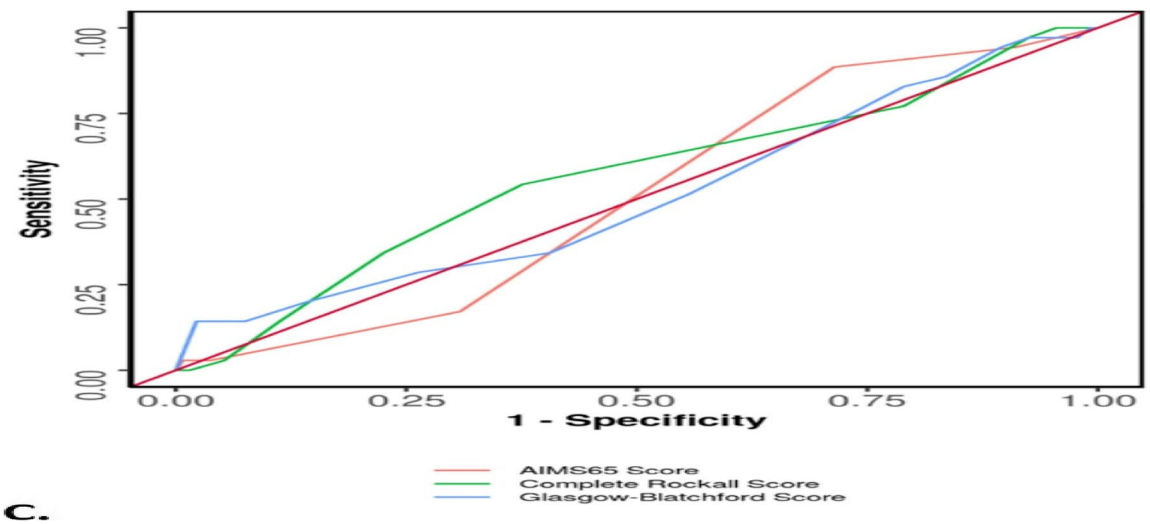

C.

Fig. 6 A comparison of the area under the receiver operating characteristic curve (AUROC) of the AIMS65 score (AIMS65), Glasgow-Blatchford score (GBS), and Rockall score (RS) in predicting rebleeding in **A** overall upper gastrointestinal bleeding (OUGIB) patients, **B** nonvariceal upper gastrointestinal bleeding (NVUGIB), and **C** variceal upper gastrointestinal bleeding (VUGIB)

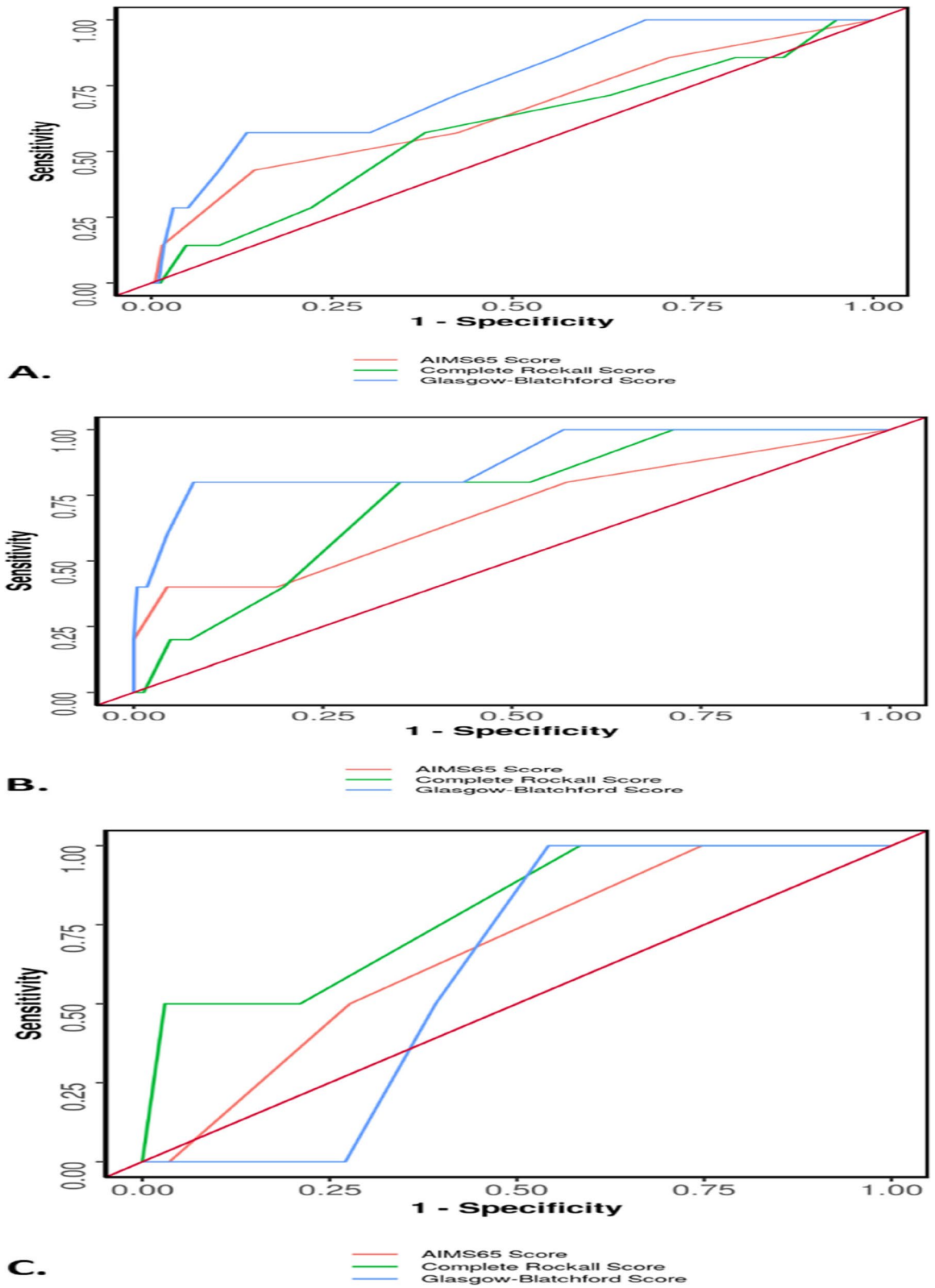

Fig. 7 A comparison of the area under the receiver operating characteristic curve (AUROC) of the AIMS65 score (AIMS65), Glasgow-Blatchford score (GBS), and Rockall score (RS) in predicting need for surgical and radiological intervention in **A** overall upper gastrointestinal bleeding (OUGIB) patients, **B** nonvariceal upper gastrointestinal bleeding (NVUGIB), and **C** variceal upper gastrointestinal bleeding (VUGIB)

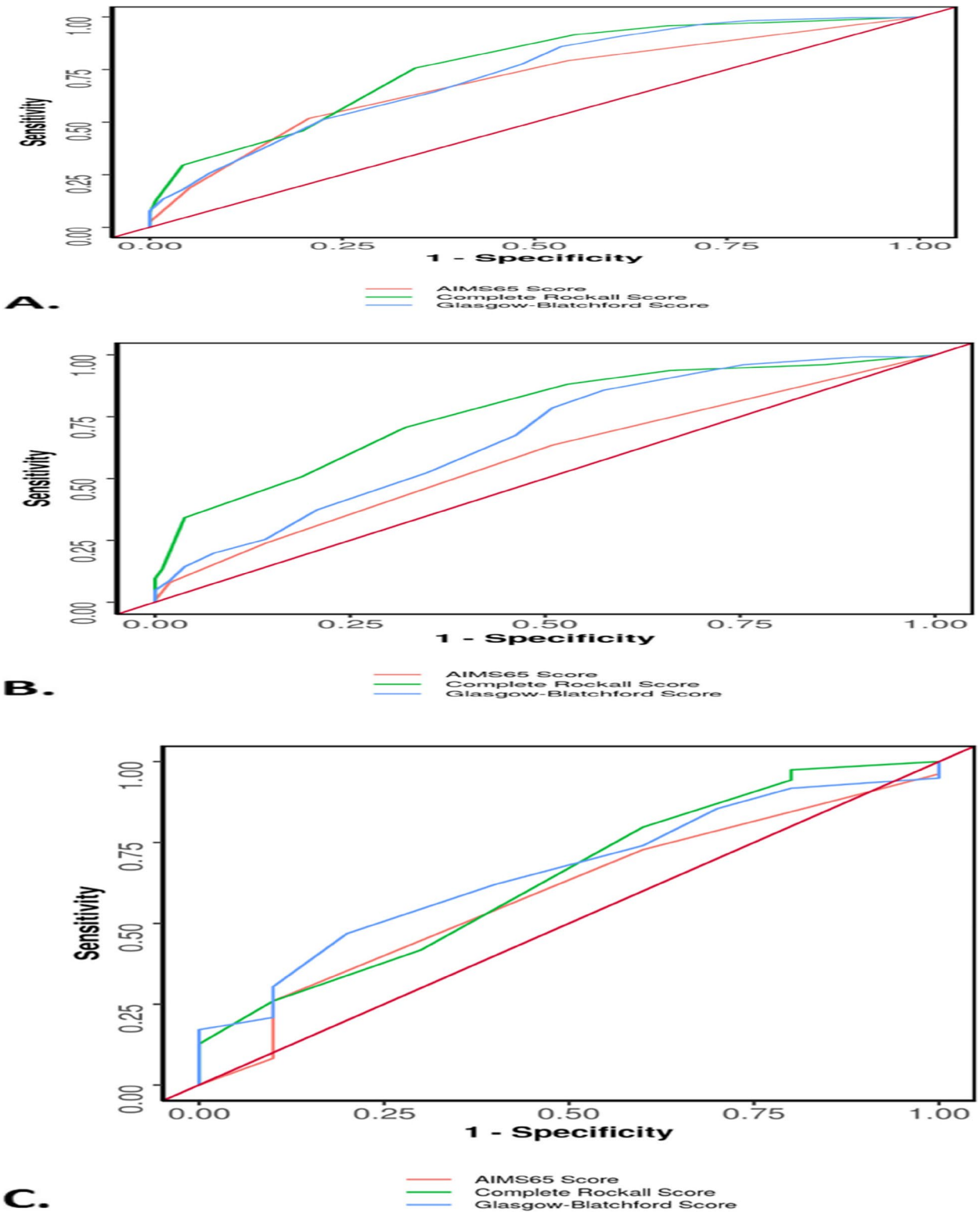

Fig. 8 A comparison of the area under the receiver operating characteristic curve (AUROC) of the AIMS65 score (AIMS65), Glasgow-Blatchford score (GBS), and Rockall score (RS) in predicting composite outcomes in **A** overall upper gastrointestinal bleeding (OUGIB) patients, **B** nonvariceal upper gastrointestinal bleeding (NVUGIB), and **C** variceal upper gastrointestinal bleeding (VUGIB)

Table 3 Association of AIMS65 score, Glasgow-Blatchford score, and Rockall score with risk of in-hospital mortality in patients regardless of the cause of upper gastroesophageal bleeding ($n=400$). Description of parameters

Variable	Total positives	True positives	True negatives	False positives	False negatives
AIMS65 score (cutoff: 1 by ROC)	18 (4.5%)	-	-	-	-
Complete Rockall score (cutoff: 4 by ROC)	288 (72.0%)	15 (3.8%)	109 (27.2%)	273 (68.2%)	3 (0.8%)
Glasgow-Blatchford score (cutoff: 10 by ROC)	255 (63.7%)	17 (4.2%)	144 (36.0%)	238 (59.5%)	1 (0.2%)

Table 4 Association of AIMS65 score, Glasgow-Blatchford score, and Rockall score with risk of in-hospital mortality in patients regardless of the cause of upper gastroesophageal bleeding ($n=400$). Primary diagnostic parameters

Variable	Sensitivity	Specificity	PPV	NPV	Diagnostic accuracy
AIMS65 score (cutoff: 1 by ROC)	83.3% (59–96)	28.5% (24–33)	5.2% (3–8)	97.3% (92–99)	31.0% (26–36)
Complete Rockall score (cutoff: 4 by ROC)	94.4% (73–100)	37.7% (33–43)	6.7% (4–10)	99.3% (96–100)	40.2% (35–45)
Glasgow-Blatchford score (cutoff: 10 by ROC)	88.9% (65–99)	45.0% (40–50)	7.1% (4–11)	98.9% (96–100)	47.0% (42–52)

Table 5 Association of AIMS65 score, Glasgow-Blatchford score, and Rockall score with risk of in-hospital mortality in patients regardless of the cause of upper gastroesophageal bleeding ($n=400$). Ranking of primary diagnostic parameters

Variable	Sensitivity	Specificity	PPV	NPV	Diag. accuracy
AIMS65 score (cutoff: 1 by ROC)	3	3	3	3	3
Complete Rockall score (cutoff: 4 by ROC)	1	2	2	1	2
Glasgow-Blatchford score (cutoff: 10 by ROC)	2	1	1	2	1

The AIMS65 score, which accurately predicts in-hospital mortality and length of stay, is a very simple risk score predicting outcomes in patients with acute upper GI bleeding. Previous studies confirmed the applicability of AIMS65 in acute upper GI bleeding patients, including bleeding of variceal and nonvariceal origin [9, 21]. Whether the AIMS65 score is applicable for predicting outcomes in patients of nonvariceal GI bleeding remains uncertain, since two of the five risk factors in AIMS65 scores are generally accepted as poor prognostic factors of liver cirrhosis, i.e., serum albumin < 3.0 g/dL and *INR* > 1.5 Therefore, the AIMS65 score might be useful for predicting outcomes in VUGIB but not in NVUGIB [22]. In our study, AIMS65 did not predict accurately the in-hospital mortality and overall 6-week mortality. One of the explanations may be the involvement of very few parameters and noninvolvement of any endoscopic parameter in the score. Whereas in our study, both RS and GBS score could easily predict both in hospital & over all 6 week mortality.

This study has certain limitations. First, this study was conducted at a single center in a regional referral hospital; hence, our results cannot be applied generally. Second, we included only those patients who underwent endoscopy and excluded patients who refused endoscopy or were discharged by the emergency department. Third, lack of interventional radiology facility may be reason for less number cased managed radiologically. Fourth, this study was powered to detect the expected difference for the primary outcome and not for the secondary outcomes. Fifth, the decisions with respect to any clinical interventions were made based on clinical judgment by individual gastroenterologists, which might have caused variability.

Conclusion

In conclusion, despite major improvements in the care of patients with UGIB over the years with major advances in endoscopic equipment, practice, therapeutic modalities, radiologic techniques, and ICU care, mortality of UGIB is still high. The present study confirms that role of these scores amplifies in segregating high-risk patients requiring immediate medical care from the low-risk patients who do not need specialized medical care and can be managed with basic supportive care.

Abbreviations

UGIB	Upper gastrointestinal bleeding
VUGIB	Variceal upper gastrointestinal bleeding
NVUGIB	Nonvariceal upper gastrointestinal bleeding
OUGIB	Overall upper gastrointestinal bleeding
NSAIDS	Nonsteroidal anti-inflammatory drugs

BUN	Blood urea nitrogen
GBS	Glasgow-Blatchford bleeding score
RS	Rockall score

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Authors' contributions
GK, methodology, investigation, and writing — original draft. SK, data curation and writing — review and editing. SK., writing — review and editing. SS, writing — review and editing. DJ, writing — review and editing. RM, writing — review and editing. TJ, writing — review and editing. NV, writing — review and editing. LKU, formal analysis and data curation. GR, formal analysis and data curation.

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Availability of data and materials
The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

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Yes.

Consent for publication
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Competing interests
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