

Diverticular Bleeding

THAD WILKINS, MD, *Medical College of Georgia, Augusta, Georgia*

CHRISTINE BAIRD, MD, *Fort Hood, Texas*

ANDREW N. PEARSON, MD; *Cardiology Gastroenterology Associates of Myrtle Beach, Myrtle Beach, South Carolina*

ROBERT R. SCHADE, MD, *Medical College of Georgia, Augusta, Georgia*

Diverticular bleeding is a common cause of lower gastrointestinal hemorrhage. Patients typically present with massive and painless rectal hemorrhage. If bleeding is severe, initial resuscitative measures should include airway maintenance and oxygen supplementation, followed by measurement of hemoglobin and hematocrit levels, and blood typing and crossmatching. Patients may need intravenous fluid resuscitation with normal saline or lactated Ringer's solution, followed by transfusion of packed red blood cells in the event of ongoing bleeding. Diverticular hemorrhage resolves spontaneously in approximately 80 percent of patients. If there is severe bleeding or significant comorbidities, patients should be admitted to the intensive care unit. The recommended initial diagnostic test is colonoscopy, performed within 12 to 48 hours of presentation and after a rapid bowel preparation with polyethylene glycol solutions. If the bleeding source is identified by colonoscopy, endoscopic therapeutic maneuvers can be performed. These may include injection with epinephrine or electrocautery therapy. If the bleeding source is not identified, radionuclide imaging (i.e., technetium-99m-tagged red blood cell scan) should be performed, usually followed by arteriography. For ongoing diverticular hemorrhage, other therapeutic modalities such as selective embolization, intra-arterial vasopressin infusion, or surgery, should be considered. (*Am Fam Physician*. 2009;80(9):977-983. Copyright © 2009 American Academy of Family Physicians.)



This clinical content conforms to AAFP criteria for evidence-based continuing medical education (EB CME).

Diverticular bleeding is the source of 17 to 40 percent of lower gastrointestinal (GI) hemorrhage in adults, making it the most common cause of lower GI bleeding.¹ In one study of 1,593 patients with diverticulosis, severe life-threatening diverticular hemorrhage occurred in 3.1 percent of patients.² Most diverticular bleeding is self-limited, although it should be suspected in patients with massive and painless rectal hemorrhage. In adults older than 65 years, diverticular hemorrhage can lead to significant morbidity, especially in those with hemodynamic instability and comorbid conditions, including hypertension, diabetes mellitus, chronic obstructive pulmonary disease, chronic renal insufficiency, and coronary artery disease.^{1,3} This review summarizes current recommendations for the management of diverticular bleeding in adults.

Pathogenesis

Diverticula develop at sites of weaknesses in the colonic wall that occur where the vasa

recta penetrate the circular muscle layer.⁴ As a diverticulum herniates, the vasa recta drape over the dome of the diverticulum and become susceptible to trauma and disruption.⁵ Inflammatory changes are not seen histologically, and diverticulitis does not usually coexist with diverticular bleeding.⁵ Although diverticula typically occur throughout the colon, diverticular bleeding tends to occur in the thinner-walled ascending (right) colon.⁶

Diagnosis

HISTORY AND PHYSICAL EXAMINATION

Patients with diverticular bleeding usually present with abrupt onset of painless rectal hemorrhage.⁷ Occasionally, patients may present with mild abdominal cramping or the urge to defecate, secondary to blood within the colon.^{7,8} The stool may be bright red to dark maroon in color,⁹ and is often mixed with gelatinous clot.⁷ Patients may have a history of diverticulosis or diverticular bleeding.¹ *Table 1* lists possible causes of lower GI bleeding.¹

SORT: KEY RECOMMENDATIONS FOR PRACTICE

<i>Clinical recommendation</i>	<i>Evidence rating</i>	<i>References</i>
Severe postural dizziness and a postural pulse increase of at least 30 beats per minute are accurate indicators of moderate to severe blood loss.	C	10
Nasogastric lavage, followed by upper GI endoscopy if aspirate is positive for frank blood, should be performed in patients with large amounts of ongoing GI blood loss to rule out upper GI bleeding.	C	11, 12
Colonoscopy is safe, has good diagnostic yield, and should be considered the initial procedure of choice to evaluate lower GI bleeding.	C	11, 16-18
Urgent colonoscopy is safe in the setting of lower GI bleeding.	B	11, 16-18
Technetium-99m-tagged red blood cell scanning or arteriography can be used in patients who have ongoing hemorrhage with nondiagnostic endoscopic evaluation.	C	12, 25
Endoscopic therapeutic maneuvers, such as epinephrine injection or electrocautery therapy, can be used to treat diverticular bleeding.	B	12, 25
Patients should avoid using aspirin and nonsteroidal anti-inflammatory drugs because of their association with diverticular bleeding.	C	37
Fiber supplementation (32 g per day) and increasing levels of physical activity may prevent the progression of diverticular disease.	B	38-40

GI = gastrointestinal.

A = consistent, good-quality patient-oriented evidence; B = inconsistent or limited-quality patient-oriented evidence; C = consensus, disease-oriented evidence, usual practice, expert opinion, or case series. For information about the SORT evidence rating system, go to <http://www.aafp.org/afpsort.xml>.

Table 1. Differential Diagnosis of Lower GI Bleeding

<i>Diagnosis</i>	<i>Distinguishing features</i>	<i>Frequency (%)</i>
Diverticular bleeding	Acute, severe, painless bleeding in the setting of known or suspected diverticular disease	17 to 40
Angiodysplasia	Recurrent, painless bleeding episodes; can be chronic, leading to iron deficiency anemia	2 to 30
Colitis		9 to 21
Ischemic colitis	Self-limited, bloody diarrhea followed by acute lower abdominal pain in patients with cardiac risk factors	
Infectious colitis	Bloody diarrhea with fever and high-risk diet or previous antibiotic use	
Inflammatory bowel disease	Bloody diarrhea associated with recurrent abdominal pain and weight loss	
Colon cancer	Slow, chronic blood loss with change in bowel habit or iron deficiency anemia	11 to 14
Postpolypectomy or post-endoscopic biopsy bleeding	Self-limited bleeding occurring within 30 days of a previous polypectomy or biopsy	11 to 14
Hemorrhoids	Bleeding associated with bowel movements and anal pruritus; usually painless, but pain may be present with thrombosed hemorrhoids	4 to 10
Upper GI bleeding	Elevated blood urea nitrogen-to-creatinine ratio, or positive nasogastric aspirate for blood	0 to 11

NOTE: Listed in approximate order of frequency.

GI = gastrointestinal.

Adapted with permission from Macmillan Publishers Ltd. Zuccaro G Jr. Management of the adult patient with acute lower gastrointestinal bleeding. American College of Gastroenterology. Practice Parameters Committee. Am J Gastroenterol. 1998;93(8):1204.

Diagnosis and Treatment of Patients with Lower GI Hemorrhage

Patients may have a normal blood pressure and pulse if the bleeding has stopped. If bleeding is persistent and severe, patients may be tachycardic, hypotensive, or may exhibit orthostatic hypotension, which is defined as a postural pulse increase of 30 beats per minute or a postural systolic blood pressure decrease of 20 mm Hg.¹⁰ Severe postural dizziness and a postural pulse increase of at least 30 beats per minute are accurate indicators of acute blood loss of more than 630 mL, with a sensitivity of 97 percent and specificity of 98 percent (positive likelihood ratio [LR+] = 48; negative likelihood ratio [LR-] = 0.02).¹⁰ Late signs of severe blood loss include poor skin turgor, dry skin, and altered level of consciousness. The abdominal examination is usually normal but may demonstrate tenderness to palpation. Blood is typically found during rectal examination. Nasogastric lavage should be performed in patients passing large amounts of bright red- to dark maroon-colored stool because 10 to 15 percent of such hemorrhage is from an upper GI source.^{11,12} Upper endoscopy should be performed if frank blood is aspirated from nasogastric lavage.

INITIAL RESUSCITATIVE MEASURES

If a patient has unstable vital signs or presents with severe bleeding, rapid assessment and resuscitation should precede the diagnostic evaluation. Resuscitative measures include maintenance of the airway, oxygen supplementation, and placement of two large-bore intravenous lines, with subsequent intravenous fluid resuscitation using normal saline or lactated Ringer's solution. Laboratory evaluation includes coagulation studies; measurement of hemoglobin, hematocrit, and serum electrolyte levels; and determination of blood urea nitrogen-to-creatinine ratio.¹³ When abnormal, the ratio (especially if 33 or less) is helpful for ruling out lower GI bleeding with a sensitivity of 96 percent and a specificity of 17 percent (LR+ = 1.2; LR- = 0.2).¹³ Patients should be typed and crossmatched for packed red blood cells, and transfusion initiated based on the severity of the patient's clinical situation and comorbidities. Admission to the intensive care

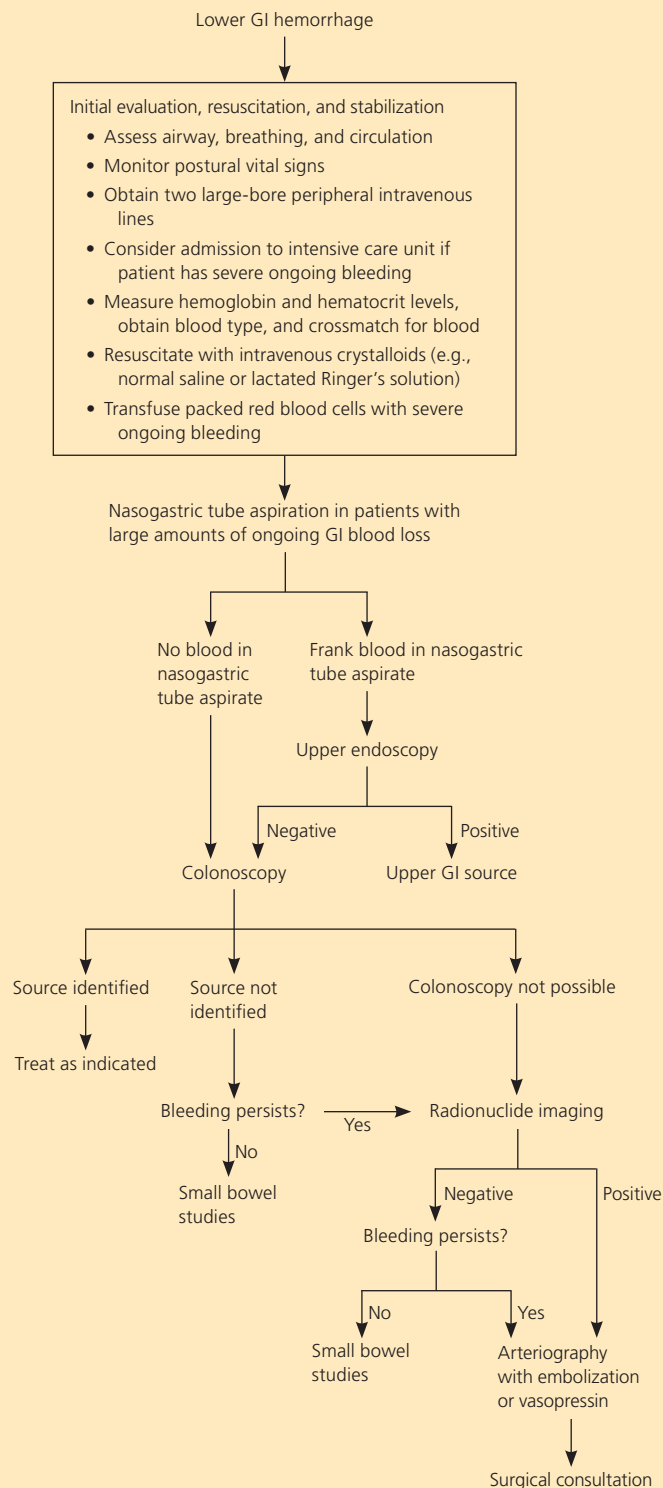


Figure 1. Algorithm for lower GI hemorrhage.

GI = gastrointestinal.

Adapted with permission from Macmillan Publishers Ltd. Zuccaro G Jr. Management of the adult patient with acute lower gastrointestinal bleeding. American College of Gastroenterology. Practice Parameters Committee. Am J Gastroenterol. 1998;93(8):1203.

Diverticular Bleeding

unit is recommended if the patient has significant comorbid conditions, has postural blood pressure changes, remains hemodynamically unstable, or requires transfusion following initial resuscitative measures.^{1,3}

Diagnostic Testing

Diagnostic test selection is determined in part by local expertise and test availability. Methods to evaluate the lower GI tract for bleeding include direct visualization with a colonoscope, radionuclide imaging, and arteriography. *Figure 1*¹ provides an algorithmic approach to lower GI bleeding, and *Table 2* lists advantages and disadvantages of these tests.

COLONOSCOPY

In patients with lower GI bleeding, the initial diagnostic procedure of choice is colonoscopy. During the procedure, the colonoscopist evaluates the colon for mucosal changes, infectious pathology, colitis, and ischemic changes to exclude these diagnoses. Colonoscopy should be performed within 12 to 48 hours of presentation and after colonic lavage with purge preparation (1 L polyethylene glycol solution every 30 to 45 minutes for at least two hours or until there is clear effluent). Colonic diverticula associated with bright red- to maroon-colored stool with clots are the most common findings on colonoscopy and are suggestive of, but not diagnostic for, diverticular bleeding in the absence of other pathologic findings. Active bleeding or stigmata of hemorrhage (visible vessel or pigmented protuberance) are identified in only 10 to 20 percent of colonoscopic examinations for diverticular bleeding.¹⁴ When present, these findings are associated with a high risk of continued or recurrent bleeding.¹⁵

The advantage of colonoscopy over other diagnostic modalities is direct visualization, allowing for exclusion of other etiologies of lower GI bleeding, as well as for immediate therapy. Colonoscopy is safe and effective, with a diagnostic yield of 69 to 80 percent in acute lower GI bleeding.^{11,16-18} In a review of four studies with 549 urgent colonoscopies performed for lower GI bleeding, only one complication (diverticulum perforation) was reported.^{11,16-18} *Figure 2* shows a colonoscopic image of a blood-filled colon with clots and diverticula.

RADIONUCLIDE IMAGING

Patients with ongoing hemorrhage for whom colonoscopy has failed to localize the site of bleeding should

Table 2. Comparison of Tests to Assess Lower GI Bleeding

Test	Advantages	Disadvantages
Colonoscopy	Precise localization of bleeding and potential therapeutic intervention Excludes other causes of GI bleeding	Poor visualization in unprepared or massively bleeding patient; risk of sedation
Radionuclide imaging	Noninvasive; excellent sensitivity	Regional localization only; must be performed during active bleeding; no potential for therapeutic intervention
Arteriography	Does not require bowel preparation; precise anatomic localization	Must be performed during active bleeding; risk of intestinal infarction

NOTE: Listed in typical sequence of use.

GI = gastrointestinal.

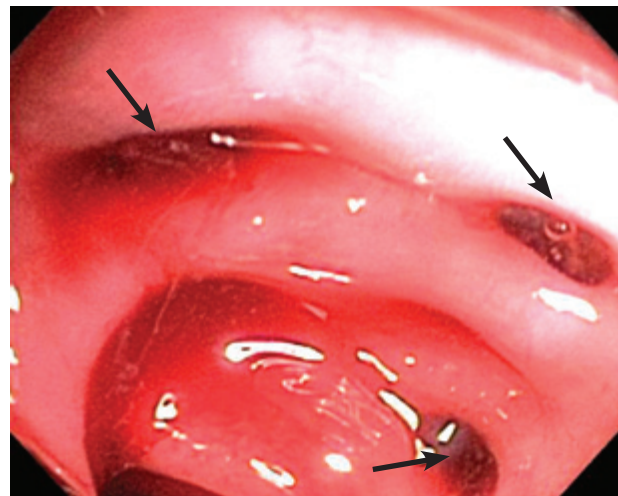


Figure 2. Colonoscopic image of a blood-filled colon with clots and diverticula (arrows).

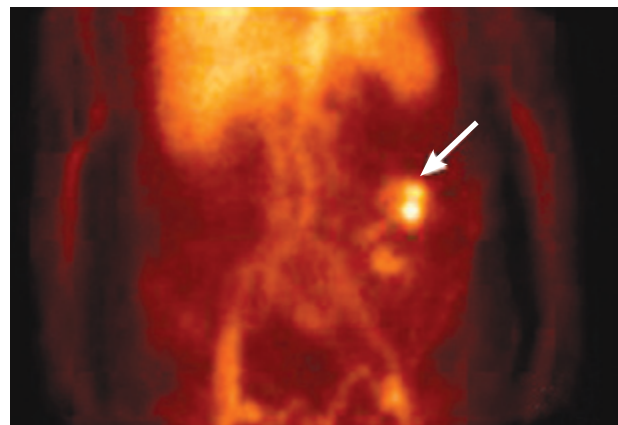


Figure 3. Technetium-99m-tagged red blood cell scan showing extravasation of tagged red blood cells into the colon lumen in the sigmoid and descending colon, with radionuclide collection in the descending colon (arrow).

have a nuclear medicine technetium-99m-tagged red blood cell scan. In this study, red blood cells obtained from the patient are “tagged” with a radioactive isotope and reinjected into the patient. The radiolabeled cells are then detected with a nuclear medicine camera. If GI bleeding is present, the radiolabeled red blood cells are detected in the lumen of the intestines (*Figure 3*). The tagged cells circulate for 48 hours and offer the advantage of repeat scanning in a patient with rebleeding and a previous negative study.

Another advantage of a technetium-99m-tagged red blood cell scan is that it may detect a low bleeding rate (0.1 mL per minute or 144 mL per day) if bleeding is continuous.¹⁹ In lower GI bleeding, the likelihood of a positive scan is 51 to 59 percent; a positive scan has an accuracy of 75 to 97 percent in localization to a region of the abdomen.^{20,21} The technetium-99m-tagged red blood cell scan is often performed before arteriography, although there have been no studies evaluating the effectiveness of a nuclear medicine scan preceding arteriography. A negative scan generally suggests that arteriography will also fail to identify an active source of hemorrhage.

ARTERIOGRAPHY

Arteriography involves injection of contrast dye into the superior and inferior mesenteric arteries and their branches, which supply the ascending and descending colon with blood. An area of extravasation (contrast blush) can be seen in patients with active GI bleeding (*Figure 4*). The diagnostic yield of arteriography is 40 to 78 percent in active lower GI bleeding. Approximately 2 to 4 percent of patients who undergo diagnostic arteriography procedures develop a complication such as contrast allergy, contrast-induced renal failure, bleeding from the arterial puncture site, or embolism of a dislodged thrombus.²²⁻²⁴

Treatment

If bleeding stigmata, such as a protuberant vessel or pigmented spots, associated with a diverticulum are visualized during colonoscopy, therapy can be applied directly to this area. A small, retrospective study of endoscopic therapy in 10 patients found no rebleeding episodes using a combination of epinephrine injection and electrocautery therapy.^{12,25} Endoscopically placed clips (endoclips), fibrin sealant, and band ligation were

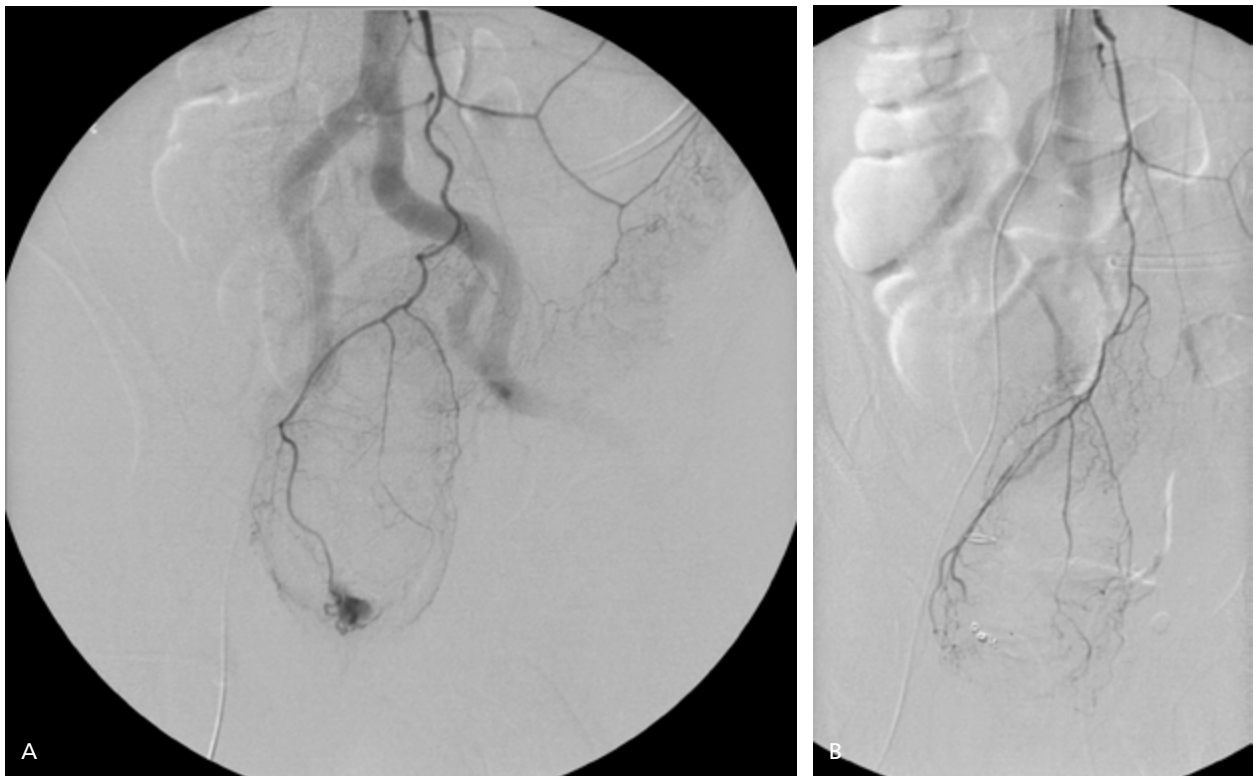


Figure 4. Arteriography demonstrating (A) extravasation of contrast into the intestinal lumen during a superselective arteriography. (B) Completion of superselective coil embolization of identified bleeding site.

Diverticular Bleeding

shown to be effective in controlling diverticular bleeding in three small case series.²⁶⁻²⁸ If colonoscopy is not available or if it fails to reveal or control the bleeding source, further intervention is required. A tagged red blood cell scan is typically performed with attempts to localize the bleeding source and assist with targeted therapy by arteriography or surgery.

Intra-arterial vasopressin infusion during arteriography is successful in identifying bleeding in 72 percent of patients and controlling bleeding in 90 percent of patients. However, it is complicated by a 50 percent rebleeding rate and is seldom used in practice.²⁹ Selective arteriography with therapeutic embolization is effective (76 to 100 percent of patients had controlled hemorrhage) and safe (less than 20 percent of patients experienced ischemia following embolization).^{30,31}

Surgical intervention is rarely required because the bleeding is self-limited in 86 percent of patients, and there is a high rate of success at controlling bleeding by nonsurgical means.³² Indications for surgical intervention include large transfusion requirements (i.e., more than four units of packed red blood cells in a 24-hour period); recurrent hemorrhage that is refractory or not amenable to therapy; or hemodynamic instability that does not respond to medical therapy. In patients with uncontrolled bleeding requiring emergency surgery, mortality is high (10 to 20 percent), often because of hypotension and comorbid conditions.^{2,23,33} The surgical procedure of choice is directed segmental resection, which requires preoperative localization of hemorrhage. A subtotal colectomy performed for nonlocalized lower GI bleeding is associated with increased morbidity (37 percent) and mortality (11 to 33 percent), and should be performed only in patients with uncontrolled massive hemorrhage when there are no alternatives.^{29,34} The rebleeding rate in one study with a mean follow-up of one year was zero for subtotal colectomy, 14 percent for segmental resection with localization of bleeding, and 42 percent with segmental resection with nonlocalization of bleeding.³⁵ Elective resection should be considered in patients with two or more episodes of diverticular hemorrhage.

Prognosis and Follow-up

Although most diverticular bleeding is self-limited and resolves spontaneously,^{8,34} blood loss is massive and rapid in 9 to 19 percent of patients.^{29,36} Patients at high risk of adverse outcomes include those with comorbid diseases, poor nutrition, or preexisting liver disease.¹ Following the resolution of diverticular hemorrhage and the initial colonoscopy, surveillance colonoscopy is

not recommended unless it is performed for other indications, such as colorectal cancer screening. The use of aspirin and nonsteroidal anti-inflammatory drugs is associated with an increased risk of diverticular bleeding (odds ratio = 1.9 to 18.4).³⁷ To prevent progression of diverticular disease, patients should increase their dietary fiber intake or begin fiber supplementation (32 g per day), and increase their level of physical activity.³⁸⁻⁴⁰ Obesity (body mass index greater than or equal to 30 kg per m²) is a significant risk factor for diverticular bleeding (relative risk = 2.0).⁴¹ Avoidance of certain nuts, corn, or popcorn to prevent complications is no longer recommended in patients with diverticular disease.⁴²

Figure 3 provided by Hadyn Williams, MD, Department of Radiology, Medical College of Georgia in Augusta. Figure 4 provided by William Bates III, MD, Department of Radiology, Medical College of Georgia.

The Authors

THAD WILKINS, MD, is an associate professor in the Department of Family Medicine at the Medical College of Georgia in Augusta.

CHRISTINE BAIRD, MD, currently resides in Fort Hood, Tex. At the time this manuscript was written, Dr. Baird was chief resident of the Department of Family Medicine at the Medical College of Georgia.

ANDREW N. PEARSON, MD, is currently in private practice at Cardiology Gastroenterology Associates of Myrtle Beach (S.C.). At the time this manuscript was written, Dr. Pearson was a fellow of gastroenterology in the Department of Medicine at the Medical College of Georgia.

ROBERT R. SCHADE, MD, is a professor in the Department of Medicine at the Medical College of Georgia. He is chief of the Division of Gastroenterology/Hepatology and medical director of the Special Procedures/Endoscopy unit.

Address correspondence to Thad Wilkins, MD, Medical College of Georgia, 1120 15th St., Augusta, GA 30912 (e-mail: twilkins@mcg.edu). Reprints are not available from the authors.

Author disclosure: Nothing to disclose.

REFERENCES

1. Zuccaro G Jr. Management of the adult patient with acute lower gastrointestinal bleeding. American College of Gastroenterology. Practice Parameters Committee. *Am J Gastroenterol.* 1998;93(8):1202-1208.
2. McGuire HH Jr, Haynes BW Jr. Massive hemorrhage for diverticulosis of the colon: guidelines for therapy based on bleeding patterns observed in fifty cases. *Ann Surg.* 1972;175(6):847-855.
3. Strate LL, Orav EJ, Syngal S. Early predictors of severity in acute lower intestinal tract bleeding. *Arch Intern Med.* 2003;163(7):838-843.
4. Meyers MA, Volberg F, Katzen B, Alonso D, Abbott G. The angioarchitecture of colonic diverticula. Significance in bleeding diverticulosis. *Radiology.* 1973;108(2):249-261.
5. Meyers MA, Alonso DR, Gray GF, Baer JW. Pathogenesis of bleeding colonic diverticulosis. *Gastroenterology.* 1976;71(4):577-583.
6. Wong SK, Ho YH, Leong AP, Seow-Choen F. Clinical behavior of complicated right-sided and left-sided diverticulosis. *Dis Colon Rectum.* 1997; 40(3):344-348.
7. Reinus JF, Brandt LJ. Vascular ectasias and diverticulosis. Common

- causes of lower intestinal bleeding. *Gastroenterol Clin North Am*. 1994;23(1):1-20.
8. Stollman NH, Raskin JB. Diagnosis and management of diverticular disease of the colon in adults. Ad Hoc Practice Parameters Committee of the American College of Gastroenterology. *Am J Gastroenterol*. 1999;94(11):3110-3121.
 9. Fine KD, Nelson AC, Ellington RT, Mossburg A. Comparison of the color of fecal blood with the anatomical location of gastrointestinal bleeding lesions: potential misdiagnosis using only flexible sigmoidoscopy for bright red blood per rectum. *Am J Gastroenterol*. 1999;94(11):3202-3210.
 10. McGee S, Abernethy WB III, Simel DL. The rational clinical examination. Is this patient hypovolemic? *JAMA*. 1999;281(11):1022-1029.
 11. Jensen DM, Machicado GA. Diagnosis and treatment of severe hematochezia. The role of urgent colonoscopy after purge. *Gastroenterology*. 1988;95(6):1569-1574.
 12. Davila RE, Rajan E, Adler DG, et al., for the Standards of Practice Committee. ASGE Guideline: the role of endoscopy in the patient with lower-GI bleeding. *Gastrointest Endosc*. 2005;62(5):656-660.
 13. Chalasani N, Clark WS, Wilcox CM. Blood urea nitrogen to creatinine concentration in gastrointestinal bleeding: a reappraisal. *Am J Gastroenterol*. 1997;92(10):1796-1799.
 14. Foutch PG, Zimmerman K. Diverticular bleeding and the pigmented protuberance (sentinel clot): clinical implications, histopathological correlation, and results of endoscopic intervention. *Am J Gastroenterol*. 1996;91(12):2589-2593.
 15. Jensen DM, Machicado GA, Jutabha R, Kovacs TO. Urgent colonoscopy for the diagnosis and treatment of severe diverticular hemorrhage. *N Engl J Med*. 2000;342(2):78-82.
 16. Rossini FP, Ferrari A, Spandre M, et al. Emergency colonoscopy. *World J Surg*. 1989;13(2):190-192.
 17. Caos A, Benner KG, Manier J, et al. Colonoscopy after Golytely preparation in acute rectal bleeding. *J Clin Gastroenterol*. 1986;8(1):46-49.
 18. Forde KA. Colonoscopy in acute rectal bleeding. *Gastrointest Endosc*. 1981;27(4):219-220.
 19. Smith R, Copely DJ, Bolen FH. 99mTc RBC scintigraphy: correlation of gastrointestinal bleeding rates with scintigraphic findings. *AJR Am J Roentgenol*. 1987;148(5):869-874.
 20. Dusold R, Burke K, Carpentier W, Dyck WP. The accuracy of technetium-99m-labeled red cell scintigraphy in localizing gastrointestinal bleeding. *Am J Gastroenterol*. 1994;89(3):345-348.
 21. Suzman MS, Talmor M, Jennis R, Binkert B, Barie PS. Accurate localization and surgical management of active lower gastrointestinal hemorrhage with technetium-labeled erythrocyte scintigraphy. *Ann Surg*. 1996;224(1):29-36.
 22. Colacchio TA, Forde KA, Patsos TJ, Nunez D. Impact of modern diagnostic methods on the management of active rectal bleeding. Ten year experience. *Am J Surg*. 1982;143(5):607-610.
 23. Leitman IM, Paull DE, Shires GT III. Evaluation and management of massive lower gastrointestinal hemorrhage. *Ann Surg*. 1989;209(2):175-180.
 24. Koval G, Benner KG, Rösch J, Kozak BE. Aggressive angiographic diagnosis in acute lower gastrointestinal hemorrhage. *Dig Dis Sci*. 1987;32(3):248-253.
 25. Jensen DM, Machicado GA, Jutabha R, Kovacs TO. Urgent colonoscopy for the diagnosis and treatment of severe diverticular hemorrhage. *N Engl J Med*. 2000;342(2):78-82.
 26. Hokama A, Uehara T, Nakayoshi T, et al. Utility of endoscopic hemoclipping for colonic diverticular bleeding. *Am J Gastroenterol*. 1997;92(3):543-546.
 27. Andress HJ, Mewes A, Lange V. Endoscopic hemostasis of a bleeding diverticulum of the sigma with fibrin sealant. *Endoscopy*. 1993;25(2):193.
 28. Farrell JJ, Graeme-Cook F, Kelsey PB. Treatment of bleeding colonic diverticula by endoscopic band ligation: an in-vivo and ex-vivo pilot study. *Endoscopy*. 2003;35(10):823-829.
 29. Browder W, Cerise EJ, Litwin MS. Impact of emergency angiography in massive lower gastrointestinal bleeding. *Ann Surg*. 1986;204(5):530-536.
 30. DeBarros J, Rosas L, Cohen J, Vignati P, Sardella W, Hallisey M. The changing paradigm for the treatment of colonic hemorrhage: superselective angiographic embolization. *Dis Colon Rectum*. 2002;45(6):802-808.
 31. Gordon RL, Ahl KL, Kerlan RK, et al. Selective arterial embolization for the control of lower gastrointestinal bleeding. *Am J Surg*. 1997;174(1):24-28.
 32. Chen CY, Wu CC, Jao SW, Pai L, Hsiao CW. Colonic diverticular bleeding with comorbid diseases may need elective colectomy. *J Gastrointest Surg*. 2009;13(3):516-520.
 33. Britt LG, Warren L, Moore OF III. Selective management of lower gastrointestinal bleeding. *Am Surg*. 1983;49(3):121-125.
 34. McGuire HH Jr. Bleeding colonic diverticula. A reappraisal of natural history and management. *Ann Surg*. 1994;220(5):653-656.
 35. Parkes BM, Obeid FN, Sorensen VJ, Horst HM, Fath JJ. The management of massive lower gastrointestinal bleeding. *Am Surg*. 1993;59(10):676-678.
 36. Peura DA, Lanza FL, Gostout CJ, Foutch PG. The American College of Gastroenterology Bleeding Registry: preliminary findings. *Am J Gastroenterol*. 1997;92(6):924-928.
 37. Laine L, Smith R, Min K, Chen C, Dubois RW. Systematic review: the lower gastrointestinal adverse effects of non-steroidal anti-inflammatory drugs. *Aliment Pharmacol Ther*. 2006;24(5):751-767.
 38. Aldoori WH, Giovannucci EL, Rimm EB, Wing AL, Trichopoulos DV, Willett WC. A prospective study of diet and the risk of symptomatic diverticular disease in men. *Am J Clin Nutr*. 1994;60(5):757-764.
 39. Aldoori WH, Giovannucci EL, Rockett HR, Sampson L, Rimm EB, Willett WC. A prospective study of dietary fiber types and symptomatic diverticular disease in men. *J Nutr*. 1998;128(4):714-719.
 40. Strate LL, Liu YL, Aldoori WH, Giovannucci EL. Physical activity decreases diverticular complications. *Am J Gastroenterol*. 2009;104(5):1221-1230.
 41. Strate LL, Liu YL, Aldoori WH, Syngal S, Giovannucci EL. Obesity increases the risks of diverticulitis and diverticular bleeding. *Gastroenterology*. 2009;136(1):115-122.
 42. Strate LL, Liu YL, Syngal S, Aldoori WH, Giovannucci EL. Nut, corn, and popcorn consumption and the incidence of diverticular disease. *JAMA*. 2008;300(8):907-914.