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Risk Factors for Adverse Outcomes in Patients Hospitalized With Lower Gastrointestinal Bleeding

Neil Sengupta, MD, Elliot B. Tapper, MD, Vilas R. Patwardhan, MD, Gyanprakash A. Ketwaroo, MD, MSc, Adarsh M. Thaker, MD, Daniel A. Leffler, MD, MS, and Joseph D. Feuerstein, MD

Division of Gastroenterology (N.S., E.B.T., V.R.P., G.A.K., D.A.L., J.D.F.) and Department of Medicine (A.M.T.), Beth Israel Deaconess Medical Center, Boston, MA

Abstract

Objective—To determine which risk factors and subtypes of lower gastrointestinal bleeding (LGIB) are associated with adverse outcomes after hospital discharge (30-day readmissions, recurrent LGIB, and death).

Patients and Methods—We conducted a prospective observational study of consecutive patients admitted with LGIB to Beth Israel Deaconess Medical Center from April 1, 2013, through March 30, 2014. Patients were contacted 30 days after discharge to determine hospital readmissions, recurrent LGIB, and death. Multivariable Cox proportional hazards regression models were used to describe associations of variables with 30-day readmissions or recurrent LGIB. Logistic regression was used to determine association with mortality.

Results—There were 277 patients hospitalized with LGIB. Of the 271 patients surviving to discharge, 21% (n=57) were readmitted within 30 days, 21 of whom were admitted for recurrent LGIB. The following factors were associated with 30-day readmissions: developing in-hospital LGIB (hazard ratio [HR], 2.26; 95% CI, 1.08–4.28), anticoagulation (HR, 1.82; 95% CI, 1.05–3.10), and active malignancy (HR, 2.33; 95% CI, 1.11–4.42). Patients discharged while taking anticoagulants had higher rates of recurrent bleeding (HR, 2.93; 95% CI, 1.15–6.95). Patients with higher Charlson Comorbidity Index scores (odds ratio [OR], 1.57; 95% CI, 1.25–2.08), active malignancy (OR, 6.57; 95% CI, 1.28–28.7), and in-hospital LGIB (OR, 11.5; 95% CI, 2.56–52.0) had increased 30-day mortality risk.

Conclusion—In-hospital LGIB, anticoagulation, and active malignancy are risk factors for 30-day readmissions in patients hospitalized with LGIB. In-hospital LGIB, Charlson Comorbidity Index scores, and active malignancy are risk factors for 30-day mortality.

Lower gastrointestinal bleeding (LGIB) is a common cause of hospitalization in the United States, occurring with an annual incidence of 20 to 30 cases per 100,000 people.^{1,2} Hospitalization for LGIB is associated with substantial resource utilization and costs given the frequent need for invasive endoscopic and radiologic procedures.³ However, our understanding regarding the natural history and epidemiology of LGIB remains limited

compared with our knowledge of upper gastrointestinal bleeding (UGIB), where clinical advances have led to a steady decline in hospitalizations for UGIB.⁴⁻⁶

The in-hospital mortality associated with LGIB is approximately 4%, related primarily to advanced age, intestinal ischemia, and the presence of multiple comorbidities.⁷ In a recent retrospective study of patients with colonic bleeding, the rates of recurrent bleeding and mortality within 1 year were 19% and 4.2%, respectively.⁸ However, data on short-term outcomes after hospitalization for LGIB are limited. A retrospective study using a Veteran's Affairs database reported an unadjusted 30-day readmission rate for gastrointestinal bleeding (GIB) ranging from 13.7% to 14.7%.⁹ Finally, although an increased short-term mortality rate is well established for patients developing UGIB while hospitalized for another reason,^{10,11} there are limited data on whether nosocomial LGIB is similarly associated with an increased risk of mortality.

Because LGIB represents a spectrum of different etiologies and risk factors, certain patients with LGIB may have an increased risk of early rehospitalization, recurrent GIB, and death. Our primary aims were to report 30-day readmission rates in patients hospitalized for LGIB and to describe clinical risk factors that predict 30-day hospital readmission, recurrent bleeding, and mortality. An additional goal was to report the yield and utilization of endoscopic and radiologic procedures in a cohort study of patients admitted to the hospital with LGIB when no standardized approach was specified.

PATIENTS AND METHODS

Patients

We conducted a prospective observational cohort study of consecutive patients admitted with LGIB or developing LGIB in the hospital. Data were collected on patients admitted to Beth Israel Deaconess Medical Center (Boston, Massachusetts), a tertiary care medical center, from April 1, 2013, through March 30, 2014. All patients with acute GIB (N=750) were included in a prospective database at the time that the inpatient gastroenterology team was consulted. Patients were included in this study if the reason for gastroenterology consultation was the presence of overt LGIB, defined by the presence of hematochezia or maroon stools. Patients with hematochezia or maroon stools who were ultimately found to have an upper gastrointestinal source of bleeding were excluded for the purposes of this study.

We obtained baseline demographic information and the following clinical data via medical record review during the index hospitalization associated with LGIB: date of admission, comorbidities, Charlson Comorbidity Index score, antiplatelet medications and anticoagulants on admission, vital signs, and initial laboratory studies. We also recorded the details of in-hospital management, including transfusion requirements (packed red blood cells, platelets, and fresh frozen plasma), intensive care unit (ICU) requirements, endoscopic and radiologic procedures or interventions, and etiology of LGIB. Time to colonoscopy was recorded in the database. For all etiologies aside from diverticular bleeding, the bleeding source was defined based on the presence of stigmata of hemorrhage on endoscopic evaluation. Patients were classified as having definitive diverticular bleeding if there were

stigmata of hemorrhage at colonic diverticula or active bleeding noted on computed tomographic angiography, tagged red blood cell scanning, or angiography in a known region of diverticulosis. Patients were classified as having presumed diverticular bleeding if fresh blood was noted during colonoscopy in regions of diverticular disease. Patients not undergoing a procedure, or those without stigmata of hemorrhage, were classified as having no source identified. Endoscopic interventions included the use of clips, electrocautery, epinephrine, or argon plasma coagulation.

Hospital discharge data included length of stay (LOS), number and list of discharge medications, and date of discharge. Patients were mailed a letter to inform them of the study and the plan to contact them by telephone to complete a survey. An investigator (N.S., V.R.P., or J.D.F.) subsequently contacted all the patients by telephone 30 days after discharge to assess the occurrence and causes of all interval hospital readmissions. Patients were asked whether they had any recurrent GIB after initial discharge and whether the bleeding episode required an emergency department (ED) visit or hospitalization. Deaths occurring during the 30-day follow-up period were confirmed by reviewing the medical record and online death registries.¹² The online medical record was also reviewed for further confirmation of hospital readmissions in the setting of recurrent GIB.

Patients who died during initial hospitalization were excluded from postdischarge statistical analysis. The study was approved by the Beth Israel Deaconess Medical Center Institutional Review Board.

Statistical Analyses

Categorical variables are reported as percentages to describe proportions, and continuous variables are reported as medians (interquartile ranges) or as otherwise indicated. Comparisons between groups for categorical data were made using Fisher exact tests. Continuous data were compared using 2-sample *t* tests for normally distributed variables and Wilcoxon rank sum tests for nonnormally distributed variables. Univariable and multivariable Cox proportional hazards regression models were used to determine the association of in-hospital LGIB and other clinical variables to 30-day hospital readmission and recurrent bleeding. Multivariable analyses were adjusted for the following plausible confounders: age, Charlson Comorbidity Index score, active malignancy, and blood transfusion requirements. Univariable logistic regression was used to determine associations of clinical variables and postdischarge mortality given that dates of death were not available for all patients. All the analyses were performed using JMP Pro version 10.0 software (SAS Institute Inc). A 2-tailed *P* = .05 was considered significant.

RESULTS

Demographic and In-hospital Data

A total of 277 patients were admitted with LGIB or developed LGIB during their initial hospitalization. Ten percent of patients (*n* = 29) developed in-hospital LGIB while hospitalized for another reason. Two percent of patients (*n* = 6) died during their index hospitalization. Four patients died of septic shock, and 2 patients died of hemorrhagic shock.

Patients with in-hospital LGIB were more likely to die during the index hospitalization than patients presenting to the ED with LGIB (14% [n=4] vs 1% [n=2]; $P=.001$). These 6 patients were excluded from postdischarge analyses.

We included 271 patients in the final analysis (25 with in-hospital LGIB and 246 with LGIB on presentation to the ED). See Table 1 for complete demographic and clinical data. The median patient age was 66 years (interquartile range, 52–79 years), and 52% (n=140) were men. Twenty-eight percent of patients (n=75) were receiving systemic anticoagulation at the time of LGIB. Twenty-eight percent of patients (n=75) required ICU care during hospitalization, and 40% (n=109) required packed red blood cell transfusion. Patients with in-hospital LGIB were older (70 years vs 65 years; $P=.05$), had a higher median Charlson score (7 vs 5; $P=.002$), and were more likely to have renal failure (48% vs 22%; $P=.006$), to have cirrhosis (20% vs 7%; $P=.03$), to require blood transfusion (60% vs 38%; $P=.05$), to require fresh frozen plasma (28% vs 11%; $P=.02$), and to require ICU care (60% vs 25%; $P<.001$). Patients with in-hospital LGIB had a lower nadir hemoglobin level (7.7 g/dL vs 9.6 g/dL; $P<.001$), more medications on discharge (12 vs 9; $P=.05$), and a longer hospital LOS (12 days vs 3 days; $P<.001$).

Bleeding: Sources and Interventions

The most common etiology of LGIB in the cohort was diverticular bleeding (n=50, 18%). Ten percent of patients (n=27) had definitive diverticular bleeding with stigmata of hemorrhage on colonoscopy, whereas 8% (n=23) had a presumed diverticular bleed. For the 25 patients with in-hospital LGIB, the most common etiologies of LGIB were ischemic colitis (n=5, 20%) and hemorrhoidal bleeding (n=5, 20%). Of note, 30% of all patients (n=82) did not have a confirmed source of hematochezia or maroon stools. Included in this group without a confirmed source of bleeding were 18% (n=49) of the cohort that had neither an endoscopic nor a radiologic procedure during hospitalization. Twelve percent of patients (n=33) had an endoscopic or radiologic procedure performed but no source of bleeding detected. Five percent of patients (n=14) had a tagged red blood cell or angiographic study performed when the patient was not actively bleeding. An additional 7% of patients (n=19) had a colonoscopy performed but did not have either stigmata of hemorrhage detected or fresh blood noted in regions of diverticulosis. Median time to colonoscopy in these 19 patients was 48 hours.

Forty-six percent of patients (n=125) underwent colonoscopy during their index hospitalization, of which 46% (n=58) had a positive finding as the source of LGIB. Patients with in-hospital LGIB were equally likely to have had a colonoscopy during the index hospitalization as patients presenting to the ED with LGIB (32% [n=8] vs 48% [n=117]; $P=.15$). Median time to colonoscopy was 45 hours in the group. The time to colonoscopy was similar in patients whose colonoscopy localized the source of LGIB and patients in whom the colonoscopy was negative (46 hours vs 45 hours; $P=.57$). Other endoscopic and radiologic procedures performed along with their respective yields are listed in Table 2.

Surgical intervention was required in 12 patients (4.4%) for the management of persistent bleeding. Five patients required total colectomy for persistent bleeding related to inflammatory colitis, 3 patients had a left-sided colectomy due to diverticular bleeding, and

1 patient had a subtotal colectomy due to ischemic colitis. Two patients required hemorrhoidectomy for the management of bleeding, and 1 patient underwent rectal resection due to radiation proctitis. All the surgical interventions led to resolution of bleeding, and there were no major complications.

30-Day Postdischarge Outcomes

Ten percent of the original cohort (n=27) was lost to follow-up before the 30-day study call (no answer despite multiple attempts, n=12; patient refused telephone call, n=12; patient did not speak English, n=3). Patient who were lost to follow-up were equally likely to have had in-hospital LGIB compared with patients presenting to the ED with LGIB (8% [n=2] vs 10% [n=25]; $P>.99$).

Twenty-one percent of all patients (n=57) were readmitted to the hospital within 30 days of initial discharge. Median time to readmission was 10 days (range, 1–29 days). The most common cause for readmission was recurrent GIB, with 21 patients being readmitted. Other common causes for readmission included infection (n=8), congestive heart failure (n=8), thrombotic complications (n=3), and renal failure (n=3). The 3 patients with thrombotic complications were all receiving anticoagulation at the time of LGIB and had their anticoagulants held for at least 72 hours during index hospitalization.

On univariable Cox proportional hazards regression models (see Table 3 for clinical variables associated with 30-day readmission), patients with in-hospital LGIB had a higher rate of 30-day readmission (HR, 2.26; 95% CI, 1.08–4.28; $P=.03$). Additional predictors of 30-day readmission included systemic anticoagulation at the time of LGIB (HR, 1.82; 95% CI, 1.05–3.10; $P=.03$), active malignancy (HR, 2.33; 95% CI, 1.11–4.42; $P=.03$), an initial hospital LOS greater than 4 days (HR, 1.78; 95% CI, 1.05–3.04; $P=.03$), and the number of medications on hospital discharge (HR, 1.07; 95% CI, 1.02–1.11; $P=.005$).

Patients receiving systemic anticoagulation at hospital discharge after LGIB had a higher rate of readmission owing to recurrent bleeding (HR, 2.93; 95% CI, 1.15–6.95; $P=.02$). Other clinical variables and their association with readmission for recurrent bleeding on univariable Cox proportional hazards models are listed in Table 3. In-hospital LGIB was not associated with a higher rate of recurrent admission for GIB (HR, 1.00; 95% CI, 0.16–3.45; $P>.99$).

On a multivariable Cox proportional hazards model adjusting for age, Charlson Comorbidity Index score, active malignancy, and blood transfusion requirement, developing in-hospital LGIB was associated with a higher rate of 30-day readmissions (HR, 2.19; 95% CI, 1.03–4.25; $P=.04$).

Of the 21 patients with hospital readmission for recurrent bleeding within 30 days, the most common causes of bleeding at the index hospitalization were inflammatory colitis (n=6), diverticular bleeding (n=4), hemorrhoidal bleeding (n=3), and postpolypectomy bleeding (n=2) (Table 4). Six of the 21 patients did not have an identified source of bleeding at the index colonoscopy. Three of the 21 patients had undergone an endoscopic intervention at the

index hospitalization, and 3 patients had undergone either an angiographic or surgical intervention.

In addition to the 21 patients readmitted with recurrent bleeding within 30 days, 19 additional patients reported any recurrent bleeding on the 30-day callback. Five of these 19 patients required an ED visit but not hospital admission, whereas the remainder of the bleeding episodes were self-limited and did not necessitate hospital or ED care. No patients with recurrent bleeding either required surgical intervention or had required surgical intervention during their index hospitalization.

The association of etiology of LGIB during the index hospitalization with treatment of LGIB and postdischarge 30-day readmissions and recurrent bleeding is presented in Table 4. Rebleeding events are distributed between rebleeding requiring hospital readmission, rebleeding requiring only an ED visit, and outpatient rebleeding that subsided without any hospital requirements. Patients with hemorrhoidal bleeding (29%, n=6/21), no source of LGIB identified (23%, n=19/82), inflammatory colitis (23%, n=11/48), and diverticular bleeding (22%, n=11/50) had frequent all-cause 30-day hospital readmissions.

Postdischarge Mortality

Three percent of all patients (n=8) died after the initial hospital discharge within the 30-day follow-up period. No deaths were due to recurrent bleeding. Causes of death during follow-up included malignancy (n=4), sepsis (n=2), and myocardial infarction (n=2). Patients with in-hospital LGIB had a greater risk of dying within 30 days of hospital discharge (odds ratio [OR], 11.5; 95% CI, 2.56–52.0; $P=.002$). Patients with a higher Charlson score had a higher odds of postdischarge mortality (OR, 1.57; 95% CI, 1.25–2.08; $P<.001$). Other clinical variables and their associations with postdischarge mortality are depicted in Table 5.

DISCUSSION

In the United States, LGIB is a common cause for hospitalization, and it is associated with significant morbidity and mortality. This study demonstrates that hospitalization for LGIB is associated with a high 30-day readmission rate of 21%, and a moderate 8% risk of early recurrent bleeding requiring hospital readmission. We demonstrate that patients developing LGIB while already admitted to the hospital represent a higher-risk population and carry a significant rate of early hospital readmission and death compared with patients presenting to the ED with LGIB.

Recent studies in patients with nonvariceal UGIB have shown that patients with bleeding while hospitalized for another condition tend to be sicker, have a longer LOS, and have a higher risk of death than outpatients presenting with nonvariceal UGIB.^{10,11} It is conceivable that a similar relationship exists in patients developing LGIB while admitted to the hospital for another condition given that inpatients may be at excess risk for conditions such as ischemic colitis. The present data corroborate these findings in LGIB because patients in this cohort with in-hospital LGIB clearly represented a sicker group that was older with a higher Charlson Comorbidity Index score and that had a greater need for blood products and ICU care. More importantly, this subset of patients with in-hospital LGIB had

higher rates of 30-day readmissions and in-hospital and postdischarge mortality. Thus, LGIB developing in the hospital may serve as a marker indicating a high risk of postdischarge adverse outcomes.

Although recent studies have reported readmission rates in the setting of GIB,^{9,13} there are limited data regarding risk factors for patients with LGIB that are associated with hospital readmissions and rebleeding. We established in-hospital LGIB, use of anticoagulation, longer hospital LOS, and active malignancy as risk factors that may predict 30-day readmission after hospitalization for LGIB. These novel observations add to the literature regarding readmission risk factors previously established for other common gastrointestinal conditions, such as inflammatory bowel disease and acute pancreatitis.^{14,15} Future study is necessary to design strategies to mitigate early readmission and rebleeding risk, as have been undertaken in other fields.^{16–19} Given that common causes of hospital readmission and death in the present cohort of patients with LGIB included infection, volume overload, renal failure, and thromboembolic events, potential strategies to mitigate readmission risk could include aggressive monitoring of volume status and infection control as an outpatient, as well as ensuring that patients are restarted on antiplatelets and anticoagulants when possible to decrease postbleeding thrombotic events.^{20,21}

Previous studies of patients with LGIB have shown that advanced age, intestinal ischemia, multiple comorbidities, blood cell transfusion, and in-hospital LGIB were risk factors for in-hospital mortality.⁷ The present study confirms and extends these results by demonstrating that in-hospital LGIB and concurrent active malignancy also serve as risk factors for postdischarge mortality and 30-day readmissions. We also demonstrate that a higher Charlson Comorbidity Index score is a risk factor for postdischarge mortality after hospitalization for LGIB. These results are consistent with those of previous studies demonstrating that the Charlson comorbidity index can predict postdischarge mortality for the general population.^{22,23} More importantly, the association between in-hospital LGIB and 30-day readmission remained significant after adjusting for the Charlson comorbidity score. In view of the present data, patients with these risk factors are likely to benefit from close follow-up after initial discharge by their providers to take steps to prevent hospital readmissions and death.

To our knowledge, this is one of the first studies to determine the risk factors for early postdischarge adverse outcomes in the setting of LGIB. We confirmed the etiology of LGIB in most patients and provided the frequency and diagnostic utility of endoscopic and radiologic procedures in this cohort. Another strength of this study is that we achieved a high follow-up rate and captured information regarding frequency of rebleeding in patients who did not require hospital readmission. In addition, we had access to multiple community-affiliated hospitals and practice records, allowing us to capture readmissions that may have been missed had we evaluated only a single medical center.

These data must be interpreted in the context of the study design. This was a single-center study performed at a tertiary care institution, thus limiting generalizability. On the other hand, there was substantial patient heterogeneity in the cohort given that we included all patients presenting with hematochezia or maroon stools. We also observed a higher-than-

expected rate of no bleeding source being identified during hospitalization compared with other reports of detecting bleeding sources in lower intestinal bleeding.^{24,25} One reason for this difference is that we did not use a systematic approach to performing an endoscopic or radiographic procedure given that this study was observational, with a primary focus on reporting postdischarge outcomes. We did not have a structured protocol for urgent colonoscopy in this cohort, and, thus, we likely were unable to determine the etiology of LGIB in several patients owing to colonoscopy being performed at the time when the bleeding had subsided. In addition, this may reflect the stringent definition of causative etiology of LGIB requiring the presence of stigmata of hemorrhage and may be a more realistic estimation of the rate of localization in a cohort of patients presenting with hematochezia. Another explanation for this high rate of no diagnosis is that we included patients who did not undergo an endoscopic or radiologic procedure in the hospital. We included these patients in the analysis given that the main goal was to describe risk factors for poor postdischarge outcomes after LGIB as opposed to focusing on endoscopic localization or hemostasis. We performed additional analyses on this subset of patients and found that patients who either did not have a procedure performed or had a procedure without a subsequent source detected were not at higher risk for readmission or recurrent bleeding.

Another limitation of this study is that we potentially missed a significant proportion of patients who had an upper gastrointestinal source of hematochezia given that there was not a systematic method of performing endoscopy to exclude proximal sources of bleeding. This is relevant given that previous studies have shown that 10% to 20% of patients with hematochezia may have an upper source of bleeding.²⁵ It is possible that survival bias may have affected the primary outcome in the present study if patients with in-hospital LGIB had early hospital readmission or death, leading to differential loss to follow-up before the 30-day study call. However, this would likely only underestimate the association that we noted between in-hospital LGIB and postdischarge adverse outcomes. Finally, although we describe etiologies of LGIB that are associated with rebleeding, the results are limited by the low number of rebleeding events. In addition, the clinical applicability of the rebleeding data may be limited given that we included patients with inflammatory colitis, who have a different pathogenesis than other patients with LGIB. Future, larger studies are necessary to help clarify which etiologies of LGIB are at highest risk for early rebleeding. In addition, future studies using a systematic approach to the management of LGIB, including early colonoscopy by gastroenterologists experienced in hemostasis, with the exclusion of proximal sources of bleeding, are necessary to determine whether such an approach may reduce in-hospital rebleeding or need for surgery, as well as postdischarge adverse outcomes.

CONCLUSION

In summary, we identified in-hospital LGIB as a risk factor for 30-day readmissions and in-hospital and postdischarge mortality in patients hospitalized with LGIB. Other risk factors for early readmission included use of anticoagulation, longer hospital LOS, and the presence of active malignancy. We believe that these results serve as an impetus for future studies to test strategies to reduce hospital readmissions and mortality after hospitalization for LGIB.

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Abbreviations and Acronyms

angio	angiographic
AVM	arteriovenous malformation
CT	computerized tomography
d/c	discharge
ED	emergency department
endo	endoscopic
FFP	fresh frozen plasma
GIB	gastrointestinal bleeding
HR	hazard ratio
IBD	inflammatory bowel disease
ICU	intensive unit care
IQR	interquartile range
IR	interventional radiology
LGIB	lower gastrointestinal bleeding
LOS	length of stay
NSAID	nonsteroidal anti-inflammatory drug
OR	odds ratio
UGIB	upper gastrointestinal bleeding

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TABLE 1

Baseline Characteristics^a

Characteristic	Total cohort (N=271)	In-hospital LGIB (n=25)	LGIB on presentation to hospital (n=246)	P value
Age (y [IQR]), median	66 (52–79)	70 (61–82)	65 (51–79)	.05
Male sex (No. [%])	140 (52)	16 (64)	124 (50)	.21
White race (No. [%])	191 (70)	19 (76)	172 (70)	.65
Smoking (No. [%])	35 (13)	3 (12)	32 (13)	>.99
Comorbidities (No. [%])				
Hypertension	151 (56)	18 (72)	133 (54)	.09
Congestive heart failure	38 (14)	4 (16)	34 (14)	.76
Coronary artery disease	51 (19)	6 (24)	45 (18)	.43
Atrial fibrillation	52 (19)	7 (28)	45 (18)	.28
Renal failure	65 (24)	12 (48)	53 (22)	.006
Active malignancy	25 (9)	4 (16)	21 (9)	.27
IBD	49 (18)	2 (8)	47 (19)	.27
Cirrhosis	21 (8)	5 (20)	16 (7)	.03
History of GIB	83 (31)	6 (25)	77 (31)	.65
Home medications (No. [%])				
Anticoagulants	75 (28)	10 (40)	65 (26)	.16
Warfarin	53 (20)	5 (20)	48 (20)	>.99
Other	22 (8)	5 (19)	17 (7)	.05
Antiplatelets				
Aspirin	111 (41)	15 (60)	96 (39)	.05
Clopidogrel	23 (8)	2 (8)	21 (9)	>.99
NSAIDs	22 (8)	1 (4)	21 (9)	.70
Etiology of GIB (No. [%])				.005
AVM	7 (3)	0	7 (3)	
Diverticular	50 (18)	0	50 (20)	
Definitive	27 (10)	0	27 (11)	
Presumptive	23 (8)	0	23 (9)	
Ischemic colitis	19 (7)	5 (20)	14 (6)	
Hemorrhoidal	21 (8)	5 (20)	16 (7)	
Rectal or jejunal varices	2 (1)	0	2 (1)	
Inflammatory colitis	48 (18)	4 (16)	44 (18)	
Infectious colitis	9 (3)	2 (8)	7 (3)	
Postpolypectomy	22 (8)	0	22 (9)	
Radiation proctitis	7 (3)	1 (4)	6 (2)	
Jejunal/ileal ulcer	4 (1)	0	4 (2)	
Unidentified source	82 (30)	9 (36)	73 (30)	

Characteristic	Total cohort (N=271)	In-hospital LGIB (n=25)	LGIB on presentation to hospital (n=246)	P value
Charlson Comorbidity Index (score [IQR]), median	6 (3–8)	7 (6–9)	5 (2–8)	.002
Blood transfusion (No. [%])	109 (40)	15 (60)	94 (38)	.05
Fresh frozen plasma (No. [%])	34 (13)	7 (28)	27 (11)	.02
ICU care (No. [%])	75 (28)	15 (60)	60 (25)	<.001
Medications on discharge (No. [IQR]), median	10 (6–13)	12 (8–15)	9 (6–13)	.05
Nadir hemoglobin (g/dL), median ^b	9.4	7.7	9.6	<.001
LOS (d [IQR]), median	4 (2–8)	12 (10–23)	3 (2–7)	<.001

^a AVM = arteriovenous malformation; GIB = gastrointestinal bleeding; IBD = inflammatory bowel disease; ICU = intensive care unit; IQR = interquartile range; LGIB = lower gastrointestinal bleeding; LOS = length of stay; NSAID = nonsteroidal anti-inflammatory drug.

^b SI conversion factor: To convert hemoglobin values to g/L, multiply by 10.0.

TABLE 2 Endoscopic and Radiologic Procedures Performed in the Hospital^a

Procedure (No.	Procedures performed [% of total]) (n=271)	Positive findings (No. [% of procedures]) ^b
Upper endoscopy	67 (25)	0
Colonoscopy	125 (46)	58 (46)
Push enteroscopy	2 (1)	1 (50)
Single balloon	2 (1)	0
Sigmoidoscopy	66 (24)	45 (68)
Capsule endoscopy	8 (3)	2 (25)
CT angiography	45 (17)	14 (31)
Tagged red blood cell scan	7 (3)	1 (14)
IR angiography	16 (6)	7 (44)
No procedures performed	49 (18)	
Endoscopy intervention	21 (8)	
Any intervention ^c	46 (17)	

^aCT = computed tomography; IR = interventional radiology.^bPercentage calculated by the number of respective procedures performed.^cEndoscopic, radiographic, or surgical intervention required for gastrointestinal bleeding.

TABLE 3

Factors Associated With 30-Day Readmissions and Recurrent GIB on Univariate Cox Proportional Hazards Regression Models^a

Clinical variable	30-d readmissions			Recurrent GIB		
	HR	95% CI	P value	HR	95% CI	P value
In-hospital LGIB	2.26	1.08–4.28	.03	1.00	0.16–3.45	>.99
Age	1.00	0.99–1.01	.96	0.99	0.96–1.01	.18
Male sex	0.96	0.57–1.63	.89	0.87	0.36–2.06	.75
Anticoagulated at time of LGIB	1.82	1.05–3.10	.03	1.64	0.65–3.90	.28
Anticoagulation at d/c ^b	1.60	0.84–2.85	.15	2.93	1.15–6.95	.02
LOS >4 d	1.78	1.05–3.04	.03	1.01	0.41–2.39	.98
ICU care	1.03	0.56–1.80	.93	1.02	0.36–2.51	.97
Active malignancy	2.33	1.11–4.42	.03	1.00	0.16–3.46	.99
IBD	0.89	0.42–1.68	.73	1.32	0.43–3.36	.60
Cirrhosis	1.73	0.72–3.58	.20	0.53	0.03–2.56	.50
History of GIB	1.04	0.58–1.81	.88	0.49	0.14–1.33	.17
No. of discharge medications	1.07	1.02–1.11	.005	1.03	0.95–1.10	.44
Aspirin on discharge	0.96	0.54–1.66	.89	0.21	0.03–0.71	.009
Diverticular bleed	1.15	0.55–2.18	.70	0.88	0.21–2.61	.84
Any intervention	1.73	0.89–3.13	.10	2.15	0.77–5.29	.14
Blood transfusion	1.33	0.78–2.25	.29	0.85	0.33–2.00	.71
Lowest hemoglobin level in hospital	0.90	0.79–1.01	.09	0.99	0.81–1.19	.88
Ischemic colitis	0.79	0.19–2.14	.68	<.001	NA ^c	.08
No source identified	0.87	0.48–1.50	.62	0.95	0.36–2.27	.91
No procedures performed	0.93	0.43–1.81	.85	0.84	0.20–2.47	.77
No procedures and no source identified	0.77	0.39–1.42	.42	0.95	0.31–2.42	.92
Charlson Comorbidity Index score	1.06	0.98–1.14	.14	0.97	0.86–1.09	.63

^a d/c = discharge; GIB = gastrointestinal bleeding; HR = hazard ratio; IBD = inflammatory bowel disease; ICU = intensive care unit; LGIB = lower gastrointestinal bleeding; LOS = length of stay; NA = not applicable.

^b Refers to index hospital d/c.

c, Unstable model, no patients with ischemic colitis and recurrent bleeding.

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TABLE 4
Intervention During Index Hospitalization and 30-Day Outcomes by Etiology of LGIB^a

Etiology of LGIB ^b	Treatment during index hospitalization (No.)				Recurrent GIB (No.)		
	Endo ^c	Angio	Surgical	None	30-d readmissions (No.)	Hospital admission	ED visit
Diverticular (n=50)	7	8	3	32	11	4	0
Inflammatory colitis (n=48)	0	0	5	43	11	6	2
Postpolypectomy (n=22)	11	1	0	10	4	2	0
Hemorrhoidal (n=21)	0	0	2	19	6	3	0
Ischemic colitis (n=19)	0	0	1	18	4	0	1
Radiation proctitis (n=7)	3	0	1	3	2	0	1
No source (n=82)	0	0	0	82	19	6	1
							3

^a angio = angiographic; ED = emergency department; endo = endoscopic; GIB = gastrointestinal bleeding; LGIB = lower gastrointestinal bleeding.

^b Refers to the etiology of LGIB at the index hospitalization.

^c Endoscopic intervention (argon plasma coagulation, electrocautery, clips, or epinephrine).

TABLE 5

Factors Associated With 30-Day Mortality in Patients Hospitalized With LGIB

Variable	OR	95% CI	P value
In-hospital LGIB	11.5	2.56–52.0	.002
Age	1.04	1.00–1.10	.06
Charlson Comorbidity Index score	1.57	1.25–2.08	<.001
ICU requirement	4.50	1.08–22.4	.04
Active malignancy	6.57	1.28–28.7	.03
Congestive heart failure	3.91	0.77–16.7	.07
Renal failure	1.95	0.39–8.15	.39
LOS >4 d	4.44	1.00–30.7	.05
Blood transfusion	0.89	0.18–3.70	.88
Use of FFP	7.73	1.75–34.3	.009

FFP = fresh frozen plasma; ICU = intensive care unit; LGIB = lower gastrointestinal bleeding; LOS = length of stay; OR = odds ratio.