American College of Radiology
ACR Appropriateness Criteria®
Radiologic Management of Lower Gastrointestinal Tract Bleeding

Variant 1: **Lower gastrointestinal tract bleeding. Active bleeding clinically observed as hematochezia or melena in a hemodynamically stable patient. Next step.**

Procedure	Appropriateness Category
CTA abdomen and pelvis without and with IV contrast	Usually Appropriate
Diagnostic/therapeutic colonoscopy	Usually Appropriate
RBC scan abdomen and pelvis	Usually Appropriate
Transcatheter arteriography/embolization	May Be Appropriate
MRA abdomen and pelvis without and with IV contrast	Usually Not Appropriate
Surgery	Usually Not Appropriate

Variant 2: **Lower gastrointestinal tract bleeding. Active bleeding in a hemodynamically unstable patient or a patient who has required more than 5 units of blood within 24 hours. Next step.**

Procedure	Appropriateness Category
CTA abdomen and pelvis without and with IV contrast	Usually Appropriate
Transcatheter arteriography/embolization	Usually Appropriate
Diagnostic/therapeutic colonoscopy	May Be Appropriate (Disagreement)
Surgery	May Be Appropriate
MRA abdomen and pelvis without and with IV contrast	Usually Not Appropriate
RBC scan abdomen and pelvis	Usually Not Appropriate

Variant 3: **Lower gastrointestinal tract bleeding. Colonoscopy localized the bleeding site and treatment was attempted. Ongoing or recurrent bleeding. Next procedure or intervention.**

Procedure	Appropriateness Category
Transcatheter arteriography/embolization	Usually Appropriate
CTA abdomen and pelvis without and with IV contrast	May Be Appropriate (Disagreement)
Diagnostic/therapeutic colonoscopy	May Be Appropriate (Disagreement)
Surgery	May Be Appropriate
MRA abdomen and pelvis without and with IV contrast	Usually Not Appropriate
RBC scan abdomen and pelvis	Usually Not Appropriate

Variant 4: **Lower gastrointestinal tract bleeding. Transcatheter arteriography localized the bleeding site and treatment was attempted. Ongoing or recurrent bleeding. No other prior radiological or endoscopic investigations. Next procedure or intervention.**

Procedure	Appropriateness Category
Diagnostic/therapeutic colonoscopy	Usually Appropriate
CTA abdomen and pelvis without and with IV contrast	May Be Appropriate
Surgery	May Be Appropriate
Transcatheter arteriography/embolization	May Be Appropriate
MRA abdomen and pelvis without and with IV contrast	Usually Not Appropriate
RBC scan abdomen and pelvis	Usually Not Appropriate

Variant 5: **Lower gastrointestinal tract bleeding. Obscure (nonlocalized) recurrent bleeding in a hemodynamically stable patient (assumes a prior negative adequate colonoscopy and upper gastrointestinal endoscopy). Next procedure or intervention.**

Procedure	Appropriateness Category
Capsule endoscopy	Usually Appropriate
CT enterography abdomen and pelvis with IV contrast	Usually Appropriate
MR enterography	May Be Appropriate
Push enteroscopy	May Be Appropriate
RBC scan abdomen and pelvis	May Be Appropriate
RBC scan with SPECT or SPECT/CT abdomen and pelvis	May Be Appropriate
Transcatheter arteriography/embolization	May Be Appropriate (Disagreement)
Fluoroscopy small-bowel follow-through	Usually Not Appropriate
Surgery	Usually Not Appropriate

RADIOLOGIC MANAGEMENT OF LOWER GASTROINTESTINAL TRACT BLEEDING

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Summary of Literature Review

Introduction/Background

Acute gastrointestinal tract bleeding (GIB) remains an important cause of morbidity and mortality. In the United States, >750,000 patients visit the emergency department each year with GIB, and in nearly half of those visits, the source of GIB is in the lower gastrointestinal tract [1]. Despite advances in management, the mortality rate for patients with GIB remains at approximately 10% but increases to 40% in cases of massive bleeding associated with hemodynamic instability or the requirement for transfusion of >4 units of blood. Acute lower GIB is defined as bleeding into the large bowel or bleeding into the small-bowel distal to the ligament of Treitz. This condition may present as either melena or hematochezia, depending on the site and severity of bleeding. Causes of lower GIB include inflammatory bowel disease, neoplasms, stress ulcers, surgical anastomoses, vascular lesions such as angiodysplasia, and diverticulosis, with diverticulosis accounting for 30% of cases [2]. In a subgroup of patients, portal hypertension can cause lower GIB as a result of clinically obvious anorectal varices or obscure ectopic varices in the small or large bowel [3]. This publication focuses on the appropriateness of various diagnostic and therapeutic options in the management of acute nonvariceal lower GIB.

Approximately 75% of episodes of acute lower GIB due to diverticulosis stop spontaneously, especially in patients requiring transfusions of <4 units of blood over a 24-hour period [4]. Hence, in a substantial number of patients with acute lower GIB, conservative management is likely to be sufficient. For these patients, no immediate interventions are required, and diagnostic tests to identify the source of lower GIB can be arranged electively. In this document, the appropriateness of diagnostic and therapeutic options in various scenarios is discussed by variants. Availability and expertise were not considered when determining appropriateness. It is assumed all procedures and interventions are widely available and are performed and interpreted by an expert.

Special Treatment Considerations

Transcatheter Embolization

Transcatheter embolization should immediately follow transcatheter arteriography when the site of extravasation is seen. Recurrent bleeding and ischemic complications are less frequent when embolization is distal to a marginal artery [5] and when the length of devascularized bowel on completion angiography is a few centimeters or less [6]. The use of a microcatheter allows for distal access and superselective embolization of single vasa recta at the site of bleeding. Instead of embolic material, vasopressin infusion is indicated when a diffuse source of bleeding is identified or when superselective catheterization fails or is not technically possible. To provide targeted transcatheter embolization therapy, extravasation from a branch must be positively identified during arteriography. In the vast majority of hemodynamically stable patients, transcatheter arteriography is negative; for these patients, conservative management without embolization is sufficient [7].

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Technical success during transcatheter embolization is defined as successful deposition of the embolic agent in an arterial branch demonstrating contrast extravasation and subsequent cessation of contrast extravasation. Technical success rates in cases of lower GIB generally range from 73% to 100% [8-20]. When technical failure does occur, it is usually the result of vessel tortuosity or spasm.

Embolization is commonly performed using microcoils. Embolization using coils has demonstrated lower rates of recurrent bleeding than embolization with other agents (12% versus 36%) [21]. However, coils depend on an intact coagulation cascade for thrombus formation between the metallic struts to ensure hemostasis. *N*-Butyl cyanoacrylate (NBCA), a liquid adhesive agent that rapidly polymerizes upon contact with blood even in the presence of coagulopathy, has also been shown to demonstrate very high technical and clinical success rates (98% and 86%, respectively) with a low complication rate (6.1%) in patients with lower GIB [22]. Another agent that acts independently of any underlying coagulopathy or thrombocytopenia is ethylene-vinyl alcohol copolymer dissolved in dimethyl sulfoxide. In a study of 30 patients who underwent embolization using this copolymer for massive lower GIB, no differences were noted in outcomes between patients who had coagulopathy or were taking antiplatelet drugs and the remaining patients [23]. Overt rebleeding after technically successful transcatheter embolization is not uncommon. As a result, clinical success rates are usually lower than technical success rates. After superselective embolization of a distal branch at or near the vasa recta, collateralization that is known to prevent bowel necrosis can also cause rebleeding in the culprit lesion. In a recent series, although technical success rates of transcatheter embolization were higher, clinical success rates ranged from 63% to 96% [8-10,14-18,20], with rebleeding rates ranging from 11.1% to 50% [11-13,19,24]. In spite of this, transcatheter embolization has provided definitive treatment for 81% to 86% of patients [10,16].

The efficacy of transcatheter embolization varies depending on the location of the bleeding (eg, small bowel versus colon). Rebleeding is more common after small-bowel embolization than after colonic lesion embolization, likely because of the more robust vascular supply and greater number of potential collateral pathways in the small bowel [25]. The pathology causing the bleeding also affects success rates. A meta-analysis of 25 studies demonstrated that recurrent bleeding after superselective embolization occurred in only 15% of patients with colonic diverticular bleeding but occurred in 45% of patients with a pathologic lesion that had a more diffuse arterial blood supply (such as angiodysplasia or inflammatory bowel lesion) [14]. Coagulopathy is also a well-known risk factor for recurrent bleeding; in such cases, correction of coagulopathy is the first step for stable patients. In unstable patients, transcatheter embolization using liquid embolic agents such as NBCA may provide effective hemostasis, although a fair amount of expertise and control are needed when using this agent to avoid the ischemic complications that are likely when more branches of a single vasa rectum or more vasa recta are embolized [26]. In patients with underlying coagulopathy or low platelet count, an alternative to NBCA is ethylene-vinyl alcohol copolymer. However, this agent must also be used by an operator who is familiar with this technique to avoid retrograde reflux into a nontargeted vessel. Signs of minor ischemic injury to the bowel (such as self-limited abdominal pain or asymptomatic serum lactic acid elevation) are not uncommon sequelae of embolization in patients with lower GIB. However, major ischemic complications (those requiring treatment) are uncommon, usually occurring at a rate of 3% or lower (although a rate as high as 11% has also been reported) [8-20].

If a patient has had multiple bleeding episodes and a diagnosis has not been determined, provocative transcatheter arteriography can be used to identify the location of the bleeding. With this technique, anticoagulants, vasodilators, and thrombolytic drugs can be infused to provoke bleeding, allowing clinicians to identify the source. The yield of provocative arteriography ranges from 31% to 89% [27,28] in part because of the lack of a standardized technique. Even though this technique precipitates active bleeding, identification of the bleeding source allows treatment, and there are no published reports of a patient experiencing uncontrollable hemorrhage with this technique. Nevertheless, evidence to support routine use of provocative arteriography in rebleeding is not established, and this method should be used on a case-by-case basis based on local expertise.

Discussion of Procedures or Treatment by Variant

Variant 1: Lower gastrointestinal tract bleeding. Active bleeding clinically observed as hematochezia or melena in a hemodynamically stable patient. Next step.

The primary role of an investigative examination in a hemodynamically stable patient is to identify the site that caused or is causing the bleeding; this information can then be used to guide an appropriate targeted therapy. In these patients, manifestation of acute lower GIB is clinically obvious and frequently intermittent. Radiologic examinations commonly used in these patients include radionuclide scans, CT angiography (CTA), and transcatheter arteriography.

Radiologic examinations in these patients rely on abnormal tracer or contrast accumulation during the scan to identify the site of bleeding and, when possible, the nature of the culprit lesion. Historically, the accuracy of a diagnostic modality has been compared with the accuracy of transcatheter arteriography as the standard of reference. However, transcatheter arteriography has well-known limitations in locating the site of bleeding, mainly because of the intermittent nature of the bleeding and the inability of this modality to accurately define the nature of most culprit pathologies. A better method for assessing the efficacy of an examination would be to determine the effect of the modality on clinical and cost outcomes.

CTA Abdomen and Pelvis

The role of CTA in acute lower GIB has been evolving over the past decade. CTA is a special CT technique with emphasis on evaluating the blood vessels following administration of iodinated contrast material. CTA can detect bleeding rates as low as 0.3 mL/min [29]. To avoid masking of extravasation, positive oral contrast material should not be administered before CTA. If pre-existing positive oral contrast material is seen extensively in the bowel, CTA should not be performed. The arterial phase of CTA can be used to identify the beginning of intraluminal extravasation of intravascular contrast and to locate the culprit arterial branch; this information allows for more focused transcatheter arteriography and embolization. Along with the arterial phase, the portal venous phase of CTA can be used to further evaluate the nature of the culprit pathology. Noncontrast CT has no role in patients with acute GIB, whereas multiphase CTA can be completed within minutes and can be conducted even in hemodynamically precarious patients. In one prospective study, multiphase CTA was able to identify active bleeding or a potential bleeding lesion in 92% of cases versus the 29% of cases identified with transcatheter arteriography [30]. In 5 of 19 patients with active bleeding after CTA, transcatheter arteriography results were negative in spite of a short interval between CTA and transcatheter arteriography (median, 33 minutes); these results highlight the extremely intermittent nature of GIB. Individual studies have shown that the sensitivity of CTA ranges from 79% to 100% [31-35]. These studies also demonstrated that the specificity and diagnostic accuracy of CTA are quite high (50%–100% and 74%–98%, respectively). In a meta-analysis of 14 studies published from 2003 through 2016, the sensitivity and specificity of CTA were 90% and 92%, respectively, among 549 patients with lower GIB [36]. Importantly, negative CTA is a good indicator that conservative management can be initiated. In a retrospective review of 62 patients with lower GIB, approximately three-fourths of the patients settled spontaneously with conservative management when CTA was negative [37]. In another retrospective review, transcatheter arteriography was negative in all 14 patients with lower GIB who had negative CTA results [38], highlighting the lack of evidence to support transcatheter arteriography when CTA is negative. Another study demonstrated that no intervention was needed in any patient who was hemodynamically stable at the time of negative CTA [39]. However, in a study of patients who had further episodes of bleeding after negative CTA, all were unstable and 79% (11 of 14) required further intervention [37].

Although transcatheter arteriography immediately after negative CTA should be avoided in hemodynamically stable patients, management of unstable patients with negative CTA results remains challenging and should be approached on a case-by-case basis. In addition to being more swiftly obtainable than radionuclide scans, CTA has a number of other advantages as an initial test to localize lower GIB. This modality can often yield a diagnosis of the pathologic cause of the bleeding, sometimes even when the patient is no longer actively bleeding. In one study, CTA results could be used to identify the pathology preoperatively in 50% of cases [40]. Defining the cause of the bleeding can help clinicians determine the prognosis and identify the best options for treatment, thus allowing patients with lesions that are unfavorable for embolization to be triaged directly to surgery. In one study, as many as 40% of patients could be triaged directly to surgery as a result of CTA [39]. CTA can also provide information about the arterial anatomy, identifying variant anatomy or vessel occlusions that could influence subsequent transcatheter embolization. Visualization of extravasation during transcatheter angiography is more likely to occur when extravasation is first seen on CTA due to nondiverticular etiology or among patients with hemoglobin <100 g/L [41]. At one academic tertiary medical center, likely because of these advantages, the use of CTA increased from 3.8% to 56.6% between 2005 and 2012, whereas the use of radionuclide scans decreased from 83.3% to 50.6% [42].

Diagnostic/Therapeutic Colonoscopy

Urgent colonoscopy can be used to detect the site and cause of acute lower GIB and to treat the bleeding at the same time when appropriate. In a randomized controlled trial, urgent colonoscopy was compared with standard care (radionuclide scan and transcatheter arteriography followed by colonoscopy when other tests were negative) in 100 patients with acute lower GIB [43]. Although the bleeding source was definitively diagnosed in 42% of patients in

the colonoscopy arm versus only 22% in the standard care group, there was no difference between the groups in outcomes, including rebleeding rates and length of hospital stay. Additionally, although the diagnostic yield for colonoscopy has been reported to range from 74% to 100% [44], colonoscopy can be very challenging in patients with major bleeding, as the bleeding can obscure the endoscopists view. CTA can also be used to guide colonoscopy. In a study of 55 patients with diverticular lower GIB, colonoscopy was able to identify the culprit lesion more frequently in patients with positive CTA than in those with negative CTA (60% versus 31%) [45]. In a retrospective review of 638 patients, the bleeding source was detected more frequently on colonoscopy when extravasation had been identified on CTA than when extravasation was absent (68% versus 20%) [46]. In another study of 223 patients who underwent colonoscopy within 24 hours of hospitalization for acute lower GIB, vascular lesions in the ascending colon were detected more often when colonoscopy was guided by previous CTA, and endoscopic therapy was used more frequently among patients who had undergone CTA [47]. However, rebleeding rates and transfusion needs for patients who had undergone CTA before colonoscopy were not significantly different than in patients who underwent colonoscopy without CTA. As such, routine performance of CTA ahead of urgent colonoscopy has not been shown to affect the clinical outcome. In addition, a recent randomized trial of patients with hematochezia has also called into question the role of urgent colonoscopy in this setting, as patients undergoing urgent colonoscopy had essentially the same clinical outcomes as those undergoing elective colonoscopy [48].

MRA Abdomen and Pelvis

MR angiography (MRA) is a special MRI technique where gadolinium-based contrast material is injected and images are acquired at higher spatial and lower temporal resolution in multiple angiographic phases. This technique can be modified by acquiring images faster to improve temporal resolution (time-resolved MRA), similar to catheter angiography but only at lower resolution. Such techniques can be useful in patients in whom CTA is unsuitable because of persistence of oral contrast in the bowel. However, MRI currently takes significantly longer to acquire than CTA and currently does not play a primary role in evaluating acute ongoing lower GIB. MR enterography (MRE) is a special technique that requires patients to ingest a large volume of an enteric contrast material to distend the small bowel; thus, this technique is not feasible in a patient with ongoing acute lower GIB. Although a small case series (n = 4) demonstrated that MRI with a blood pool agent offers the ability to acquire cross-sectional imaging (similar to CTA) and the ability to acquire early and delayed imaging (similar to radionuclide scans) [49], no studies have demonstrated the superiority of this method over other imaging modalities.

Surgery

Surgery is not considered as a diagnostic tool to localize the site of bleeding in hemodynamically stable patients. In a series of 63 patients with acute lower GIB, nonsurgical diagnostic tools successfully localized the site of bleeding in 61 patients [50]. Extensive surgical resection without localization of the culprit lesion in patients with massive GIB often leads to poor outcomes versus the outcomes seen with limited resection after successful localization [51]. Thus, when surgery is deemed necessary, especially in hemodynamically stable patients with recurrent lower GIB, it is preferably performed after successful endoscopic (upper or lower GI endoscopy, capsule endoscopy [CE], or push enteroscopy) or radiologic (CTA, transcatheter arteriography, CT enterography [CTE], or MRE) localization.

RBC Scan Abdomen and Pelvis

Planar radionuclide red blood cell (RBC) scans have traditionally been used as the initial diagnostic test for hemodynamically stable patients, as these scans are noninvasive and more sensitive than transcatheter arteriography for detecting slower rates of bleeding (approximately 0.05–0.1 mL/min versus 0.5–1.0 mL/min for transcatheter arteriography); additionally, a 2- to 3-mL accumulation of labeled blood is sufficient for the detection of bleeding with radionuclide scans [52]. Although these scans are frequently used in patients with acute lower GIB, the results with this modality are positive <50% of the time; among patients with positive results on this scan, many do not require hemostatic therapy, thus calling into question the predictive value of this method regarding the need for subsequent hemostatic therapy [53]. In addition, planar radionuclide scans frequently provide inaccurate localization of the site of bleeding, which can lead to erroneous focus during subsequent transcatheter arteriography. Several recent studies of radionuclide scans have reported incorrect localization of bleeding in 10% to 33% of cases, with some of these patients subsequently undergoing wrong-site surgery [54-56]. In one study of cases identified as positive on planar radionuclide scan, the site of bleeding was found to be identified incorrectly on 11.5% of scans when these results were compared with those from subsequent transcatheter arteriography, and the specificity for localization of the source of bleeding was also poor with planar radionuclide scan (33.3%) compared with CTA (90.9%) [56]. For better localization of the site of bleeding, single-photon emission computed tomography (SPECT) can be performed when planar radionuclide images demonstrate a new focus of abnormal extravascular activity that

conforms to the bowel. Three-dimensional image display in SPECT could improve localization of the site of bleeding. In a 12-year prospective study of 40 patients with lower GIB, planar scintigraphy with SPECT correctly localized the bleeding site in 75% of cases (15 of 20 positive scintigraphy) [54]. In addition to SPECT, noncontrast multidetector CT images can also be acquired and fused with SPECT images (SPECT/CT). Three-dimensional distribution of radionuclide tracer as seen on SPECT, combined with the soft-tissue images of the bowel on CT, would be used to better localize the bleeding segment of the bowel. A small retrospective study (n = 20) compared the accuracy of locating the site of GIB among the 3 radionuclide scan imaging protocols. When planar imaging alone was used, the accuracy was low (1 of 3). When SPECT images were acquired after planar imaging was used, the accuracy improved (5 of 7), and the accuracy was highest (6 of 6) when SPECT and CT (SPECT/CT) were both acquired [57].

Transcatheter Arteriography/Embolization

Similar to an urgent colonoscopy, transcatheter arteriography can be used to detect the site of acute lower GIB and offer treatment at the same time. Historically, studies have compared the sensitivity of radionuclide scan and CTA with that of transcatheter arteriography in detecting the site of bleeding. However, it is now well accepted that negative transcatheter arteriography after a positive radionuclide scan study or CTA is not uncommon. In a recent study, transcatheter arteriography revealed active extravasation in only 24% of patients with a positive radionuclide scan [24]. Additionally, lower GIB is frequently intermittent, sometimes changing from minute to minute [58]. Transcatheter arteriography can detect extravasation only if it happens during the few seconds while contrast is being injected into a mesenteric artery, and selective separate injections into superior and inferior mesenteric arteries are often required in patients with acute lower GIB. Among some patients with negative transcatheter arteriography results, bleeding might have simply stopped during the procedure. In one study, the incidence of a negative transcatheter arteriography was higher among patients with a stable hemodynamic status versus unstable patients, and 80% of those patients were successfully managed conservatively [7]. Additionally, an undue delay after a positive radionuclide scan or CTA will negatively affect the usefulness of subsequent transcatheter arteriography. In a retrospective review of 120 patients with a positive radionuclide scan, the odds of detecting bleeding on subsequent transcatheter arteriography were increased by 6.1-fold if the time to positive (defined as the time from the start of radionuclide scanning to the appearance of a radionuclide blush) was ≤9 minutes versus >9 minutes [59]. If extravasation is not seen on transcatheter arteriography, targeted transcatheter treatment is not possible. Thus, arrangements should be made to perform transcatheter arteriography as soon as possible after a positive radionuclide scan or CTA. This requires strong collaboration among diagnostic and interventional radiologists in the department.

Variant 2: Lower gastrointestinal tract bleeding. Active bleeding in a hemodynamically unstable patient or a patient who has required more than 5 units of blood within 24 hours. Next step.

CTA Abdomen and Pelvis

CTA preceding transcatheter arteriography was positive in 94% of patients with lower GIB [42]; additionally, 9 of 10 patients with positive CTA were found to be hemodynamically unstable [39]. Even in hemodynamically unstable patients, CTA is feasible and can be used to locate the site and source of bleeding, allowing clinicians to then use a targeted treatment such as transcatheter embolization or surgical resection.

Diagnostic/Therapeutic Colonoscopy

Similar to transcatheter arteriography, urgent colonoscopy can be used to locate and treat the bleeding at a culprit lesion when the source is in the colon, but rapid bowel preparation is required for this technique, which can limit the role of urgent colonoscopy in an unstable patient. However, a recent systematic review and meta-analysis of 12 studies found that urgent colonoscopy was safe but failed to improve important clinical outcomes versus elective colonoscopy [60].

MRA Abdomen and Pelvis

Closer monitoring and ability to resuscitate is limited during MRI study. Thus, it does not have a role in cases of acute ongoing lower GIB in hemodynamically unstable patients.

Surgery

It is reported that patients who underwent total colectomy were more likely to have received >4 units of blood prior to surgery than those who underwent partial colectomy [51] and their operative time was also longer [51]; this is likely due to delay in localization of the source of bleeding prior to surgery. Although total colectomy is associated with more complications including higher mortality, it remains the operation of choice for nonlocalized acute lower

GIB over partial colectomy due to reduced rates of recurrent bleeding. Even in hemodynamically unstable patients, localization using CTA, transcatheter arteriography, or colonoscopy should be considered. Surgery without localization should only be reserved for uncontrollable GIB [50]. In patients who are too ill to tolerate urgent surgery, transcatheter embolization can be performed at the time of diagnostic transcatheter arteriography. Although 7% to 25% of patients with lower GIB will ultimately require surgery to stop the bleeding or address the underlying pathology [61,62], stopping the hemorrhage with transcatheter embolization provides time to stabilize the patient and prepare the bowel, both of which will contribute to a better surgical outcome.

RBC Scan Abdomen and Pelvis
Similar to MRI, radionuclide scans are relatively time consuming, taking 60 minutes or more to complete a study. Although the patient can be closely monitored during the study, a targeted intervention is often required when a patient remains hemodynamically unstable in spite of resuscitation efforts due to ongoing acute lower GIB. Thus, radionuclide scans do not have a role in these patients.

Transcatheter Arteriography/Embolization
Transcatheter arteriography is likely to identify the site of lower GIB in patients who have massive bleeding resulting in either hemodynamic instability or a requirement for transfusion of >5 units of blood [63]. Although transcatheter arteriography also offers the possibility of targeted transcatheter embolization, a study in a tertiary medical facility demonstrated that transcatheter arteriography was positive in just 43% of patients with lower GIB [42], and this rate was not different among hemodynamically stable and unstable patients [7].

The choice between urgent colonoscopy, transcatheter arteriography, CTA, or surgery depends on the level of hemodynamic instability.

Variant 3: Lower gastrointestinal tract bleeding. Colonoscopy localized the bleeding site and treatment was attempted. Ongoing or recurrent bleeding. Next procedure or intervention.

When patients rebleed after an initial colonoscopy successfully diagnosed the culprit lesion and are hemodynamically unstable, the choice of modality to offer hemostatic therapy—such as repeat colonoscopy, transcatheter embolization, or surgery—is based on the lesion. In this scenario, when patients rebleed but are hemodynamically stable, the choice between conservative management, elective repeat colonoscopy, or elective surgery is also based on the lesion and patient preference.

CTA Abdomen and Pelvis
When the bleeding site has been positively identified by colonoscopy, CTA can be used to assess the extent of disease and precisely locate the source of bleeding. This would allow clinicians to then use treatment such as targeted transcatheter embolization or limited surgical resection.

Diagnostic/Therapeutic Colonoscopy
Based on the attempts used to secure hemostasis at the site of bleeding during the initial colonoscopy, a repeat colonoscopy would be considered appropriate if similar or alternative techniques and hemostatic agents with appropriate expertise are available.

MRA Abdomen and Pelvis
When the bleeding site has been positively identified by colonoscopy, MRI has no role.

Surgery
Positive localization of the site of bleeding facilitates limited surgical resection. However, this is reserved for when alternative therapeutic tools such as repeat colonoscopy or transcatheter embolization are not feasible or are unavailable. Surgical resection would also be appropriate if colonoscopic intervention or transcatheter embolization is unlikely to be effective for certain pathology such as a tumor identified on the initial colonoscopy.

RBC Scan Abdomen and Pelvis
When the bleeding site has been positively identified by colonoscopy, a radionuclide scan has no role.

Transcatheter Arteriography/Embolization
When the bleeding site has been positively identified by colonoscopy and the patient continues to bleed, a focused transcatheter arteriography should be considered. If the endoscopist was initially successful in placing an endoclip at the site of bleeding, this could be used to perform focused transcatheter arteriography; however, interventional radiologists should be aware of the possibility of the endoclip falling off and migrating with peristalsis. Upon positive identification of contrast extravasation at the site of bleeding, targeted embolization should be performed.

Variant 4: Lower gastrointestinal tract bleeding. Transcatheter arteriography localized the bleeding site and treatment was attempted. Ongoing or recurrent bleeding. No other prior radiological or endoscopic investigations. Next procedure or intervention.

When patients rebleed and are hemodynamically unstable after an initial successful localization of the site of bleeding by transcatheter arteriography and targeted embolization, the choice of repeat transcatheter arteriography, urgent colonoscopy, or surgery is based on the etiology of bleeding. When patients rebleed but remain hemodynamically stable after an initial successful localization of the site of bleeding by transcatheter arteriography and targeted embolization, the choice between conservative management alone or elective colonoscopy is based on the etiology of bleeding.

CTA Abdomen and Pelvis

When the bleeding site has been positively identified by transcatheter arteriography but the nature of underlying lesion is not well defined, CTA should be considered to triage the patient toward appropriate repeat intervention. However, if the patient is hemodynamically unstable and requires urgent re-intervention, colonoscopy or surgery is based on the lesion. If targeted embolization was performed satisfactorily during the initial transcatheter arteriography, repeat arteriography should only be considered after careful deliberation.

Diagnostic/Therapeutic Colonoscopy

Although studies have suggested colonoscopy was more successful in detecting the cause of bleeding when extravasation was identified on CTA than when extravasation was absent [46], the rate of its success in identifying and applying hemostatic technique following contrast extravasation during transcatheter arteriography is not known. However, positive identification of the bleeding site on transcatheter arteriography would allow for a focused interrogation on colonoscopy in hemodynamically stable patients. In addition, transcatheter embolization when performed could stabilize an otherwise unstable patient and allow appropriate bowel preparation in anticipation for an elective colonoscopy.

MRA Abdomen and Pelvis

When the bleeding site has been positively identified, MRI has no role in ongoing or recurrent bleeding.

Surgery

Positive localization of the site of bleeding following transcatheter arteriography facilitates limited surgical resection for ongoing or recurrent bleeding. Although the site of bleeding is positively identified, if the nature of the underlying lesion is in question following transcatheter arteriography, CTA should be performed for better delineation of the lesion to plan appropriate surgical intervention and to have an informed discussion with the patient.

RBC Scan Abdomen and Pelvis

When the bleeding site has been positively identified, a radionuclide scan has no role in ongoing or recurrent bleeding.

Transcatheter Arteriography/Embolization

When the bleeding site has been positively identified by colonoscopy and the patient continues to bleed, a focused transcatheter arteriography should be considered. If the endoscopist was initially successful in placing an endoclip at the site of bleeding, this could be used to perform focused transcatheter arteriography; however, interventional radiologists should be aware of the possibility of the endoclip falling off and migrating with peristalsis. Upon positive identification of contrast extravasation at the site of bleeding, targeted embolization should be performed.

Variant 5: Lower gastrointestinal tract bleeding. Obscure (nonlocalized) recurrent bleeding in a hemodynamically stable patient (assumes a prior negative adequate colonoscopy and upper gastrointestinal endoscopy). Next procedure or intervention.

Overt obscure GIB is defined as clinically noticeable bleeding that persists or recurs after an adequate endoscopic or radiologic evaluation fails to identify the site and cause of bleeding. In patients with suspected acute lower GIB, up to 15% of bleeds are known to have an upper GI source [48]. Therefore, upper GI endoscopy should be performed after these patients undergo an adequate but negative colonoscopy. If the initial upper or lower GI endoscopy is considered suboptimal, repeating the endoscopy should be the first step. In cases of GIB that continues to be obscure, it is important to identify the culprit lesion that requires targeted treatment to prevent further bleeding. However, for obscure bleeding, which often originates from the small bowel, there is no clear consensus on the optimal study to assess the small bowel.

Capsule Endoscopy
A meta-analysis of 17 studies compared CE with PE and small-bowel barium radiography (BR) in patients with obscure GIB [64]. The diagnostic yield was 63% to 67% for CE, 28% for PE, and 8% for small-bowel BR.

CT Enterography Abdomen and Pelvis
CTE has been used recently in stable patients with obscure GIB. Unlike CTA, CTE is performed after patients ingest a large volume of a neutral enteric contrast material that distends the small-bowel lumen. This optimizes contrast resolution between the bowel mucosa and lumen, thereby improving the conspicuity of mucosal lesions. Additionally, a neutral oral contrast does not interfere with the ability to visualize the lumen and bowel wall with CT. Although there is often concordance between CTE and CE, CTE occasionally detects lesions not seen on CE and vice versa [65,66]. In one study, CTE had much better sensitivity for detecting small-bowel bleeding sources than CE (88% versus 38%), primarily because of its ability to detect small-bowel masses [66]. However, a systematic review of 18 studies demonstrated that CTE had lower sensitivity than CE in cases of obscure GIB (34% versus 53%) [67]. A retrospective review suggested that the diagnostic yield of CTE increases from 17% to 58% (adjusted odds ratio, 7.2) when the initial bleeding is considered massive (causing hypotension with systolic blood pressure <90 mm Hg or requiring a transfusion of ≥4 units of blood during a 24-hour period) [68]. Another study demonstrated that CE led to a diagnosis in 57% of patients who had negative CTE [69].

Fluoroscopy Small-Bowel Follow-Through
In one study, patients with obscure GIB were randomized to CE or small-bowel BR [70], and the diagnostic yield with small-bowel BR was poor (7% versus 30% with CE). Thus, small-bowel BR should not be considered a useful diagnostic tool in patients with obscure GIB.

MR Enterography
MRE, like CTE, requires patients to ingest a large volume of an enteric contrast material to distend the small bowel. In a recent series of 25 pediatric patients, the diagnostic yield was 76% with MRE [71]. Recently, several studies have also compared CE with MRE and demonstrated better diagnostic yields for CE [72,73]. Although MRE offers evaluation without radiation, there is not enough direct evidence to suggest that MRE has an advantage over CTE, CE or PE in patients with obscure GIB, particularly in adults.

Push Enteroscopy
In a randomized controlled study comparing CE and PE as first-line methods for the evaluation of obscure bleeding, CE identified the bleeding source more often than PE (50% versus 24%), and a management strategy that began with CE rather than PE reduced the percentage of patients needing additional studies (25% versus 79%) [74]. Thus, PE should be reserved for when CE is unavailable or has failed to identify the source of bleeding.

Surgery
Without localizing the site of bleeding, total colectomy has high rates of recurrent bleeding and has poor outcome [51]. Surgery is not used as a diagnostic tool to identify the site and source of obscure bleeding. Nonsurgical tools should be used systematically to locate the site of bleeding. Based on the etiology, focused limited surgical resection can be considered for appropriate pathologies in hemodynamically stable patients experiencing recurrent obscure GIB.

RBC Scan with SPECT or SPECT/CT Abdomen and Pelvis
When the bleeding source is suspected to be in the small bowel after negative upper and lower gastrointestinal endoscopy results are obtained in a hemodynamically stable patient, radionuclide scan with SPECT/CT could localize abnormal tracer accumulation to a short segment of small bowel and guide subsequent targeted therapy.

RBC Scan Abdomen and Pelvis
When the bleeding source is suspected to be in the small bowel after negative upper and lower gastrointestinal endoscopy results are obtained in a hemodynamically stable patient, there is no role for planar-only radionuclide scans without SPECT/CT in evaluation of the small bowel because of its often lower accuracy in locating the site of bleeding.

Transcatheter Arteriography/Embolization
When the bleeding source is suspected to be in the small bowel after negative upper and lower GI endoscopy results are obtained in a hemodynamically stable patient, there is no role for transcatheter arteriography in the evaluation of the small bowel.

Summary of Recommendations

- **Variant 1**: CTA of the abdomen and pelvis without and with intravenous (IV) contrast, diagnostic/therapeutic colonoscopy, or RBC scan abdomen and pelvis is usually appropriate as the next step for a hemodynamically stable patient with lower GIB and active bleeding clinically observed as hematochezia or melena. These procedures are equivalent alternatives (ie, only one procedure will be ordered to provide the clinical information to effectively manage the patient's care).
- **Variant 2**: CTA of the abdomen and pelvis without and with IV contrast or transcatheter arteriography/embolization is usually appropriate as the next step for a hemodynamically unstable patient with active lower GIB or a patient who has required >5 units of blood within 24 hours. These procedures are equivalent alternatives (ie, only one procedure will be ordered to provide the clinical information to effectively manage the patient's care). Diagnostic/therapeutic colonoscopy may be appropriate for this clinical scenario, but the experts could not agree on the exact appropriateness category.
- **Variant 3**: Transcatheter arteriography/embolization is usually appropriate as the next intervention for a patient with ongoing or recurrent lower GIB where colonoscopy has localized the bleeding site and treatment was attempted. CTA of the abdomen and pelvis without and with IV contrast or repeat diagnostic/therapeutic colonoscopy may be appropriate for this clinical scenario, but the experts could not agree on the exact appropriateness category.
- **Variant 4**: Diagnostic/therapeutic colonoscopy is usually appropriate as the next intervention for a patient with ongoing or recurrent lower GIB where transcatheter arteriography has localized the bleeding site and treatment was attempted. The patient had no other prior radiological or endoscopic investigations.
- **Variant 5**: CE or CTE of the abdomen and pelvis with IV contrast is usually appropriate as the next procedure or intervention in a hemodynamically stable patient with obscure (nonlocalized) recurrent lower GIB, assuming a prior negative adequate colonoscopy and upper gastrointestinal endoscopy. These procedures are equivalent alternatives (ie, only one procedure will be ordered to provide the clinical information to effectively manage the patient's care). Transcatheter arteriography/embolization may be appropriate for this clinical scenario, but the experts could not agree on the exact appropriateness category.

Supporting Documents

The evidence table, literature search, and appendix for this topic are available at https://acsearch.acr.org/list. The appendix includes the strength of evidence assessment and the final rating round tabulations for each recommendation.

For additional information on the Appropriateness Criteria methodology and other supporting documents go to www.acr.org/ac.

Appropriateness Category Names and Definitions

Appropriateness Category Name	Appropriateness Rating	Appropriateness Category Definition
Usually Appropriate	7, 8, or 9	The imaging procedure or treatment is indicated in the specified clinical scenarios at a favorable risk-benefit ratio for patients.
May Be Appropriate	4, 5, or 6	The imaging procedure or treatment may be indicated in the specified clinical scenarios as an alternative to imaging procedures or treatments with a more favorable risk-benefit ratio, or the risk-benefit ratio for patients is equivocal.
May Be Appropriate (Disagreement)	5	The individual ratings are too dispersed from the panel median. The different label provides transparency regarding the panel's recommendation. "May be appropriate" is the rating category and a rating of 5 is assigned.
Usually Not Appropriate	1, 2, or 3	The imaging procedure or treatment is unlikely to be indicated in the specified clinical scenarios, or the risk-benefit ratio for patients is likely to be unfavorable.

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