

Early Predictors of Severity in Acute Lower Intestinal Tract Bleeding

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Background: Identification of high-risk patients with lower intestinal tract bleeding (LIB) is challenging, and prognostic factors have not been clearly defined. The aim of this study was to determine risk factors for severe acute LIB.

Methods: A total of 252 consecutive patients admitted with acute LIB were identified. Data were collected on 24 clinical factors available in the first 4 hours of evaluation. The outcome was severe bleeding, which was defined as continued bleeding within the first 24 hours of hospitalization (transfusion of ≥ 2 units of blood and/or hematocrit decrease of $\geq 20\%$) and/or recurrent bleeding after 24 hours of stability (additional transfusions, further hematocrit decrease of $\geq 20\%$, or readmission for LIB within 1 week of discharge).

Results: Severe LIB occurred in 123 patients (49%). Independent correlates of severe bleeding were as follows: heart rate, ≥ 100 /min (odds ratio [OR], 3.67; 95% confidence interval [CI], 1.78-7.57); systolic blood pressure, ≤ 115 mm Hg (OR, 3.45; 95% CI, 1.54-7.72); syncope (OR, 2.82; 95% CI, 1.06-7.46); nontender abdominal examination (OR, 2.43; 95% CI, 1.22-4.85); bleeding per rectum during the first 4 hours of evaluation (OR, 2.32; 95% CI, 1.28-4.20); aspirin use (OR, 2.07; 95% CI, 1.12-3.82); and more than 2 active comorbid conditions (OR, 1.93; 95% CI, 1.08-3.44).

Conclusion: Clinical data available on initial evaluation can be used to identify patients at risk for severe LIB, who may benefit most from urgent intervention.

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ACUTE LOWER intestinal tract bleeding (LIB) is a common and potentially life-threatening disorder with an estimated annual incidence of hospitalization of 20 to 30 per 100 000 persons.¹ Bleeding occurs primarily in elderly patients and can result in substantial morbidity and mortality.^{1,2} A significant proportion of patients with acute LIB experience severe, persistent hemorrhage.^{3,4} Accurate triage is essential to ensure that these patients receive aggressive supportive care and urgent interventions. Recent data suggesting that early colonoscopic intervention (within 12 hours of hospital admission) can improve outcomes in select populations with LIB⁵⁻⁷ highlight the importance of targeting severely bleeding patients. However, identification of high-risk patients with LIB is challenging. The differential diagnosis of LIB is broad,^{8,9} and current diagnostic modalities are time and resource intensive. Moreover, LIB is frequently intermittent,^{10,11} often obscuring the source and severity of bleeding.

Little systematic effort has been devoted to determination of prognostic factors in LIB.^{9,12,13} Consequently, prognostication and triage currently rely heavily on the experience and judgment of the clinician. In contrast, clear prognostic factors have been ascertained for upper gastrointestinal tract bleeding (UGIB),¹⁴⁻²¹ and these risk factors have helped guide and standardize the care of patients who present with this disorder. Patients with UGIB who meet high-risk criteria are routinely triaged to emergent interventions and intensive inpatient monitoring, whereas those with low-risk findings are evaluated less aggressively, sometimes in the outpatient setting. Prospective studies have demonstrated that the consistent application of evidence-based risk stratification to the management of UGIB can reduce duration of hospitalization and resource utilization while maintaining patient safety and quality of care.²²⁻²⁵

Elucidation of risk factors for severity in acute LIB would enable identification of high-risk patients who may benefit most from aggressive supportive care

and early intervention. To address this need, we collected clinical data from a cohort of consecutive patients admitted for acute LIB with the aim of determining risk factors for severe or recurrent bleeding.

METHODS

PATIENT POPULATION AND STUDY LOCATION

All patients admitted to the Brigham and Women's Hospital, Boston, Mass, from August 1, 1996, to June 30, 1999, were eligible for the study. The study protocol received approval from the hospital's institutional review board. Patients were excluded from the study if any indication of a UGIB or a small bowel source of bleeding became evident during the admission. Such indications included hematemesis, coffee-ground emesis, or evidence of UGIB on endoscopy, nasogastric lavage, radionuclide scan, or angiography. In addition, patients described as having "melena" or "black" or "maroon" stools were required to have an upper gastrointestinal tract source excluded by either upper endoscopy or a nasogastric lavage. Other exclusion criteria included bleeding more than 3 days before presentation,²⁶ low-grade bleeding (stool samples positive for occult blood or scant blood visible on toilet tissues only), patients transferred from inpatient units at other acute care hospitals, and patients already hospitalized for other indications.

CASE IDENTIFICATION

A multistage case identification process was used to ensure that all patients hospitalized for LIB during the study period were ascertained. A total of 2323 candidate admissions were identified using a list of 69 *International Classification of Diseases, Ninth Revision (ICD-9)* codes representing LIB, as well as a wide range of diagnoses associated with LIB (eg, diverticulosis of colon). This set of diagnostic codes has been used previously to identify patients hospitalized with LIB¹ and is intentionally broad.

The computerized discharge summaries from these 2323 hospitalizations were reviewed as a preliminary screen for study eligibility (L.L.S.). Patients were excluded at this stage if it was clear that they had no evidence of gastrointestinal bleeding or met any of the exclusion criteria. The most common reasons for exclusion at this stage were admission for a condition associated with LIB in the absence of bleeding (eg, colon cancer without overt bleeding), a history of an intestinal disorder (eg, inflammatory bowel disease), chronic or low-grade bleeding, and verified UGIB. Cases in which the presence, source, or acuity of bleeding was uncertain were not excluded at this point. This process narrowed the potential study candidates to 373. The medical records corresponding to these admissions were requested and reviewed (L.L.S.). Additional patients were subsequently excluded, most commonly for chronic or low-grade bleeding (54 patients, 15%), bleeding while an inpatient (34 patients, 9%), and UGIB (20 patients, 7%). Eight patients (2%) were excluded because of unavailable medical records. Ultimately, 252 patients with acute LIB who satisfied all inclusion criteria were included in the study.

DATA COLLECTION

Data were collected using a standardized instrument. Potential predictors were collected from the record of the initial medical evaluation before ascertainment of outcomes from the subsequent entries in the hospital record. A comprehensive computerized hospital database was used to obtain laboratory values and blood product transfusion requirements. To assess

interrater reliability, a separate reviewer independently reassessed a random sample (5%) of the records.

PREDICTIVE VARIABLES

Twenty-four potential predictors obtainable within 4 hours of presentation to the hospital were selected based on relevant literature and clinical experience. Variables recorded included the following: age; sex; ethnicity; comorbid conditions (according to the Charlson Comorbidity Index, a validated, weighted index of 19 comorbid conditions that predict mortality)²⁷; history of diverticulosis and/or LIB; daily use of aspirin (any dosage) or use during the previous week of at least 2 doses of a nonsteroidal anti-inflammatory agent or anticoagulant medication; stool color and frequency; number of hours from onset of bleeding to presentation; bleeding per rectum during the first 4 hours of medical evaluation; history of syncope or lightheadedness; history of abdominal pain or cramping or recent change in bowel habit; initial heart rate and blood pressure; initial platelet count and prothrombin time; and presence on initial medical evaluation of abdominal tenderness, gross blood on rectal examination, or altered mental status.

OUTCOME CRITERIA

The principal outcome was severe LIB. In the absence of an accepted reference standard or definition for this entity, an operational definition based on clinical knowledge of markers of severe bleeding was adopted. Severe LIB encompassed both continued bleeding within the first 24 hours (defined by the requirement of at least 2 units of packed red blood cells and/or a decrease in hematocrit of $\geq 20\%$) and/or recurrent bleeding after 24 hours of clinical stability (defined by additional blood transfusion requirements and/or a further decrease in hematocrit of $\geq 20\%$ and/or readmission to the hospital for LIB within 1 week of discharge). The initial change in hematocrit was calculated using the value obtained on presentation and the lowest value obtained during the first 24 hours of hospitalization. The change in hematocrit during the first 24 hours was used and not the admission value alone in an attempt to account for hematocrit equilibration. The change in hematocrit after rebleeding was based on the last value available before the rebleeding and the first hematocrit level obtained after rebleeding was recognized. The independent reviewer's assessment of the outcome, severe LIB, was consistent in 88% of the records reviewed (κ , 0.78).

These outcome criteria for severe LIB were intended to capture a range of patients who require substantial inpatient support, independent of the process of care or underlying comorbid diseases. The purpose of delineating risk factors was to aid in risk stratification and, ultimately, in the triage of appropriate patients to early interventions such as urgent colonoscopy. Blood transfusions, though subject to variations in care practices, were included in the outcome criteria, because aggressive resuscitation can prevent a significant decrease in hematocrit even in the presence of severe bleeding. Death was not included as an outcome measure because the mortality rate in LIB is low ($<5\%$) and death is rarely due to ongoing bleeding.¹ Other data recorded included the origin of the bleeding, cause of mortality, if any, and information regarding diagnostic and therapeutic procedures (surgery, endoscopy, angiography, radionuclide scan).

STATISTICAL ANALYSIS

Statistical analysis was performed using the statistical software (SAS software package, version 7.1; SAS Institute Inc, Cary, NC). To simplify clinical application, all continuous data were

categorized at either standard clinical cutoff points (heart rate, platelet count, prothrombin time) or statistical break points (the mean for age, Charlson Comorbidity Index, and number of stools before presentation, and quartiles for systolic blood pressure). Ethnic background was not stated for 4% of patients and was assumed to be white. Ten percent of values for gross blood on rectal examination, number of stools before presentation, and prothrombin time were missing, and dummy-coded categories were created for these missing values.

Univariate logistic regression was used to assess the relationship between each potential predictor and LIB status. Results are reported as odds ratios with 95% confidence intervals. All reported *P* values are 2-sided. A multivariable prediction model for severe bleeding was constructed using logistic regression with forward selection. Variables with a univariate significance of *P* < .10 were entered into the analysis, and those maintaining a *P* < .05 were selected for the final model. The univariate predictors not included in the model were reevaluated as potential confounders. Age and comorbid disease were analyzed for potential interactions with the significant variables chosen for the logistic model.

The stability of the risk factors with respect to patient sampling was validated using a standard bootstrap analysis²⁸ with 1000 iterations. The ability of the model to discriminate patients with and without severe LIB was examined by calculating the area under the receiver operating characteristic curve.²⁹ The goodness of fit of the model was examined using the Hosmer-Lemeshow test.³⁰ In a multivariable model, the addition of a new variable that proves to be highly explanatory will reduce or eliminate the significance of the existing variables. This concept was used to test whether our model was supplementary to clinical judgment by forcing in a variable that represented a surrogate of the clinical perception of severity. This variable included emergent radiographic evaluation, colonoscopy within 12 hours of admission, or surgery for bleeding control.

RESULTS

PATIENT CHARACTERISTICS

Fifty-seven percent of the patients were female, with an average age of 66 years (range, 20-97 years). Seventy-eight percent had at least one comorbid medical condition (Charlson Comorbidity Index score, ≥ 1). The mean initial hematocrit was 35%. A total of 103 patients (41%) required blood transfusions during the first 24 hours of hospitalization. Of these patients, 11 patients (11%) received only 1 unit of packed red blood cells, 52 patients (51%) received 2 units, and 40 (39%) received more than 2 units. Eleven patients (4%) underwent surgery for bleeding control. There were 6 deaths (2%), but none was due primarily to bleeding.

Inpatient colonoscopy was performed on 144 patients (57%). Sixty patients (24%) underwent flexible sigmoidoscopy. A total of 191 patients (76%) had either a flexible sigmoidoscopy or colonoscopy. Of the 47 patients who underwent only a flexible sigmoidoscopy, 41 (87%) had a documented left-sided source. Additional procedures included esophagogastroduodenoscopy in 40 patients (16%), a radionuclide scan in 34 (13%), and angiography in 22 (9%). Eighty-three patients (33%) were subjected to more than one procedure. Forty patients (16%) did not undergo any procedure during their hospital stay, primarily because of the availability of a presumed clinical diagnosis in the absence of persistent bleed-

ing (27 patients). Twenty-three such patients had a prior diagnosis of gastrointestinal disease (eg, inflammatory bowel disease, colorectal cancer) and a compatible presentation. The clinical diagnosis of infectious colitis was made in 4 patients. Six patients refused intervention.

BLEEDING EVENTS

One hundred twenty-three (49%) of the 252 patients experienced severe LIB. A total of 117 patients (46%) had continued bleeding, 18 (7%) had recurrent bleeding, and 13 (5%) had both. Of those patients with continued bleeding, 26 (22%) had a decrease in hematocrit of at least 20%, 69 (59%) received at least 2 units of packed red blood cells, and 22 (19%) had both. All 8 patients readmitted to the hospital for bleeding also met the criteria for continued bleeding during the initial bleeding episode. Five (83%) of the 6 deaths occurred in patients with severe bleeding. In the severe bleeding group, the mean initial and 24-hour nadir hematocrits were 31% and 26%, respectively, compared with 38% and 34% in the patients without severe bleeding.

The most common causes of bleeding included probable or definite diverticular hemorrhage, hemorrhoids, ischemic colitis, postpolypectomy, and malignancy (**Table 1**). Of the remaining diagnoses, the most prevalent were nonischemic forms of colitis. Definite diverticular hemorrhage was defined as colonoscopic visualization of a diverticulum with active bleeding, adherent clot, or visible vessel; evidence of bleeding on angiography or radionuclide scan corresponding to an area of diverticulosis on colonoscopy; or pathological confirmation in a resected specimen. Probable diverticular hemorrhage was defined as a complete colonoscopy that revealed only diverticulosis.¹ No diagnosis was made in 22 patients (9%).

RISK FACTORS FOR SEVERE LIB

Univariate analysis (**Table 2**) revealed that patients with severe bleeding were more likely to present with signs of hemodynamic instability (initial systolic blood pressure, ≤ 115 mm Hg; initial heart rate, ≥ 100 /min; history of syncope) and signs of persistent bleeding (gross blood on rectal examination, bleeding during the first 4 hours of evaluation). A nontender abdominal examination and a Charlson Comorbidity Index score of more than 2²⁷ were more common in patients with severe bleeding. Age, history of diverticulosis, history of LIB, and anticoagulation were notable among the variables that were not univariate predictors of severe bleeding.

Multivariable logistic regression analysis identified 7 independent risk factors for severe LIB: initial heart rate of 100/min or more, initial systolic blood pressure of 115 mm Hg or less, history of syncope, nontender abdominal examination, bleeding per rectum during the first 4 hours of evaluation, aspirin use, and Charlson Comorbidity Index score of more than 2 (**Table 3**). There were no confounders of this model. No significant interactions were found between the independent predictors and age (>66 years) or comorbid disease (Charlson Comorbidity Index score, >2).

Table 1. Sources of LIB

Source	No. (%) of Patients	
	Total (n = 252)	With Severe LIB* (n = 123)
Diverticular bleeding†	75 (30)	50 (67)
Probable	69 (28)	45 (65)
Definite	6 (2)	5 (83)
Hemorrhoids	30 (12)	6 (20)
Ischemic colitis	26 (10)	5 (19)
Postpolypectomy	17 (7)	11 (65)
Malignancy	14 (6)	7 (50)
Infectious colitis	10 (4)	4 (40)
Nonspecific colitis‡	11 (4)	3 (11)
Inflammatory bowel disease	9 (4)	3 (33)
Radiation colitis	7 (3)	3 (43)
Arteriovenous malformation	8 (3)	6 (75)
Stercoral ulcer	6 (2)	3 (33)
Other§	17 (7)	10 (59)
No origin identified	22 (9)	12 (55)

Abbreviation: LIB, lower intestinal tract bleeding.

*Severe LIB was defined as continued bleeding in first 24 hours (≥ 2 units of blood and/or $\geq 20\%$ decrease in hematocrit) and/or recurrent bleeding after 24 hours of stability (further decrease in hematocrit of $\geq 20\%$ and/or additional transfusions or readmission within 1 week).

†Diverticular bleeding was defined as definite (colonoscopic visualization of diverticulum with active bleeding, adherent clot, or visible vessel; evidence of bleeding on a radiographic study in an area of diverticulosis; or pathologic confirmation) or probable (complete colonoscopy revealing only diverticulosis).¹

‡Nonspecific colitis was defined as nondiagnostic endoscopy, pathology, stool cultures, or clinical evaluation.

§Other sources included anal fissure (3 patients), surgical suture line bleeding (4 patients), colostomy site trauma (3 patients), solitary colonic ulcer (2 patients), colonic stricture, hemorrhagic polyp, graft-vs-host disease, rectal Dieulafoy, and prostate biopsy site (1 patient each).

||No origin identified was defined as unrevealing diagnostic procedures or no diagnostic procedure and an inconclusive presentation and clinical evaluation.

Thirty-seven (84%) of 44 patients with more than 3 risk factors, 85 (43%) of 197 with 1 to 3 risk factors, and 1 (9%) of 11 with no risk factors experienced severe LIB. Eighty percent of the patients who required operative hemostasis had 3 or more risk factors. The area under the receiver operating characteristic curve was 0.76, reflecting reasonable ability of the model to discriminate between patients with and without severe LIB. The *P* value for the Hosmer-Lemeshow test was .85, indicating that there was no significant difference between the observed data and the values predicted by the model. After bootstrap analysis, all of the risk factors except syncope (*P* < .10) retained significance at the *P* < .05 level, suggesting that the model would perform well if applied to a new patient population. Furthermore, 6 of the risk factors maintained significance after controlling for a surrogate of the evaluating clinicians' assessment of severity, suggesting that these independent risk factors have prognostic utility beyond that of routine clinical judgment.

COMMENT

Lower intestinal tract bleeding is a unique disease process that differs substantially from UGIB in origin, presentation, and clinical course.^{1,3,31} In contrast to UGIB,

Table 2. Univariate Correlations With Severe LIB*

Characteristic	Patients With Severe LIB, % (n = 123)	Patients Without Severe LIB, % (n = 129)	Unadjusted OR (95% CI)†
Mean age >66 y	28	25	1.48 (0.9-2.42)
Female	28	29	1.01 (0.62-1.67)
Nonwhite	15	19	0.73 (0.43-1.23)
Medical history			
Charlson Comorbidity Index score >2‡	49	33	1.91 (1.15-3.17)
History of LIB	13	10	1.39 (0.77-2.51)
History of diverticulosis	14	11	1.56 (0.88-2.78)
Medication use§			
Aspirin	18	13	1.69 (0.98-2.91)
Nonsteroidal anti-inflammatory	7	8	0.93 (0.47-1.86)
Anticoagulant	9	8	1.25 (0.65-2.42)
Presenting symptoms			
Abdominal pain	18	23	0.76 (0.46-1.25)
Change in bowel habit	40	37	1.78 (0.98-3.24)
Syncope	8	3	3.18 (1.29-7.87)
Light-headedness	16	12	1.59 (0.91-2.77)
Bright red blood per rectum	42	45	0.82 (0.39-1.73)
>3 Stools before presentation (mean)	19	14	1.59 (0.93-2.73)
Presentation ≤ 6 h from onset	19	17	1.32 (0.79-2.21)
Initial physical examination findings			
Heart rate ≥ 100 /min	15	6	3.16 (1.65-6.04)
Systolic blood pressure (quartiles), mm Hg			
≥ 146	12	15	Reference
131-145	12	16	0.93 (0.47-1.83)
116-130	9	12	0.91 (0.44-1.89)
≤ 115	17	8	2.61 (1.28-5.33)
Nontender abdomen	40	35	1.95 (1.09-3.52)
Gross blood on rectal examination	41	35	2.96 (1.35-6.49)
Change in mental status	1	2	0.51 (0.13-2.10)
Bleeding in first 4 h of evaluation¶	21	15	1.87 (1.12-3.15)
Initial laboratory values			
Platelets <150 000/ μ L	6	5	1.24 (0.56-2.72)
Prothrombin time ≥ 15 s	10	12	1.35 (0.65-2.78)

Abbreviations: CI, confidence interval; LIB, lower intestinal tract bleeding; OR, odds ratio.

*Severe LIB was defined as continued bleeding in first 24 hours (≥ 2 units of blood and/or $\geq 20\%$ decrease in hematocrit) and/or recurrent bleeding after 24 hours of stability (further decrease in hematocrit of $\geq 20\%$ and/or additional transfusions or readmission within 1 week).

†ORs and 95% CIs were determined using logistic regression.

‡Charlson Comorbidity Index is a validated, weighted score of comorbid disease.²⁷

§Medication use was defined as any dose of daily aspirin, at least 2 doses during the previous week of nonsteroidal anti-inflammatory drug or anticoagulant, or bright red blood per rectum vs other stool colors (eg, maroon, black).

||Dummy-coded category used to adjust for missing data.

¶Bleeding per rectum during the first 4 hours of medical evaluation.

prognostic factors important for risk stratification of patients with LIB have not been clearly defined. In our study, 7 independent risk factors for severe LIB were identified: tachycardia, low systolic blood pressure, syncope, nontender abdominal examination, bleeding per rec-

Table 3. Independent Risk Factors for Severe Lower Intestinal Tract Bleeding*

Predictor	OR (95% CI)†	P Value‡
Heart rate ≥ 100 /min‡	3.67 (1.78-7.57)	<.001
Systolic blood pressure ≤ 115 mm Hg‡§	3.45 (1.54-7.72)	.003
Syncope	2.82 (1.06-7.46)	.04
Nontender abdominal examination result‡	2.43 (1.22-4.85)	.01
Bleeding in the first 4 h of evaluation	2.32 (1.28-4.20)	.005
Aspirin use¶	2.07 (1.12-3.82)	.02
>2 Active comorbid conditions#	1.93 (1.08-3.44)	.02

Abbreviations: CI, confidence interval; OR, odds ratio.

*Severe lower intestinal tract bleeding was defined as continued bleeding in first 24 hours (≥ 2 units of blood and/or $\geq 20\%$ decrease in hematocrit) and/or recurrent bleeding after 24 hours or stability (further decrease in hematocrit of $\geq 20\%$ and/or additional transfusions or readmission within 1 week).

†ORs, 95% CIs, and *P* values were determined using multiple logistic regression.

‡Values on initial evaluation.

§Reference group was systolic blood pressure of 146 mm Hg or higher.

||Bleeding per rectum during the first 4 hours of medical evaluation.

¶Any daily dose of aspirin.

#According to the Charlson Comorbidity Index, a validated, weighted score of comorbid disease.²⁷

tum during the first 4 hours of medical evaluation, aspirin use, and more than 2 active comorbid conditions (Charlson Comorbidity Index score, >2). The likelihood of severe bleeding increased with the number of risk factors present. The identified risk factors are easy to obtain during the initial evaluation and may aid in the triage of patients to timely and appropriate diagnostic and therapeutic interventions.

Previous studies designed to evaluate prognostic factors for gastrointestinal bleeding have focused largely on patients with UGIB,¹⁴⁻²¹ and a prediction rule has been developed for a mixed population of patients with either UGIB or LIB.^{12,13} Principal risk factors for poor outcomes identified in these studies include hypotension, hematemesis, anemia, ongoing bleeding, endoscopic stigmata of recent hemorrhage, evidence of cirrhosis, comorbid disease, advanced age, change in mental status, elevated blood urea nitrogen level, and coagulopathy. Some of the risk factors identified in our study parallel those derived for patients with UGIB.^{12-16,19,21} Markers of hemodynamic instability (tachycardia, hypotension, syncope), as well as bleeding soon after presentation, reflect blood volume loss and bleeding rate; as such, it is not surprising that these factors are predictive of outcome in both UGIB and LIB.³²

There are notable differences between our findings and those derived from populations with UGIB, emphasizing the importance of defining LIB-specific risk factors. Several points of divergence may be ascribed to differing origins of bleeding in UGIB and LIB. Variceal bleeding is a significant source of UGIB³³ but not LIB. It is therefore possible that coagulopathy and change in mental status were risk factors in studies of UGIB, but not in our study, because they reflect underlying liver disease.

Unlike UGIB, the abdominal examination result in LIB varies with the underlying disease process. A nontender abdomen is commonly found in disorders associated with severe LIB (eg, diverticular hemorrhage, vascular malformations), whereas abdominal tenderness may accompany disorders with less severe LIB (eg, ischemic colitis, inflammatory bowel disease). This discrepancy seems to explain the significance of a nontender abdomen in our model.

Our study has several strengths. We used an encompassing list of ICD-9 codes to identify a comprehensive and heterogeneous cohort of consecutive patients with acute LIB. Data collection was conducted in a standardized and chronologic fashion and resulted in little missing information. In addition, an independent medical record review was undertaken to confirm the reliability of our review process. Potential risk factors were selected and formulated to be reliable and readily available during the initial evaluation of patients with LIB. The outcome measure was designed to reflect severe bleeding rather than in-hospital complications and mortality. Death is a rare complication of LIB¹⁻³; in our study death occurred in only 2% of patients.

Our study also has several limitations. Despite systematic attempts to minimize bias and missing data, retrospective investigation is often less complete and less accurate than prospective study. Importantly, the retrospective nature of the study did not permit standardization of the process of care, which can vary in this population. Moreover, this was a single institution study, and though the results were statistically cross-validated, their applicability to other populations requires further testing. In addition, the lack of a widely used definition or marker of severity of LIB complicates the identification of risk factors. Finally, the identified risk factors do not capture all patients at risk for severe bleeding. Other as-yet-unidentified factors are likely to be of prognostic importance in this complex entity.

Defining risk factors for severity in acute LIB is a first step in understanding this disorder and improving its management. Beyond prognostic information, the availability of risk factors for severe bleeding should help to identify patients who are most likely to benefit from aggressive care. Technologic advancements in endoscopy have greatly improved the utility of colonoscopy in LIB. Traditionally, colonoscopic evaluation was delayed due to the need for bowel cleansing, the fear of increased procedural risks, and the lack of proven therapeutic efficacy. In recent years, several studies suggest that emergent colonoscopy (within 12 to 24 hours of admission) for acute lower intestinal tract hemorrhage is safe and effective. Endoscopic therapy using a variety of techniques, including epinephrine injection and thermal contact, can be used in 15% to 50% of patients and provides effective hemostasis in 70% to 100%.^{4-7,34} Early colonoscopic intervention, particularly for severe diverticular bleeding, in addition to improving diagnostic and therapeutic yield, may decrease rebleeding and surgical intervention rates, length of hospital stay, and cost of treatment.⁴⁻⁷ However, this procedure is logistically complicated and resource intensive, and it may not be appropriate or feasible for patients without severe

bleeding. Therefore, the ability to target high-risk patients for emergent colonoscopy should significantly improve the utility of this procedure in practice.

In conclusion, our study reveals that simple, objective clinical criteria available on initial presentation can be used to identify patients at risk for severe or recurrent LIB. These criteria seem to be additive to routine clinical judgment, and their systematic application may aid in the triage of LIB patients to appropriate care and timely interventions. Further studies are planned to validate these findings prospectively in other populations and to develop a prediction rule for use in the initial care of patients with acute LIB.

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