8 The Role of Radiology in Obstructing or Bleeding Anal and Rectal Cancers

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Introduction

Over 40,000 new cases of anorectal malignancy are diagnosed each year in the United States, with rectal cancer 7 times more common than anal cancer. Recommended imaging studies for initial staging include CT scan of the chest, abdomen, and pelvis, endorectal ultrasound, pelvic MRI, and PET/CT; recommendations vary depending on tumor histology, size, and organizational guidelines [1]. In a minority of these cases, the patient presents emergently due to a complication. This chapter considers imaging methods that are available to assist the diagnosis and management of patients who present with bowel obstruction or hemorrhage caused by anorectal malignancies. Several of the most commonly employed tests and their appropriate use in the emergency setting are described. As obstruction and bleeding are not usually encountered together, they will be discussed separately.

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Obstruction and Malignancy

Malignancy is the most common cause of large bowel obstruction (LBO) in adults, accounting for up to 60% of cases [2]. The clinical presentation of abdominal pain, constipation or obstipation, and abdominal distention is typically insidious, unlike the common presentation of small bowel obstruction. The goals of imaging in this situation are to confirm or exclude obstruction, determine the level of blockage and the cause, to reveal the extent of disease, and to search for complications.

Abdominal Radiography

When LBO is suspected, the most common initial imaging study is abdominal radiography. This should include both supine and upright abdominal radiographs, which can detect LBO (Fig. 8.1), and help exclude small bowel obstruction (SBO) and pneumoperitoneum. A left lateral decubitus view can be done in lieu of an upright view in a patient unable to stand. The colon is considered to be dilated if its diameter exceeds 6 cm in the transverse, descending and sigmoid portions; the normal cecum can be significantly larger [3]. The sensitivity of abdominal radiographs for LBO is 84%, specificity only 72%; ileus or pseudo-obstruction can also cause a dilated colon [4]. Radiography may also be useful in reveal-

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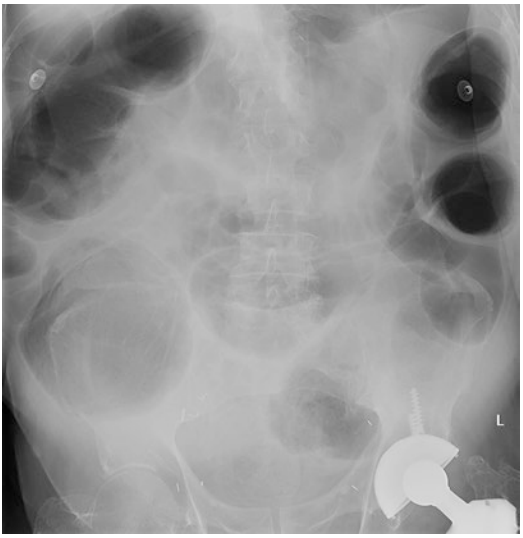

Fig. 8.1 An 87-year-old male with constipation. Supine abdominal radiograph shows dilated colon secondary to obstructing rectal cancer

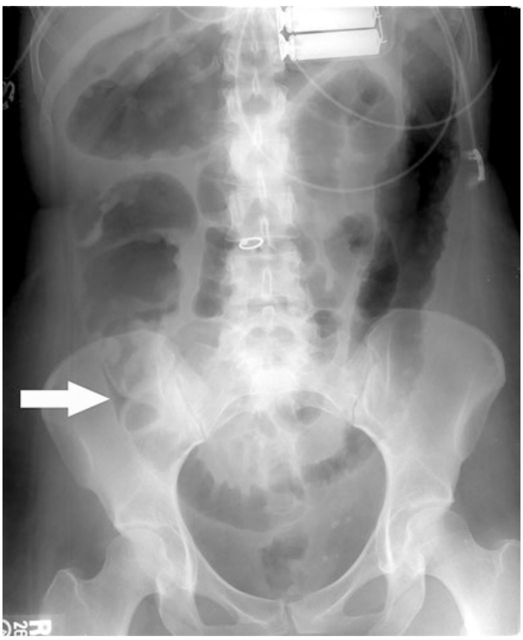

Fig. 8.2 A 29-year-old female with ulcerative colitis and abdominal pain. Supine abdominal radiograph shows triangular collection of peritoneal gas in right lower quadrant (arrow) due to colon perforation

ing complications of LBO, such as pneumatosis intestinalis, portal venous gas, and perforation manifested as pneumoperitoneum (Fig. 8.2). Upright views are more sensitive for the detection of pneumoperitoneum and can detect as little 1 ml of air in the peritoneal cavity [5].

Computed Tomography (CT)

Multidetector CT is the preferred method for diagnosing the cause of LBO. It can show the level of obstruction and can reveal intraluminal as well as mural and extraluminal disease. Metastatic disease, both local and regional, can be assessed. Inflammation, ischemia, and bowel perforation can also be diagnosed. A dilated colon with a transition point of luminal constriction allows the diagnosis of LBO by CT (Fig. 8.3) [6]. The sensitivity of CT for the diagnosis of LBO is 96%, specificity of 93% [7]. CT is useful to evaluate patients who have been treated for LBO by diagnosing postoperative complications. Colonic stents may be used to palliate obstructing rectal cancers; in these cases CT can demonstrate stent position (Fig. 8.4) and reveal complications such as migration, perforation, and tumor ingrowth [8].

Technical options for performing CT depend on the situation. Intravenous contrast is highly recommended, as this improves delineation of anatomic structures and helps in revealing a mass, ischemia, and inflammation. Contraindications to the use of iodinated intravenous contrast include iodine allergy (not to be confused with shellfish allergy) and renal insufficiency [9]. Oral contrast is helpful to show intraluminal features of the bowel, but the prolonged time needed for its consumption and passage distally may render it impractical in an emergency. In selected cases, rectal contrast may help to prove luminal obstruction. Multiplanar reformations (MPRs) are routinely performed and help to demonstrate pathologic anatomy. In the acute setting, a grasp of the extent of the patient's disease is helpful to

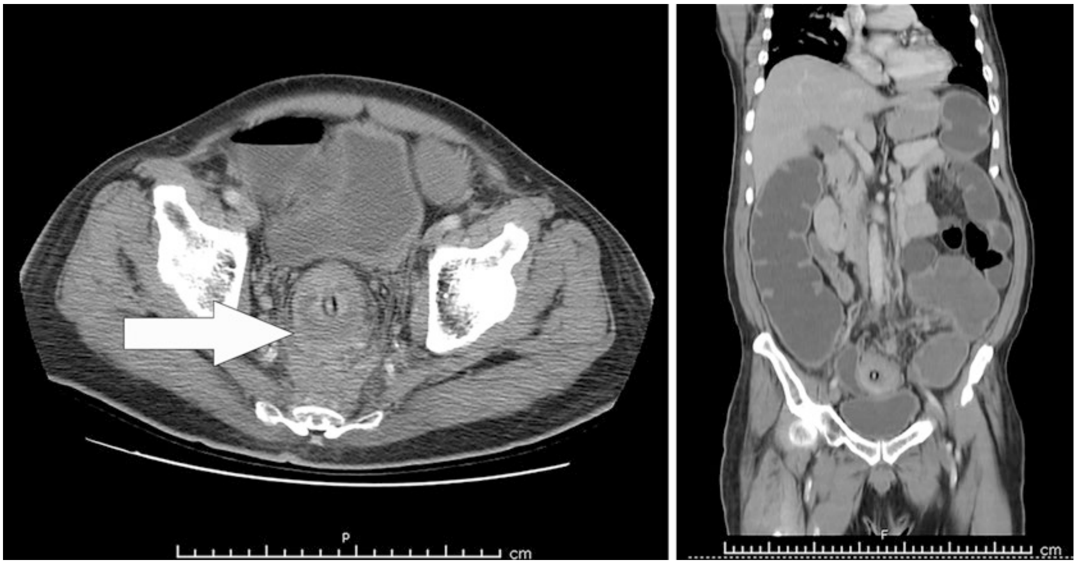

Fig. 8.3 A 51-year-old male with abdominal pain and distention. Axial and coronal images from contrast-enhanced CT reveal rectal cancer (arrow) causing colon obstruction. A decompression tube is seen in the rectal lumen

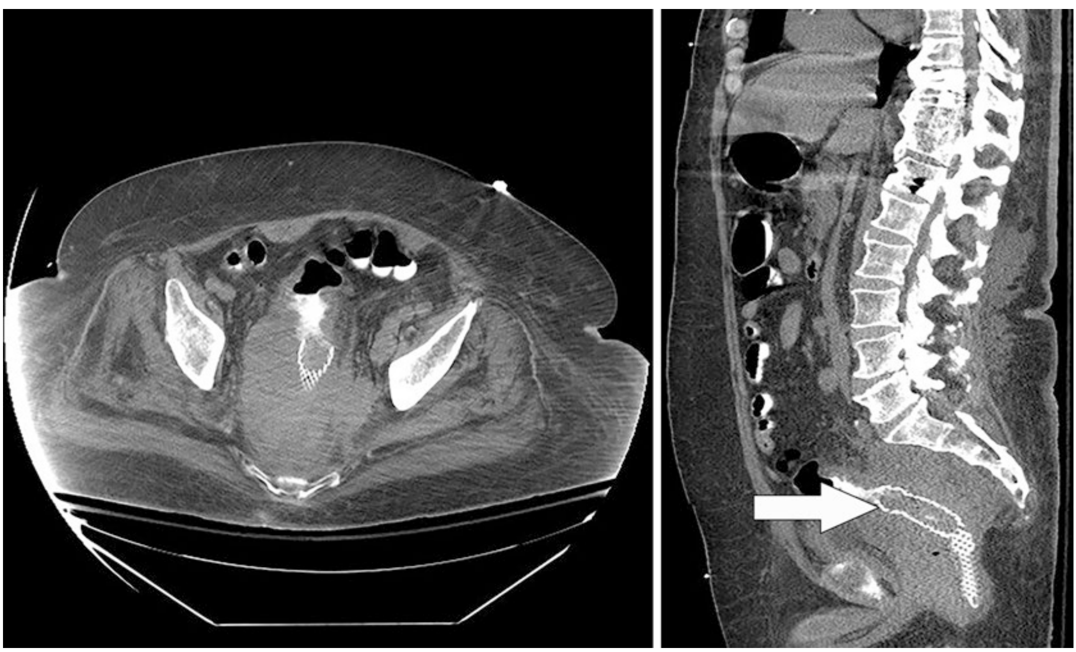

Fig. 8.4 A 67-year-old male with obstructing rectal cancer, palliated by rectal stent (arrow), as seen on contrast-enhanced CT

inform the choice of treatment. CT of the chest, abdomen, and pelvis with intravenous and oral contrast can be done to stage the malignancy.

Contrast Enema

A contrast enema is less commonly performed than CT. It is still a useful diagnostic tool to distinguish mechanical LBO from pseudo-obstruction and may be helpful to prove the diagnosis of colonic volvulus (Fig. 8.5). The retrograde passage of contrast material from the rectum to the ileocecal valve disproves colonic obstruction. Water-soluble iodinated contrast material (similar to that used for intravenous injection) should be used in preference to barium. Its advantages include absorbability by the peritoneum in the event of perforation and decreased artifact if CT is performed afterward [7]. Hence the term "barium enema" in the emergency context is misleading and should be avoided. A scout radiograph of the abdomen should be done before the enema, so that preexistent calcifications and other radiopaque intra-abdominal objects will not be confused with the contrast material. After a digital rectal exam, a flexible catheter is inserted into the rectum, and contrast material is allowed to flow retrograde by gravity, monitored by fluoroscopy [10]. Inflow of contrast is terminated when the cecum is opacified, a point of obstruction is reached, or extraluminal contrast material (indicating colon perforation) is seen. The study is documented as the radiologist captures fluoroscopic images and the technologist performs overhead radiographs; "overheads" are useful for showing the entire abdomen and allowing measurements.

Fig. 8.5 An 82-year-old male with constipation and abdominal pain. Radiograph from contrast enema shows smooth luminal tapering with a twisted appearance of the sigmoid colon, typical of sigmoid volvulus

Magnetic Resonance Imaging (MRI)

MRI is not commonly used to evaluate LBO; however, it is the preferred technique for local staging of rectal cancer. It can assess tumor location, size, relation to anal sphincter, extramural spread, peritoneal, and lymph node involvement (Fig. 8.6). The examination can be performed using either 1.5 or 3 Tesla scanners. Neither endorectal coils, bowel preparation, nor endoluminal contrast is necessary. Intravenous contrast

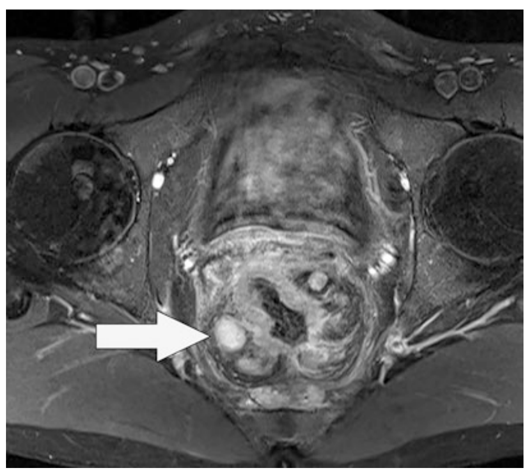

Fig. 8.6 A 29-year-old male T4 N2 rectal cancer. Gadolinium-enhanced axial T1 fat-suppressed MRI shows rectal wall thickening with spiculations extending into the mesorectal fat and enlarged mesorectal lymph nodes (arrow)

Fig. 8.7 A 22-year-old pregnant female with mass noted on obstetric ultrasound. T2 axial and sagittal MRI shows telescoping of rectum, typical of intussusception, caused by carcinoma of rectum (arrow)

and diffusion weighted imaging may improve tumor detection. T2-weighted imaging is crucial and should be done in sagittal, axial, and coronal planes.

T2-weighted imaging is more sensitive in distinguishing diseased from normal tissue and helps determine the extent of local invasion. High-resolution 3-mm-thick sections should also be done perpendicular to the tumor's long axis, as seen on the sagittal views [11]. A unique role for MRI is the imaging of pregnant patients with acute abdominal pain (Fig. 8.7), where CT is contraindicated due to concern for fetal exposure to ionizing radiation [12]. Disadvantages to the use of MRI include lack of availability in the emergency setting and patient safety issues related to cardiac pacemakers and other ferromagnetic implanted medical devices.

Bleeding from Anorectal Malignancies

Malignancy is a relatively uncommon etiology of rectal bleeding, accounting for less than 10% of cases [13]. The most common causes are colonic diverticula and angiodysplasia, while ischemic colitis, inflammatory bowel disease, and rectal varices are also in the differential diagnosis. Colonoscopy is the appropriate first diagnostic maneuver to diagnose the cause, and potentially treat, rectal bleeding [14]. In the emergency situation, the limitations of colonoscopy include poor visualization of the mucosa due to lack of colon preparation and blood filling the lumen and hemodynamic instability. CT angiography and radionuclide scintigraphy are diagnostic imaging tests which can supplement or be used instead of colonoscopy. Catheter angiography has a lower sensitivity to detect bleeding and is more appropriate as a therapeutic tool. The goals of imaging are detecting active bleeding, localizing the site, and diagnosing the cause, with the aim of guiding surgery and/or therapeutic angiography.

CT Angiography (CTA)

CT angiography can detect bleeding rates as low as 0.35 mL/min, superior to catheter angiography and slightly less sensitive than nuclear medicine [15]. CTA sensitivity for acute hemorrhage is as high as 92%. CTA technique requires the rapid injection of intravenous contrast at a rate

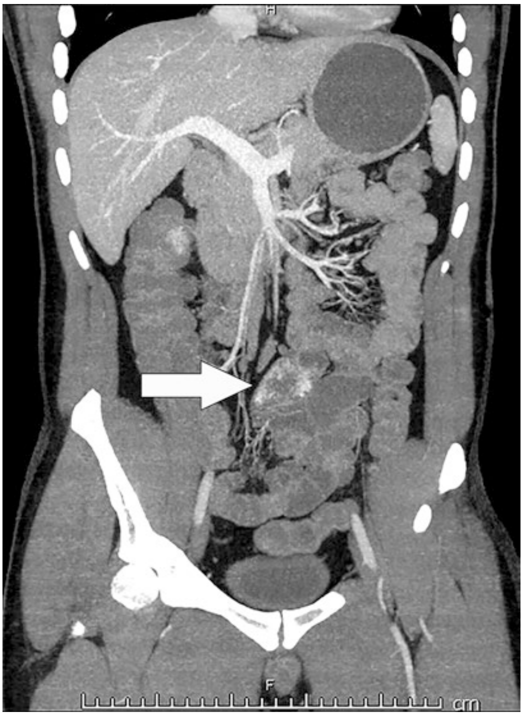

Fig. 8.8 A 28-year-old male with hematochezia. CT angiogram shows small bowel luminal enhancement (arrow) consistent with active bleeding. At surgery, a Meckel diverticulum with heterotopic gastric mucosa was found

Fig. 8.9 A 58-year-old female with metastatic breast cancer and abnormal pelvic finding on PET/CT. CT angiogram shows enhancing vessel in pedunculated rectal mass (arrow) which proved to be a villous adenoma

of 4–6 ml/s. No oral contrast should be used, as it obscures hemorrhage in the bowel lumen. A scan before injecting contrast is useful to show opaque-ingested material, medications, suture, and surgical clips which could be mistaken for sites of bleeding. After contrast injection, scanning is performed in both arterial and venous phases. Increasing density with the bowel lumen from one phase to the next (noncontrast, arterial, venous) is proof of active bleeding (Fig. 8.8) [16]. Images are reconstructed with thin (1–2 mm) slices in axial, coronal, and sagittal planes. Maximum intensity projections (MIPs) are also created in multiple planes. MIPs increase the conspicuity of small areas of increased density, thus are helpful in showing subtle foci of contrast spillage into the bowel lumen, or small angiodysplasias and arteriovenous malformations. Volume rendering (VR), which assigns colors to voxels based on their attenuation, is useful for revealing bowel wall edema, hyperemia, and thickening [17]. Beyond the detection of bleeding, CTA can show local tumor size and morphology (Fig. 8.9), lymph node involvement, distant metastasis, and complications such as bowel obstruction, perforation, and abscess. The limitations of CTA include the hazards of iodinated intravenous contrast, renal failure, and allergy to iodine. The dose of ionizing radiation is a concern in younger and pregnant patients.

Scintigraphy

Scintigraphy for gastrointestinal bleeding typically uses the patient's own erythrocytes, labelled with 99 m technetium. Various labelling methods are available, the most efficient being the in vitro method in which blood is withdrawn from the patient; RBCs are labelled with 99mTc and then reinjected [18]. This results in tagging of the entire circulating RBC pool, which can be imaged using a gamma camera. Dynamic images are acquired, from 1 to 20 seconds per image. The duration of imaging is long enough to allow detection of intermittent bleeding, from 1 to 4 hours. Diagnosis of a gastrointestinal bleed requires that four criteria be met: a focus of extravascular activity should start in a previously normal area, activity should increase in intensity over time, activity should move in either antegrade or retrograde fashion, and activity should conform to the bowel (Fig. 8.10) [19]. Bleeding rates as

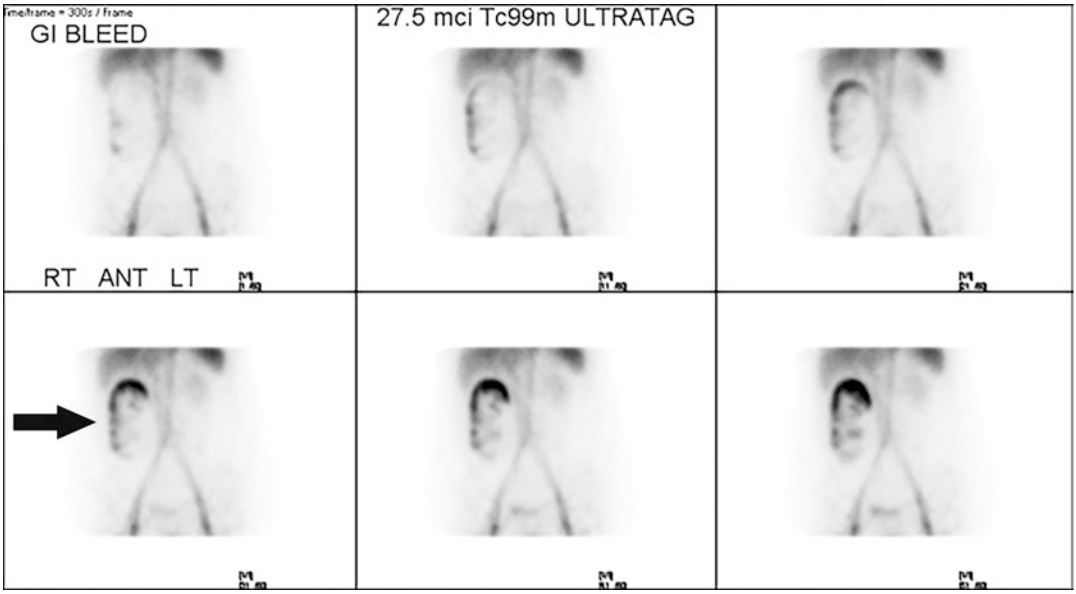

Fig. 8.10 A 51-year-old female with hematochezia. 99mTc tagged RBC scintigraphy shows increasing activity that corresponds to the shape of the right colon (arrow). The source was a bleeding diverticulum

low as 0.05–0.2 mL/min can be detected, with a sensitivity of 93% and specificity of 95% [20]. Detection of bleeding within the first few minutes of the scan predicts a positive angiogram. Advantages of scintigraphy compared to CTA are the capacity to detect lower rates of bleeding over a longer period of observation, lower radiation dose, and avoiding the risk of iodine allergy and nephrotoxicity. Limitations of scintigraphy include relative lack of availability, longer time to perform the study, and lack of anatomic detail compared to CTA [21].

Catheter Angiography

Catheter angiography is usually undertaken as a therapeutic procedure, to treat the source of GI bleeding identified by CTA or scintigraphy. Since iodinated contrast material is used, renal failure and iodine allergy are contraindications. It is performed by an interventional radiologist, in a suite with angiographic equipment. Cone-beam CT, combining cross-sectional imaging with catheter angiography, and automatic vessel detection software are technical advances [22]. Vascular access is most commonly obtained by femoral

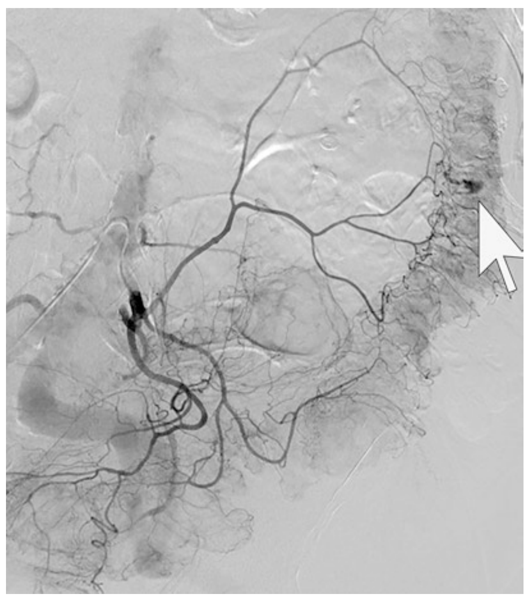

Fig. 8.11 An 85-year-old male with hematochezia. Selective inferior mesenteric artery angiogram shows focal extravasation of contrast in the left colon (arrow), from a bleeding diverticulum

artery puncture, followed by catheter insertion over a guidewire. The bleeding site is approached by selective catheterization of the feeding artery (Fig. 8.11). Bleeding can be controlled by injecting embolic material through the catheter. Gelatin sponges, particles, coils, or glue may be used, at the discretion of the operator. Post-embolization angiography is done to determine success. Major hazards are rebleeding and bowel ischemia [23]. A review of outcomes from several small series using super-selective mesenteric embolization has shown rates of immediate hemostasis of 96–100%, with the need for repeat embolization as high as 22% and progression to surgery of 12.5% [24].

Conclusion

Abdominal radiography is a rapid method to detect the presence of intestinal obstruction or perforation. CT with intravenous contrast is a useful and widely available tool to evaluate obstructing anorectal malignancy and its complications. Oral and rectal contrast can also be used with CT. Contrast enema is less often performed, but can directly prove or disprove colon obstruction. MRI is the preferred imaging technique to stage rectal malignancy, but is less useful in the setting of bowel obstruction; it is a valuable alternative to CT for imaging of pregnant patients. CT angiography can simultaneously show the cause of rectal bleeding and associated structural abnormalities and can guide subsequent therapeutic angiography. Scintigraphy is the most sensitive imaging method for GI bleeding and is valuable as an alternative to CTA in patients with renal failure and iodine allergy.

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