Analysis of the diagnostic utility of Glasgow-Blatcford Score, Rockall Score, AIMS65 Score, BUN-to-albumin ratio and BUN-to-creatinine ratio for predicting the need for transfusion in upper gastrointestinal bleeding

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ABSTRACT

Objective: This study aimed to compare the predictive accuracy of commonly used risk scores in predicting the need for transfusion among patients with upper gastrointestinal bleeding (UGIB).

Material and Methods: This retrospective diagnostic utility study was conducted at a tertiary care academic hospital. The primary outcome was the diagnostic accuracy of the Glasgow-Blatchford Score (GBS), the Rockall Score, the AIMS65 Score, the BUN-to-albumin ratio (BAR), and the BUN-to-creatinine ratio (BCR) in the prediction of transfusion in UGIB.

Results: Results from the study showed that 75% of the 104 patients included in the study received blood transfusions, with a median of 3 (IQR 2 - 4) units. Admission hemoglobin and hematocrit values were higher in the non-transfusion group (p<0.001 for both comparisons). The GBS (AUC 0.790 [95% CI 0.699 - 0.864]; p<0.001), AIMS65 (AUC 0.672 [95% CI 0.573 - 0.761]; p=0.001), and BAR (AUC 0.625 [95% CI 0.525 - 0.718, p=0.04) were found to be useful diagnostic indices in predicting transfusion administration, with ideal cut-offs of >0, >10.75, and >0, respectively. But Rockall and BCR were not found to be useful diagnostically. The study suggests that these indices can be used as decision tools for transfusion administration in patients with acute upper gastrointestinal bleeding.

Conclusion: The GBS demonstrated superior accuracy compared to AIMS65 and BAR, while Rockall score and BCR were found to be ineffective. The GBS may therefore be useful to clinicians when assessing the potential need for blood transfusions in patients with UGIB.

Keywords: upper gastrointestinal bleeding; blood transfusion; risk scores

INTRODUCTION

Upper gastrointestinal bleeding (UGIB) is a clinical entity originating from the gastrointestinal tract and manifested by bleeding presentations such as hematemesis, melena or indirect signs of blood loss such as syncope and dizziness. As a result, a variety of clinical scenarios may arise, with varying severity and potential complications. Although clinical scenarios may bring a different approach based on both the severity of bleeding and the patient's baseline health status, the approach to UGIB in the emergency department (ED) can be characterized by three cornerstones (1). Specifically, these include: 1) hemodynamic stabilization 2) risk assessment and 3) diagnosis and treatment (endoscopy and, interventional radiology or surgery, if necessary).

Risk scores such as Glasgow-Blatchford score (GBS), Rockall score, and AIMS65 score are primarily used to predict poor outcomes (2–4). In spite of this, the changing etiologic factors in UGIB and the favorable effect of mortality improvements indicate that it is not a single condition (5).

There are numerous elements to consider, but transfusion is one of the most important (6). The restrictive strategy has been shown to be beneficial to mortality, as it maintains perfusion, prevents increased bleeding owing to high blood pressure, and reduces complications with each transfusion (7). Although such a strategy may result in more favorable outcomes for patients, the fact that the patient will be closer to the borderline of hypovolemia or profound anemia when receiving restrictive blood transfusions suggests that the clinician should monitor these patients more closely. In order to ensure close monitoring, it is first and foremost important to identify patients at an early stage that may require blood transfusion.

Although there are several indications for red blood cell transfusion in UGIB, acute blood loss of 30% or more is among the most urgent. In cases where blood loss starts rapidly and severely without being compensated, hemorrhagic shock can result (8). While it gives poor prognosis to patients, it makes diagnosing and deciding on transfusions easier for doctors. It is possible, however, that transfusions will be required even before such dramatic events take place. The level of hemoglobin is another reason to consider blood transfusions (1). There is however a risk of misleading results if hemodilution has not yet been completed (9). In these cases, transfusions are not always a straightforward decision. An external assessment is insufficient; it is unknown when UGIB began, how long it lasted, whether it ended, or to what severity it bled. Therefore, it can be concluded that any parameter that leads to the right transfusion decision or identifies patients at risk of transfusion will benefit patient care.

Consequently, this study aims to determine whether GBS, Rockall, AIMS65 scores and BUN-to-creatinine (BCR) and BUN-to-albumin (BCR) ratios can be used to determine the need for transfusions in upper gastrointestinal bleeding. Specifically, we hypothesize that higher scores on these risk assessment tools and ratios are associated with a greater likelihood of needing transfusions. This study aims to provide objective and evidence-based guidance on clinical decision-making relating to UGIB by examining the utility of risk scores and ratios as predictors of transfusion needs. Ultimately, this may improve outcomes for UGIB patients by reducing unnecessary transfusions and associated complications.

MATERIAL and METHODs

Study Design

This study was designed as a single-center retrospective observational diagnostic-utility study and was conducted at the University of Health Sciences, Okmeydanı Training and Research Hospital. An ethics committee's approval was obtained before the study was conducted (no: 339), and all research was conducted in accordance with the Declaration of Helsinki.

Study Population

Study participants were consecutive adult patients who presented to the ED with UGIB manifestations such as hematemesis, melena or secondary blood loss symptoms like syncope or dizziness within 18 months of the study and were diagnosed with UGIB by endoscopy.

The study excluded patients with active lower gastrointestinal bleeding, patients with variceal UGIB, and patients with incomplete data. In accordance with hospital protocols and physician decisions, transfusions were administered with a restrictive strategy.

Outcome Measures

Age, gender, vital signs (pulse rate, blood pressure), NSAID use, hemoglobin (g/dl), hematocrit (%), platelet count (cells/µL), International Normalized Ratio (INR), albumin (g/dl), BUN (mg/dl), creatinine (mg/dl) values, BCR, BAR, blood transfusion status and number of units transfused, Rockall score, GBS, high risk or low-risk lesion according to Forrest classification, and length of hospital stay were analyzed. The patient files were reviewed to determine patients' previous UGIB history, smoking habits, and alcohol consumption.

Statistics

The statistical analysis of the study was carried out with the Statistical Package for Social Sciences (SPSS) v.28 for MAC (IBM Corp., Armonk, NY, USA) and MedCalc 20.104 (MedCalc Software Ltd., Ostend, Belgium). Data were expressed as mean + standard deviation, median (interquartile range [IQR]), number, and percentage. A histogram and Shapiro-Wilk test were used to assess the conformity of the data to the normal distribution. Student's t-tests and Mann-Whitney U tests were used to compare the parameters of paired independent groups with continuous data, whereas chi-square tests or Fisher's exact tests were used to compare parameters with categorical data. For analyzing the diagnostic value of different risk scores and ratios for transfusion necessity, receiver operating characteristics (ROC) were plotted, and accuracy is determined using AUROC. Using the DeLong method, different risk scores and ratios were compared. An alpha value of <0.05 determined statistical significance.

RESULTs

A total of 104 patients were included in the study. Patients were divided into two groups according to whether they received blood transfusions. There were 26 (25%) patients in the study who did not receive blood transfusions, and 78 (75%) patients received blood transfusions. The median number of units of blood transfused to patients was 3 (interquartile range 2 - 4 units). As shown in Table 1, in comparison with the transfusion group, the average age of the non-transfusion group was 13.08 years younger (9.55% CI 4.19 - 21.99) than the transfusion group (56.7±21.63) (p=0.005). Gender did not differ significantly between the groups (p=0.067). Based on the use of NSAIDs, statistically significant differences between the two groups were not observed (p=0.544). A significant difference was found between the no-transfusion group (65.4%) and the transfusion group (29.5%) in terms of smoking rates (p=0.001). Alcohol use and UGIB history were not statistically different between the groups (p=0.452, p=0.9, respectively). In terms of mean pulse rate, tachycardia rate, median systolic blood pressure, and median diastolic blood pressure, there was no statistically significant difference between the groups (p=0.447, p=0.411, p=0.442, p=0.544, respectively).

Compared to the non-transfusion group, the mean admission hemoglobin value was 3.69 (95% CI 2.68 - 4.7) mg/dL higher than the transfusion group (8.43±2.43 mg/dL) (p<0.001). The mean hematocrit % in the no transfusion group (35.57±4.26) was 10.04 (95% CI 7.19 - 12.9) % higher than that of the mean hematocrit % in the transfusion group (25.53±6.9) (p<0.001). In terms of median MCV, INR, BUN, and creatinine values, there was no statistically significant difference between the groups (p=0.542, p=0.145, p=0.553, p=0.62). There was no significant difference in platelet count between groups (p=0.897). The mean albumin value in the transfusion group (3.57±0.64) was 0.58 (0.34-0.82) lower than that in the no transfusion group (4.15±0.48) (p<0.001). In the transfusion group, the median hospital stay was 5 days (IQR 4 - 7), which was statistically significantly higher than in the non-transfusion group (3 days, IQR 2 - 5) (p<0.001).

In the no transfusion group, the median Rockall score was 2 (IQR 1 - 4.24), and in the transfusion group, the median Rockall score was 3 (IQR 2 - 5), with no statistically significant difference between the two groups (p=0.073). Compared to the transfusion group (11 [IQR 8.75 - 14]), the no-transfusion group had significantly lower GBS (6.5 [IQR 5 - 9.25]) (p<0.001). The rate of high-risk lesions measured via Forrest classification did not differ statistically significantly between the groups (p=0.99). In the group who didn't receive transfusions (0 [IQR 0 - 0.25]), the median AIMS65 score was significantly lower than in the group who received transfusions (1 [IQR 0 - 2]) (p=0.004). The mean BCR did not differ statistically significantly between the groups (p=0.161). Mean BAR in the transfusion group (11.39±6.72) was 2.93 (95% CI 0.79 - 5.07) higher than in the no transfusion group (8.47±3.87) (p=0.008).

The area under the curve analysis for predicting transfusion administration showed that BCR and Rockall score were ineffective (p=0.182, p=0.071, respectively). In predicting transfusion, BAR (AUC 0.625 [95% CI 0.525 - 0.718, p=0.04), AIMS65 score (AUC 0.672 [95% CI 0.573 - 0.761]; p=0.001) and GBS (AUC 0.790 [95% CI 0.699 - 0.864]; p<0.001) have been shown to be useful diagnostic indices. Using the Youden index, the ideal cut-offs were: BAR score >10.75 with 44.87% (95% CI 33.6 - 56.6 %) sensitivity and 76.92 % (95% CI 56.4 - 91 %) specificity; AIMS65 score >0 with 56.41 % (95% CI 44.7 - 67.6 %) sensitivity and 76.92 % (95% CI 56.4 - 91 %) specificity; GBS >9 with 70.51 % (95% CI 59.1 - 80.3 %) sensitivity and 76.92 % (95% CI 56.4 - 91 %) specificity. A comparison of the AUROCs in terms of predicting outcome revealed that the GBS was more accurate than the AIMS 65 score (difference between areas [DBA] 0.118 [95% CI 0.011 - 0.226], p=0.0315) and BAR (DBA 0.165 [95% CI 0.05 - 0.277], p=0.0038) (figure 1).

According to the results of a correlation analysis of the amount of transfusion administered (in units) with scores of transfused patients (n=78), the following results were obtained: BCR did not correlate statistically significantly with the amount of blood transfusion administered (p=0.48, r=0.079). The amount of blood transfusion administered correlated weakly with BAR (p=0.023, r=0.258), AIMS65 (p=0.002, r=0.351), and Rockall (p<0.001, r=0.375) scores. Blood transfusion amount and GBS had a moderately positive correlation (p<0.001, r=0.445).

Table 1. Comparative analysis of demographic and laboratory data between subjects who received blood transfusions and those who did not

	transfusion (n=78)	no transfusion (n=26)	*p*	mean difference (95% CI)
Age	56.7±21.63	43.62±18.79	0.005	13.08 (4.19-21.97)
Gender (female)	23 (29.5%)	3 (11.5%)	0.067	
NSAIDs	43 (55.1%)	14 (53.8%)	0.544	
Smoking	23 (29.5%)	17 (65.4%)	0.001	
Alcohol	12 (15.4%)	3 (11.5%)	0.452	
History of UGIB	22 (28.2%)	7 (26.9%)	0.900	
Pulse rate (beats/min)	95.76±14.11	92.74±15.25	0.447	
Tachycardia	28 (35.9%)	8 (30.9%)	0.411	
Systolic BP	102.5 (90-110)	110 (100-110)	0.442	
Diastolic BP	70 (60-70)	70 (60-70)	0.544	
HGB (g/dL)	8.43±2.43	12.12±1.51	<0.001	3.69 (2.68-4.7)
HCT (%)	25.53±6.9	35.57±4.26	<0.001	10.04 (7.19-12.9)
MCV (fL)	85 (81-88.63)	85 (84-92)	0.542	
PLT (10^3/µL)	268.64±103.17	266.23±74.97	0.897	
INR	1.09 (1.03-1.18)	1.07 (1-1.17)	0.145	
BUN (mg/dL)	34 (25-48.25)	34.5 (23.75-43)	0.553	
Creatinin (mg/dL)	0.87 (0.7-1.03)	0.91 (0.72-1.06)	0.62	
Albumin (mg/dL)	3.57±0.64	4.15±0.48	<0.001	0.58 (0.34-0.82)
High Risk Lesion*	21 (26.9%)	7 (26.9%)	0.99	
Lenght of hospital stay (days)	5 (4-7)	3 (3-4)	<0.001	

HGB: hemoglobin; NSAIDs: non-steroid anti inflammatory drugs; UGIB: upper gastrointestinal bleeding; BP: blood pressure; HCT: hematocrit; MCV: mean cell volüme; PLT: platelet; INR: international normalised ratio; BUN: blood urea nitrogen, *as defined in Forrest classification

Table 2. A comparison of transfusion group and no transfusion group with regards to the Rockall, Glasgow-Blatchford, AIMS65 scores, and the BUN-to-creatinine ratios (BCR), and the BUN-to-albumin ratios (BAR) measurements

	transfusion (n=78)	no transfusion (n=26)	p	mean difference (95% CI)
Rockall	3 (2 - 5)	2 (1 - 4.25)	0.073	
Glasgow-Blatchford	11 (8.75 - 14)	6.5 (5 - 9.25)	<0.001	
AIMS65	1 (0 - 2)	0 (0 - 0.25)	0.004	
BCR	44.12+-16.77	38.97+-15.7	0.161	
BAR	11.39+-6.72	8.47+-3.87	0.008	2.93 (0.79 - 5.07)

AIMS65: albumin level <3.0 mg/dL, INR >1.5, altered mental status, systolic blood pressure ≤90 mm Hg, and age >65 years; BCR: Blood urea nitrogen to creatinin ratio; BAR: blood urea nitrogen to albumin ratio

Table 3. The diagnostic utility of Rockall, Glasgow-Blatchford, AIMS65 scores and BUN-creatinine ratios (BCR), BUN-albumin ratios (BAR) in predicting transfusion in UGIB

	AUC (95% CI)	p	Cut-Off	Sensitivity (95% CI)	Specifity (95% CI)
BCR	0.586 (0.485-0.682)	0.182			
BAR	0.625 (0.525-0.718)	0.04	>10.75	44.87 (33.6-56.6)	76.92 (56.4-91)
AIMS65	0.672 (0.573-0.761)	0.001	>0	56.41 (44.7-67.6)	76.92 (56.4-91)
Glasgow-Blatchford	0.790 (0.699-0.864)	<0.001	>9	70.51 (59.1-80.3)	76.92 (56.4-91)
Rockall	0.616 (0.489-0.742)	0.071			

AIMS65: albumin level <3.0 mg/dL, INR >1.5, altered mental status, systolic blood pressure ≤90 mm Hg, and age >65 years; BCR: Blood urea nitrogen to creatinin ratio; BAR: blood urea nitrogen to albumin ratio
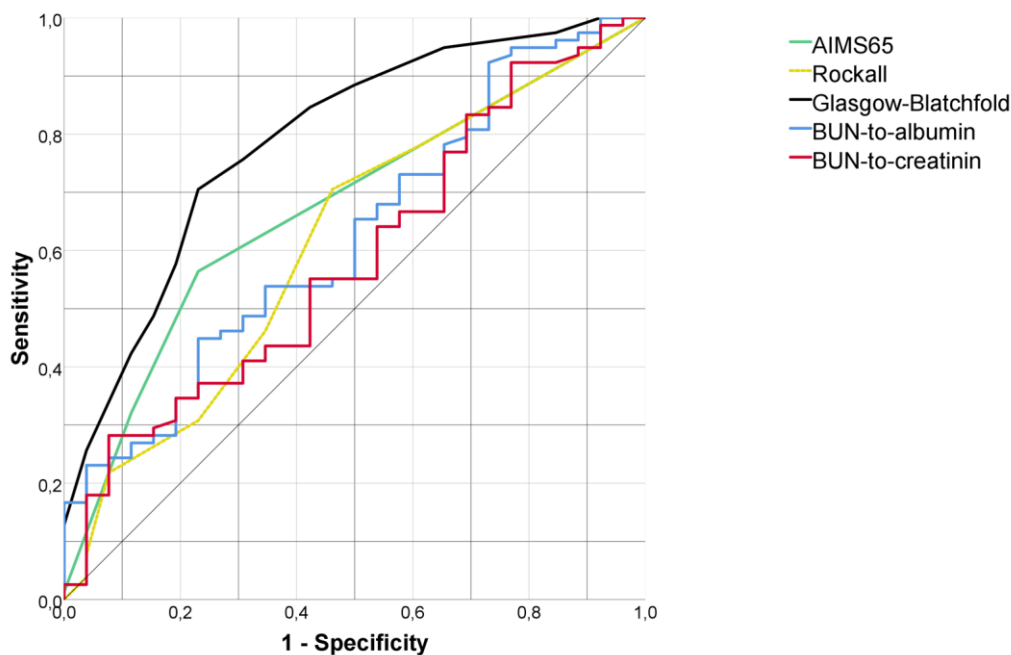

Figure 1: Comprison of Various scores to predict need for transfusion via ROC

DISCUSSION

In this study, the diagnostic accuracy of AIMS65, Rockall, Glasgow-Blatchford and GBSs and the BCR and the BAR was analyzed to predict the need for blood transfusions in ED patients with upper gastrointestinal bleeding. Results of the study indicate that GBS, BAR and AIMS65 scores can be used as diagnostic tools to predict this outcome, whereas and Rockall scores cannot. In terms of AUROC comparison, the GBS outperformed both the BAR and AIMS65 scores. It is possible to draw clinical conclusions from these results.

A timely detection of patients with significant bleeding who will require blood transfusions is crucial in managing UGIB. The rest of this discussion will examine our study's clinical implications and limitations in greater depth.

The GBS was the most effective predictor of transfusion need among the clinical scores we studied. GBS a 9-parameter pre-endoscopic risk score, has been found to be diagnostically valuable in determining mortality and rebleeding, among other factors, in previous studies (3,10).

However, the AIMS 65 and Rockall studies have been shown to be diagnostically valuable in different upper gastrointestinal bleeding outcomes (11,12). Considering the need for transfusion as an indication of ongoing bleeding, these results are unsurprising (13). Despite claims that some machine learning models and artificial intelligence applications can provide better results than these clinical risk stratification scores, clinicians still benefit from these scores in discharge decisions and identifying at-risk patients (14).

Clinical guidelines for the management of upper GI bleeding advise clinicians to determine a patient's risk (1). The main criteria used to stratify patients are poor outcomes, such as mortality and rebleeding (10). Upper GI bleeding is associated with a poor outcomes for a number of reasons. A poor outcome has been associated with hemodynamic instability and signs of perfusion impairment, as well as advanced age in previous studies (15). Factors associated with rebleeding include active bleeding during endoscopy, large ulcerations, and low pre-albumin and high D-dimer levels (5,12). Meanwhile, cancer, low hemoglobin levels at presentation, and a transfusion requirement are associated with both rebleeding or ongoing bleeding and mortality (16–18).

The percentage of patients who received blood transfusions, which is associated with poor outcomes, was found to be 25% in our study. Based on the literature, this rate seems to be lower than that reported in previous studies(16,19). However, when the average age of our participants is examined, it is also noted that this average is lower than that in the literature (5,12). Nevertheless, as in previous studies, the average age of transfused patients was significantly higher than that of the nontransfused group (14,20). Even though several factors contribute to the etiology of UGIB, NSAIDs-associated bleeding usually has a benign outcome (21). In addition, we think the lower mean age and use of NSAIDs among the patients in our study may explain the low blood transfusion rate. There is, however, a need to remember that when blood transfusion rates and amounts are compared with different studies, the UGIB guidelines have recommended a more restrictive transfusion strategy for the past 10 years, and the hemoglobin thresholds for blood transfusion indications differ as well (1).

The use of endoscopy is an essential component of good upper GI bleeding management. It can also diagnose the lesion and perform hemostatic approaches when necessary and directly affect treatment, making it an important tool in this context. Endoscopy has been recognized as one of the most effective strategies used to reduce UGIB mortality in the last 30 years, but it does not benefit patients at the earliest stage of the disease (22). Thus, it is recommended that an endoscopy be performed within 24 hours of the patient's arrival (23). Diagnostic endoscopy typically classifies bleeding based on Forrest's classification (24). Based on this classification, there are three types of lesions with active bleeding, lesions with stigmata of new bleeding, or lesions without active bleeding. According to our study, transfusion decisions were not influenced by high-risk or low-risk lesions in the Forrest classification. Although some studies do not link the Forrest classification to the need for transfusion, one cannot say it is totally unrelated to transfusion, given that the Forrest classification has been shown to be associated with

rebleeding (25,26). Consequently, we attribute the equal proportion of bleeding-risk lesions in the two groups to the fact that blood transfusion is determined not only by the amount of bleeding present, but also by the patient's basal factors.

There has been much debate over the relationship between uremia and gastrointestinal bleeding for many years. There is a connection between gastrointestinal bleeding and elevated urea (27,28). Some theorists attribute this connection to prerenal azotemia caused by blood loss, while others attribute it to uremia predisposing to bleeding. Despite differing opinions on how this relationship occurs, urea elevation is present in most patients with upper gastrointestinal bleeding. Approximately 35 years ago, the BCR was found to be diagnostically valuable in separating upper gastrointestinal bleeding from healthy volunteers, but recent studies have suggested that this score may also be used to distinguish between upper gastrointestinal bleeding and lower gastrointestinal bleeding (29,29). The results of our study indicated that, while BCR in the transfusion group were above the cut-offs determined by previous studies in favor of upper intestinal bleeding, they were not diagnostically valuable in predicting the need for transfusions according to AUROC analysis.

Based on our study, BAR provides useful diagnostic information for predicting transfusion need. In previous studies, albumin levels, which are not frequently measured in EDs, were associated with mortality and hospitalization for intensive care units (30,31). It may be recommended to monitor the laboratory value of albumin in patients presenting to the ED with suspected upper gastrointestinal bleeding if other studies support these results.

The most significant indication for blood transfusion is hemorrhagic shock, which is marked by low blood pressure and rapid pulse (8). During this clinical scenario, the pulse rate increases initially, and blood pressure decreases as the bleeding continues. The literature describes a variety of drugs, medical conditions, and clinical applications that can suppress pulse rate and mask ongoing bleeding (32,33). Systolic and diastolic blood pressure and pulse rate did not differ significantly between the transfusion and non-transfusion groups. Studies have shown an association between decreased blood pressure on admission and poor prognosis outcomes such as mortality or rebleeding and transfusion requirements (16,18). Shock, however, is not only the result of the amount of bleeding, but also the rate at which it occurs. According to our study, this contradictory finding from the literature can be explained by different bleeding rates and conditions that suppress pulse rate.

Limitations

Despite providing valuable insights, the study has a few limitations. The first limitation of the study was that it was retrospective and based on data collected from a single center. Therefore, the results cannot be generalized to other populations and settings. A second limitation of the study was that it was conducted on patients who were admitted to the hospital for UGIB. There may have been a limitation to the study's generalizability for those patients who didn't require hospitalization or those with lower gastrointestinal bleeding. Thirdly, the study did not consider certain factors that may

affect the performance of scoring systems. Fourth, the sample size was relatively small, which may limit the statistical power of the analysis and the ability to detect significant differences between the scoring systems. Furthermore, the study did not examine how the scoring systems impacted clinical decision-making or patient outcomes, such as length of hospital stay. Therefore, further research is needed to evaluate the clinical implications of the findings.

CONCLUSION

Finally, in order to identify whether transfusions are necessary in patients with UGIB, this study examined the predictive accuracy of Glasgow-Blatchford, AIMS65, and Rockall scores as well as BCR and BAR scores. The results of our study showed that the GBS outperformed the AIMS65 and BAR scores in terms of accuracy. In addition, Rockall and BCR failed to predict transfusion requirements in UGIB. The GBS might be useful for clinicians evaluating the transfusion risk of UGIB patients.

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Ethical approval: All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and/or with the Helsinki Declaration of 1964 and later versions.

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