Effectiveness of risk scoring systems in predicting endoscopic treatment in colonic diverticular bleeding

Noriaki Oguri,*† Takashi Ikeya, * Daiki Kobayashi,* Kazuki Yamamoto,* Takaaki Yoshimoto,* Ayaka Takasu,* Takeshi Okamoto,* Yasutoshi Shiratori,* Shuhei Okuyama,* Koichi Takagi,* Kenji Nakamura§ and Katsuyuki Fukuda*

*Division of Gastroenterology, St. Luke’s International Hospital, †Department of Gastroenterology and Hepatology, Kyorin University Hospital, §Department of Epidemiology, Graduate School of Public Health, St. Luke’s International University, Tokyo and ‡Department of Gastroenterology, Tokyo Dental College Ichikawa General Hospital, Chiba, Japan

Key words
colic diverticular bleeding, NOBLADS score, SRH, Strate score.

Accepted for publication 11 October 2019.

Correspondence
Takashi Ikeya, Division of Gastroenterology, St. Luke’s International Hospital, 9-1 Akashicho, Chuo-ku, Tokyo 104-8560, Japan.
Email: takaike@luke.ac.jp

Declaration of conflict of interest: Authors declare no conflict of interests for this article.

Abstract

Background and Aims: The identification of stigmata of recent hemorrhage (SRH) in colonic diverticular bleeding (CDB) enables an endoscopic treatment and can improve the clinical outcome. However, SRH identification rate remains low. This study aims to investigate whether NOBLADS and Strate scoring systems are useful for predicting SRH identification rate of CDB pre-procedurally via colonoscopy.

Methods: In this single-center retrospective observational study, 302 patients who experienced their first episode of CDB from April 2008 to March 2018 were included. Patients were classified into SRH-positive and SRH-negative groups. The primary outcome was SRH identification rate. The secondary outcomes were active bleeding in SRH and early rebleeding rates. The usefulness of the NOBLADS and Strate scores as predicted values of SRH identification was evaluated using the area under the receiver operating characteristic curve.

Results: There were 126 and 176 patients in the SRH-positive and SRH-negative groups, respectively. The area under the receiver operating characteristic curve for SRH identification using the NOBLADS score was 0.74 (95% confidence interval, 0.69–0.80) and that using the Strate score was 0.74 (95% confidence interval, 0.68–0.79). Active bleeding and early rebleeding rates increased according to each score. By setting the cut-off of the NOBLADS score to four points, treatment was possible in 70.2% (66/94) patients. Addition of extravasation at computed tomography to a NOBLADS score of ≥4 points allowed treatment of all patients (24/24).

Conclusions: Severity scoring in acute lower gastrointestinal bleeding was effective for predicting SRH identification in CDB. We suggest that combination of these scorings and CT findings could offer a new therapeutic strategy.

Introduction

Colonic diverticular bleeding (CDB) is the most common cause of acute lower gastrointestinal bleeding (ALGIB) in adults and accounts for about 50% of all cases of ALGIB.1,4 Although 75% of CDB cases stop spontaneously, CDB sometimes causes severe bleeding and requires intervention to control the bleeding.5,6 Even if hemostasis is achieved, rebleeding occurs in 14–38% of cases.2,5

Either endoscopic treatment or interventional radiology is performed for CDB. Stigmata of recent hemorrhage (SRH), such as active bleeding (AB), non-bleeding visible vessels, and adherent clot, was proposed as an indication for endoscopic treatment.7 CDB with SRH, especially AB, has been associated with a high rate of rebleeding following conservative management.7,8 The identification of SRH in CDB enables endoscopic treatment and can improve the clinical outcome.7

Current consensus guidelines from the American Society for Gastrointestinal Endoscopy recommend early endoscopic evaluation for severe ALGIB within the first 24 h of admission.9 It was reported that early colonoscopy in cases of ALGIB significantly reduced hospital stay, total hospitalization cost, rebleeding rate, blood transfusion requirement, and length of ICU stay.10–12

Reliable endoscopic procedures are required to achieve hemostasis and prevent recurrent bleeding. However, because of the large and complex surface area of the colon and the multitude of diverticula present, the identification rate of SRH by colonoscopy is still low.7,13,14 At present, it is unclear whether SRH can be identified pre-procedurally via colonoscopy.

For upper gastrointestinal bleeding (UGIB), severity scores, such as the Glasgow Blatchford score and the Rockall score, are useful for predicting whether endoscopic treatment is appropriate.15,16 Comparisons of each score have been performed and their usefulness has also been reported.17 As a scoring system for prediction of severe ALGIB, Aoki et al. in 2016 reported the NOBLADS score, with Strate et al. reporting their scoring system...
The NOBLADS and Strate scores include all causes of ALGIB (such as malignant tumor, ischemic colitis, and hemorrhoids), which do not require endoscopic treatment. In this study, we investigated whether the SRH identification rate in CDB could be predicted pre-procedurally via colonoscopy using the NOBLADS and Strate scores.

**Methods**

This retrospective study was undertaken at St. Luke’s International Hospital. The predetermined primary outcome was the SRH identification rate by endoscopy for CDB using the NOBLADS and Strate scores. Secondary outcomes were AB rate in SRH and early rebleeding (within 30 days after initial treatment) rate.

The study included 814 patients who experienced their first episode of ALGIB and underwent colonoscopy between April 2008 and March 2018. We excluded 512 patients who were hospitalized, were inadequately scored, or had an obvious cause of hematochezia other than CDB (malignant tumor, ischemic colitis, infectious colitis, inflammatory bowel disease, rectal ulcer, bleeding after polypectomy, or angioectasia) on clinical assessment, imaging, and endoscopy. NOBLADS and Strate scores were determined retrospectively for patients who met the earlier conditions during the study period.

Data were also collected regarding patients’ characteristics, comorbidity, extravasation (the presence of extravasated contrast material with an attenuation level > 90 Hounsfield units on computed tomography [CT] and types of SRH). After screenings, 302 patients met all criteria for CDB.

Definite CDB cases (SRH identified by colonoscopy) were classified as the SRH-positive group, and endoscopic clipping (EC) or endoscopic band ligation (EBL) was applied to the diverticulum as treatment. Presumptive CDB cases (ALGIB in the presence of a diverticulum but without any other major colonic lesions or evidence of SRH) were classified as the SRH-negative group.

The study protocol was approved by the institutional review board (18-R063) at St. Luke’s International Hospital, and patient consent was waived owing to the study’s retrospective design.

**Table 1** NOBLADS score and Strate score

| NOBLADS score (all factors are 1 point) | Strate score (all factors are 1 point) |
|----------------------------------------|----------------------------------------|
| No abdominal pain                      | Heart rate $\geq$ 100/min              |
| NSAIDs                                 | Systolic blood pressure $\leq$ 100 mmHg |
| Albumin $< 3$ g/dL                     | Antiplatelet agents (nonaspirin)       |
| Charlson comorbidity index $\geq$ 2   | Syncope                                |
|                                         | Heart rate $\geq$ 100/min              |
|                                         | Systolic blood pressure $\leq$ 115 mmHg |
|                                         | No abdominal pain                      |
|                                         | Charlson comorbidity index $\geq$ 3    |

NSAIDs, non-steroidal anti-inflammatory drugs.

**Management of acute lower gastrointestinal bleeding.** Patients with ALGIB underwent contrast-enhanced CT whenever possible after medical examination and preliminary investigations.

Patients considered as having CDB underwent colonoscopy for diagnosis and treatment within 24 h of admission, with bowel preparation using polyethylene glycol. Hemodynamically unstable patients underwent colonoscopy without bowel preparation. Colonoscopy was performed with a water-jet scope (PCF-Q260AZI, PCF-Q260HI, or PCF-H290I; Olympus Medical Systems, Tokyo, Japan). A soft hood (D201-12704; Olympus Medical Systems) was attached to the endoscope. Colonoscopy was performed by expert endoscopists (board-certified members of the Japanese Society of Gastroenterology, having experience with $> 1000$ routine colonoscopies) or by nonexpert endoscopists under expert supervision.

The most commonly performed endoscopic treatment for CDB was EC, between April 2008 and May 2009, and EBL, performed between April 2009 and March 2018. Hemoclips (HX-600-090L, HX-600-135, HX-610-090L, or HX-610-135; Olympus Optical Co. Ltd, Tokyo, Japan) were used for EC. EBL was performed using a band-ligator device (MD-48710 EVL Device, Sumitomo Bakelite Co. Ltd, Tokyo, Japan).

**Statistical analysis**

**Risk factor evaluation.** We compared patients’ characteristics between the SRH-positive and SRH-negative groups using bivariate analyses, a $\chi^2$ test for categorical variables, and a t-test for continuous variables. We performed multivariable logistic regression, controlling for potential covariates, defined as clinically important variables or those with a $P$-value $< 0.05$ on bivariate analyses. All analyses were performed in 2019, using SPSS (ver. 24.0, IBM, Japan).

**Adaptation of NOBLADS and Strate scoring.** We calculated the NOBLADS and Strate scores for each patient to assess whether these could predict SRH identification in patients with CDB. Sensitivity and specificity were calculated based on the scores, and receiver operating characteristic curves were drawn. The area under the curves (AUCs) with 95% confidence interval (CI) were also calculated to examine validity of cut-off scores.

**Results**

The data from 302 patients were included in our analysis, 126 cases (41.7%) in the SRH-positive group and 176 (58.3%) in the SRH-negative group. Patients’ characteristics, endoscopic findings, and mean scores are reported in Table 2. The median age of patients was 67.4 (95% CI, 40.2–94.6) years, and 231 (76.4%) were men. The distribution of SRH types was as follows: AB 44/126 (34.9%); non-bleeding visible vessels 41/126 (32.5%); and adherent clot 41/126 (32.5%). Ninety-six (76.2%) of the detected sites of bleeding in the SRH-positive group were on the right side of the colon. Severe LGIB (transfusion of $\geq 2$ units of packed red blood cells, a decrease in hematocrit of $\geq 20%$, and/or recurrent bleeding after initial colonoscopy) occurred in 113 patients (37.4%).
Table 2  Patient characteristics, comorbidities, types of SRH, and outcome (n = 302)

| Characteristics                          | Data                   |
|-----------------------------------------|------------------------|
| Median age (95% CI)                     | 67.4 (40.2–94.6)       |
| Male                                    | 231 (76.5%)            |
| Vital sign                              |                        |
| Median heart rate (95% CI)              | 87.5 (53.1–121.8)      |
| Median systolic blood pressure (95% CI) | 127.9 (76.4–179.4)     |
| Median Charlson comorbidity index (95% CI)| 1.34 (0–4.27)            |
| Median albumin (95% CI)                 | 3.75 (2.92–4.58)       |
| Comorbidity                             |                        |
| Hypertension                            | 185 (61.3%)            |
| Hyperlipidemia                          | 96 (31.8%)             |
| Diabetes mellitus                       | 64 (21.2%)             |
| Chronic kidney disease                  | 34 (11.3%)             |
| Syncope                                 | 52 (19.2%)             |
| Extravasation                           | 58 (22.5%)             |
| Contrast-enhanced CT                    | 256 (84.8%)            |
| Plain CT                                | 25 (8.3%)              |
| No CT                                   | 21 (7.0%)              |
| Definitive CDB                          | 126 (41.7%)            |
| Located right side of the colon         | 96 (76.2%)             |
| Stigmata of recent hemorrhage           |                        |
| Non-bleeding visible vessels            | 41 (32.5%)             |
| Active bleeding                         | 41 (32.5%)             |
| Adherent clot                           | 44 (34.9%)             |
| Presumptive CDB                         | 176 (68.3%)            |
| Severe ALGIB                            | 113 (37.4%)            |
| Mean NOBLADS score (95% CI)             | 3.03 (0.86–5.20)       |
| Mean Strate score (95% CI)              | 2.94 (0.77–5.12)       |

ALGIB, acute lower gastrointestinal bleeding; CDB, colonic diverticulitis bleeding; CI, confidence interval; CT, computed tomography; SRH, stigmata of recent hemorrhage.

In the 281 patients who underwent CT, 256 (84.8%) underwent contrast-enhanced CT and 25 (8.3%) underwent plain CT. The mean NOBLADS and Strate scores were 3.03 (95% CI, 0.86–5.20) and 2.94 (95% CI, 0.77–5.12), respectively. On univariate analysis, significant differences between the two groups were identified for the following variables (Table 3): systolic blood pressure < 100 mmHg; heart rate > 100 beats/min; no diarrhea; no abdominal pain; syncope; use of non-steroidal anti-inflammatory drugs; disease score ≥ 3; on dialysis; and albumin level < 3 g/dL. On multivariate analysis, only non-steroidal anti-inflammatory drugs use was retained a significant factor (Table 4).

The AUC of the NOBLADS score for SRH identification was 0.74 (95% CI, 0.69–0.80) and 0.74 (95% CI, 0.68–0.79) for the Strate score. Both NOBLADS and Strate scores had similar discriminative abilities for predicting SRH identification, and both showed moderate accuracy (Fig. 1). A threshold NOBLADS score of 4 or more was best at predicting endoscopic treatment, with a sensitivity of 53.97% and specificity of 83.52%.

By setting the cut-off of the NOBLADS score to 4 points, treatment was possible in 70.2% (669/94) of patients. AB and early rebleeding rates also increased according to the score (Fig. 2).

We classified the rate of SRH identification with and without extravasation (Figure S1). When the score was limited to 3 or less, there was no significant difference between the presence and absence of extravasation (35.3% vs 26.9%). However, addition of the presence of extravasation on CT to a NOBLADS score of 4 or more allowed treatment of all patients (24/24).

Discussion

Our study results showed that severity scoring alone in ALGIB effectively predicted SRH identification. However, prediction could be improved by including extravasation seen on CT.

The previous studies reported an SRH identification rate of 23–43%7,11,20–22 which was consistent with our SRH identification rate being 41.7%. SRH identification was improved (i) by colonoscopy performed within 24 h, (ii) by expert endoscopists who have performed > 1000 colonoscopies, (iii) with the use of disposable distal attachments and water-jet systems, and (iv) bowel preparation using oral lavage solution.7,14 High SRH identification rates of approximately 40% have been reported in studies that have included CT before colonoscopy.21,22 The earlier conditions were met in our study and, thus, the SRH identification rate was comparatively high.

In recent years, several scoring systems have been proposed as methods of predicting the severity and mortality of ALGIB.9,10 These methods are scored regardless of the underlying pathology and it is unclear whether they are accurate as CDB is the commonest cause of severe hemorrhage in ALGIB.

The AUC of the Glasgow Blatchford score for prediction of endoscopic treatment for UGIB was 0.75.17 Our results (AUCs: NOBLADS, 0.74; Strate, 0.74) showed that the usefulness of the NOBLADS and Strate scoring systems for predicting endoscopic treatment for ALGIB was equal to that of the Glasgow Blatchford score for predicting UGIB. Using a cut-off NOBLADS score of 4 points, the SRH identification rate increased to 70.1% (68/97). In their description of the NOBLADS score, Aoki et al.18 suggested that a NOBLADS score of 4 or higher was useful for predicting treatment, with our study results confirm this.

Active bleeding and the rate of early rebleeding also increased according to each score; thus, it is appropriate to perform urgent colonoscopy to implement hemostasis and to prevent rebleeding in cases with a high score. However, because SRH identification, AB, and the rate of early rebleeding are all low, patients with low scores may be assigned to conservative treatment and elective colonoscopy for diagnosis.

The usefulness of contrast-enhanced CT in SRH identification has been shown in the previous reports.21–22 and in cases of extravasation observed at CT, sensitivity and specificity for SRH identification were 57.6 (95% CI, 44.8–69.7) and 91.2 (95% CI, 85.1–95.4), respectively.23 However, contrast-enhanced CT in cases of ALGIB is currently not routinely performed, except in some high-volume centers. In our hospital, CT is performed in most cases, and we assessed whether extravasation on CT added value in cases with a high score. However, because SRH identification, AB, and the rate of early rebleeding are all low, patients with low scores may be assigned to conservative treatment and elective colonoscopy for diagnosis.

The usefulness of contrast-enhanced CT in SRH identification has been shown in the previous reports.21–22 and in cases of extravasation observed at CT, sensitivity and specificity for SRH identification were 57.6 (95% CI, 44.8–69.7) and 91.2 (95% CI, 85.1–95.4), respectively.23 However, contrast-enhanced CT in cases of ALGIB is currently not routinely performed, except in some high-volume centers. In our hospital, CT is performed in most cases, and we assessed whether extravasation on CT added value in cases with a high score. However, because SRH identification, AB, and the rate of early rebleeding are all low, patients with low scores may be assigned to conservative treatment and elective colonoscopy for diagnosis.

The usefulness of contrast-enhanced CT in SRH identification has been shown in the previous reports.21–22 and in cases of extravasation observed at CT, sensitivity and specificity for SRH identification were 57.6 (95% CI, 44.8–69.7) and 91.2 (95% CI, 85.1–95.4), respectively.23 However, contrast-enhanced CT in cases of ALGIB is currently not routinely performed, except in some high-volume centers. In our hospital, CT is performed in most cases, and we assessed whether extravasation on CT added value in cases with a high score. However, because SRH identification, AB, and the rate of early rebleeding are all low, patients with low scores may be assigned to conservative treatment and elective colonoscopy for diagnosis.
enhanced CT in order to identify extravasation, the results of this study suggest that contrast-enhanced CT might not be necessary in patients with a low score.

Colonoscopy is a necessary tool for the diagnosis in CDB, and all patients should be considered for colonoscopy if possible. However, in this study, SRH identification for hemostasis, AB, and rebleeding rates were low in patients with low scores. In hospitals where emergency CT or colonoscopy cannot be performed easily, we recommend that patients with CDB be assigned to management according to their scores. Conservative treatment and elective colonoscopy for diagnosis is an acceptable management strategy for patients with a score of 3 points or less, whereas patients with a score of 4 points or more should undergo CT followed by colonoscopy for the purpose of hemostasis.

The limitations of our study should be acknowledged. First, this was a retrospective observational study from a single center. Due to a lack of clinical information, such as findings on rectal examination, a validated and reliable scoring system such as the Oakland score could not be used. Second, CDB causes hematochezia without abdominal pain or diarrhea and is relatively easy to distinguish clinically and on simple tests. However, bleeding in presumptive CDB cases might not be due to colonic diverticula. Third, our study had many CDB cases of the right side of the colon, where bleeding is apt to be severe. Fourth, routine CT may be an unusual practice in many hospitals. Lastly, it has been reported in the previous studies that colonoscopy preceded by CT offers a high SRH identification rate; therefore, because almost all patients underwent CT in our study, information bias cannot be denied.

Table 3  Univariate analysis comparing risk factors between SRH-positive and SRH-negative groups

| Risk Factor                        | SRH-positive group (n = 126) (%) | SRH-negative group (n = 176) (%) | P-value*  |
|-----------------------------------|---------------------------------|---------------------------------|---------|
| Male                              | 102 (81)                        | 129 (73)                        | 0.122   |
| Systolic blood pressure < 100 mmHg| 25 (20)                         | 16 (9)                          | 0.017   |
| Heart rate > 100/min              | 39 (30)                         | 36 (20)                         | 0.037   |
| No diarrhea                       | 126 (100)                       | 168(95)                         | 0.015   |
| No abdominal pain                 | 126 (100)                       | 165 (94)                        | 0.004   |
| Syncope                           | 35 (28)                         | 17 (10)                         | 0.001   |
| NSAIDs                            | 19 (15)                         | 13 (7)                          | 0.032   |
| Antiplatelet (nonaspirin) agents  | 19 (15)                         | 14 (8)                          | 0.05    |
| Low-dose aspirin                  | 32 (25)                         | 46 (26)                         | 0.885   |
| Anticoagulants                    | 12 (10)                         | 16 (9)                          | 0.89    |
| Charlson comorbidty index ≥ 3     | 34 (27)                         | 27 (15)                         | 0.13    |
| Dialysis                          | 5 (4)                           | 1 (1)                           | 0.037   |
| Albumin < 3 g/dL                  | 13 (10)                         | 5 (3)                           | 0.007   |

*P-value was characterized by χ² test and statistical significance was defined as P < 0.05.
NSAIDs, non-steroidal anti-inflammatory drugs; SRH, stigmata of recent hemorrhage.

Table 4  Multivariate analysis comparing risk factors between SRH-positive and SRH-negative groups

| Risk Factor                        | Adjusted OR (95% CI) | P-value*  |
|-----------------------------------|----------------------|---------|
| SBP < 100 mmHg                    | 1.23 (0.84–1.80)     | 0.292   |
| HR > 100/min                      | 1.58 (0.88–2.83)     | 0.126   |
| No diarrhea                       | 1                    | No available |
| No abdominal pain                 | 1                    | No available |
| Syncope                           | 1                    | No available |
| NSAIDs                            | 2.50 (1.08–5.80)     | 0.032   |
| Charlson comorbidty index ≥ 3     | 1.87 (0.96–3.65)     | 0.065   |
| Dialysis                          | 4.00 (0.40–40.0)     | 0.238   |
| Albumin < 3 g/dL                  | 2.11 (0.64–7.03)     | 0.222   |

*P-value was characterized by likelihood ratio test and statistical significance was defined as P < 0.05.
NSAIDs, non-steroidal anti-inflammatory drugs; SRH, stigmata of recent hemorrhage.

Figure 1  Receiver operating characteristic curves and the AUC using each scores for stigmata of recent hemorrhage identification (n = 302). (a) NOBLADS score and (b) Strate score. AUC, area under the receiver operating characteristic curve.
In conclusion, the severity prediction score in ALGIB was useful in predicting SRH identification for CDB. Indications for contrast-enhanced CT together with colonoscopy may be considered according to these scorings and further prospective studies could confirm this therapeutic strategy for CDB.

Acknowledgments
We thank all members of the GI Endoscopy center at St. Luke’s International Hospital for their skilled assistance at endoscopic procedures. We would like to thank Editage (www.editage.com) for English language editing.

References
1. Gayer C, Chino A, Lucas C et al. Acute lower gastrointestinal bleeding in 1,112 patients admitted to an urban emergency medical center. Surgery 2009; 146: 600.
2. Gostout CJ, Wang KK, Ahlquist DA et al. Acute gastrointestinal bleeding. Experience of a specialized management team. J. Clin. Gastroenterol. 1992; 14: 260.
3. Bloomfield RS, Rockey DC, Shetazine MA. Endoscopic therapy of acute diverticular hemorrhage. Am. J. Gastroenterol. 2001; 96: 2367–2372.
4. Isii N, Setoyama T, Deshpande GA et al. Endoscopic band ligation for colonic diverticular hemorrhage. Gastrointest. Endosc. 2012; 75: 382–387.
5. McGuire HH Jr. Bleeding colonic diverticula. A reappraisal of natural history and management. Ann. Surg. 1994; 220: 653–6.
6. Isii N, Ozata F, Nagata N, Kaise M. Effectiveness of endoscopic treatments for colonic diverticular bleeding. Gastrointest. Endosc. 2018; 87: 58–66.
7. Jensen DM, Machicado GA, Jutabha R et al. Urgent colonoscopy for the diagnosis and treatment of severe diverticular hemorrhage. N. Engl. J. Med. 2000; 342: 78–82.
8. Jensen DM, Ohning GV, Kovacs TO et al. Natural history of definitive diverticular hemorrhage based on stigmata of recent hemorrhage and colonoscopic Doppler blood flow monitoring for risk stratification and definitive hemostasis. Gastrointest. Endosc. 2016; 83: 416–23.
9. Pasha SF, Shergill A, Acosta RD et al. The role of endoscopy in the patient with lower GI bleeding. Gastrointest. Endosc. 2014; 79: 875–885.
10. Saraireh H, Tayyem O, Siddiqui MT et al. Early colonoscopy in patients with acute diverticular bleeding is associated with improvement in healthcare-resource utilization. Gastroenterol Rep 2019; 7: 115–20.
11. Nagata N, Niikura R, Sakurai T et al. Safety and effectiveness of early colonoscopic in management of acute lower gastrointestinal bleeding on the basis of propensity score matching analysis. Clin. Gastroenterol. Hepatol. 2016; 14: 558–64.
12. Navaneethan U, Njie B, Venkatesh PG, Sanaka MR. Timing of colonoscopy and outcomes in patients with lower GI bleeding: a nationwide population-based study. Gastrointest. Endosc. 2014; 79: 297–306.
13. Jansen A, Harenberg S, Grenda U, Elsing C. Risk factors for colonic diverticular bleeding: a Westernized community based hospital stay. World J. Gastroenterol. 2009; 15: 457–61.
14. Niikura R, Nagata N, Aoki T et al. Predictors for identification of stigmata of recent hemorrhage on colonic diverticula in lower gastrointestinal bleeding. J. Clin. Gastroenterol. 2015; 49: e24–30.
15. Blatchford O, Murray WR, Blatchford M. A risk score to predict need for treatment for upper-gastrointestinal haemorrhage. Lancet 2000; 356: 1318–21.
16. Vreeburg EM, Terwee GB, Snel P et al. Validation of the Rockall risk scoring system in upper gastrointestinal bleeding. Gut 1999; 44: 331–335.
17 Stanley AJ, Laine L, Dalton HR et al. Comparison of risk scoring systems for patients presenting with upper gastrointestinal bleeding: international multicenter prospective study. BMJ 2017; 356: i6432.
18 Aoki T, Nagata N, Shimbo T et al. Development and validation of a risk scoring system for severe acute lower gastrointestinal bleeding. Clin. Gastroenterol. Hepatol. 2016; 14: 1562–70.
19 Strate LL, Saltzman JR, Ookubo R, Mutinga ML, Syngal S. Validation of a clinical prediction rule for severe acute lower intestinal bleeding. Am. J. Gastroenterol. 2005; 100: 1821–7.
20 Green BT, Rockey DC, Portwood G et al. Urgent colonoscopy for evaluation and management of acute lower gastrointestinal hemorrhage: a randomized controlled trial. Am. J. Gastroenterol. 2005; 100: 2395–402.
21 Nagata N, Niikura R, Aoki T et al. Role of urgent contrast-enhanced multidetector computed tomography for acute lower gastrointestinal bleeding in patients undergoing early colonoscopy. J. Gastroenterol. 2015; 50: 1162–72.
22 Sugiyama T, Hirata Y, Kojima Y et al. Efficacy of contrast-enhanced computed tomography for the treatment strategy of colonic diverticular bleeding. Intern. Med. 2015; 54: 2961–7.
23 Umezawa S, Nagata N, Arimoto J et al. Contrast-enhanced CT for colonic diverticular bleeding before colonoscopy: a prospective multicenter study. Radiology 2018; 288: 755–61.
24 Oakland K, Guy R, Uberoi R et al. Acute lower GI bleeding in the UK: patient characteristics, interventions and outcomes in the first nationwide audit. Gut 2018; 67: 654–62.

Supporting information

Additional supporting information may be found online in the Supporting Information section at the end of the article.

Figure S1. SRH identification rate using combination of each score and extravasation at CT. P value was calculated by Fisher’s exact test.
a) NOBLADS score, b) Strate score.