REVIEW

Upper gastrointestinal bleeding risk scores: Who, when and why?

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Abstract

Upper gastrointestinal bleeding (UGIB) remains a significant cause of hospital admission. In order to stratify patients according to the risk of the complications, such as rebleeding or death, and to predict the need of clinical intervention, several risk scores have been proposed and their use consistently recommended by international guidelines. The use of risk scoring systems in early assessment of patients suffering from UGIB may be useful to distinguish high-risks patients, who may need clinical intervention and hospitalization, from low risk patients with a lower chance of developing complications, in which management as outpatients can be considered. Although several scores have been published and validated for predicting different outcomes, the most frequently cited ones are the Rockall score and the Glasgow Blatchford score (GBS). While Rockall score, which incorporates clinical and endoscopic variables, has been validated to predict mortality, the GBS, which is based on clinical and laboratorial parameters, has been studied to predict the need of clinical intervention. Despite the advantages previously reported, their use in clinical decisions is still limited. This review describes the different risk scores used in the UGIB setting, highlights the most important research, explains why and when their use may be helpful, reflects on the problems that remain unresolved and guides future research with practical impact.

Key words: Upper gastrointestinal bleeding; Risk scores; Risk assessment; Rockall score; Glasgow blatchford score

Core tip: Upper gastrointestinal bleeding (UGIB) remains a significant cause of hospital admission. In order to stratify patients according to the risk of complications, such as rebleeding or death, and to predict the need of clinical intervention, several risk scores have been proposed and their use consistently recommended by international guidelines. This review describes the different risk scores used in the UGIB setting, highlights the most important research, explains why and when

their use may be helpful, reflects on the problems that remain unresolved and guides future research with practical impact.

INTRODUCTION

Acute upper gastrointestinal bleeding (UGIB) remains a common cause of visits to the Emergency Department, with an estimated incidence of about 100 per 100000 hospitalizations[1], and being associated to significant morbidity, 30 d mortality and health-care costs[2,3].

Many risk factors are known to influence the outcome in UGIB setting. Age, comorbidities, presence of shock, endoscopic diagnosis, haemoglobin values at the time, ulcers' size, stigmata of recent haemorrhage and need for a blood transfusion have all been described as significant risk factors for rebleeding and death[4-8].

Patients suffering from UGIB are generally admitted for observation with or without upper endoscopy. However, emergency endoscopy is not continuously available in many hospitals. An United Kingdom audit of 6750 patients suffering from UGIB has revealed that only 52% of the hospitals had an out-of-hours endoscopy service and only 50% patients received endoscopy within 24 h[9].

In order to stratify the risk of complications, rebleeding, need of clinical intervention or death, several clinical scores are in use. Although recommended in the prevailing guidelines[10,11] they are erratically applied in the clinical practice. To encourage the use of a risk score in the context of UGIB, it should be easy to calculate, contain easy access variables, have high accuracy in predicting relevant outcomes and distinguish low-risk from high-risk patients.

The purpose of this paper is to describe the different risk scores already in use, explain why and when they may be useful, reflect on their limitations in clinical practice and direct future investigations. Since the majority of the literature is limited to non-variceal UGIB (NVUGIB), this review article will focus on such condition.

UPPER GI BLEEDING RISK SCORES - WHO?

From the different UGIB risk scores described, three main groups can be established: The scores only require endoscopic parameters, those that incorporate clinical and endoscopic parameters and those based solely on clinical parameters.

Score with endoscopic variables only

Forrest classification is based on endoscopic findings of an ulcer and is still useful to stratify patients into high- and low-risk categories in terms of rebleeding[12].

The Forrest classification divides ulcers in six different categories, depending on the endoscopic findings. High risk lesions include those characterized by spurting haemorrhages (Forrest Ⅰa), oozing haemorrhages (Forrest Ⅰb), nonbleeding visible vessels (Forrest Ⅱa), adherent clots (Forrest Ⅱb). Low risk lesions include haematin on the ulcer base (Forrest Ⅱc), and clean ulcer base (Forrest Ⅲ).

Forrest Ⅰa, Ⅰb and Ⅱa lesions require endoscopic treatment. For the ulcers with adherent clots (Forrest Ⅱb) clot removal should be attempted by vigorous irrigation and should be treated according to the underlying lesion[13,14].

Clinical and endoscopic scores

The most cited score incorporating clinical and endoscopic elements is the Rockall score. However, other scores such as the Baylor Bleeding Score (BBS), the Cedars-Sinai Medical Centre Predictive Index (CSMCPI), and more recently the progetto nazionale emorragia digestiva (PNED) score have also been reported.

The Rockall score, which ranges from 0 to 11, was developed in 1996 to predict mortality due to UGIB[15]. This score incorporates five variables: Age, haemodynamic status, patient's comorbidities, endoscopic diagnosis and presence of major stigmata of recent haemorrhage (Table 1). Patients' stigmata of recent haemorrhage (blood in upper gastrointestinal tract, adherent clot, visible or spurting vessel) are recognised risk factors for rebleeding, surgery and death and are indications for endoscopic therapy[16-18].

The BBS was originally developed for predicting rebleeding in patients with non-variceal haemorrhage[19]. This scoring system, which ranges from 0 to 24, is divided into three parts: (1) a pre-endoscopy score based on age and number and severity of concurrent diseases; (2) an endoscopic score based on site and stigmata of bleeding; and (3) a post-endoscopy score, which includes both the pre-endoscopy and the endoscopy score (Table 2).

The CSMCPI was developed as a guideline for determining the appropriate length of stay for patients admitted suffering from UGIB. Developed in 1996, by Hay *et al*[20], CSMCPI is based on four variables previously identified as independent predictors of outcome in patients suffering from UGIB : Endoscopic findings, symptoms at the time, haemodynamic instability, and number of comorbidities. The CSMCPI ranges from 0 to 11 (Table 3).

An Italian score of 10, the PNED score[21], was developed and validated to predict 30 d mortality after non-variceal bleeding. The PNED score is based on ten variables, (8 clinical and 2 laboratorial), and ranges from 0 to 24 (Table 4).

Table 1 Rockall score				
Score Variable	0	1	2	3
Age	< 60 yr	60-79 yr	≥ 80 yr	
Shock	No shock, systolic BP ≥ 100, pulse < 100	Tachycardia, systolic BP ≥ 100, pulse ≥ 100	Hypotension, systolic BP < 100	
Comorbidity	No major comorbidity		Cardiac failure, ischaemic heart disease, any major comorbidity Malignancy of UGI tract	Renal failure, liver failure, disseminated malignancy
Diagnosis	Mallory-Weiss tear, no lesion identified and no SRH	All other diagnoses		
Major SRH	None or dark spot only		Blood in UGI tract, adherent clot, visible or spurting vessel	

Admission score: Sum of age, shock and comorbidity; full score: Sum of age, shock, comorbidity, diagnosis and major SRH; BP: Blood pressure (measured in mmHg); UGI: Upper gastrointestinal; SRH: Stigmata of recent haemorrhage.

Table 2 Baylor bleeding score					
Pre-endoscopy score	1	2	3	4	5
Age (yr)	30-49	50-59	60-69		≥ 70
No. of illnesses	1-2			3-4	> 5
Severity of illnesses				Chronic[1]	Acute[2]
Endoscopy Score					
Site of bleeding			Posterior wall bulb		
Stigmata of bleeding	Clot		Visible vessel		Active bleeding

Pre-endoscopy score: Sum of the scores for age and the number and severity of concurrent illnesses; Endoscopy score: Sum of the scores for site and stigmata of haemorrhage; Post-endoscopy score: Sum of the pre-endoscopy and endoscopy score; [1]Chronic: Presence of a concurrent chronic life-threatening illness; [2]Acute: Presence of a concurrent acute life-threatening illness.

Scores with clinical variables only

Several studies have tried to develop clinical scoring systems to stratify the patients' risks based on the data immediately available at the time of the visit to the Emergency Department. These risk scores can be used to help physicians decide on the need for hospital admission, inpatient monitoring level and time for endoscopic evaluation.

Clinical risk scores may be useful to identify high-risk patients requiring immediate intervention and low-risk patients that can be safely discharged[11]. The main clinical scores reported in the literature are the clinical Rockall score and the Glasgow-Blatchford Score (GBS). Other scores such as the AIMS65 and the T-score were only recently described.

The clinical Rockall score is calculated without the endoscopic findings[15,22] (Table 1), and only includes 3 clinical variables: The patient's age, the haemodynamic status, and the occurrence of a comorbid disease. A maximum score of 7 is possible.

The GBS incorporates 8 clinical or laboratorial variables (heart rate, haemoglobin value, blood urea nitrogen, systolic blood pressure, melena occurrence, syncope, hepatic disease, or heart failure) (Table 5). The GBS ranges from 0 to 23, with higher scores indicating higher likelihood of a need for an endoscopic intervention.

Saltzman *et al*[23] developed an acronymic risk score named AIMS65 which incorporates albumin level < 3.0 g/dL (A), international normalized ratio (INR) > 1.5 (I), altered mental status (M), systolic blood pressure ≤ 90 mmHg (S), and age > 65 years (65) (Table 6).

An Italian study developed the T-score which included 4 clinical parameters commonly assessed in the UGIB setting: (1) general conditions (poor, intermediate, good); (2) pulse (< 90 beats/min, 90-110 beats/min, > 110 beats/min); (3) systolic blood pressure (< 90 mmHg, 90-110 mmHg, > 110 mmHg); and (4) haemoglobin level (≤ 8 g/dL, 9-10 g/dL, > 10 g/dL)[24] (Table 7).

Although some other non-endoscopic scores have been developed, they still present some limitations which preclude their use in the clinical practice. For example, the Cambridge score[25], described by Cameron and colleagues, incorporates 14 clinical and laboratorial variables, but has not been externally validated. An American score based on artificial neural networks (ANN) has been assessed, not only as a means to predict endoscopic findings, but also for the need for endoscopic treatment in patients suffering from UGIB[26,27]. However, it requires the inclusion of 27 of the patients' variables and a specialized computer software for analysis.

THE IMPORTANCE OF OUTCOMES

When should we use a risk score?

Despite methodological and demographic differences,

Table 3 Cedars-sinai medical centre predictive index

Score	EGD findings[1]	Time[2]	Haemodynamics	Comorbidities
0	Ulcer without SHR, non-bleeding MW tear Erosive disease, normal EGD	> 48 h	Stable	≤ 1
1	Ulcer with flat spot or clot, erosive disease with SHR, angiodysplasia	< 48 h	Intermediate	2
2	Ulcer with non- bleeding visible vessel or SHR	In hospital	Unstable	3
3				≥ 4
4	Persistent haemorrhage, varices UGI cancer			

[1]Score for endoscopic findings was reduced by 1 point if effective endoscopic therapy was applied (not applicable to varices or cancer); [2]Time from onset of symptoms to hospitalization; SHR: Stigmata of recent haemorrhage; MW: Mallory-Weiss tear; EGD: Esophagogastroduodenoscopy; UGI: Upper gastrointestinal.

Table 4 Progetto nazionale emorragia digestiva score

Score	1	2	3	4
Variables	ASA 3 Time to admission < 8 h	Hb level ≤ 7 g/dL Age ≥ 80 Renal failure	Rebleeding ASA 4 Neoplasia Liver cirrhosis	Failure of endoscopic treatment

ASA: American Society of Anaesthesiology; GI: Gastrointestinal.

the outcomes evaluated in the different studies are relatively similar. However, when attempting to implement different scoring systems in clinical practice it is important to know the primary outcome variable that was measured in each developed study. A summary of the main outcomes of each score is listed in Table 8.

There is evidence that most of the mortality in patients suffering from NVUGIB is not directly related to bleeding[3]. So, adding clinical variables to a risk score may increase its ability to predict a specific outcome.

The Rockall score should be used as a tool for identifying patients with low risk of rebleeding and death according to the clinical and endoscopic risk factors. Patients with Rockall scores of less than or equal to 2 should be considered for management in the community. This score was prospectively derived from 4185 cases of UGIB over a 4 mo period in 1993 and was afterwards validated by the same investigators on the following year in 1625 cases from the same hospitals[15]. A higher Rockall score indicates a higher risk of a poor outcome. In a prospective validation of this score, Rockall *et al*[28] showed that the patients with a score of 2 or less (29.4% of the cohort) had a rebleeding rate of 4.3% and a mortality rate of 0.1%, suggesting that such patients could have been safely managed in the outpatient setting.

The Rockall score has been prospectively and externally validated in different populations[29-32]. Church and Palmer from Edinburgh proposed that the Rockall score could be used to predict rebleeding and death by doing a retrospective analysis of cases of peptic ulceration enrolled into two trials of endoscopic haemostasis. The authors showed a correlation between the Rockall score and mortality or rebleeding. Patients with scores of 8 or greater had a significantly poorer outcome[33].

Several studies have shown that the Rockall score was closely correlated with the probability of death, but not so close to the chance of rebleeding[30-32,34,35]. This observation may be partly explained by the fact that the Rockall score was originally developed for the prediction of mortality rather than for the prediction of rebleeding and also because not all patients received endoscopic therapy[15].

The clinical Rockall score, without endoscopy, can be used to improve the quality of patients' care by identifying those patients less likely to require intensive health care services and selecting them for endoscopic evaluation as outpatients, allowing substantial resource savings.

Tham *et al*[22] reported that patients classified as low risk, *i.e.*, clinical Rockall score of 0, can be managed in the outpatient setting because these patients had no adverse outcomes and did not require transfusion.

Phang *et al*[36] demonstrated that clinical Rockall may be helpful to determine the appropriate environment into which UGIB patients should be admitted. In this study 60.5% of the patients with a clinical Rockall score of < 4 (low risk) had a mortality rate of 3.2%, meaning that they could have been managed in a general ward. On the other hand, from the 39.5% of patients with a clinical Rockall score of ≥ 4 (high risk), the mortality had a rate of 22.4%, indicating that those patients should be admitted to an intensive care unit. However, Gralnek *et al*[37] found that the complete rockall Score identified more low-risk patients than the clinical Rockall score.

Regarding peptic ulcer disease, BBS was initially proposed to predict rebleeding after endoscopic therapy, but was rarely used in the clinical practice. The original BBS study revealed that the cut-off of ≥ 11 had a sensitivity of 100% and a specificity of 79% for the prediction of rebleeding[19]. The same authors who

Table 5 Glasgow blatchford score

Variable	Score
Blood urea (mmol/L)	
6.5-8	2
8-10	3
10-25	4
> 25	6
Hb (g/L) for men	
120-130	1
100-120	3
< 100	6
Hb (g/L) for women	
100-120	1
< 100	6
Systolic blood pressure (mmHg)	
100-109	1
90-99	2
< 90	3
Pulse $\geqslant$ 100/min	1
History and comorbidities	
Melaena	1
Syncope	2
Hepatic disease[1]	2
Cardiac failure[2]	2

[1]Known history or clinical and laboratory evidence, of chronic or acute liver disease; [2]Known history or clinical and echocardiographic evidence, of cardiac failure.

Table 6 AIMS65 Score

Variable	Score
Albumin < 3 g/dL	1
International normalized ratio > 1.5	1
Systolic blood pressure < 90 mmHg	1
Altered mental status	1
Age > 65 yr	1

Table 7 T-score

Score Variable	1	2	3
General conditions	Poor	Intermediate	Good
Pulse (beats/min)	> 110	90-110	< 90
Systolic blood pressure (mmHg)	< 90	90-110	> 110
Haemoglobin levels (g/dL)	$\leqslant$ 8	9-10	> 10

Table 8 Outcomes

Scores	Primary outcome	Original studies
Endoscopy based score		
Forrest classification	Rebleeding	[12]
BBS	Rebleeding	[19]
CSMCPI	Mean length of stay	[20]
Rockall	Mortality	[15]
PNED	Mortality	[21]
Clinical scores		
Clinical rockall	Mortality	[15]
GBS	Need intervention	[41]
AIMS65	Mean length of stay/mortality	[23]
T-score	Time to endoscopy	[24,65]

BBS: Baylor bleeding score; CSMCPI: Cedars-sinai medical centre predictive index; PNED: Progetto nazionale emorragia digestiva; GBS: Glasgow blatchford score.

created this score had validated it prospectively in a cohort of 47 patients with bleeding peptic ulcer who had undergone endoscopic therapy[38]. Twenty-six patients were categorized as high-risk and 19 as low-risk. The rebleeding rate for high-risk patients was 31% and 0% for low-risk patients.

The CSMCPI may help to select low-risk patients suitable for early discharge[20,39]. In the original study of Hay *et al*[20] patients with a CSMCPI of 3 were considered suitable for discharge within 24 h. Seventy percent of UGIB patients (349 of 500) were considered as low-risk according to this cut-off. Complications occurred in 2 patients (0.6%) classified as low-risk. The routine use of the CSMCPI was associated with a reduced time of admission in 79% of all low-risk cases with a potential reduction of 2.1 bed-days per patient.

An italian study compared the three main endoscopy-based scores (CSMCPI, BBS and Rockall) and found out that the full Rockall score was superior in predicting mortality and rebleeding, particularly in low risk patients. In this study all scores were better at predicting mortality than rebleeding[29].

Marmo *et al*[21] developed the PNED score to predict 30 d mortality in patients suffering from acute NVUGB and validated it in a large cohort of patients. The PNED score is simple, reliable and accurate in identifying high-risk patients (score > 4 points) most likely to benefit from high levels of care and prevent death[21]. In a previous study the PNED score was significantly more accurate than the Rockall score in predicting death in non-variceal bleeders. This score introduces the failure to perform endoscopic haemostasis as a variable. As a matter of fact, in a former study by the same authors, the impossibility to perform endoscopic therapy was the strongest predictor of a negative outcome, being thus associated with an 11-fold risk of death[40].

The GBS should be used to predict the need for treatment (blood transfusion, endoscopic therapy or surgical intervention). This clinical score was developed from a prospective cohort involving 1748 patients admitted for UGIH in 19th centres in Scotland[41]. The greatest feature of the GBS is its ability to identify low-risk patients (GBS = 0) who do not need to be admitted into a hospital. With a high sensitivity and a high negative predictive value, the GBS indicates that almost all patients with a score equal to 0 can be safely discharged. In return, its positive predictive value remains low due to the low specificity (32%), significantly overestimating the risk of poor outcomes. A GBS of 0 was validated in the United Kingdom to safely discharge patients from Emergency Departments with suspected UGIB: Eighty-four patients with a GBS equal to 0 were managed as outpatients without adverse events during the follow-up[42]. In another United Kingdom study, 142 low-risk patients were managed

without admission, and none of them required endoscopic intervention, blood transfusion or surgery. In this cohort of patients the 28 d mortality rate was 0[43].

The GBS has been shown to be as good as the Rockall score in predicting the need for any intervention, namely the need for therapeutic endoscopy[41,42,44-47]. The GBS has also been shown to be superior to the clinical Rockall score in identifying patients with suspected UGIB who have a low likelihood of an adverse clinical outcome (blood transfusion, endoscopic therapy, interventional radiology, surgery or 30 d mortality) and can be considered for early discharge[48].

A multicentre study by Stanley *et al*[47] found that the GBS was equivalent to both the full and clinical Rockall scores in predicting death. It was however superior to the clinical Rockall score, and similar to the full Rockall score in predicting the need for endoscopic therapy or surgical intervention and superior to both in predicting the need for blood transfusion. This late finding is similar in both scores, because the GBS includes the measurement of haemoglobin levels on admission.

A study by Ahn *et al*[49] including patients with cancer who visited the Emergency Department, reported a greater accuracy of the GBS when compared to the Rockall score in predicting intervention in those patients.

Clinical variables such as liver disease, cardiovascular disease, presence of syncope, altered mental status and melena are susceptible to a subjective interpretation in GBS. Thus, a modified GBS could be used to eliminate subjective variables. A multicentre North American study reported that a modified GBS (without urea or syncope variables) was superior to the clinical Rockall score in predicting high risk of endoscopic stigmata in bleeding or rebleeding[50]. Another North American study has only incorporated the four quantitative variables, eliminating the subjective variables such as history of syncope, presence of melena, liver disease, cardiovascular disease, as well as altered mental status. The reported conclusion is that the modified GBS performed as well as the full GBS while outperforming both clinical and endoscopic Rockall Scores for prediction of clinical outcomes[51].

Some studies have suggested that the rate of identified low-risk patients could be increased by using a higher GBS cut-off value[45,52-57] or by incorporating age as a variable[52,58]. Stephens *et al*[52] showed that there was a relationship between age and significant endoscopic findings in patients categorized as low-risk by GBS. In this study, patients with a GBS of ≤ 2, for each additional year of age, had the chance of a significant endoscopic finding increased by 8%. The authors concluded that using GBS ≤ 2 and age of less than 70 years to define low-risk patients allows 10.5% of patients suffering from UGIB to be safely managed in the community. Over a 5-year period of managing such patients without hospital admission, McLaughlin *et al*[43] showed that any of them required endoscopic intervention, blood transfusion or surgery, and that the 28 d mortality was nil. A recent multicentre Danish study reported that a GBS cut-off value of ≤ 1 and an age modified low-risk version can be safely and effectively used to reduce unnecessary admissions for suspected UGIB[55].

AIMS65 can potentially be used to predict in-hospital mortality, length of stay, and cost in patients with acute UGIB[23]. When more than two components of AIMS65 are present, the mortality risk is considered to be high.

Hyett *et al*[59] has reported the superiority of the AIMS65 score when compared to the GBS in predicting inpatient mortality, but inferiority in predicting the need for blood transfusion. In a north American retrospective study, the AIMS65 showed no ability to predict the need for blood transfusion[60]. In a retrospective Japanese study, the AIMS65, but not the GBS, was considered an independent prognostic factor for poor overall survival[61]. On the other hand, in a recent study by Jung *et al*[62], the AIMS65 was insufficient in predicting outcomes in peptic ulcer bleeding.

In a recent Turkish study, the GBS was found to have superior sensitivity when compared to the AIMS65 score in identifying patients who were not likely to require interventions, including emergency endoscopy[63]. Such finding can be linked to the lower number of variables considered in this score. This score may not be able to detect low-risk patients with UGIB, but further studies are required.

Masaoka *et al*[64] recently proposed an algorithm to assess the mortality risk, which consisted in applying the AIMS65 score after detecting low-risk patients with GBS ≤ 2.

The T-score can be used to triage patients who are likely to have high-risk endoscopic stigmata and therefore need intervention[24]. It has the ability to predict high-risk endoscopic stigmata, rebleeding and mortality with an accuracy similar to the GBS[65]. According to Tammaro and collaborators, a T-score of ≤ 6 was able to predict the presence of high risk endoscopic stigmata and the need for an early endoscopy with a specificity of 96% and a positive predictive value of 74.5%[65].

Das *et al*[26] showed that ANN was superior to the admission Rockall score and similar to the full Rockall score to predict the need for endoscopic intervention, but its applicability in clinical practice is complex and time consuming.

Therapeutic decisions - why or why not should we use a risk score?

The consensus opinion recommends the early use of risk stratification scores in patients suffering from UGIB[10,11,13]. Many of these differ in the outcomes they were suggested for (risk of mortality, rebleeding and need for therapeutic intervention). However, in the era of increased outpatient management of UGIB, predicting the need for therapeutic intervention may be as useful as predicting rebleeding and death. Stratification risk systems could reduce the resources and costs without adversely influencing the patients' outcomes[66].

The greatest interest of clinical scores lies in their

ability to identify patients at low risk of complications who are suitable for early discharge without endoscopy. There is considerable evidence from several geographical regions (both in the United Kingdom and around the world)[41,42,44,46,48,56] that the GBS is an excellent risk assessment tool and accurately identifies patients with a low risk of requiring intervention or death. However, the best GBS cut-off for these situations is not clearly defined. Moreover, using a cut-off of 0 to predict low risk for adverse events has a practical limitation, since most of the patients who visit the Emergency Department with UGIB will score at least 1 point[41,42,46,65,67]. Possible explanations for the reported cut-off variation are differences in the demographics characteristics, aetiology of UGIB, routine use of proton pump inhibitors before endoscopy and adherence to guidelines regarding the need for endoscopic therapy.

Although with high sensitivity to identify patients at high risk for developing the need for blood transfusion, endoscopic therapy, or surgical intervention, the GBS has a low specificity[44,45,48,56,68,69].

Advanced age is a risk factor for death[70] and low-risk patients in general are younger than high-risk patients with UGIB. Despite not including age and being developed for predicting clinical intervention after UGIB detection, the GBS has proven to be equivalent to the Rockall score in predicting death[47]. Nevertheless, the ability of the GBS to identify low-risk patients may be enhanced by incorporating age as a variable[52,58].

Although there is greater consensus that certain endoscopic findings are associated with a high risk for adverse outcomes (*e.g.,* active bleeding or non-bleeding visible vessel), and other findings indicate a low risk for such outcomes (*e.g.,* clean-base ulcer, Mallory-Weiss tear), some controversy remains in what concerns the need of endoscopy as a component for early risk stratification at the initial patients' triage[71].

Almost all patients in the low risk group of the Rockall score had no stigmata of recent haemorrhage[29,35] and in clinical practice decisions regarding patient length of stay, admission place (intensive care unit versus regular ward) and therapeutic decisions are usually made on the basis of endoscopic appearance rather than the Rockall score[13]. The Forrest classification has shown a higher specificity and positive predictive value for the prediction of rebleeding and death when compared to other four scoring systems that were evaluated (the Rockall, the CSMCPI, the GBS and the BBS scores)[34].

The responsibility for initial patient assessment lies on the Emergency Department staff who invariably are general physicians or surgeons and may be uncomfortable about discharging patients without an endoscopy. Thus, although the GBS has shown a great ability to detect patients with low risk of complications in the Emergency Department setting, an endoscopy continues to support the patient management. On the other hand, by adopting a policy of urgent endoscopies in all patients with acute UGIB, several patients will undergo an unnecessary urgent procedure.

Another important key question in the management of patients with UGIB is the timing of the endoscopy, even though the overall consensus suggests that it should be performed within 24 h from admission[10]. Earlier endoscopy was not associated with a reduction in mortality or need for surgery. However, it was associated with an increased efficiency of care, a potential improvement in the control of haemorrhage in high-risk patients, and a reduction in the length of stay. All these factors support the routine use of early endoscopies, unless specific contraindications occur[72,73].

The Rockall Score is unable to address this question, since it requires endoscopic findings. A retrospective study by Lim *et al*[74] revealed that performing an endoscopy within 13 h for high-risk patients with a GBS of > 12 is associated with a reduced mortality. The timing of urgent endoscopy following an episode of UGIB may be also differentiated according to the simplified clinical T-score of $\leqslant 6$[65].

The need for a therapeutic endoscopy may also be a subjective decision[75] and a score that would equally help endoscopists in the decision to perform an urgent intervention is still warranted. Ideally, simple clinical scores could facilitate the identification of high-risk patients who could benefit from an early endoscopy with therapeutic intervention. Farooq *et al*[76] reported that the use of clinical Rockall and GBS was less accurate than a clinical triage decision in predicting the need for endoscopic therapy. In the study by Attar *et al*[67], the GBS showed an equivalent sensitivity when compared to endoscopists (both 98%) in the detection of urgent upper endoscopy necessity. However, both GBS and endoscopists showed a very poor specificity, being unable to detect non urgent patients to endoscopy.

In a recent multicentre study, although clinical knowledge of the endoscopists (described as "gut feeling") was an independent predictor for an adverse outcome, it had a lower sensitivity and a worst predictive power compared to prediction scores[77].

The reasons for not using clinical scores may be that they are difficult to calculate and time consuming and do not add much information to the physician's knowledge. Furthermore, no clinicians will feel comfortable in managing an elderly patient as an outpatient even if he has a GBS of 0. When there is clinical concern on avoiding admission in elderly patients, the use of an age modified GBS should be considered[55].

In real life, patients may also take antiplatelet and anticoagulant medications that may further increase the rebleeding rate and mortality, an issue not addressed in most reported studies. However, the AIMS65 includes the INR as a risk factor and an INR > 1.5 has been shown to be independently associated with in-hospital mortality in acute NVUGIB in a recent multicentre United Kingdom national audit[78].

The variables of AIMS65, with the exception of blood pressure, are different from those in the GBS. Albumin level and age may also contribute to the superiority of this score for the prediction of mortality[59]. Furthermore,

it has advantages over the existing risk scores, including the fact of being easy to remember and lacking the subjectivity in its calculation.

All scores seem to have lower performance in high-risk patients. Most clinical scores have poor specificity, possibly leading to unjustified upper endoscopies in the emergency context. However, the sensitivity of these scores may be likely more important than specificity, since they may help in physician's decisions, ensuring that any patient who may have a poor prognosis is discharged.

Extending the definition of low-risk patient may lead to outpatient management of patients who may actually need clinical intervention. Indeed, the cut-off value for considering patients to be at low or high risk may depend on local healthcare assistance and outpatient support and therefore needs to be carefully assessed in different populations.

Personalized medicine can help in stratification of patients according to biomarkers and guide optimal treatment and prevention. The molecular pathological epidemiology (MPE) is a recently established interdisciplinary and transdisciplinary field, which emerged from the complex relationship between etiological factors, molecular alterations, and disease evolution[79,80]. MPE may stratify UGIB into different subtypes according to the pathogenic mechanisms, enabling a more efficient and individualized approach.

To date, most of MPE research is applied to cancer[81,82], but this approach may also be important to UGIB and further investigation is needed to evaluate its contribution.

CONCLUSION

We believe that the value of risk scores in predicting the outcomes in acute UGIB has been proven far beyond any scepticism. Routine use of scoring systems by unspecialized medical staff could save lives, alert to the severity of a patient's condition and lead to an immediate referral. Furthermore, it could be an auxiliary tool for endoscopists that are often asked to perform an urgent endoscopy and have to decide whether the procedure should be done immediately or delayed up to 24 h. Endoscopic based scores can determine intensive care strategies, endoscopic therapy and length of hospitalization. As a means to predict low risk patients amenable to an early discharge and outpatient management, the Rockall and GBS are the two most commonly used and recommended risk stratification systems[13].

T-score, recently described, can potentially be useful to predict high-risk endoscopic stigmata and the need of early intervention[65]. We recommend the use of non-endoscopic scores as the pre-endoscopic Rockall score or the GBS, as a decision tools for patients with acute UGIB. The scores may be useful when endoscopy are not available in the emergency department. A patient with Rockall score or the GBS equal to 0 can be safely discharged.

Moreover, we also advocate early endoscopy (within 12 to 24 h of admission) and early discharge of patients with low risk lesions or low post-endoscopic risk scores (*e.g.,* post-endoscopic Rockall score $\leqslant$ 2).

Theoretically, the perfect score would be applicable in the two different stages of the patient's assessment, pre- and post-endoscopy, with excellent accuracy for the main outcomes in the context of UGIB: Rebleeding, death, and need of clinical intervention. However, since both scores have reached sufficient levels of efficiency that enable their safe employment in clinical practice, and until further research proves this premise, endoscopists should continue to rely on their "gut feeling" and on all the endoscopic findings as the key factors to guide their therapeutic decisions in patients with UGIB.

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