# Lower Gastrointestinal Bleeding

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**KEYWORDS**

• Lower gastrointestinal bleeding • Emergency • Surgery

**KEY POINTS**

- Most episodes of lower gastrointestinal bleeding stop spontaneously and can be effectively managed with common clinical tools.
- Computed tomography angiography is widely available and expeditious for localization of gastrointestinal bleeding.
- Resuscitative endovascular balloon occlusion of the aorta (REBOA) may temporize the unstable patient with gastrointestinal bleed, allowing definitive therapy.
- Standard upper and lower endoscopy allows diagnosis and therapeutic management for most presentations of gastrointestinal bleeding.

## INTRODUCTION

Gastrointestinal bleeding, responsible for 612,000 hospital days and $1.2 billion in aggregate health care expenditures in 2009,[1] is a common clinical problem encountered by general surgeons. Hospitalization for gastrointestinal bleeding increased 22% between 2000 to 2009,[1] likely a consequence of an increasing elderly population and proliferating anticoagulant usage.

Hematochezia or melena are frequent clinical impetus for patients to seek evaluation. Although not definitive for localization, their presence in the absence of hematemesis raises the suspicion of lower gastrointestinal bleeding (LGIB), defined as gastrointestinal bleeding with a source distal to the ligament of Treitz. LGIB is associated with colonic sources, such as diverticulosis or angiodysplasia, but can include small bowel sources. LGIB outcomes are more favorable than upper gastrointestinal bleeding (UGIB) and 80% resolve spontaneously.[2] Less invasive efficacious interventions likely contributed to the decline in mortality and morbidity over the preceding 20 years.[3]

Because general surgeons have clinical expertise in hemorrhagic shock, critical care, vascular access, endoscopy, and definitive surgical interventions, they are

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well-equipped to manage LGIBs, particularly in resource-limited settings. Evaluation and management goals for LGIB are constant: resuscitate the patient, localize the source, control the bleeding, and prevent recurrence. We review diagnostic and management modalities the general surgeon should be prepared to execute when managing LGIB.

## INITIAL EVALUATION

Bleeding acuteness, duration, number of episodes, pain, melena, heartburn, hematemesis, recent endoscopic, colorectal or aortic procedures, nonsteroidal anti-inflammatory drug (NSAID) use, smoking, and caffeine consumption may direct suspicions to an upper or lower etiology. Comorbid conditions such as heart disease, heart failure, chronic kidney disease, or cirrhosis may also suggest etiologies and affect management decisions.

Physical examination findings, such as irregularly irregular heart rhythm, spider angiomas, palmar erythema, scleral icterus, jaundice, caput medusa, or abdominal guarding may suggest etiologies and exacerbating factors. Because hemorrhoids were the most common etiology for hematochezia in one series of emergency department patients, rectal examination or anoscopy should be considered.[4]

Impaired mentation, confusion, stupor, agitation, obtundation, pallor, cyanosis, diaphoresis, tachypnea, accessory muscle use, extensive hematemesis, gross hematochezia, or objective findings, such as tachycardia, hypoxemia, or hypotension, suggest an unstable patient in need of urgent resuscitation.

Complete blood count, complete metabolic panel, ionized calcium, prothrombin time, international normalized ratio, partial thromboplastin time, fibrinogen, lactate, and arterial blood gas are considered based on severity of presentation. Thromboelastography allows rapid characterization of coagulation deficits or anticoagulant effect and may aid in targeting component blood therapy.

After initial workup, the patient may be categorized as stable or unstable to clarify the subsequent algorithm for localization and control. Patients not anticoagulated, with hemoglobin greater than 13 g/dL, and systolic blood pressure greater than 115 mm Hg, may be managed with interval endoscopy as an outpatient.[5] Other patients may be admitted to a level of care appropriate to the severity of presentation.

## RESUSCITATION OF THE UNSTABLE PATIENT

Patients in extremis or pulseless may require initiation of cardiopulmonary resuscitation and consideration of dramatic salvage options. Like penetrating injuries, gastrointestinal bleeding is frequently a point source, and trauma management principles can be applied to catastrophic LGIB. Resuscitative thoracotomy allows rapid control of infra-diaphragmatic bleeding, though outcomes in LGIB are not reported and likely poor.

Resuscitative endovascular balloon occlusion of the aorta (REBOA), with relatively low cost and growing availability, is increasingly used for nontraumatic hemorrhage. REBOA for nontraumatic hemorrhage had a lower 24-hour mortality (19% vs 51%, $P = .001$) but prolonged critical care course and similar overall mortality (68% vs 64%) to traumatic hemorrhage.[6] Another report found a mortality rate of 36% ($n = 11$) despite 64% of patients presenting in arrest.[7] REBOA for salvage in life-threatening LGIB is feasible, and future data may elucidate the optimal application.

Unstable patients with a pulse may be initially managed following principles of trauma resuscitation. Supplementary oxygen will pre-oxygenate for possible airway control and optimize oxygen delivery. Pulse oximetry, cardiac rhythm, and blood

pressure monitoring should be continuous. Should the airway require control, ketamine or etomidate have favorable hemodynamic profiles for sedation.[8] Dual intravenous access (18 g or larger) is critical for therapeutic interventions. Intraosseous access, even in multiple extremities, is a rapid alternative, preventing delays in therapeutic intervention when peripheral access is difficult. If adequate access remains difficult, large-bore infusion catheters or introducer sheaths are preferred over standard size central venous catheters. Femoral placement in the urgent setting can be performed using landmarks, is easily compressible if hematoma occurs, and reserves alternative locations for clean placement in the nonurgent setting.

Prolonged attempts to measure blood pressure or place invasive lines should not delay empiric treatment with blood products. Transfusion of packed red blood cells, fresh frozen plasma (FFP), and platelets in at least 1:2:2 ratio is a standard of care in traumatic hemorrhagic shock. As applied to nontraumatic hemorrhage, several reports found no benefit of higher ratio (1:1:1) transfusion.[9,10] Massive transfusion, with a rapid hemodynamic response to fewer than 10 units, is associated with increased morbidity.[11] Should access to blood products be exhausted, isotonic crystalloid or albumin solution are alternatives. Volume can be infused concurrently through multiple sites with rate titrated to hemodynamic response. Pressure bags, manual compression, or rapid transfusion devices allow faster infusion than standard pumps set to maximum rate. If available, in-line warming should be used, as insufficient evidence of harm to blood products exists.[12]

Hypocalcemia, acidosis, and hypothermia contribute to coagulopathy and empiric administration of calcium and bicarbonate, as well as active patient rewarming are warranted. Tranexamic acid, a low-cost antifibrinolytic agent with a mild risk profile, reduces mortality in traumatic hemorrhagic shock. Despite a possible benefit in UGIB, a recent randomized controlled trial did not corroborate any benefit in LGIB.[13]

Reversal of anticoagulant agents should be considered. Clinical status and underlying indication can be considered in determining the duration and degree of reversal. Warfarin can be reversed in approximately 10 minutes with prothrombin-complex concentrates (PCC). PCC has durable effect at 48 hours and may be useful in comorbid conditions in which large-volume transfusion is less desirable.[14] FFP reversal of warfarin is slower and less durable than PCC but more cost-effective. If prolonged reversal is acceptable, vitamin K provides reversal within 12 to 24 hours and may minimize the risk of rebleeding, as effect of acute reversal wanes. Platelet transfusion occurs empirically with massive transfusion, but is commonly practiced in patients taking antiplatelet agents. Platelet transfusion in gastrointestinal bleeding with platelet counts greater than $100 \times 10^9$/L has limited benefit and may increase mortality.[15]

Proliferating novel oral anticoagulants (NOACs) and absence of reversal agents has created difficulty managing severe hemorrhage. For doses taken less than 2 hours prior, activated charcoal may limit absorption but can obscure endoscopic visualization. PCC may partially reverse NOAC agents, but thromboembolic risk, cost, and lack of evidence may limit use to unstable patients. Dabigatran can be reversed with the monoclonal antibody agent idarucizumab. Oral factor Xa inhibitors (rivaroxaban, apixaban, edoxaban, and betrixaban) currently have no reversal agents approved by the Food and Drug Administration and cannot be dialyzed, thus rendering care supportive. Depending on renal function and agent half-life, the anticoagulant effect may subside after 24 hours. When approved, investigational agents andexanet alfa (universal factor Xa antidote) and ciraparantag (direct thrombin inhibitors, factor Xa inhibitors, and heparins) should alleviate this dilemma.[16]

## URGENT LOCALIZATION AND CONTROL IN THE UNSTABLE PATIENT

With resuscitation initiated, gross localization of bleeding source to upper or lower gastrointestinal tract aids in determining the appropriate treatment algorithm. Although melena or hematochezia without hematemesis suggests LGIB, the prevalence of UGIB in this scenario is between 32% and 74%.[17] Known liver disease or presence of stigmata suggests variceal UGIB better suited to nonsurgical interventions, such as endoscopic banding or transjugular intrahepatic portosystemic shunting. Nasogastric tube aspiration is described to differentiate UGIB and LGIB, but numerous reports suggest both poor sensitivity and negative predictive value.[17,18] Of patients with melena but not hematemesis, 93% with a confirmed UGIB source had at least 2 of the following: presence of melena, age younger than 50, or blood urea nitrogen:creatinine ratio less than 30.[19]

Detailed later, several options for rapid localization and control of bleeding exist. Computed tomography angiography (CTA) for localization is rapid, widely available, and has excellent sensitivity in identifying bleeding sources. In the unstable patient, angioembolization is frequently recommended as the initial diagnostic and therapeutic modality due to its favorable risk profile and hemostasis efficacy. Upper endoscopy is the gold standard for localization and control if UGIB suspicion is high, but aspiration risk and airway protection must be considered. If the above resources are unavailable, empiric operative intervention may be appropriate. A suggested algorithm for diagnosis and management of LGIB is presented in **Fig. 1**.

## CONSIDERATION OF TRANSFER

Patient transfer is associated with increased in-hospital mortality for diverticular bleeds.[20] Spontaneous resolution occurs in 80% of LGIB, only 18% require

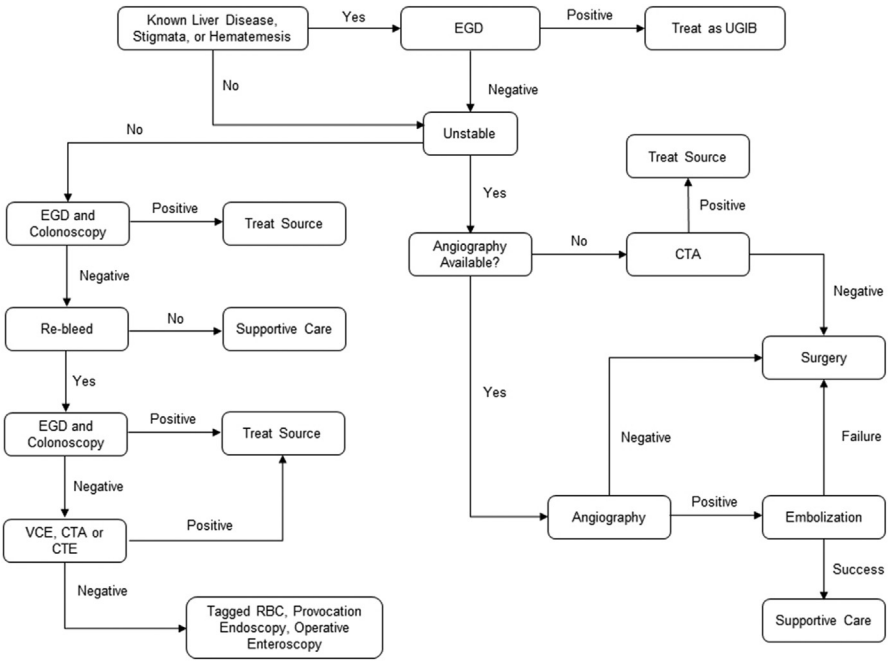


**Fig. 1.** Suggested algorithm for LGIB management. EGD, esophagogastroduodenoscopy.

transfusion, and only 8.5% require more than 2 units.[4,21] Of patients meeting traditional indications for operative intervention, 60% were managed nonoperatively without mortality.[22] Multiple prediction tools are described to identify high-risk patients with LGIB, but none has achieved universal acceptance. Commonly described characteristics include hypotension, tachycardia, gross blood on rectal examination, recurrent hematochezia within 4 hours, and increasing number of comorbidities (chronic obstructive pulmonary disease, chronic kidney disease, diabetes mellitus).[23]

For stable patients, these reports highlight most patients can be safely managed with limited resources and avoid costly transfer. For unstable patients, however, the need and availability of significant resources is an important determinant of whether transfer to high care should be considered. Emergent surgical intervention to control LGIB bleeding may be appropriate even in the patient requiring subsequent transfer for additional resources. Dao and colleagues[20] suggest deference of urgent surgical intervention for diverticular bleeding may be a source of increased mortality noted in transfer patients. The decision to transfer is a complex assessment of variables the surgeon must make based on clinical experience and available resources.

## ENDOSCOPIC TECHNIQUES FOR LOCALIZATION AND CONTROL

Flexible endoscopy is the standard of care for localization and control of gastrointestinal bleeding in the stable patient. In evaluation of LGIB, upper endoscopy should be considered to exclude UGIB sources. Urgent (<24 hours) colonoscopy is recommended in some LGIB management guidelines suggesting benefits of increased localization, reduced rebleeding, and reduced need for surgery.[24] Meta-analyses report similar findings of improved localization, but no difference in bleeding recurrence, transfusion requirement, or surgical intervention was evident.[25] Improved source localization favors urgent colonoscopy in patients with recurrent LGIB following prior unsuccessful localization attempts. Regardless of timing, adequate bowel preparation increases diagnostic yield, success of cecal intubation, and reduces perforation risk. Suspected postpolypectomy bleeding is a notable exception in which enema alone may be adequate for successful localization and intervention.[26] High-volume (4 to 6 L) polyethylene glycol preparations have been associated with better visualization.[27] Nasogastric tube placement and prokinetic agent administration may facilitate completion of bowel preparation in the patient intolerant of oral intake. The benefit of aggressive bowel preparation must be weighed against risks of aspiration and airway compromise in the unstable or debilitated patient.

The potential of therapeutic intervention, in addition to diagnostic ability, makes colonoscopy the standard of care in stable patients with LGIB patients. Powered irrigation systems are beneficial for clearing residual intraluminal blood and breaking up clots. Visualized active bleeding, a nonbleeding visible vessel, or adherent clot may herald a hemorrhagic source and prompt intervention, but the possibility of additional proximal sources should not be excluded. Initial epinephrine injection may temporize active bleeding and improve visualization for additional interventions. Mucosal lift with saline injection may improve access to technically difficult locations enabling interventions. Diverticular and postpolypectomy bleeding are frequently amenable to epinephrine injection and hemostatic clip placement, although band ligation has been described. Emerging topical hemostatic agents offer a technically easy and rapid approach to achieving high rates of immediate endoscopic hemostasis (96.5%, n = 108), but may be associated with higher bleeding recurrence.[28] Argon beam coagulation is frequently described for colonic angiodysplasia with a reported success rate of 85% and may achieve hemostasis in radiation colitis or gastrointestinal tumors as

well.[29] Equipment availability and local experience will determine the precise techniques used. The ACG Guideline for Management of Patients with Acute LGIB (2016) is available for free on the Internet[30] and is a rich source of technical details for performing endoscopic hemostatic therapies.[24]

## RADIOGRAPHIC TECHNIQUES FOR LOCALIZATION AND CONTROL

CTA, with a reported sensitivity of 84.8% and specificity of 96.9%, is a useful resource to localize gastrointestinal bleeding, particularly when localization may aid urgent transfer or surgical decision-making.[31] CTA more frequently identified an active bleeding source (31.3% vs 14.8%, $P = .031$) with a similar rate of inconclusive examinations when compared with endoscopy.[32] The shorter time to performance of CTA versus endoscopy underscores the utility of CTA for rapid diagnosis. Compared with tagged-red blood cell (RBC) scintigraphy, CTA was found to have a superior localization rate (38% vs 53%, $P = .008$).[33] CTA before traditional angiography reduced the number studies performed and, despite an increase in contrast administration, did not adversely affect renal function.[34]

Tagged-RBC scintigraphy is a well-described diagnostic modality in gastrointestinal bleeding with a reported accuracy of 75% in localization.[35] Advantages may include high sensitivity for slow bleeding and ability to perform repeat examinations to identify intermittent bleeding up to 48 hours after tagged-RBC infusion. Despite advances in imaging acquisition technology, the true positive rate was only 39% in one recent retrospective series.[36] The investigators noted a false-positive rate of 10%, which resulted in 5 surgeries that they labeled as "incorrect surgeries." Positivity within 2 hours was associated with higher accuracy (86%) in localization.[35] Positivity $\leq$9 minutes from injection has a sensitivity of 92% and a 6.1-fold increase ($P = .020$) in likelihood of a positive finding on subsequent angiography. This relationship was inversely correlated with increasing time between positive scan and angiography, underscoring the need to expeditiously obtain CTA or angiographic confirmation of a positive tagged-RBC scan.[37] Delayed positivity (3–24 hours after injection) was associated with greater frequencies of transfusion, surgery, and bleeding source located in the stomach or small bowel.[38] Additional weakness of scintigraphy, beyond lacking therapeutic value, include imprecise localization, time requirement for the examination, and false positives or incorrect localization due to radiotracer migration and pooling. The current role of scintigraphy is less clear than historically, but likely most applicable in stable patients with unrevealing endoscopic and/or angiographic examinations.

Catheter angiography is the only radiologic modality imparting both diagnostic and therapeutic capability, making it critical in the unstable patient where time required for bowel preparation and endoscopy is prohibitive. In LGIB, angiography following a positive CTA has a localization success rate between 48% and 67% with less than 90 minutes to angiography enhancing the detection rate.[39] Among identified active bleeding, selective angiography and embolization achieved a 100% rate of immediate hemostasis, but was associated with recurrent bleeding in as frequently as 35% of cases within 30 days.[40] Ischemic events were reported in only 0% to 5% of embolizations performed in several recent retrospective series.[39,41] Success of embolization for active tumor-associated hemorrhage was reported in 91% (n = 11) of cases without an incident of intestinal ischemia.[41] Considering resource utilization, invasiveness, and potential morbidity (eg, hematoma, infection, pseudoaneurysm, arteriovenous-fistula), angiography seems best used when therapeutic interventions are likely, such as in unstable patients.

Impaction of diverticula via high-dose barium enema is reported as an effective therapy for hemostasis in patients with acute diverticular bleeding with a source not identifiable by urgent colonoscopy.[42] A small randomized controlled trial of barium enema after resolution of diverticular bleeding demonstrated a reduction of recurrent bleeding at 1 year. Although these reports have limitations, given its safety, the utility of barium impaction therapy as a salvage therapy for multiply-comorbid patients to avoid surgery is intriguing.

## RECURRENT AND OBSCURE LOWER GASTROINTESTINAL BLEEDING

Recurrence of LGIB is common. Reported readmission rate for recurrent LGIB is 13.7% at 14 days, and 19.0% at 1 year.[43,44] Risk factors identified include malignancy, nonsteroidal anti-inflammatory use, nonaspirin antiplatelet agents, dual antiplatelet therapy, and age older than 65.[43,44]

Early rebleeding in the unstable patient can be evaluated and treated with angiography and embolization or, if previously localized, surgical intervention. Previously localized sources in the stable patient can be addressed based on management of the underlying etiology. The most challenging scenarios occur with recurrent bleeding after inconclusive attempts at localization. Repeat (ie, "second-look") upper and lower endoscopy has diagnostic yield of 40% to 65% and should be considered.[45] Continued failure to localize bleeding should prompt evaluation for suspected small bowel source.

Obscure gastrointestinal bleeding was defined as unlocalized recurrent bleeding despite standard upper and lower endoscopy as well as radiographic evaluations. Because small bowel pathology in identified in most cases, this scenario is alternatively referred to as "suspected small bowel bleeding." Angiodysplasia, inflammatory bowel disease, Dieulafoy lesions, neoplasms, and NSAID ulcers are frequently cited etiologies.[46] Evaluation of small bowel bleeding sources may include a combination of CTA, computed tomography enterorrhaphy (CTE), or video capsule endoscopy (VCE). VCE has become the primary endoscopic modality for initial evaluation of suspected small bowel bleeding with a diagnostic yield of 38% to 83%.[47] Abdominal pain, signs of bowel obstruction, history of inflammatory bowel disease, or suspected adhesive disease should prompt abdominal imaging with CTE before performing VCE. In the stable patient with suspected active bleeding, CTA is preferred over CTE. A negative CTE can be subsequently evaluated with VCE. Dissolvable patency capsules can evaluate passage if capsule entrapment is a concern. Identified lesions, most commonly angiodysplasia, can be managed with deep enteroscopy (eg, push, single-balloon, double-balloon) and endoscopic hemostatic methods (ie, argon beam coagulation) although some question the long-term efficacy of this technique.[48] Regardless, deep enteroscopy is an uncommon surgeon skill and may require collaboration with experienced gastroenterologists.

Rarely, a bleeding source remains elusive despite extensive attempts at localization. Repeat VCE within 2 weeks, particularly with overt rebleeding or a >4 g/dL drop in hemoglobin, has a 50% to 75% diagnostic yield.[49] Pharmacologic provocation using fibrinolytics, anticoagulants, and vasodilators during angiography is another approach to identify occult bleeding sources, with a success rate of 29% to 80%.[50] Endoscopy with heparin and clopidogrel provocation had a diagnostic yield of 71% for occult bleeding sources, frequently angiodysplasia or Dieulafoy lesions, without any adverse events.[51] Intraoperative small bowel enteroscopy is an effective but morbid diagnostic option when surgical therapy is undertaken or all other modalities are exhausted. Recurrent obscure gastrointestinal bleeding is a challenging scenario that requires a methodical and persistent approach to successfully manage.

## SURGICAL INTERVENTIONS FOR LOCALIZATION AND CONTROL

Indications for surgical intervention may include unavailable or unsuccessful angiography in the unstable patient, recurrent bleeding despite repeated endoscopic or angiographic interventions in the stable patient, or etiology best managed by definitive resection, such as neoplasm. Although 60% of patients meeting them can be managed nonoperatively without mortality, traditional indications for surgery include more than 6 units of blood, hemodynamic instability, continued bleeding longer than 72 hours, or rebleeding more than 24 hours after presentation.[22] A suggestive algorithm for surgical decision-making is presented in Fig. 2.

Most literature on LGIB surgical interventions are retrospective and published before damage control surgery was widely adopted. Without adequate evidence to guide decisions, a variety of approaches are reasonable and ultimately a judgment of the surgeon. We present an approach using patient stability and localization as major determinants for surgical decision-making.

If a bleeding source has been localized, in the stable patient, anatomic resection and anastomosis is an ideal approach, although patient factors may exclude primary anastomosis. In the unstable patient with localized LGIB, anatomic resection for bleeding control with temporary abdominal closure may be considered. Anastomosis or ostomy creation can be subsequently considered depending on comorbidities and resuscitation response.

If a bleeding source has not been localized, upper endoscopy to exclude UGIB sources may prevent morbid empiric resections. If an UGIB source is identified and endoscopic hemostasis is unsuccessful, operative intervention can be immediately performed to achieve control of nonvariceal sources. Variceal bleeding can be addressed endoscopically by an appropriately skilled endoscopist or temporized with tamponade catheters, such as the Blakemore or Minnesota tube, allowing

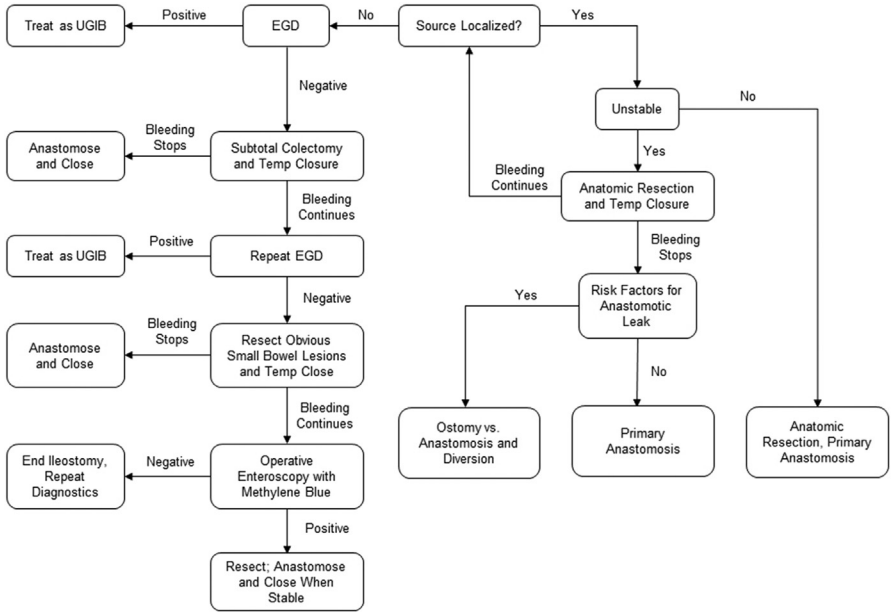


**Fig. 2.** Suggested algorithm for surgical management of LGIB. EGD, esophagogastroduodenoscopy; Temp, temporary.

transfer to a facility with appropriate resources. Depending on patient stability, colonoscopy may be attempted for suspected postpolypectomy bleeding, but is less successful for other etiologies in the unprepped patient. If a bleeding source remains elusive, abdominal exploration is indicated.

In the unstable patient with unlocalized LGIB, subtotal colectomy is the traditional empiric surgical intervention. Rebleeding risk with segmental colon resection is greater than with subtotal colectomy, although the limited evidence does not agree whether this confers increased mortality.[52–55] Ileorectal anastomosis was described in most of these series, a practice avoided today in unstable patients. Unsurprisingly, anastomotic leak was the primary source of mortality in one series.[54] Resection with temporary closure and delayed anastomosis is a reasonable approach. Oncologic mesenteric resection should be performed for suspicions of a neoplastic process if feasible. Before colonic mobilization, if an intact ileocecal valve is present, an enterotomy in the distal ileum may allow identification of proximal blood, suggesting a small bowel etiology. Exploration for a Meckel diverticulum or mass can be performed before empiric colon resection.

In stable patients with unlocalized LGIB, all endoscopic and radiographic modalities for localization of small bowel bleeding should be exhausted before any surgical intervention. Intraoperative enteroscopy may exclude small bowel etiology before performing an empiric resection. Intraoperative methylene blue injection may aid in the identification of bleeding source.[56] Voron and colleagues[57] provide a detailed technical review on the performance of this infrequently used technique. If intraoperative enteroscopy is unsuccessful, options include empiric resection of any bowel lesions (ie, Meckel diverticulum or mass), anatomic segmental resection based on suspicions (ie, sigmoidectomy for extensive diverticulosis), or an empiric subtotal colectomy with anastomosis. Surgical intervention for unlocalized bleeding in the stable patient is a vexing challenge.

## OTHER MANAGEMENT ISSUES IN LOWER GASTROINTESTINAL BLEEDING

High-risk patients not requiring immediate intervention should be closely monitored. Invasive hemodynamic monitoring may be beneficial and adequate vascular access is critical. Urgently placed semi-sterile access should be replaced when prudent. Hemoglobin, lactate, electrolyte, creatinine, and coagulation parameters can be followed at a frequency appropriate to patient stability. Dynamic measures of volume responsiveness (pulse-pressure variability) have superior predictive value than traditional static measurements (central venous pressure) and may guide volume resuscitation.[58] Point-of-care transthoracic ultrasonography may aid assessment of cardiac function and volume status. Persistent hypotension despite adequate volume resuscitation suggests concurrent cardiac pathology, which electrocardiogram, serial troponins, and transthoracic echocardiography may elucidate.

Resuscitation goals may include mean arterial pressure greater than 65 mm Hg, systolic blood pressure higher than 90 mm Hg, central venous saturation of greater than 60%, urine output of greater than 0.5 mL/kg/h, and normalization of lactic acid or base deficit. Goals of 0.9 mmol/L for ionized calcium, pH >7.1, and temperature higher than 34°C may correct and prevent coagulopathy. Maintenance of hemoglobin greater than 7.0 g/dL is standard of care for critically ill patients with a goal of greater than 8.0 g/dL in the setting of acute coronary syndrome or chronic cardiovascular disease.[59] Several studies examined liberal (<9 g/dL) and restrictive (<7 g/dL) transfusion triggers in UGIB and found no difference in mortality, morbidity, and myocardial infarction, but advantages including reduced blood product usage and shorter length of stay.[60,61]

Evidence to guide resumption of anticoagulants after LGIB is limited. Deep venous thrombosis prophylaxis may be safe 24 hours after LGIB.[62] Review of medications and indications may identify anticoagulants for discontinuation to reduce rebleeding risk, although risk-benefit discussion with the prescribing physician may be required. Resumption of non-NOAC anticoagulation 7 days after LGIB does not increase risk of recurrent bleeding, but does reduce risk of thromboembolic events.[63] NSAID use may increase risk of recurrent LGIB and should be avoided.[64] Proton pump inhibitor prophylaxis is recommended by some guidelines to mitigate this risk. Future evidence will clarify the best approach to managing anticoagulation post-LGIB.

## SUMMARY

LGIB is a common entity in general surgery practice. Familiarity with the various diagnostic and therapeutic modalities is necessary for optimal patient care. Evolving resuscitation strategies, pharmaceuticals, diagnostic technology, and management devices are altering traditional management algorithms. As less invasive interventions become more efficient, surgical interventions are becoming less frequent. With experience in managing hemorrhagic shock, endoscopy, and definitive surgical interventions, the surgeon knowledgeable of the evolving practice landscape is well-positioned to provide efficient and complete care to most patients with LGIB.

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