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Techniques in Vascular and Interventional Radiology

Chronic Mesenteric Ischemia

Luke R. Wilkins, MD, and James R. Stone, MD, PhD

Endovascular management and treatment of chronic mesenteric ischemia has taken on an increasing role in recent years. The safety, efficacy, and cost-effectiveness have been validated in several studies. The procedure is best performed by an operator with a complete understanding of the pertinent imaging findings; a thorough knowledge of the risks, benefits, limitations, and technical challenges of the procedure; and understanding of the importance and necessity of long-term clinical management. This article outlines a general approach to endovascular management of chronic mesenteric ischemia and discusses indications, potential complications, and technical aspects of the procedure.

KEYWORDS Mesenteric ischmeia, stent, angioplasty

Background

Chronic mesenteric ischemia is an uncommon clinical entity owing in part to a robust collateral vascular network. Classic descriptions of chronic mesenteric ischemia require narrowing or occlusion of 2 or more main visceral arteries before the development of symptoms. However, it is increasingly being recognized that comprises of 1 or more of the celiac, superior mesenteric arteries (SMAs), or inferior mesenteric arteries (IMAs) may lead to the development of symptoms secondary to the inconsistency of collateral blood flow.

Chronic mesenteric ischemia most frequently occurs in the setting of atherosclerotic disease with resultant narrowing of 1 or more mesenteric arteries. However, in contrast to most other atherosclerotic diseases, chronic mesenteric ischemia is more frequently seen in women.[1] This is likely secondary to differences in the orientation of the mesenteric vessels to the aorta, with a more acute angle to the aorta in women when compared with men.[2] The likely result is altered flow dynamics and increased susceptibility to atherosclerotic disease. More specifically, women with a body mass index of 25-29.9 had a mean aortomesenteric angle of 49.5°. This is in contrast to male patients in the same body mass index range with a mean aortomesenteric angle of 63.8°. This difference may affect flow dynamics, predisposing women to atherosclerotic disease of the mesenteric vessels. Other etiologies of SMA stenosis or narrowing include fibromuscular dysplasia, vasculitides, and postoperative intimal hyperplasia.

The natural history and factors affecting progression of mesenteric artery stenoses are not well defined. Progression from chronic to acute mesenteric ischemia is associated with >50% mortality. However, given the risks associated with open surgical and endovascular treatments, if and when to treat asymptomatic mesenteric arterial lesions remains a controversial topic.

Clinical Evaluation

History and Physical Examination

Chronic mesenteric ischemia is often referred to "intestinal angina" and is classically manifested as recurrent episodes of abdominal pain secondary to insufficient splanchnic blood flow during periods of heightened demand. Postprandial pain will generally begin shortly after eating and last 1-2 hours and is typically described as crampy and dull. In addition, nonspecific symptoms can also be seen, including nausea, vomiting, and diarrhea. Patients typically have a history of smoking and underlying atherosclerotic disease, with approximately half of patients having known peripheral vascular disease or coronary artery disease.[3] Weight loss is present in approximately 80% of patients and is attributable to "food aversion"

Department of Radiology and Medical Imaging, University of Virginia Health System, Charlottesville, VA.

Address reprint requests to Luke R. Wilkins, MD, Department of Radiology and Medical Imaging, University of Virginia School of Medicine, Box 800170, Charlottesville, VA 22901. E-mail: lrw6n@virginia.edu

1089-2516/15/$ - see front matter © 2015 Elsevier Inc. All rights reserved.
http://dx.doi.org/10.1053/j.tvir.2014.12.005

owing to anticipation of postprandial pain. Although physical findings are frequently nonspecific, an abdominal bruit may be detected in up to 50% of patients.

Imaging

Evaluation of chronic mesenteric ischemia may be performed with catheter-based angiography, computed tomographic angiography (CTA), magnetic resonance angiography (MRA), or ultrasound. Although catheter-based angiography remains the gold standard, advances in noninvasive methods have led to the use of ultrasound, CTA, or MRA as the initial tests to evaluate for mesenteric arterial disease before proceeding to angiography.

Duplex ultrasound is an inexpensive and readily available imaging modality to screen for chronic mesenteric ischemia. This option provides physiological flow data and can be performed in the fasting and postprandial states to detect physiologically significant stenoses.[4] In the fasting state, the SMA possesses a high-resistance waveform characteristic of the splanchnic circulation whereas the celiac artery demonstrates higher end-diastolic velocities (EDV), with flow throughout the cardiac cycle owing to the low resistance within the liver and spleen. However, in the postprandial state, the SMA will show a marked increase in EDV with a less dramatic increase seen in the celiac circulation. A significant stenosis will be characterized by an increase in the peak systolic velocity and EDV during duplex ultrasound (US) investigation. Retrograde flow in the hepatic artery may be seen with a severe stenosis or occlusion of the celiac artery, whereas loss of diastolic flow or flow reversal may be seen with a significant stenosis of the SMA. Limitations of duplex US include presence of overlying bowel gas, normal variant arterial anatomy, patient body habitus, operator training, and lack of uniform criteria for interpretation of the duplex US findings.[4] Additionally, multivessel disease can lead to the overestimation of stenotic lesions secondary to the development of rich collateral arterial flow.

CTA has become increasingly used to diagnose chronic mesenteric ischemia. In addition to localizing sites of occlusive lesions, CTA allows for secondary findings such as an occult pancreatic malignancy and bowel ischemia or infarction. In the setting of previous endovascular or surgical treatment, CTA can allow for assessment of stent or graft patency, respectively.[5] Recent progress in the display of acquired CT data, including multiplanar reformation, maximum intensity projection, volume rendering, and surface shaded display, has been used to optimally delineate significant lesions and aid greatly in preprocedure planning (Fig. 1).[6]

MRA is another noninvasive imaging modality for the assessment of chronic mesenteric ischemia. Traditional techniques such as phase contrast and time of flight may be supplanted by the use of fast, contrast-enhanced sequences to provide superior imaging with minimization of motion and flow artifacts. Although the spatial resolution of MRA is inferior to catheter-based angiography and CTA, its sensitivity and specificity for evaluation of proximal stenotic or occlusive lesions within the renal arteries exceeds 90%.[7] Furthermore, MRA can perform functional assessment of intestinal perfusion using cine phase contrast and compare flow within the SMA and SMV following a meal. Significant postprandial increases in flow through the SMV as compared with the SMA have been found to predict the presence of mesenteric ischemia.[8]

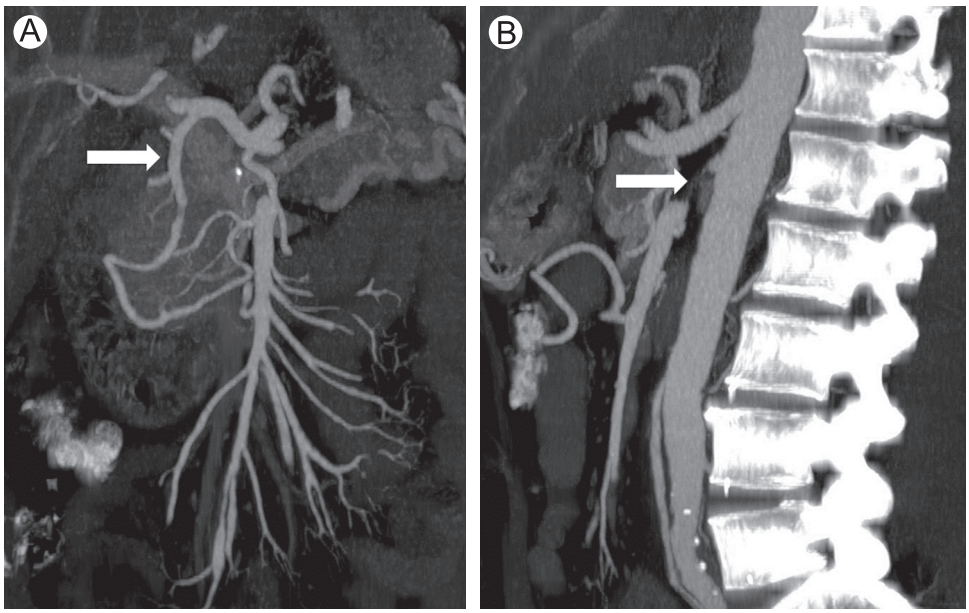

Figure 1 A 64-year-old patient with symptoms of weight loss, abdominal pain with eating, and food fear. (A) Maximum intensity projection (MIP) reconstruction of a CTA in a coronal plane shows dilation of the GDA and pancreaticoduodenal arcade (arrow), concerning for SMA ostial narrowing. (B) Sagittal plane image demonstrates short-segment occlusion of the SMA (arrow). GDA, gastroduodenal artery.