Analysis of risk scoring for the outpatient management of acute upper gastrointestinal bleeding

John C H Chan, Lakshmana Ayaru

Department of Gastroenterology,
Imperial College Healthcare
Trust, London, UK

Correspondence to

L Ayaru, Department of
Gastroenterology, Imperial
College Healthcare Trust,
Charing Cross and Hammersmith
Hospitals, Fulham Palace Road,
London W6 8RF, UK;
lakshmana.ayaru@imperial.
nhs.uk

Accepted 1 October 2010

Published Online First

16 November 2010

Objective To determine whether the Glasgow–Blatchford bleeding score (GBS) or pre-endoscopy Rockall score was better at accurately identifying patients with acute upper gastrointestinal bleeding (AUGIB) who were at low risk of the need for clinical intervention and death and therefore suitable for outpatient management.

Design Retrospective database and case note review of all patients admitted to the emergency departments with AUGIB from 1 January 2008 to 31 December 2009.

Setting Two tertiary centre teaching hospitals.

Patients 432 patients met the inclusion criteria.

Intervention None.

Main outcome measure Clinical interventions (blood transfusion, endoscopic therapy and surgery) and death.

Results Of 432 patients, 40 (9.3%) had a GBS of 0 and none required intervention or died. In contrast, 13/104 patients (12.5%) who had a pre-endoscopy Rockall score of 0 and 23/125 patients (18.4%) who had a complete Rockall score <3, required clinical intervention. The performance of the scores at these cut-offs were: GBS (sensitivity 100%, specificity 16.1%, positive predictive value (PPV) 37.8%, negative predictive value (NPV) 100%, accuracy 82.3%), pre-endoscopy Rockall (sensitivity 91.2%, specificity 32.0%, PPV 41.2%, NPV 87.5%, accuracy 70.9%) and complete Rockall (sensitivity 84.5%, specificity 50.7%, PPV 55.8%, NPV 81.6%, accuracy 76.2%). For prediction of the need for intervention or death, the accuracy of the GBS (0.82; 95% CI 0.78 to 0.86) was superior to the pre-endoscopy Rockall score (0.71; 95% CI 0.67 to 0.76).

Conclusion The GBS but not the pre-endoscopy Rockall score identifies patients with upper gastrointestinal bleeding who may be suitable for outpatient management, therefore potentially allowing for more efficient use of hospital resources.

Introduction

Acute upper gastrointestinal bleeding (AUGIB) is the commonest emergency

managed by gastroenterologists with an incidence in the UK of between 50 and 150 per 100 000 adults per year.¹ Its severity can range from that caused by a low risk small Mallory–Weiss tear not requiring intervention to a large volume variceal bleed with a high risk of rebleeding and death.^{1–3}

The majority of patients with AUGIB however are at a low risk of requiring clinical intervention or death^{1,3} but most are admitted to hospital regardless of severity for observation and endoscopy which occurs after a variable length of time.² If low risk patients could be identified accurately at the time of presentation to an emergency department, unnecessary hospital admission could be avoided. This may allow for more efficient use of hospitals' resources and reduce exposure of patients to hospital associated hazards.⁴

A risk scoring system may help clinicians to identify a greater number of patients with low risk AUGIB for outpatient management. Several scoring systems have been developed for the risk stratification of AUGIB^{3,5–8} but the majority of these use endoscopy and aim to identify the risk of a poor outcome rather than the need for intervention. For example, the complete Rockall score has been the most widely validated^{1,9,10} but was principally designed to predict death based on a combination of clinical and endoscopic findings.³ Endoscopic triage for outpatient management is problematic as resources in most countries do not allow for universal provision of endoscopy within the time frame that patients are in the emergency department.

The optimum risk score to identify patients with AUGIB for outpatient management is unclear. The Glasgow–Blatchford bleeding score (GBS) is a non-endoscopic score that was developed to

predict the need for intervention or death in patients with AUGIB.⁷ The inventors showed that low risk patients with AUGIB, defined as a GBS of 0, did not require clinical intervention or die and a proportion could be managed as outpatients without adverse events.¹¹ A recent study has shown that a modified GBS score of ≤ 2 and age less than 70 years identified a larger number of low risk patients than a GBS of 0 without associated adverse outcomes.¹²

The British Society of Gastroenterology guidelines (SIGN guidelines) for the management of upper gastrointestinal bleeding have however recommended that a pre-endoscopy Rockall score of 0 be used to identify patients who may be suitable for early discharge or non-admission.^{13 14} This is based on subgroup analysis of the original Rockall data and other prospective studies which showed that a score of 0 identified patients with AUGIB at presentation who have an extremely low risk of death (0.2%).^{15 16} The GBS score was not recommended due to a lack of external validation.

The aim of this study was to determine if the GBS, modified GBS or pre-endoscopy Rockall score could accurately identify a group of patients with AUGIB who were at low risk of the need for intervention and death and therefore suitable for outpatient management. We hypothesised that the GBS would be more accurate than the pre-endoscopic Rockall score in predicting these outcomes.

Table 1 The Glasgow–Blatchford bleeding score and modified Glasgow–Blatchford bleeding score*

Variable	Score value
Blood urea	
6.5–7.9	2
8.0–9.9	3
10.0–25.0	4
>25.0	6
Haemoglobin for men (g/l)	
120–129	1
100–119	3
<100	6
Haemoglobin for women (g/l)	
100–119	1
<100	6
Systolic blood pressure	
110–109	1
90–99	2
<90	3
Other markers	
Pulse ≥ 100 /min	1
Presentation with melaena	1
Presentation with syncope	2
Hepatic disease	2
Cardiac failure	2

*Modified Glasgow–Blatchford bleeding score: total score of ≤ 2 and age <70 years.

Methods

Data collection

A retrospective analysis was carried out of patients admitted to the Hammersmith and Charing Cross Hospitals with AUGIB over a 2 year period (1 January 2008 to 31 December 2009). Inclusion criteria were patients aged 18 years or over presenting to the emergency departments with a primary diagnosis of AUGIB (haematemesis, including coffee-ground vomiting and/or melaena). Exclusion criteria were patients with an inpatient bleed, lower gastrointestinal bleeding and who were transferred from another hospital.

Patients were identified by searching an accident and emergency database of presenting diagnoses as well as laboratory results, endoscopic, discharge and coding databases using the keywords haematemesis, melaena and gastrointestinal haemorrhage. The following data were extracted: date of admission, age, history of syncope, melaena, comorbidities, pulse rate, blood pressure, blood urea level, haemoglobin and endoscopic findings. The length of hospital stay, interventions (blood transfusion, endoscopic therapy, angiography and surgery), episodes of rebleeding and in-hospital mortality within 30 days of the index bleed were also documented. The appropriateness of endoscopic therapy was analysed by determining if there were stigmata of recent haemorrhage (SRH) associated with a treatable lesion consistent with published guidelines.¹⁷ We defined rebleeding as any further episodes of haematemesis, melaena and/or fall in haemoglobin which required an oesophogastroduodenoscopy.

Patients were scored with the GBS (table 1), modified GBS,¹² pre-endoscopy Rockall (table 2) and complete Rockall^{3 15} scoring systems.

Statistical analysis

Sensitivity and specificity characteristics of the GBS, modified GBS, pre-endoscopy Rockall and complete Rockall for the prediction of the need for intervention or death were presented as receiver operating

Table 2 Pre-endoscopy Rockall score

Variable	Score value
Age (year)	
<60	0
60–79	1
≥ 80	2
Shock	
SBP ≥ 100 , pulse <100	0
SBP ≥ 100 , pulse ≥ 100	1
SBP <100	2
Comorbidity	
No major comorbidity	0
Cardiac failure, ischaemic heart disease, any major comorbidity	2
Renal failure, liver failure, disseminated malignancy	3

SBP, systolic blood pressure.

characteristics (ROC) curves. The area under the ROC curve was used to assess the overall accuracy of the scores. The following cut-off points were used to demonstrate maximal sensitivity for prediction of the need for intervention or death (GBS >0 , modified GBS >2 , pre-endoscopy Rockall >0 , complete Rockall >2). An exact 95% CI for each proportion, including sensitivity, specificity and predictive values, were derived assuming a binomial distribution using Graph Pad Prism 4 (Graph Pad Software Inc, San Diego, California, USA) and SPSS software, V.11.5 (SPSS Inc, Chicago, Illinois, USA).

Results

A total of 1151 patients were identified as having had haematemesis and/or melaena and 719 were excluded for the following reasons: no record of attendance at emergency department or admission to hospital ($n=173$), not the primary admission symptom ($n=59$), inpatient bleed ($n=391$), colonic bleed ($n=19$), transferred from another hospital ($n=16$) and incomplete data for risk scoring ($n=61$). The remaining 432 patients therefore made up the study population.

Table 3 Demographic, presentation, intervention and outcome of patients

Patients (n=432)	
Gender (n (%))	
Male	299 (69.2)
Female	133 (30.8)
Age (years)	
Range	18–96
IQR	43–71
Median	56
Mean	56.4
Presentation (n (%))	
Haematemesis	189 (43.8)
Melaena	160 (37.0)
Haematemesis and melaena	82 (19.2)
Endoscopy (n (%))	
Had endoscopy	349 (80.8)
Scoped within 24 h	295 (68.5)
Did not have endoscopy	83 (19.2)
Intervention (n (%))	
Total intervention	148 (34.3)
Transfusion	109 (25.2)
Endoscopic treatment	85 (19.7)
Surgery	6 (1.4)
Hospital stay (days)	
Range	0–109
Median	4
Mean	7.8
Discharged within 24 h	47 (10.9%)
Rebleeding and mortality (n (%))	
Rebleeding	31 (7.2)
30-day in-hospital mortality	10 (2.3)

The overall demographics and outcome of the patients are shown in table 3. Of 432 patients, 349 (80.8%) were admitted to hospital and had an endoscopy which was performed within 24 h in 68.5%. The remaining 83 patients (19.2%) were admitted to hospital and not endoscoped during their inpatient stay.

Ulcers, inflammation and varices were the most common endoscopic diagnoses (table 4).

A significant proportion of patients ($n=148$, 34.3%) who presented with upper gastrointestinal haemorrhage required clinical intervention (blood transfusion $n=109$, endoscopic therapy $n=74$, surgery $n=6$). Endoscopic therapy consisted of variceal banding ($n=34$), injection of epinephrine ($n=32$), thermal therapy ($n=28$), endoscopic clip application ($n=22$) and argon plasma coagulation ($n=3$). A total of six patients required surgery, four for duodenal ulcer bleeding which could not be controlled by endoscopic therapy, one for an ulcerated gastric tumour and one for small bowel obstruction secondary to a gallstone ileus. The mean length of hospital stay was 7.8 days (median 4 days, IQR 43–71 days). The overall rebleeding rate was 7.2% and the 30 day in-hospital mortality was 2.3%.

All 432 patients were scored with both the GBS and the pre-endoscopy Rockall score. The 349 patients who underwent endoscopy had separate GBS and complete Rockall scores calculated. Figure 1A–C shows the clinical intervention and deaths for individual GBS, pre-endoscopy Rockall and complete Rockall scores. There were 40 patients (9.3%) with a GBS score of 0 and none required clinical intervention, rebled or died, resulting in 100% sensitivity and 100% negative predictive value (NPV). Moreover, none of the

Table 4 Endoscopic diagnoses (n=349)

	Total (n=432)	GBS=0 (n=40)	GBS >0 (n=392)
Had endoscopy	349	18	331
Endoscopic diagnosis			
Normal	55	6	49
Mallory–Weiss	9	0	9
Ulcers	121	6	115
Oesophageal ulcers	(18)	(2)	(16)
Gastric ulcers	(56)	(3)	(53)
Duodenal ulcers	(53)	(1)	(52)
Varices	60	0	60
Oesophagitis	78	4	74
Gastritis	58	3	55
Duodenitis	55	3	52
Cancer	8	0	8
Other diagnosis	8	0	8
Incomplete procedure	3	0	3
With SRH	74	0	74

GBS, Glasgow-Blatchford bleeding score; SRH, stigmata of recent haemorrhage.

Figure 1 Need for intervention or deaths by score of the (A) Glasgow-Blatchford bleeding score (GBS), (B) pre-endoscopy Rockall score and (C) complete Rockall score.

Figure 2 Receiver operating characteristics curves of the Glasgow-Blatchford bleeding score (GBS) and pre-endoscopy Rockall score.

patients with a GBS of 0 had varices, upper gastrointestinal malignancy or SRH on endoscopy (table 4). In contrast, 13 of 104 patients (12.5%) with a pre-endoscopy Rockall score of 0 required intervention. Blood transfusion was given in 10 patients (admission haemoglobin of <10 g/dl ($n=7$), admission haemoglobin >10 g/dl and drop in haemoglobin of ≥ 2 g/dl ($n=2$)). Endoscopic therapy was applied in six patients who had SRH on endoscopy, with one patient requiring surgery for a bleeding duodenal ulcer. Similarly, 23 of 125 patients (18.4%) who had a complete Rockall score of 2 or less had interventions which were blood transfusion ($n=20$) (admission haemoglobin <10 g/dl, $n=16$), endoscopic therapy for SRH ($n=2$) and surgery ($n=1$). A total of 106 patients met the modified Blatchford score's criteria of low risk (GBS ≤ 2 , age less than 70 years).¹² A total of 4.7% ($n=5$) of these patients, all with SRH, required endoscopic therapy and/or surgery ($n=1$).

The score performances at the predetermined cut-offs were: GBS (sensitivity 100%, specificity 16.1%, positive predictive value (PPV) 37.8%, NPV 100%, AUC 0.82), modified GBS (sensitivity 95%, specificity 45.1%, PPV 43.8%, NPV 95.3%, AUC 0.83), pre-endoscopy Rockall (sensitivity 91.2%, specificity 32.0%, PPV 41.2%, NPV 87.5%, AUC 0.71) and complete Rockall (sensitivity 84.5%, specificity 50.7%, PPV 55.8%, NPV 81.6%, AUC 0.76). By ROC curve comparison (figure 2), the overall accuracy of the GBS score (0.82, 95% CI 0.78 to 0.86) was superior to the pre-endoscopy Rockall score's AUC (0.71, 95% CI 0.66 to 0.76). Comparison between the GBS and complete Rockall score could only be made between patients who had an upper gastrointestinal endoscopy ($n=349$). In this group of patients, the accuracy of the GBS was 0.77 (95% CI 0.73 to 0.82) and not significantly different to that of the complete Rockall score (0.76, 95% CI 0.71 to 0.81).

Patients with a GBS of 0 had an average stay of 2.1 bed days. Assuming a cost of £450 per bed day,¹⁸

this could potentially lead to a saving of £19 125 per year for the hospitals in this study if this group were managed as outpatients. Assuming a population of 60 million in the UK, an incidence of bleeding of 100/100 000 per year and that 9.3% of patients have a GBS of 0, application of the GBS score in emergency departments could lead to a cost saving of £5 273 100 per year for the National Health Service.

Discussion

This study has shown that the GBS was superior to the pre-endoscopy Rockall scoring system in predicting the need for intervention or death in patients with AUGIB. None identified as low risk by the GBS required intervention or died, in contrast with a significant proportion of those identified as low risk by the Rockall scoring system and the modified GBS.

The standard of care for the triage of patients with AUGIB involves endoscopic assessment but in the UK due to limited resources only 50% of patients have an endoscopy within 24 h and just 55% of hospitals have a consultant on-call rota for out of hours endoscopy.² The hospitals in our study do have an on-call bleeding rota and endoscopy was performed within 24 h in 68% of patients. The performances of other healthcare systems also do not demonstrate universal provision of endoscopy within 24 h.^{19–22}

The GBS may therefore be a valuable tool to identify patients who will not benefit from early endoscopy and thus avoid unnecessary admission to hospital for this test. Studies that have investigated the GBS,^{7 11 12 23 24} such as our study, have demonstrated that a GBS of 0 was associated with an NPV for intervention or death approaching 100% and that the score identifies patients with major stigmata of haemorrhage and upper gastrointestinal malignancy as high risk (GBS >0). The proportion of low risk patients in this study was 9.3%, which ranges from 3.0% to 15.8% in other studies.^{7 11 12 23 24} The reasons for this variation are unclear but different patient populations (low frequency in Japan),²⁴ referral patterns and setting (high-est in community hospitals)⁷ may play a role.

A limitation of the GBS in this study as in others^{7 11 24} was the low PPV (37.8%), and therefore a significant number of low risk patients with AUGIB were not captured by a cut-off of 0. Stephens *et al*¹² modified the GBS for AUGIB by including age as a component. By defining low risk as GBS ≤ 2 and age less than 70 years, a greater number of low risk cases (34.2%) were identified in comparison with the original GBS (12.5%), without compromising the NPV of 100%. In contrast, we found that while a similar proportion of patients (24.5%) were identified by the modified GBS, 4.7% required intervention, limiting its utility in the safe discharge of patients.

The optimum risk scoring system for the outpatient management of patients with AUGIB has not been established. We and the Glasgow group^{7 11} have now

shown that the GBS is superior to the pre-endoscopy Rockall score for the prediction of intervention and death. This is probably because the Rockall score was not developed to predict the need for intervention in AUGIB and the significant rate of intervention (12.5%) in those with a pre-endoscopy Rockall score of 0 in our view makes the score unsuitable for outpatient triage.

We found that the GBS was, overall, no more accurate than the complete Rockall score for predicting intervention or death while others have found the GBS^{7 11} or complete Rockall²⁵ to be superior. It is notable however that a complete Rockall score of ≤ 2 only had a NPV of 81.6% for intervention or death and therefore may not be that useful on its own for deciding whether a patient can be discharged from hospital.

Another promising non-endoscopic score which has been evaluated for the triage of non-variceal upper gastrointestinal bleeding is the Artificial Neural Network.²⁶ This complex score requires computer software for analysis and therefore may not lend itself in the emergency setting to ease of use but which nevertheless should be compared in future studies to the GBS.

Potential weaknesses of this study are: (1) we cannot be certain patients with a GBS of 0 did not present to other hospitals with rebleeding although in our view this is unlikely given that the associated endoscopic diagnoses were of extremely low risk and (2) that the decision to give blood transfusions and apply endoscopic therapy was not protocol based which could have led to bias. The latter is also a limitation of the other published studies in this area^{7 11 12 23 24} but our analysis showed that endoscopic therapy was consistently applied in this study according to consensus guidelines.^{14 17} Moreover the vast majority of patients were transfused if they had a haemoglobin value of < 10 g/dl or were unstable with a ≥ 2 g/dl drop in haemoglobin which we view as appropriate but is difficult to benchmark as there is little agreement on what constitutes best practice.^{14 17}

The utility of risk scoring for upper gastrointestinal bleeding²⁷ can also be questioned as none is routinely used in clinical practice. This probably stems from the fact that a particular score in a system does not trigger a specific clinical decision which is acceptable to clinicians but the 100% NPV of a GBS of 0 may change this. We also estimated that significant cost savings could be made if the GBS was implemented in emergency departments for risk stratification of AUGIB but accept that the calculations are speculative.

In summary, the GBS is a simple non-endoscopic risk scoring system which comprises clinical and laboratory variables. It can be easily calculated in the emergency department to help decide which patients with AUGIB may be candidates for discharge. A multicentre prospective study should be carried out to validate the effect of the introduction of the GBS into accident and emergency departments with the intention of avoiding admission of patients identified as low risk.

Acknowledgements The authors thank Dr William Glazebrook and Ms Maxine Powell for access to the Accidents and Emergency Department database and Ms Marie Desy-Field for obtaining patients' notes and discharge summaries. The authors also thank the endoscopy staff at Charing Cross and Hammersmith Hospitals.

Competing interests None.

Ethical approval The study was approved by the hospital audit committee.

Provenance and peer review Not commissioned; externally peer reviewed.

References

1. Palmer KR. Non-variceal upper gastrointestinal haemorrhage: guidelines. *Gut* 2002;51(Suppl 4):iv1–6.
2. Hearnshaw SA, Logan RF, Lowe D, *et al.* Use of endoscopy for management of acute upper gastrointestinal bleeding in the UK: results of a nationwide audit. *Gut* 2010;59:1022–9.
3. Rockall TA, Logan RF, Devlin HB, *et al.* Incidence of and mortality from acute upper gastrointestinal haemorrhage in the United Kingdom. Steering Committee and members of the National Audit of Acute Upper Gastrointestinal Haemorrhage. *BMJ* 1995;311:222–6.
4. Subramanian V, Hawkey CJ. Assessing bleeds clinically: what's the score? *Lancet* 2009;373:5–7.
5. Saeed ZA, Winchester CB, Michaletz PA, *et al.* A scoring system to predict rebleeding after endoscopic therapy of nonvariceal upper gastrointestinal hemorrhage, with a comparison of heat probe and ethanol injection. *Am J Gastroenterol* 1993;88:1842–9.
6. Hay JA, Lyubashevsky E, Elashoff J, *et al.* Upper gastrointestinal hemorrhage clinical–guideline determining the optimal hospital length of stay. *Am J Med* 1996;100:313–22.
7. Blatchford O, Murray WR, Blatchford M. A risk score to predict need for treatment for upper-gastrointestinal haemorrhage. *Lancet* 2000;356:1318–21.
8. Cameron EA, Pratap JN, Sims TJ, *et al.* Three-year prospective validation of a pre-endoscopic risk stratification in patients with acute upper-gastrointestinal haemorrhage. *Eur J Gastroenterol Hepatol* 2002;14:497–501.
9. Vreeburg EM, Terwee CB, Snel P, *et al.* Validation of the Rockall risk scoring system in upper gastrointestinal bleeding. *Gut* 1999;44:331–5.
10. Sanders DS, Carter MJ, Goodchap RJ, *et al.* Prospective validation of the Rockall risk scoring system for upper GI hemorrhage in subgroups of patients with varices and peptic ulcers. *Am J Gastroenterol* 2002;97:630–5.
11. Stanley AJ, Ashley D, Dalton HR, *et al.* Outpatient management of patients with low-risk upper-gastrointestinal haemorrhage: multicentre validation and prospective evaluation. *Lancet* 2009;373:42–7.
12. Stephens JR, Hare NC, Warshaw U, *et al.* Management of minor upper gastrointestinal haemorrhage in the community using the Glasgow Blatchford Score. *Eur J Gastroenterol Hepatol* 2009;21:1340–6.
13. Palmer K, Nairn M; Guideline Development Group. Management of acute gastrointestinal blood loss: summary of SIGN guidelines. *BMJ* 2008;337:a1832.
14. Scottish Intercollegiate Guidelines Network (SIGN). 105 Management of Acute Upper and Lower Gastrointestinal

- Bleeding – A National Clinical Guideline*. Edinburgh: Scottish Intercollegiate Guidelines Network, 2008.
15. Rockall TA, Logan RF, Devlin HB, *et al.* Risk assessment after acute upper gastrointestinal haemorrhage. *Gut* 1996;38:316–21.
 16. Phang TS, Vornik V, Stubbs R. Risk assessment in upper gastrointestinal haemorrhage: implications for resource utilisation. *N Z Med J* 2000;113:331–3.
 17. Barkun AN, Bardou M, Kuipers EJ, *et al.*; International Consensus Upper Gastrointestinal Bleeding Conference Group. International consensus recommendations on the management of patients with nonvariceal upper gastrointestinal bleeding. *Ann Intern Med* 2010;152:101–13.
 18. Payment by results 2007/2008. http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_063684 (accessed 28 October 2010).
 19. Ananthakrishnan AN, McGinley EL, Saeian K. Outcomes of weekend admissions for upper gastrointestinal hemorrhage: a nationwide analysis. *Clin Gastroenterol Hepatol* 2009;7:296–302e1.
 20. Barkun A, Sabbah S, Enns R, *et al.*; RUGBE Investigators. The Canadian Registry on Nonvariceal Upper Gastrointestinal Bleeding and Endoscopy (RUGBE): Endoscopic hemostasis and proton pump inhibition are associated with improved outcomes in a real-life setting. *Am J Gastroenterol* 2004;99:1238–46.
 21. van Leerdam ME, Vreeburg EM, Rauws EA, *et al.* Acute upper GI bleeding: did anything change? Time trend analysis of incidence and outcome of acute upper GI bleeding between 1993/1994 and 2000. *Am J Gastroenterol* 2003;98:1494–9.
 22. Vreeburg EM, Snel P, de Bruijne JW, *et al.* Acute upper gastrointestinal bleeding in the Amsterdam area: incidence, diagnosis, and clinical outcome. *Am J Gastroenterol* 1997;92:236–43.
 23. Chen IC, Hung MS, Chiu TF, *et al.* Risk scoring systems to predict need for clinical intervention for patients with nonvariceal upper gastrointestinal tract bleeding. *Am J Emerg Med* 2007;25:774–9.
 24. Masaoka T, Suzuki H, Hori S, *et al.* Blatchford scoring system is a useful scoring system for detecting patients with upper gastrointestinal bleeding who do not need endoscopic intervention. *J Gastroenterol Hepatol* 2007;22:1404–8.
 25. Gralnek IM, Dulai GS. Incremental value of upper endoscopy for triage of patients with acute non-variceal upper-GI hemorrhage. *Gastrointest Endosc* 2004;60:9–14.
 26. Das A, Ben-Menachem T, Farooq FT, *et al.* Artificial neural network as a predictive instrument in patients with acute nonvariceal upper gastrointestinal hemorrhage. *Gastroenterology* 2008;134:65–74.
 27. Das A, Wong RC. Prediction of outcome of acute GI hemorrhage: a review of risk scores and predictive models. *Gastrointest Endosc* 2004;60:85–93.