

Rockall score in predicting outcomes of elderly patients with acute upper gastrointestinal bleeding

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Abstract

AIM: To validate the clinical Rockall score in predicting outcomes (rebleeding, surgery and mortality) in elderly patients with acute upper gastrointestinal bleeding (AUGIB).

METHODS: A retrospective analysis was undertaken in 341 patients admitted to the emergency room and Intensive Care Unit of Xuanwu Hospital of Capital Medical University with non-variceal upper gastrointestinal bleeding. The Rockall scores were calculated, and the association between clinical Rockall scores and patient outcomes (rebleeding, surgery and mortality) was assessed. Based on the Rockall scores, patients were divided into three risk categories: low risk ≤ 3 , moderate risk 3-4, high risk ≥ 4 , and the percentages of rebleeding/death/surgery in each risk category were compared. The area under the receiver operating characteristic (ROC) curve was calculated to assess the validity of the Rockall system in predicting rebleeding, surgery and mortality of patients with AUGIB.

RESULTS: A positive linear correlation between clinical Rockall scores and patient outcomes in terms of rebleeding, surgery and mortality was observed ($r =$

0.962, 0.955 and 0.946, respectively, $P = 0.001$). High clinical Rockall scores > 3 were associated with adverse outcomes (rebleeding, surgery and death). There was a significant correlation between high Rockall scores and the occurrence of rebleeding, surgery and mortality in the entire patient population ($\chi^2 = 49.29, 23.10$ and 27.64 , respectively, $P = 0.001$). For rebleeding, the area under the ROC curve was 0.788 (95%CI: 0.726-0.849, $P = 0.001$); For surgery, the area under the ROC curve was 0.752 (95%CI: 0.679-0.825, $P = 0.001$) and for mortality, the area under the ROC curve was 0.787 (95%CI: 0.716-0.859, $P = 0.001$).

CONCLUSION: The Rockall score is clinically useful, rapid and accurate in predicting rebleeding, surgery and mortality outcomes in elderly patients with AUGIB.

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Key words: Rockall score; Acute upper gastrointestinal bleeding; Prognosis; Elderly patients

Core tip: This study verified the advantages of the Rockall score in predicting the outcomes of the elderly patients with non-variceal upper gastrointestinal bleeding (UGIB) and assessed its clinical usefulness and prognostic value in rebleeding, surgery and mortality. The results suggest that the Rockall scoring system had satisfactory validity for the prediction of rebleeding, surgery and mortality in patients with acute non-variceal UGIB, and there was a positive linear correlation between the clinical Rockall scores and patient outcomes in terms of rebleeding, surgery and mortality.

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INTRODUCTION

Acute upper gastrointestinal bleeding (AUGIB) is common, costly, and potentially life-threatening and requires prompt assessment and aggressive medical management^[1]. Despite changes in management, mortality has not significantly improved over the past 50 years. Elderly patients and those with chronic medical diseases withstand AUGIB less well than younger, fitter patients, and have a higher risk of death^[2,3]. AUGIB is defined as hemorrhage that emanates proximal to the ligament of Treitz, which differentiates it from lower gastrointestinal bleeding involving the colon, and middle gastrointestinal bleeding involving the small intestine distal to the ligament of Treitz^[4]. Clinically, AUGIB often causes hypodynamia, hematemesis (vomiting of blood), melena (passage of black tarry stools due to the presence of altered blood), and systemic shock typically ensues upon loss of 15% or more of the circulating blood volume. The color of the vomitus depends on its contact time with hydrochloric acid in the stomach^[5,6]. If vomiting occurs early after the onset of bleeding, it appears red; with delayed vomiting, it is dark red, brown, or black. Coffee-ground emesis results from the precipitation of blood clots in the vomitus. Hematochezia (red blood per rectum) usually indicates bleeding distal to the ligament of Treitz. Occasionally, rapid bleeding from an upper gastrointestinal bleeding source may result in hematochezia^[7]. The rate and extent of hemorrhage, coupled with the patient's comorbidities, determine the clinical presentation of UGIB. AUGIB is a common medical emergency, the annual incidence of hospitalization for AUGIB is 50-150 per 10000 people in China, and it has a mortality of 4%-14%^[4]. Early predictors of adverse prognosis in AUGIB, include increasing age (above 60 years), an increased number of co-morbid conditions, the underlying cause of bleeding (*i.e.*, variceal), red blood cells (RBCs) in the emesis or stool, shock or hypotension on presentation, an increased number of units of blood transfused, active bleeding at the time of endoscopy, bleeding from large (> 2 cm) ulcers, onset of bleeding in the hospital, and emergency surgery^[8-10]. Timely and effective assessment of the patient's condition and the degree of risk is very important, which could serve as a basis for the establishment of treatment procedures to reduce medical costs and improve prognosis^[11].

One of the major challenges in managing UGIB involves the identification of patients who are at high risk of rebleeding and death; conversely, the identification of patients who are suitable for early discharge and outpatient endoscopy is also important for effective resource use^[12]. Similar to other common medical conditions, risk scores have been developed to try and identify those at lower or higher risk of poor outcome^[13]. An ideal risk score is one that is easy to calculate, accurate for relevant outcomes and can be measured early after presentation with AUGIB. Several clinical scoring systems have been developed to help predict outcome in patients with a view to improving patient management and promoting

cost-effective use of resources. In most published scoring systems, a combination of clinical, laboratory, and endoscopic variables are weighted to produce a score that predicts the risk of mortality, recurrent hemorrhage, need for clinical intervention, or suitability for early discharge. The commonly used systems are the Rockall score, the Baylor bleeding score, the Cedars-Sinai Medical Centre Predictive Index, and the Blatchford score^[14-17]. The most commonly used risk scoring system in UGIB is the Rockall score, which was described in 1996 following the analysis of data from a large English audit^[12]. The score was developed to assess the risk of death following presentation with UGIB and incorporates patient age, hemodynamics, comorbidities and endoscopic findings. The clinical Rockall score, which relies on only clinical variables, is used to identify patients with AUGIB who have an adverse outcome, such as death or recurrent bleeding. The complete Rockall score, which relies on clinical and endoscopic variables, is also used to identify patients with AUGIB who died or have recurrent bleeding^[18,19]. Rockall scores can be calculated both before and after endoscopy, but the post-endoscopic Rockall score provides a more accurate risk assessment. Patients at high-risk for rebleeding receive endoscopic therapy to achieve hemostasis and are subsequently treated with high-dose acid suppression to promote the formation of blood clots over the arterial defect responsible for bleeding. The aim of this study was to verify the advantages of the Rockall score in 341 patients with non-variceal upper gastrointestinal bleeding admitted to the emergency room and Intensive Care Unit (ICU) of Xuanwu Hospital, and to assess its clinical usefulness and prognostic value in rebleeding, surgery and mortality.

MATERIALS AND METHODS

Patients

This study included 341 patients with non-variceal UGIB admitted to the emergency room and ICU of Xuanwu Hospital of Capital Medical University. The median age of the patients was 72.85 ± 7.11 years (range: 60-85 years) and 181 were men and 160 were women. Patients admitted to hospital through the emergency department with a primary diagnosis of UGIB (hematemesis, melena or bloody nasogastric aspirate) were considered for inclusion, endoscopies were performed to confirm the diagnosis within 6-48 h after admission, and the characteristics of the patients are presented in Table 1. Patients were selected based on the following criteria: ≥ 60 years of age; patients with clinically significant UGIB (*i.e.*, signs of active UGIB including hematemesis, melena or hematochezia) confirmed by gastroscopy, surgery, blood or coffee grounds detected during nasogastric lavage; patients fulfilling the low-risk criteria such as having a low risk of requiring intervention (endoscopic therapy, blood transfusion, surgery) or death if they had a Rockall score ≤ 2 and were < 70 years old. Patients were excluded based on the following criteria: < 60 years of age; patients with a record of poor compliance, such as those

Table 1 Classification of patients with acute upper gastrointestinal bleeding

Classification of diseases	<i>n</i> = 341
Esophageal diseases	74
Esophageal carcinoma	37
Esophagitis	25
Mallory-Weiss syndrome	7
Hiatus hernia	5
Gastroduodenal disease	265
Peptic ulcer	151
Stomach cancer	59
Erosive gastritis	32
Anastomotic	12
Acute gastric mucosal lesion	11
Other	2

who did not undergo endoscopy; patients with acute variceal or obscure UGIB.

Calculation of Rockall scores

The clinical Rockall score, which was calculated without endoscopic findings for each patient, was based on points assigned for clinical variables: patient age at presentation, shock status based on initial heart rate and systolic blood pressure, and presence of comorbid disease (Table 2). The associations between Rockall scores and rebleeding rate, mortality rate and surgical rate were evaluated. Scores ranged from 0 to 9 and were divided into three risk categories: low risk ≤ 3 , moderate risk 3-4, and high risk ≥ 4 . We used the observed percentages of rebleeding/death/surgery in each risk category in the original patient sample of Rockall as the predicted probabilities of rebleeding/mortality for both validation samples. Calibration and discrimination were assessed as measures of validity of the scoring system. Calibration was evaluated by a χ^2 goodness of fit test, and discrimination was evaluated by calculating the area under the receiver operating characteristic (ROC) curve.

Comorbidity was based on reference standard diagnostic criteria, including cardiovascular and cerebrovascular disease, chronic obstructive pulmonary disease, chronic liver disease and cancer.

Rebleeding or bleeding recurrence was defined as a separate episode of hematemesis or melena, or nasogastric evidence of new bleeding, occurring during admission and within 24 h of initial presentation, as witnessed by hospital staff. Hematemesis was defined as the vomiting of fresh or old blood, including "coffee grounds." Melena was defined as the passage of black or tarry stools. Mortality was defined as death occurring within 30 d of hospital admission.

Successful hemostasis was defined as endoscopic hemostasis or negative occult blood in the feces, and patients were hemostatically stable when no hematemesis or melena was observed.

Rebleeding manifestations were defined by at least one of the following: recurrent hematemesis or melena, bloody or red colored vomit, or bloody stools (blood in the stool that may appear as maroon or red), or the

patient had hyperactive bowel sounds; hemorrhagic peripheral circulatory failure (due to excessive blood loss and rapid bleeding) was not improved or hemodynamic status was temporarily improved after fluid infusion and blood transfusion, and the central venous pressure fluctuated and then decreased; RBC counts and hemoglobin levels continued to decline, and high reticulocyte count (increased RBC destruction such as bleeding or hemolysis) was observed; serum creatinine level increased when 24-h total volumes of fluid infusion and urinary output were normal; a relatively large amount of fresh blood was drained by nasogastric tube lavage.

Surgical treatment guidelines were as follows: conservative treatment was not sufficient and the bleeding continued, and patients suspected of having a perforated duodenal ulcer were transferred to the surgical ICU.

Statistical analysis

SPSS statistical software version 19.0 (SPSS Inc., Chicago, IL, United States) was used for data analysis and management. The sensitivity and specificity of detecting patients who needed clinical intervention, had recurrent bleeding, or died were calculated for the clinical Rockall score and the complete Rockall score with confidence interval. The Rockall scores for all patients were calculated based on their pre-endoscopic variables. The correlation between the variables was analyzed using the Pearson product-moment correlation. Categorical variables were analyzed by χ^2 tests. We assessed the validity of the scoring systems by plotting ROC curves. A two-sided *P* value of less than 0.05 was considered statistically significant.

RESULTS

Rockall scores and clinical outcomes

Of 341 patients, 63 (18.47%) patients developed recurrent bleeding, 30 (8.79%) patients died and 31 (9.09%) patients required endoscopic treatment. The Rockall scores were calculated based on the collected data (Table 3). A positive linear correlation between the clinical Rockall scores and patient outcomes in terms of rebleeding, surgery and mortality ($r = 0.962, 0.955$ and 0.946 , respectively, $P = 0.001$) was observed. High clinical Rockall scores > 3 were associated with adverse outcomes (rebleeding, surgery and death).

Distribution of patients in the risk categories

The distribution of patients classified into the three risk categories (low, moderate, high), as determined by the Rockall risk scoring system, and the observed percentages of rebleeding, surgery and mortality in each risk category are shown in Table 4. The Rockall score identified 114 of 341 patients as low risk (≤ 3), 110 of 341 patients as moderate risk (3-4) and 117 of 341 patients as high risk (≥ 4). There were significant correlations between high Rockall scores and the occurrence of rebleeding, surgery and mortality in the entire patient population ($\chi^2 = 49.29, 23.10$ and 27.64 , respectively, $P = 0.001$).

Table 2 Rockall scores in patients with upper gastrointestinal bleeding

Variable	Scores			
	0	1	2	3
Age (yr)	< 60	60-79	≥ 80	
Shock	No shock; SBP ≥ 100 mmHg; pulse < 100 bpm	SBP ≥ 100 mmHg; Pulse ≥ 100 bpm	SBP < 100 mmHg; Pulse ≥ 100 bpm	
Comorbidity	No major		CHF, IHD, major morbidity	Renal failure, liver failure, metastatic cancer
Diagnosis	Mallory-Weiss syndrome	All other diagnoses	GI malignancy	
Evidence of bleeding	None		Blood, adherent clot, spurting vessel	

CHF: Chronic hearth failure; IHD: Ischaemic heart disease; SBP: Systolic blood pressure; GI: Gastrointestinal.

Table 3 Relationship between clinical Rockall scores and patient outcomes

Variables	Rockall score							
	1	2	3	4	5	6	7	≥ 8
Number	65	49	44	66	51	31	20	15
Rebleeding	2	3	4	9	14	11	10	10
Mortality	0	1	2	4	7	8	4	4
Surgery	0	1	3	5	9	6	4	3

Table 4 Percentages of rebleeding/death/surgery in each risk category *n* (%)

Category	Cases	Outcome		
		Rebleeding	Surgery	Mortality
Low-risk	114	5 (4.38)	1 (0.87)	1 (0.87)
Moderate-risk	110	13 (11.81)	8 (7.27)	6 (5.45)
High-risk	117	45 (38.46)	22 (18.80)	23 (19.65)

Predictive value of the Rockall score for rebleeding, surgery and mortality in patients with upper gastrointestinal bleeding

The discriminative ability of the Rockall score for the prediction of rebleeding and mortality were compared. The Rockall score was found to have good predictive value for rebleeding (area under the ROC curve was 0.788, 95%CI: 0.726-0.849, $P = 0.001$), surgery (area under the ROC curve was 0.752, 95%CI: 0.679-0.825, $P = 0.001$) and mortality (area under the ROC curve was 0.787, 95%CI: 0.716-0.859, $P = 0.001$).

DISCUSSION

Acute non-variceal UGIB remains a common and challenging emergency for gastroenterologists and general physicians^[20]. The annual incidence is 50-150 per 100000 of the population, and although there have been significant improvements in endoscopic and supportive therapies, the overall mortality stubbornly remains around 10% (4%-14%), and may even reach 27% in hospitalized patients with serious co-morbidity^[21]. AUGIB results in considerable patient morbidity and significant medical costs. Elderly patients (aged over 80 years) now account for around 25% of all AUGIB and 33% of AUGIB occurring in hospitalized patients, and therefore tend to account for much of the poor outcome associated with this condition^[1]. Many risk factors are associated with bleeding, and these must be addressed. Pharmacists, physicians, and dentists should record patients' medical history and analgesic requirements. The initial evaluation of patients with AUGIB involves recognition of a range

of symptoms depending on the source, rate, and volume of blood loss^[2]. Medical comorbidities and the use of antiplatelet medications can complicate the severity and management of bleeding, especially in the elderly. Symptoms of AUGIB include anemia, hematemesis (vomiting bright red blood or "coffee ground" material), and melena^[5,6]. Other symptoms may include epigastric pain, dyspnea, and syncope (due to volume depletion). Bleeding may be obscure when the gastrointestinal blood loss is of unknown origin^[7]. Certain prognostic factors in patients who present with AUGIB can increase the incidence of complications, including morbidity and mortality^[22]. The patient should be admitted to the ICU if one or more of the following prognostic factors are present: age greater than 60 years; shock; comorbidities (*e.g.*, cardiac, renal and hepatic diseases); current bleeding; low systolic blood pressure; need for more than 6 units of blood; and endoscopy showing major signs of bleeding.

Several clinical scoring systems, *e.g.*, the Rockall score, the Blatchford score and Acute Physiology and Chronic Health Evaluation II score, have been developed to direct appropriate patient management and predict mortality as well as rebleeding. These systems weigh a combination of clinical, laboratory and endoscopic variables to produce a score that predicts the risk of mortality, recurrent hemorrhage, the need for clinical intervention or suitability for early discharge^[23-25]. Factors commonly associated with poor outcome in patients with AUGIB may be related to presentation and co-morbidities, or to the behavior of the ulcer. Before endoscopy is performed, use of the Rockall risk scoring system is recommended. This assessment tool, which predicts the patient's outcome and estimates rebleeding risk, is the most widely

used scoring system and has been validated by several studies. The patient's age, systolic blood pressure, pulse rate and the presence of comorbidities are used for scoring. Patients with a score of 0 should be considered for non-admission or early discharge with outpatient follow-up; if the score is above 0, there is a significant risk of mortality, and endoscopy is recommended for a full assessment of bleeding risk^[14-16].

Rockall included 4185 cases of AUGIB from 74 hospitals in the United Kingdom over a four-month period in 1993. Their scoring system was based on multivariate analysis of information from history, examination, blood tests, and endoscopic investigation. The complete Rockall score makes use of both clinical and endoscopic criteria to predict the risks of rebleeding and death; the scale ranges from 0 to 11 points, with higher scores indicating higher risk. In the present study, we used Rockall's risk scoring system to classify patients and found that high clinical Rockall scores > 3 were associated with adverse outcomes (rebleeding, surgery and death), and the results obtained were widely corroborated in clinical practice. The complete Rockall score has been validated as a clinically useful score in predicting outcomes (rebleeding, mortality) of patients with acute non-variceal UGIB^[26,27]. As the original study included only 180 of 4185 patients with esophagus-stomach fundus variceal hemorrhage, some investigators argued that the Rockall score might not be ideal or accurate in predicting rebleeding and mortality in patients with esophagus-stomach fundus variceal hemorrhage.

In the present study, we found that 63 (18.47%) patients developed recurrent bleeding, 30 (8.79%) patients died and 31 (9.09%) patients required endoscopic treatment. These results were consistent with earlier research^[28]. A positive linear correlation between the clinical Rockall scores and patient outcomes in terms of rebleeding, surgery and mortality ($r = 0.962, 0.955$ and 0.946 , respectively, $P = 0.001$) was observed. High clinical Rockall scores > 3 were associated with adverse outcomes (rebleeding, surgery and death). Our results validated the clinical Rockall score in predicting patient outcome (*i.e.*, rebleeding, surgery and mortality) after acute non-variceal UGIB, which will help identify low-risk patients for delayed, elective or outpatient endoscopy, whereas those at high risk could have urgent endoscopy and a higher level of hospital care^[29-33].

Recurrence of bleeding is one of the most important factors affecting prognosis, and early prediction and treatment of rebleeding would improve the outcome in patients with acute non-variceal UGIB, as rebleeding is associated with high mortality^[34-36]. The commonly used scoring systems are the Rockall score, the Baylor bleeding score, the Cedars-Sinai Medical Centre Predictive Index, and the Blatchford score^[37]. The Cedars-Sinai Medical Centre Predictive Index was less accurate than the Rockall score in predicting patient outcome (*i.e.*, rebleeding, surgery and mortality), the Baylor bleeding score is commonly used in predicting the likelihood of rebleeding after endoscopic hemostasis of peptic ulcers, while the

complete Rockall score has been found to have good predictive value for mortality and in-hospital rebleeding. In this study, we showed that a low clinical Rockall risk score in patients with AUGIB without endoscopy was not associated with adverse outcomes (rebleeding or mortality), whereas a high clinical risk score was associated with adverse outcomes. A positive linear correlation between the clinical Rockall scores and patient outcomes in terms of rebleeding, surgery and mortality ($r = 0.962, 0.955$ and 0.946 , respectively, $P = 0.001$) was observed. The discriminative ability of the Rockall score for the prediction of rebleeding and mortality was compared. For rebleeding, the area under the ROC curve was 0.788 (95%CI: 0.726-0.849. $P = 0.001$). For mortality, the area under the ROC curve was 0.787 (95%CI: 0.716-0.859. $P = 0.001$). Our results were consistent with those of other studies and suggested that the Rockall score had good predictive value for mortality and in-hospital rebleeding, and was validated as a clinically useful scoring system for stratifying patients into high-risk and low-risk categories for mortality and in-hospital rebleeding^[38,39]. However, other reports have suggested that the Rockall score showed inadequate sensitivity and poor specificity for outcome prediction in terms of rebleeding and mortality, thus, further clinical research is needed to confirm our observations^[40].

In conclusion, our results suggest that the Rockall risk scoring system had satisfactory validity for the prediction of rebleeding, surgery and mortality in patients with acute non-variceal UGIB, and a positive linear correlation between the clinical Rockall scores and patient outcomes in terms of rebleeding, surgery and mortality was observed. The problems associated with AUGIB are challenging for patients and physicians, and a combination of clinical and laboratory assessments (including the Cedars-Sinai Medical Centre Predictive Index and Baylor bleeding score) should be performed to comprehensively assess and correctly diagnose various conditions in patients in order to develop appropriate treatment programs and improve the prognosis of patients.

COMMENTS

Background

Acute upper gastrointestinal bleeding (AUGIB) is common, costly, and potentially life-threatening and requires prompt assessment and aggressive medical management. The most commonly used risk scoring system in UGIB is the Rockall score, which was described in 1996 following the analysis of data from a large English audit.

Research frontiers

Rockall scores can be calculated both before and after endoscopy, but the post-endoscopic Rockall score provides a more accurate risk assessment. Patients at high-risk for rebleeding receive endoscopic therapy to achieve hemostasis and are subsequently treated with high-dose acid suppression to promote the formation of blood clots over the arterial defect responsible for bleeding.

Innovations and breakthroughs

Several clinical scoring systems have been developed to help predict outcome in patients with a view to improving patient management and promoting cost-effective use of resources. In most published scoring systems, a combination of clinical, laboratory, and endoscopic variables are weighted to produce a score that predicts the risk of mortality, recurrent hemorrhage, need for clinical intervention, or suitability for early discharge. The commonly used systems are the Rockall score, the Baylor bleeding score, the Cedars-Sinai Medical Centre

Predictive Index, and the Blatchford score. This study verified the advantages of the Rockall score in predicting the outcomes of the elderly patients with non-variceal UGB and assessed its clinical usefulness and prognostic value in rebleeding, surgery and mortality.

Applications

The authors found that the Rockall score is clinically useful, rapid and accurate in predicting rebleeding, surgery and mortality outcomes in elderly patients with acute upper gastrointestinal bleeding.

Peer review

This manuscript is very interesting. The authors intended to validate the clinical Rockall score in predicting outcomes (rebleeding, surgery and mortality) in elderly patients with acute upper gastrointestinal bleeding. The study is well designed and the data well support the conclusion. Rockall score plays an important role in predicting the outcomes of the elderly patients with non-variceal upper gastrointestinal bleeding. This study will be informative for the readers.

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