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Novel risk score for acute upper gastrointestinal bleeding in elderly patients: a single-centre retrospective study

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ABSTRACT

Objectives Acute upper gastrointestinal bleeding (UGIB) is a common reason for emergency hospital admission. Identifying low-risk patients suitable for outpatient management is a clinical and research priority. This study aimed to develop a simple risk score to identify elderly patients with UGIB for whom hospital admission is not required.

Design This was a single-centre retrospective study.

Setting This study was conducted at Zhongda Hospital affiliated with Southeast University in China.

Participants Patients from January 2015 to December 2020 for the derivation cohort and from January 2021 to June 2022 for the validation cohort were enrolled in this study. A total of 822 patients (derivation cohort=606 and validation cohorts=216) were included in this study. Patients aged ≥65 years with coffee-grounds vomiting, melena or/and haematemesis were included in the analysis. Patients admitted but had UGIB or transferred between hospitals were excluded.

Methods Baseline demographic characteristics and clinical parameters were recorded at the first visit. Data were collected from electronic records and databases. Multivariable logistic regression modelling was performed to identify predictors of safe discharge.

Results 304/606 (50.2%) and 132/216 (61.1%) patients were not safely discharged in the derivation and validation cohorts, respectively. A clinical risk score of five variables was entered into UGIB risk stratification: Charlson Comorbidity Index >2, systolic blood pressure <100 mm Hg, haemoglobin <100 g/L, blood urea nitrogen ≥6.5 mmol/L, albumin <30 g/L. The optimal cut-off value was ≥1, the sensitivity was 97.37% and the specificity was 19.21% for predicting the inability to discharge safely. The area under the receiver operating characteristic curve was 0.806.

Conclusions A novel clinical risk score with good discriminative performance was developed to identify elderly patients with UGIB who were suitable for safe outpatient management. This score can reduce unnecessary hospitalisations.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ This was the first study on the construction of a risk score for upper gastrointestinal bleeding in elderly patients.
⇒ This risk score used simple and easily available parameters that can be implemented in almost every hospital.
⇒ This was a single-centre retrospective study.
⇒ The patients discharged from the emergency department were not included in the analysis, which might introduce some bias.

BACKGROUND

Upper gastrointestinal bleeding (UGIB) is defined as bleeding within the gastrointestinal tract proximal to the ligament of Treitz and is a common medical emergency. In recent years, the incidence of UGIB was 67/100 000 adults per year in the USA and 134/100 000 in the UK, with mortality rates ranging from 2% to 8.6%.[1 2] UGIB is a significant cause of morbidity and mortality in elderly patients, with more than US$1 billion in indirect medical costs annually in the USA.[1 3] The incidence increased with age, meaning elderly patients had a higher incidence of UGIB (197/100 000 in those aged 65–75 and 425/100 000 in those over 75 years).[4] By 2030, approximately 0.3 billion people in China will be over 65 years old. Several risk-scoring systems have been developed to predict outcomes, including mortality, the need for hospital-based intervention and the need for blood transfusion; these include the Rockall Score (RS), Glasgow Blatchford Score (GBS), the AIMS65 and MAP(ASH).[5–9] The Asia-Pacific working group consensus suggested that UGIB can be managed using 'early risk stratification' with influential prognostic factors.[10] However, the latest UGIB guidelines for elderly patients were released in 2013 by the American Society for Gastrointestinal Endoscopy.[11]

A systematic review of 16 studies showed that the GBS was more sensitive and specific than the RS and AIMS65 in predicting hospital intervention and 30-day mortality requirements.[12] Implementing GBS prognostic assessment was associated with a 15–20% reduction in hospitalisations due to UGIB.[13] Therefore, it was recommended to identify patients at very low risk and manage them as outpatients. However, to date, there

Table 1 Comparison of demographic and mean clinical parameters of the two cohort study populations

Variable	Derivation cohort Total (n=606)	Validation cohort Total (n=216)	P value
Male, n (%)	404 (66.7)	158 (73.1)	0.079
Median age, year (IQR)	74 (68–79)	77.5 (71–84)	<0.01
Findings at endoscopy			
Peptic ulcer	302 (49.8)	91 (42.1)	
Variceal bleeding	44 (7.3)	20 (9.3)	
Upper gastrointestinal cancer	75 (12.3)	27 (12.5)	
Erosions	86 (14.2)	26 (12.0)	
Others	99 (16.4)	52 (24.1)	
Comorbidities, n (%)			
Any malignancy	110 (18.2)	30 (13.9)	0.180
Hypertension	346 (57.1)	124 (57.4)	0.937
Diabetes	145 (23.9)	48 (22.2)	0.855
Coronary heart disease	130 (21.5)	54 (25)	0.158
Heart failure	16 (2.6)	2 (0.1)	0.139
Stroke	174 (28.7)	66 (30.1)	0.609
Renal failure	72 (11.9)	22 (10.2)	0.641
Liver disease	65 (10.7)	16 (7.4)	0.160
CCI >2	112 (18.5)	62 (28.7)	0.518
≥2 comorbidities	395 (65.0)	144 (66.7)	0.693
Antiplatelet/anticoagulant use	220 (36.3)	70 (32.1)	0.304
HR (SD)	82 (15)	82 (16)	0.752
SBP, mm Hg (SD)	122 (20)	126 (23)	0.261
Hb, g/L (SD)	91 (29)	84 (24)	0.147
Coagulopathy, INR ≥1.5	19 (3.1)	14 (6.5)	0.032
BUN, mmol/L (SD)	12.5 (8.7)	11.4 (6.5)	0.221
Creatinine, µmol/L (SD)	107 (86)	109 (97)	0.820
Albumin, g/L (SD)	33.7 (6.0)	35.6 (6.0)	0.820

BUN, blood urea nitrogen; CCI, Charlson Comorbidity Index; Hb, haemoglobin; INR, international normalised ratio; SBP, systolic blood pressure.

have been few studies on these scoring systems for UGIB in elderly patients: Wang *et al* reported that the RS accurately predicted rebleeding and mortality outcomes in order adults with acute UGIB; however, the area under the receiver operating characteristic curves (AUROC) was lower than 0.8.[14] Kalkan *et al* also reported that the RS predicted mortality and rebleeding more accurately than the GBS or the AIMS65.[15] The sample sizes of both studies were small (341 and 335).

An international consensus group guideline recommended using risk scores to assess UGIB patients; nevertheless, its role in managing geriatric patients remains unclear.[5 16]

When managing UGIB patients, the challenge faced by emergency department (ED) physicians is determining the cause and whether the patient should be hospitalised for further management. However, there is no internationally recognised effective scoring system for elderly patients to stratify the disease.

We aimed to develop and validate a simple risk score system to identify elderly patients who can be safely managed as outpatients and those who will benefit from inpatient care. We also compared the discriminative ability of the new score system with the previously published risk-scoring systems.

METHODS

Design

We conducted two retrospective studies: one from January 2015 to December 2020 for the derivation cohort and the other from January 2021 to June 2022 for the validation cohort.

Table 2 Demographics and mean clinical parameters of the study population in the derivation cohort

Variable	Total cohort (n=606)	Not safely discharged, (n=304)	Safely discharged, SD (n=302)	P value
Male, n (%)	404 (66.7)	196 (64.5)	208 (68.9)	0.075
Median age, year (IQR)	74 (68–79)	73 (67–78)	75 (69–79)	0.417
Comorbidities, n (%)				
Any malignancy	110 (18.2)	70 (23.0)	40 (13.2)	<0.01
Hypertension	346 (57.1)	168 (55.3)	178 (58.9)	0.360
Diabetes	145 (23.9)	61 (20.1)	84 (27.8)	<0.05
Coronary heart disease	130 (21.5)	62 (0.4)	68 (22.5)	0.611
Heart failure	16 (2.6)	8 (2.6)	8 (2.6)	0.989
Stroke	174 (28.7)	78 (25.7)	96 (31.8)	0.095
Renal failure	72 (11.9)	48 (15.8)	26 (8.6)	<0.01
Liver disease	65 (10.7)	40 (13.2)	25 (8.3)	0.052
CCI score >2	112 (18.5)	84 (27.6)	28 (9.3)	<0.01
Antiplatelet/anticoagulant use	220 (36.3)	102 (33.6)	118 (39.1)	0.318
HR (SD)	82 (15)	84 (16)	80 (13)	0.019
≥100	76 (12.5)	52 (17.2)	24 (7.9)	
SBP, mm Hg (SD)	122 (20)	119 (21)	128 (19)	<0.01
<100	60 (10.0)	50 (16.4)	10 (3.3)	
Hb, g/L (SD)	91 (29)	76 (26)	106 (23)	<0.01
<100	390 (64.4)	260 (85.5)	130 (43.0)	
Coagulopathy, INR ≥1.5	19 (3.1)	17 (5.6)	2 (0.7)	<0.01
BUN, mmol/L (SD)	12.5 (8.7)	14.4 (9.5)	10.7 (7.4)	<0.01
≥6.5	436 (71.9)	244 (80.3)	192 (63.6)	
Creatinine, μmol/L (SD)	107 (86)	114 (97)	100 (73)	0.954
>100	182 (30.0)	114 (37.5)	68 (22.5)	
Albumin, g/L (SD)	33.7 (6.0)	31.6 (5.9)	35.9 (5.1)	<0.01
<30	160 (26.4)	128 (42.1)	32 (10.6)	

BUN, blood urea nitrogen; CCI, Charlson Comorbidity Index; Hb, haemoglobin; INR, international normalised ratio; SBP, systolic blood pressure.

Setting

This study was conducted at Zhongda Hospital affiliated with Southeast University in China.

Operational definitions

UGIB

Bleeding in the gastrointestinal tract proximal to the ligament of Treitz, presenting with coffee-ground vomiting, melena or/and haematemesis.[5 16]

Safe discharge

None of the following symptoms after presentation[17]: rebleeding or blood transfusion; therapeutic intervention to control bleeding; all causes of death.

Rebleeding

The presentation of melena or/and fresh haematemesis associated with the development of shock (systolic blood pressure (SBP) <100 mm Hg or/and pulse >100 beats/min or/and haemoglobin (Hb) decreased by more than 20 g/L after successful initial treatment).[5]

Blood transfusion

The indication for blood transfusion was an Hb level decreasing an average of <70 g/L or 80 g/L in patients at high risk of heart disease.[18]

Therapeutic intervention

Endoscopic, radiological or surgical haemostasis.

Endoscopic management

The indication for endoscopic treatment was Forrest Ia-IIb ulcer bleeding.[19]

Elderly patients

Age ≥65 years.[20]

Patient and public involvement

No patients or members of the public were involved in the design, conduct or reporting of study results. The study results were not disseminated to study participants.

Table 3 Severity outcome and therapeutic interventions of the study population in the derivation cohort

Variable	N (%)
Rebleeding	124 (20.5)
Required blood transfusion	268 (44.2)
Therapeutic intervention (total)	108 (17.8)
Endoscopic treatment	80 (13.2)
Radiological intervention	6 (1.0)
Surgery	15 (2.8)
Endoscopy+radiology	4 (0.7)
Endoscopy+surgery	2 (0.3)
Radiology+surgery	1 (0.2)
Mortality	52 (8.6)
ICU admission	50 (8.4)

ICU, Intensive Care Unit.

Data collection

Patients with coffee-grounds vomiting, melena or/and haematemesis were included. The inclusion criteria were presentation in the ED with black stool and/or haematemesis, age ≥65 years old and faecal occult blood positivity. The exclusion criteria were UGIB during hospitalisation, incomplete data, transfer from other hospitals and lower gastrointestinal bleeding manifested as bloody stool.

We recorded the following from the electronic medical record system: demographic data (sex and age), clinical presentation, comorbidities, medications history (including antiplatelet drugs, oral anticoagulant agents and/or non-steroidal anti-inflammatory drugs), haemodynamic parameters, Hb, biochemical parameters (coagulation panel, albumin, creatinine and urea nitrogen) were recorded. The need for endoscopic treatment, blood transfusion, radiological intervention or surgery was also analysed.

Table 4 Univariable analysis for predictive factors of not safely discharged in the derivation cohort

	Univariate analysis	
Variable	OR (95% CI)	P value
Age ≥65	1.51 (0.96 to 2.38)	0.075
Gender, male	0.82 (0.51 to 1.32)	0.417
CCI >2	3.74 (1.94 to 7.20)	<0.001
Antiplatelet/anticoagulant use	0.79 (0.49 to 1.26)	0.318
HR ≥100	2.39 (1.16 to 4.94)	0.019
SBP <100 mm Hg	5.75 (2.14 to 15.46)	<0.001
BUN ≥6.5 mmol/L	2.33 (1.39 to 3.92)	<0.001
Hb <100 g/L	7.82 (4.49 to 13.62)	<0.001
Albumin <30 g/L	6.14 (3.33 to 11.30)	<0.001
INR ≥1.5	9.38 (2.13 to 41.36)	0.003
Creatinine >100 µmol/L	1.93 (1.17 to 3.19)	0.010

BUN, blood urea nitrogen; CCI, Charlson Comorbidity Index; Hb, haemoglobin; INR, international normalised ratio; SBP, systolic blood pressure.

Data analysis

Eleven predictors were selected from both biological and clinical perspectives: age, sex, Charlson Comorbidity Index (CCI), SBP, heart rate, use of oral anticoagulants or oral antiplatelet agents, Hb (g/L), international normalised ratio (INR), albumin (g/L), serum urea nitrogen (mmol/L) and creatinine (µmol/L). The CCI was used to define comorbidities.[21]

We use SPSS V.22.0 and MedCalc V.19 for statistical calculations. Count data were expressed as the number of cases (n, %), and the χ^2 test was used for comparisons. Measurement data with normal distribution were expressed as mean±SD (x±s), and independent sample t-test or univariate analysis was used to compare groups. The measurement data with non-normal distribution were expressed as median (quartile) (M (Q1, Q3)), and the Mann-Whitney U test was used for comparisons. Regression models were constructed. Statistically significant variables in univariate analyses were included in the multivariate regression analyses. Regression models were constructed using backward elimination. The variables in the final regression model were classified according to the thresholds most closely related to safe discharge, resulting in easily calculated scores. Results were expressed as ORs with 95% CIs. The Hosmer-Lemeshow test was used to evaluate the goodness of fit.

A new risk score was generated based on the established logistic regression model. Receiver operating characteristic (ROC) curves with 95% CIs were used for predicting the identified ability of outcomes. Sensitivity, specificity, positive predictive value and negative predictive value were also calculated.[22] The DeLong test was used to compare areas under the curve (AUCs).

RESULTS

We included 822 patients (derivation cohort=606 and validation cohort=216). The incidence of not safely discharged (NSD) was 50.2% (304/606) and 61.1% (132/216) in the derivation and validation cohorts, respectively.

Most patients (404/606, 66.7%, and 158/216, 73.1%) were men (table 1); the median ages were 74 (68–79) and 77.5 (71–84), respectively. The incidence of diabetes, any malignancy and renal failure differed significantly between the groups, and almost one-fifth of patients had a CCI score of >2, which suggests higher morbidity in the NSD cohort (27.6% vs 9.3%, p<0.01) (table 2).

Patients in the NSD cohort were more likely to have tachycardia (heart rate ≥100, 17.2% vs 7.9%, p=0.019), hypotension (SBP <100 mm Hg, 16.4% vs 3.3%, p<0.01) and lower Hb and albumin (Hb <100 g/L, 85.5% vs 43.0%, p<0.01 and albumin <30 g/L, 42.1% vs 10.6%,

Table 5 Multivariable logistic regression analysis for predictive factors of not safely discharged in the derivation cohort

Variable	β	Ward	OR	P value	95% CI
CCI >2	0.455	5.616	1.576	0.018	1.082 to 2.295
SBP <100 mm Hg	1.479	6.735	4.726	0.009	0.955 to 23.377
BUN ≥6.5 mmol/L	0.636	3.969	1.890	0.046	1.010 to 3.534
Hb <100 g/L	1.616	27.883	5.033	<0.001	2.763 to 9.169
Albumin <30 g/L	1.065	9.339	2.901	0.002	1.465 to 5.743
	–2.193	38.259	–	<0.001	–

BUN, blood urea nitrogen; CCI, Charlson Comorbidity Index; Hb, haemoglobin; SBP, systolic blood pressure .

p<0.01). Blood urea nitrogen (BUN) was higher (≥6.5 mmol/L, 80.3% vs 63.6%, p<0.01). Coagulopathy was more frequent (INR ≥1.5 5.6% vs 0.7%, p<0.01).

Table 3 displays the clinical outcomes and therapeutic interventions. More than one-third of patients required blood transfusion (n=268/606, 44.2%), and 124 (20.5%) suffered rebleeding. Overall, 108 patients (17.8%) underwent a therapeutic intervention during admission. Fifty (8.4%) required admission to the intensive care unit. The mortality rate was 8.6% (52 patients).

Logistic regression

Based on calculations from the derivative cohort, significant predictors (p<0.05) included: CCI >2, HR ≥100, SBP <100 mm Hg, BUN ≥6.5 mmol/L, Hb <100 g/L, albumin <30 g/L, coagulopathy (INR ≥1.5) and creatinine >100 µmol/L (table 4).

These variables were included in a multivariate logistic regression model—CCI >2, SBP <100 mm Hg, BUN ≥6.5 mmol/L, Hb <100 g/L and albumin <30 g/L were statistically significant in predicting NSD (table 5). The final logistic regression function was log (odds of NSD) = 0.636 (BUN)+1.616 (Hb)+1.065 (albumin)+0.455 (CCI)+1.479 (SBP)−2.193. These variables were used to develop a prognostic scoring model (table 6).

The optimum cut-off was ≥1 point(s), the sensitivity was 97.37%, the specificity was 19.21%, the positive predictive value was 54.8% and the negative predictive value was 87.9% for predicting NSD (table 7). Only GBS ≤1 and our risk score=0 achieved a sensitivity at 97.37%; AIMS65=0 and MAP(ASH)=0 had maximal sensitivities of 96.71% and 79.61%, respectively. Our risk score performed better than GBS ≤1 for correctly classifying patients who could safely be discharged (p<0.05). Our risk score had a specificity of 19.21% at a sensitivity of 97.37% compared with a specificity of 11.92% and sensitivity of 97.37% with GBS ≤1.

The AUCs of our risk score, GBS, MAP(ASH) and AIMS65 are displayed in table 8 and figure 1. For both cohorts, our risk score had the largest AUCs of 0.806 and 0.807, respectively, which were significantly higher than those of GBS, MAP(ASH) or AIMS65 (p<0.05).

Table 6 Prognostic factors for not safely discharged for inclusion in our clinical risk score

Clinical predictive risk factor	Score
S: SBP <100 mm Hg	3
A: Albumin <30 g/L	2
H: Hb <100 g/L	3
C: CCI >2	1
N: BUN ≥6.5 mmol/L	1

BUN, blood urea nitrogen; CCI, Charlson Comorbidity Index; Hb, haemoglobin; SBP, systolic blood pressure .

DISCUSSION

The mortality rate for non-variceal UGIB decreased from 4.5% in 1989 to 2.1% in 2009, and the incidence decreased from 108 to 78 cases per 100 000 population in 1994 and 2009. However, the economic burden of immediate hospitalisation for UGIB increased from US$3.3 billion to US$7.6 billion, and a similar trend was observed for variceal UGIB.[23]

Barkun *et al* proposed that using a prognostic score system and early discharge with low risk would reduce the associated costs without increasing harm.[16] The initial assessment aimed to determine whether admission was required or an endoscopic intervention was required urgently or could be managed in the outpatient setting.[24]

Several risk-scoring systems have been used for UGIB patients; however, most are used to predict mortality, rebleeding and intervention as endpoints.[5–9] The full RS was derived in 1996 from 4185 cases of UGIB in the UK and designed to predict mortality.[5] Because the full RS relied on endoscopic findings, its use in initial ED assessment was limited.

Blatchford *et al* cited Hb, blood urea, pulse, SBP, presentation with syncope or melena and evidence of hepatic disease or cardiac failure as factors predicting the need for intervention.[7] The 2019 International Consensus Group guidelines recommended a GBS ≤1 to identify patients at very low risk for rebleeding or mortality and thus may not require hospitalisation or inpatient endoscopy.[16] GBS is clinically useful; however, it is evaluated using eight factors, making calculations cumbersome and decreasing its use in clinical practice in China.

Table 7 Clinical risk score for not safely discharged with sensitivity, specificity, PPV and NPV

Scores	Cut-off value	Sensitivity (%)	Specificity (%)	PPV (%) (95% CI)	NPV (%) (95% CI)
CSHAN	≥1	97.37	19.21	54.8 (52.8 to 56.8)	87.9 (72.3 to 95.3)
GBS	≥2	97.37	11.92	52.7 (51.1 to 54.3)	81.8 (60.9 to 92.8)
AIMS65	≥1	96.71	9.27	51.8 (50.3 to 53.2)	73.7 (50.8 to 88.3)
MAP(ASH)	≥1	79.61	41.06	57.6 (53.8 to 61.4)	66.7 (58.1 to 74.3)

GBS, Glasgow Blatchford Score; NPV, negative predictive value; PPV, positive predictive value.

Saltzman *et al* constructed a prediction model named AIMS65 comprising albumin, INR, altered mental status, blood pressure and age to predict death; they reported an area under the ROC of 0.77 for predicting death.[6] AIMS65 provided a more age-appropriate score and might be a beneficial supplement to a risk stratification model for distinguishing high-risk patients. The International Consensus Group recommended against using the AIMS65 prognostic score to predict the need for hospitalisation.[16] MAP(ASH) score was established in 2020. MAP(ASH) has good predictive accuracy for intervention and mortality.[9] However, it was a new risk score, and further research is needed to confirm its predictive effect. Furthermore, there were few studies on those score systems on geriatric patients to validate whether they suit elderly patients. Our previous research[25] found that MAP(ASH), GBS, AIMS65 and pRS (the preendoscopic Rockall score) only performed reasonably in predicting mortality and intervention with the AUROCs all below 0.8, indicating they might not be very suitable for elderly patients.

It is challenging to determine the most critical outcomes in patients with UGIB. Initially, death was the priority; however, studies showed that the mortality rate of UGIB had decreased in the last two decades.[23] Increasing attention was paid to risk scores to predict profitable outcomes such as safe discharge,[16] in which low-risk patients could avoid hospitalisation and be managed as outpatients.

We derived a simple risk score system with five variables that can be used to distinguish between patients who can be safely managed as outpatients and those who will benefit from inpatient care. The system was designed to prevent rebleeding, blood transfusion and hospital-based intervention to control bleeding and death to capture adverse events. Previous studies had reported that unstable vital signs, anaemia, hypoproteinaemia, azotemia and existing comorbidities were predictive of adverse outcomes.[7 26] In our study, we identified CCI >2, SBP <100 mm Hg, Hb <100 g/L, BUN ≥6.5 mmol/L and albumin <30 g/L as risk factors. We included the use of antiplatelet/anticoagulant medications, INR ≥1.5, age, sex, heart rate and creatinine in the model; however, these were not statistical predictors and therefore were not included in the score. Other studies suggested that the use of antiplatelet or anticoagulant medications and coagulopathy might be related to the increased severity of bleeding.[7 27] Still other studies found that advancing age and creatinine were risk factors for predicting adverse outcomes.[7 26] These findings are inconsistent with our results, probably because the target populations differ.

In practice, risk stratification scores are used to guide clinical care to select thresholds that maximise sensitivity and minimise false negatives. The guidelines suggest that patients with GBS ≤1 might be discharged to outpatient management because very few of these patients require hospital-based intervention or blood transfusion or die.

Table 8 Values of the three scoring systems in the prediction of not safely discharged

	AUC (95% CI)	P			
		CSHAN	GBS	AIMS65	MAP(ASH)
Derivation cohort					
CSHAN	0.806 (0.756 to 0.849)	*	0.019	0.025	0.031
GBS	0.762 (0.708 to 0.815)	0.019	*	0.034	0.035
AIMS65	0.711 (0.661 to 0.781)	0.025	0.034	*	0.030
MAP(ASH)	0.669 (0.612 to 0.721)	0.031	0.035	0.030	*
Validation cohort					
CSHAN	0.807 (0.722 to 0.892)	*	0.046	0.053	0.034
GBS	0.788 (0.698 to 0.878)	0.046	*	0.060	0.049
AIMS65	0.689 (0.587 to 0.792)	0.053	0.060	*	0.062
MAP(ASH)	0.767 (0.720 to 0.877)	0.034	0.034	0.062	*

GBS, Glasgow Blatchford Score.

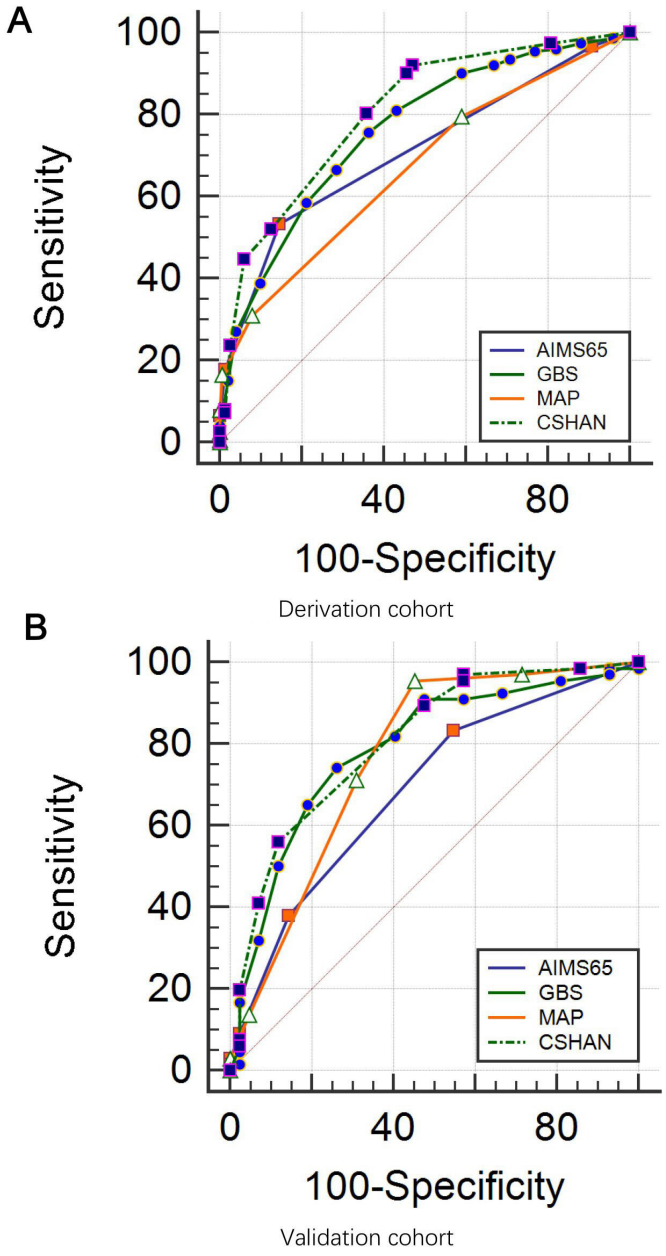

Figure 1 Curves for three scoring systems in evaluation of not safely discharged. GBS, Glasgow Blatchford Score.

In our study, the GBS ≤1 recommended by the guidelines as a cut-off value had a sensitivity of 97.37% and a specificity of 11.92% for the composite outcome. At the matched sensitivity of 97.37% (compared with GBS), the specificity significantly increased from 11.92% to 19.21%, suggesting that our score could increase the number of patients who could be safely discharged by more than 1.5-fold.

Our risk score predicted the composite outcome in the present cohort better than the current commonly used clinical risk scores (GBS, AIMS65 and MAP(ASH)). Our score improves the ability to identify very low-risk elderly patients who can be safely discharged.

A patient scoring 0 points at presentation has an 87.9% chance of safe discharge from the ED. We recommend using this threshold for patients with no other hospitalisation indications. In our cohort, 30–50% of patients presenting with UGIB could be safely discharged. A large micro-cost study in UGIB found that the average cost per patient was £2458 in the UK, and 60% of the cost was attributed to the cost of an inpatient bed. A 30–50% reduction in hospital admissions would reduce the financial burden.[28]

This study has several limitations. This was a single-centre retrospective study; patients discharged directly from ED were omitted, which might have led to selection bias. However, the patients suitable for discharge directly from ED were likely to be safely discharged with UGIB and might not significantly impact our risk score. An integral part of the safe discharge outcome is the absence of blood transfusion, which might be inaccurate because many transfusions might be considered unneeded when layered according to vital signs and anaemia.[29 30] These factors might lead to underestimating the ratio of patients who can be discharged safely.

Our study was based on clinically accessible risk stratification for elderly patients with UGIB. To our knowledge, ours is the first analysis of this type. The ROC curve showed higher predictive accuracy and sensitivity for patients with a threshold ≥1 point, which would facilitate the discharge of low-risk patients. The model is easy to implement and can assist clinical decision-making and early identification of patients with severe UGIB requiring aggressive blood cell transfusion, entering monitoring units and requiring intervention.

In conclusion, our risk score uses five easily quantifiable fundamental predictors and is easy to calculate. Compared with the previously available four risk scores, our prediction of safe discharge was the best. The score could be included in the acute medical triage route to identify UGIB patients who can be safely discharged. Further research is required to validate these findings.

Contributors YL, QL and XO conceived of the study. YL, MS and KW contributed to data collection. XO was responsible for data analyses. All authors contributed to interpretation of the results. YL drafted the manuscript. All authors contributed to the refinements of the manuscript and approved the final manuscript for publication. XO is the guarantor of the manuscript.

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Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not applicable.

Ethics approval This study was approved by the Ethics Committee for Clinical Research of Zhongda Hospital, affiliated to Southeast University. This study used the medical records obtained from the past clinical diagnosis and treatment. Upon application, the Ethics committee agreed that informed consent was not required. All methods were carried out in accordance with relevant guidelines and regulations. The ethics reference number: 2021ZDSYLL333-P01.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available upon reasonable request. The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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