Radiographic Work-Up and Treatment of Lower Gastrointestinal Bleeding

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ABSTRACT

Lower gastrointestinal hemorrhage is a common reason for hospital admission. Spontaneous cessation occurs in the majority of these patients; however, continued major bleeding is a difficult clinical problem. Emergency surgery, without prior knowledge of the bleeding site is associated with high morbidity and mortality rates. Accurate localization is therefore desirable. The authors present a review of current radiological imaging modalities and therapeutic options available to the clinician. They also provide a management algorithm to aid in the strategic management of this group of patients.

KEYWORDS: Scintigraphy, mesenteric angiography, embolization

Objectives: On completion of this article, the reader should be familiar with the evaluation and management of lower gastrointestinal bleeding.

Lower gastrointestinal (GI) hemorrhage is a relatively common reason for hospital admission and is defined as bleeding distal to the ligament of Treitz. The majority will originate from the colon and rectum; however ~25% will stem from the small bowel which poses diagnostic difficulty. Modes of presentation may be with occult bleeding detected due to patient anemia with positive fecal occult blood (FOB) test. These patients require elective endoscopy and investigations to rule out any sinister cause for the blood loss. Overt lower GI hemorrhage may arise from the anal canal (e.g., hemorrhoids) or more proximally in the colon, which can result in significant blood loss. In this review, we focus on this latter group of patients with overt blood loss above the dentate line.

Spontaneous cessation of hemorrhage occurs in 85% of patients; however, the remaining 15% will have continued bleeding and require extensive and sometimes invasive investigations in an attempt to localize and

stop the hemorrhage. The population commonly requiring hospital admission is the elderly with multiple medical comorbidities and who are least likely to withstand major hemodynamic upset or the stress of surgical intervention.

The etiology of lower GI hemorrhage in 80% of patients will be diverticular disease and vascular ectasia, the remainder a combination of neoplasm, colitis, colonic varices, and hemorrhoids. In Western societies, 65% of the population will have diverticula by the age of 65 years. Of these, 20% will present with bleeding, but only 5% will have severe hemorrhage. Spontaneous resolution occurs in 70 to 80% of cases, but rebleeding has been reported in 25 to 30%. Bleeding occurs due to erosion of the wall of the diverticulum into an adjacent submucosal branch of the vasa recta. Although diverticulosis mainly affects the sigmoid and left colon, bleeding from diverticula is distributed evenly between right and left colon.

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Angiodysplasia of the colon include arteriovenous malformations, vascular ectasias, and angiomas and are conditions of the elderly. They are an acquired abnormality and are thought to originate from chronic intermittent partial obstruction of the submucosal veins due to muscular contraction. With time, the submucosal veins become dilated and ectatic with incompetence of the precapillary sphincter resulting in angiodysplasia.¹ The lesions are generally multiple and affect the ascending colon most commonly. Although massive hemorrhage can occur from angiodysplasias, the most likely presentation is of subacute bleeding (i.e., presents with anemia and fecal occult blood positivity), which stops spontaneously and recurs in 90% of patients.

Prior to diagnostic and localization studies, the patient must be appropriately resuscitated. This involves physical examination, intravenous cannulae for volume and blood replacement, hematological and coagulation studies. Monitoring should include the passage of a Foley urinary catheter and cardiac monitoring. While resuscitation continues, the initial steps to localize the source of bleeding can be undertaken. The importance of anorectal examination and proctoscopy at the initial resuscitation cannot be overemphasized. Massive hemorrhage can occur from hemorrhoids and easily rectified with banding. The passage of a nasogastric tube and aspiration helps exclude the upper GI tract as a possible source of blood loss. This may also be achieved with upper GI endoscopy.

Before the development of accurate localization studies, surgery was the standard of care for lower GI bleeding. Blind segmental colectomy was associated with a mortality of 12% and rebleeding rate of 63%.² The rebleeding rate can be reduced with subtotal colectomy, but with significant morbidity.³ Accurate localization studies are therefore desirable to enable more targeted surgical resection with the minimum morbidity and bleeding recurrence. This localization is achieved using radionuclide scintigraphy, angiography, and to a lesser extent computed tomography (CT) and colonoscopy.

RADIONUCLIDE SCINTIGRAPHY

The role of Nuclear Medicine in the localization of lower GI hemorrhage is of varying importance. Radionuclide scintigraphy is indicated as a first line investigation or when other imaging modalities have failed to demonstrate a bleeding site. The utilization of scintigraphy depends upon local facilities and expertise. Radiolabeled sulfur colloid and Technetium-99m (Tc-99m) labeled red blood cell scintigraphy are the physiological agents most commonly used in lower GI hemorrhage (Table 1). The principle of radiolabeled sulfur colloid as an imaging modality relates to its rapid clearance from the vascular space by uptake in the liver, spleen, and bone marrow. Therefore, extravasation from the gastrointestinal tract

Table 1 Summary of the Commonly Used Radiolabeled Scans

	Sulfur Colloid	Labeled Red Cell
Type of bleeding	Active	Active/Intermittent
Sensitivity	0.1 mL/min	0.3–1 mL/min
Duration	30 min	Up to 24 h
Advantages	Not repeatable, very sensitive	Detects intermittent bleeding
Disadvantages	Needs active bleeding	Length of study, timing of images

will demonstrate a high target to background count as the colloid will not be as rapidly cleared. The identification of a bleeding site is dependent on active bleeding within minutes of the radiolabeled tracer being administered.

Good-quality commercial kits make Tc-99m red cell labeled scintigraphy the most popular nuclear medicine modality. According to kit instructions, 1 to 3 mL of blood is drawn from the patient, labeled with Tc-99m, and readministered to the patient. Early dynamic and delayed images can be obtained. Active bleeding at a rate of >0.3 mL/min can be detected using this technique. Lower bleeding rates of as low as 0.1 mL/min can be detected, but >3 mL of blood needs to have pooled at one site.⁴ Continuous and intermittent bleeding can be detected and is only limited to the half-life of the radiolabeled tracer. Nicholson et al reported a sensitivity of 97% and specificity of 85% for Tc-99m labeled red cell scintigraphy. Confirmed bleeding sites were achieved preoperatively in 48 of 50 patients, with no postoperative bleeding. This accuracy has not been borne out by all investigators; in a review by Hunter et al, bleeding scans were found positive in 52 of 203 patients (26%).^{5,6}

Some pitfalls exist in the interpretation of these scans. Tc-99m sulfur colloid is concentrated in the reticuloendothelial system of the liver and spleen. Bleeding from the hepatic or splenic flexure of the colon may be obscured by this. In addition, retroperitoneal hemorrhage can mimic GI bleeding on both Tc-99m sulfur colloid and Tc-99m-labeled erythrocyte scintigraphy.⁷ Localization of the bleeding site may also prove difficult as blood within the bowel lumen stimulates peristaltic activity with the spread of blood both proximally and distally from the bleeding source. Static images may demonstrate pooled blood that has traveled within the intestinal lumen. Dynamic imaging reduces, but does not eliminate this problem.

A special role for nuclear medicine imaging lies in detection of bleeding from Meckel's diverticulum. This is an embryological remnant due to incomplete closure of the omphalomesenteric duct. It occurs in ~2% of the population and of these up to 10% will contain ectopic mucosa,⁸ most commonly gastric. Ectopic gastric mucosa may result in parietal cell function and the production of gastric acid with subsequent mucosal

Figure 1 Meckel's scan of a 32-year-old man who presented with dark blood mixed with stool intermittently and an hemoglobin of 9 g/dl. Panendoscopy was normal. The arrow indicates the area of increased secretion of radiolabeled tracer distal to the stomach.

damage and bleeding. Scintigraphic imaging to localize gastric mucosa is based on the fact that Tc-99^m is actively secreted by cells found in gastric mucosa (Fig. 1). It is probably the most accurate noninvasive investigation to locate ectopic gastric mucosa with accuracy rates approaching 90%⁹; these rates are lower in adults.¹⁰

ANGIOGRAPHY

Since the introduction of angiography for lower GI bleeding in 1964,¹¹ the techniques have developed and been refined to make this modality one of the most valuable interventions for lower GI hemorrhage. However, angiography requires a bleeding rate of at least 0.5 mL/min to detect the site of hemorrhage, making it slightly less sensitive than scintigraphy. Angiography and embolization have still been accepted as one of the first line investigations in upper GI hemorrhage due to the therapeutic options, but some practitioners have

been hesitant to introduce this technique for lower GI bleeding due to the relative lack of a collateral blood supply with the inherent risk of ischemia and infarction.

In a patient who is actively bleeding the vessel most likely to be responsible is examined first: for rectal bleeding, the inferior mesenteric artery (IMA) and if negative, then the superior mesenteric artery (SMA). Although the celiac axis traditionally results in upper GI hemorrhage and hematemesis if both the IMA and SMA do not reveal a bleeding point the coeliac axis should be studied as an aberrant vascular anatomy (e.g., celiac axis giving rise to the middle colic and jejunal arteries.¹² One of the main advantages of angiography for hemorrhage is that it may also be therapeutic. Therapeutic options center on vasopressin infusion and embolization.

Vasopressin directly constricts arterioles and capillaries. For the intraarterial infusion of vasopressin, a catheter is introduced via the femoral artery and sits in the main trunk of the SMA or the IMA. The infusion lasts initially for 20 minutes at a rate of 0.2 mL/min. If the bleeding continues, the rate is increased incrementally until cessation occurs. When the correct dose has been determined the infusion continues for a further 6 to 12 hours followed by the infusion of saline for 6 hours.¹³ The catheter has therefore been in place for up to 24 hours, increasing the risk of groin complications. Vasopressin results in arterial constriction at multiple sites resulting in some of the side effects including myocardial ischemia, cerebral and renal arterial constriction, as well as bowel ischemia.¹⁴ These may be reduced with the concomitant intravenous infusion of nitroglycerine.

Vascular embolization was first introduced in 1974 using an autologous blood clot.¹⁵ Since then the technology has developed such that the embolization materials most commonly used now are polyvinyl alcohol particles, Gelfoam (Pfizer, Cambridge, MA/La Jolla, CA), and coils, or a combination of these materials (Fig. 2). Soon after the introduction of embolization

Figure 2 Angiogram of a 75-year-old woman admitted twice with lower gastrointestinal hemorrhage. Panendoscopy normal. (A) Per femoral angiography of the superior mesenteric artery revealed a blush of contrast in the cecum. (B) Bleeding vessel was subsequently embolized with micro-coils causing cessation of bleeding.

for lower GI bleeding, the complication of ischemia and necrosis was identified with rates of up to 20%.¹⁶ The majority of embolizations performed at this time were relatively proximal in the arterial system; the fact that colonic arteries are end arteries with a relative lack of collateral blood supply made this technique difficult to adopt widely. Superselective embolization refers to the technique of embolizing either the (1) branches of the marginal artery, (2) vessels of the distal arterial arcade, or (3) vasa recta supplying only the bleeding vessel. The caliber of these vessels is generally smaller than the #5 French catheters that are used for angiography. Development of a smaller #3 French coaxial catheter along with a steerable guide wire has enabled the embolization of small branches of the visceral arterial tree.¹⁷ These improvements have decreased, but not eliminated the risk of colonic ischemia.¹⁸ Despite brisk lower GI bleeding, not all patients are suitable for embolization. As described by Silver et al from a cohort of 77 patients who underwent angiography for lower GI hemorrhage, only 11 patients could be embolized. The remaining 66 patients were not embolized because no contrast blush was identified during angiography, or distal arterial cannulation could not be achieved due to vessel tortuosity. These patients were managed medically ($n=47$) and surgically ($n=19$). Mortality was seen to be statistically lower in the nonembolized group (14%) compared with the embolized group (55%).¹⁹ Also, in a retrospective review by Burgess et al of 15 patients following superselective embolization, it was noted that in 4 of 15 patients a bleeding site was not identified on angiography, but embolization was performed based on the results of a preceding red cell scan. Outcome in this group was unacceptably poor, with 50% intestinal ischemia and 50% continued hemorrhage. Accurate localization should therefore be confirmed angiographically prior to embolization.²⁰ Hemodynamic instability and transfusion requirement of >5 units in the immediate 24 hours are most likely to have a bleeding site identified at angiography.²¹ Provocative studies using vasodilators and thrombolytics, such as urokinase in an attempt to increase the positive pick-up rate of angiography is of limited and controversial value. A second embolization can be undertaken if bleeding recurs to improve the clinical response rate.²²

An important issue following embolization is the rebleeding rate. In a study of 27 patients by DeBarros et al, a 22% rebleed rate was experienced.²³ This compares well with other series where a rebleed rate ranging from 8 to 33% has been reported.^{18,24}

In contrast to this, vasopressin infusion is associated with a rebleed rate of up to 50%.²⁵ The vasoconstrictive effects of vasopressin end when the infusion stops. At this stage, hemostasis relies on a stable clot. Cessation of bleeding, even if only temporary, allows for full resuscitation and stabilization prior to surgery. In the

case of small bowel hemorrhage, embolization also helps identify the segment that needs to be removed.

In conclusion, embolization is a relatively safe intervention in lower GI hemorrhage and despite needing greater expertise has the advantage of quicker completion of therapy and lower rebleed rates than vasopressin infusion.

COMPUTED TOMOGRAPHY

Scintigraphy and angiography are not always accessible outside of core working hours and may not be available in some institutions. The use of CT for the localization of the bleeding site has been made possible by recent technological advances. Helical CTs with multi-row detectors allows for the intravascular concentration of ionic contrast to be maintained throughout the scan. When no oral contrast is administered, active intraluminal bleeding is the only explanation for blood seen within the lumen. In a pilot study by Sabharwal et al, 5 of 7 patients had positive CT scans. Two were confirmed by conventional angiography and the remaining 3 patients confirmed at endoscopy.²⁶ Although this technique is not a first line investigation and nontherapeutic, in centers where interventional radiology is not readily available it may aid in the localization of the bleeding site to allow a limited colonic resection.

COLONOSCOPY

Colonoscopy is indicated in most patients following a lower GI bleed. There may be a small cohort of elderly patients deemed unfit for further invasive investigations where the underlying diagnosis is in little doubt. The issue is the timing of colonoscopy. In the acute setting, with an unprepared bowel full of blood, visualization of the colonic mucosa is difficult if not impossible. To clean the bowel a polyethylene glycol bowel preparation can be given to the patient by mouth via a nasogastric tube. This facilitates colonoscopy within 6 to 12 hours of the onset of bleeding. However, it may also purge the colon of many of the stigmata of hemorrhage and therefore any abnormality seen may not be the actual source of the bleed. Although acute colonoscopy is adopted in some centers, it is not a universally adopted practice.

DISCUSSION

Although lower GI hemorrhage is a relatively common reason for hospital admission, the vast majority resolve spontaneously. However, lower GI hemorrhage varies in its severity and intermittent nature, thus making consensus in its management difficult.

In the case of continued or recurrent hemorrhage where colonoscopy cannot be performed or has failed to demonstrate a bleeding point, red cell scintigraphy may

Figure 3 Algorithm for the investigation and treatment of lower gastrointestinal hemorrhage.

play a role in the management of lower GI hemorrhage. It is generally one of the first imaging modalities suggested with the aim of detecting a sufficient rate of bleeding to facilitate angiography and interventional embolization. Massive hemorrhage in an unstable patient is best managed with angiography (Fig. 3). Angiography and embolization may work as a temporary measure in the elderly unstable patient to allow resuscitation to continue and surgery if needed to follow in an elective surgical setting when comorbidities can be minimized.

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