Risk factors for arterioocclusive mesenteric ischemia are generally acute in onset and include atrial fibrillation, recent myocardial infarction, valvular heart disease, and recent cardiac or vascular catheterization, all of which result in embolic clots reaching the mesenteric circulation. Nonocclusive mesenteric ischemia, also known as "intestinal angina," is generally more insidious and most often seen in the aging population affected by atherosclerotic disease. Patients with chronic atherosclerotic disease could also suffer an acute insult from emboli leading to complete occlusion. Nonocclusive mesenteric ischemia is also seen in patients receiving high-dose vasopressor infusions, patients with cardiogenic or septic shock, and patients with cocaine overdose. Nonocclusive mesenteric ischemia is the most prevalent gastrointestinal disease complicating cardiovascular surgery. The incidence of ischemic colitis following elective aortic repair is 5–9%, and the incidence triples in patients following emergent repair. Mesenteric venous thrombosis is less common and is associated with the presence of a hypercoagulable state including protein C or S deficiency, antithrombin III deficiency, polycythemia vera, and carcinoma.

ANATOMY AND PATHOPHYSIOLOGY

The blood supply to the intestines is depicted in Fig. 354-1. To prevent ischemic injury, extensive collateralization occurs between major mesenteric trunks and branches of the mesenteric arcades. Collateral vessels within the small bowel are numerous and meet within the duodenum and the bed of the pancreas. Collateral vessels within the colon meet at the splenic flexure and descending/sigmoid colon. These areas, which are inherently at risk for decreased blood flow, are known as *Griffiths' point* and *Sudeck's point*, respectively, and are the most common locations for colonic ischemia (Fig. 354-1, shaded areas). The splanchnic circulation can receive up to 30% of the cardiac output. Protective responses to prevent intestinal ischemia include abundant collateralization, autoregulation of blood flow, and the ability to increase oxygen extraction from the blood.

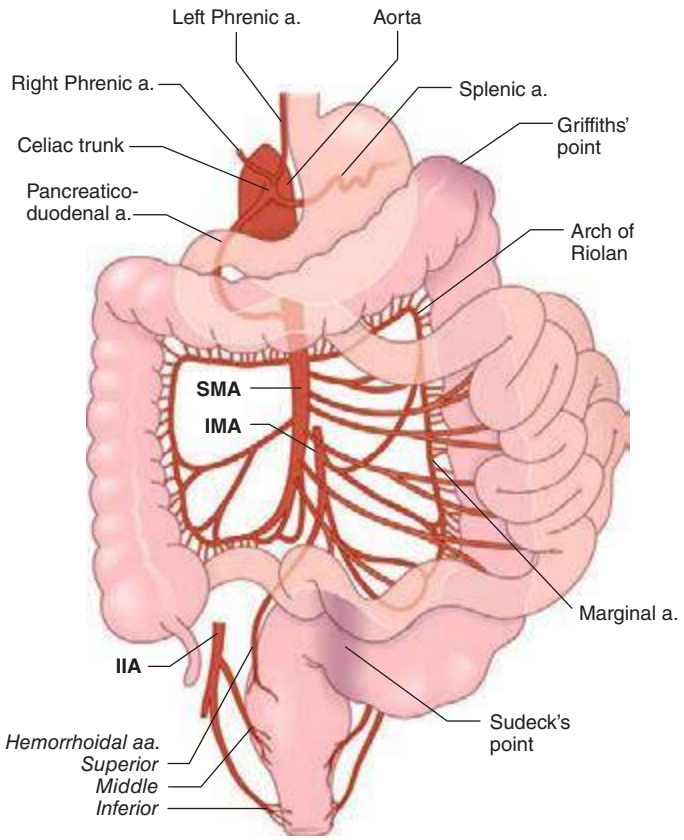

FIGURE 354-1 Blood supply to the intestines includes the celiac artery, superior mesenteric artery (SMA), inferior mesenteric artery (IMA), and branches of the internal iliac artery (IIA). Griffiths' and Sudeck's points, indicated by shaded areas, are watershed areas within the colonic blood supply and common locations for ischemia.

Occlusive ischemia is a result of disruption of blood flow by an embolus or progressive thrombosis in a major artery supplying the intestine. Emboli originate from the heart in more than 75% of cases and lodge preferentially in the superior mesenteric artery just distal to the origin of the middle colic artery. Progressive thrombosis of at least two of the major vessels supplying the intestine is required for the development of chronic intestinal angina. Nonocclusive ischemia is disproportionate mesenteric vasoconstriction (arteriolar vasospasm) in response to a severe physiologic stress such as shock. If left untreated, early mucosal stress ulceration will progress to full-thickness injury. Even in the early stages of ischemia, there is translocation of bacteria across the intestinal mucosa, resulting in bacteremia that can lead to sepsis.

PRESENTATION, EVALUATION, AND MANAGEMENT

Intestinal ischemia remains one of the most challenging diagnoses. The mortality rate is greater than 50%. The most significant indicator of survival is the timeliness of diagnosis and treatment. An overview of diagnosis and management of each form of intestinal ischemia is given in Table 354-1.

Acute mesenteric ischemia resulting from arterial embolus or thrombosis presents with severe acute, nonremitting abdominal pain strikingly out of proportion to the physical findings. Associated symptoms may include nausea and vomiting, transient diarrhea, anorexia, and bloody stools. With the exception of minimal abdominal distention and hypoactive bowel sounds, early abdominal examination is unimpressive. Later findings will demonstrate peritonitis and cardiovascular collapse. In the evaluation of acute intestinal ischemia, routine laboratory tests should be obtained, including complete blood count, serum chemistry, coagulation profile, arterial blood gas, amylase, lipase, lactic acid, blood type and cross match, and cardiac enzymes. Regardless of the need for urgent surgery, emergent admission to a monitored bed or intensive care unit is recommended for resuscitation and further evaluation. If the diagnosis of intestinal ischemia is being considered, consultation with a surgical service is necessary. Often the decision to operate is made on a high index of suspicion from the history and physical exam despite normal laboratory findings.

Other diagnostic modalities that may be useful in diagnosis but should not delay surgical therapy include electrocardiogram (ECG), echocardiogram, abdominal radiographs, computed tomography (CT), and mesenteric angiography. More recently, mesentery duplex scanning and visible light spectroscopy during colonoscopy have been demonstrated to be beneficial. The ECG may demonstrate an arrhythmia, indicating the possible source of the emboli. A plain abdominal film may show evidence of free intraperitoneal air, indicating a perforated viscus and the need for emergent exploration. Earlier features of intestinal ischemia seen on abdominal radiographs include bowel-wall edema, known as "thumbprinting." If the ischemia progresses, air can be seen within the bowel wall (*pneumatosis intestinalis*) and within the portal venous system. Other features include calcifications of the aorta and its tributaries, indicating atherosclerotic disease. With the administration of oral and IV contrast, dynamic CT angiography with three-dimensional reconstruction is a highly sensitive test for intestinal ischemia. In acute embolic disease, mesenteric angiography is best performed intraoperatively. A mesenteric duplex scan demonstrating a high peak velocity of flow in the superior mesenteric artery (SMA) is associated with an approximately 80% positive predictive value of mesenteric ischemia. More significantly, a negative duplex scan virtually precludes the diagnosis of mesenteric ischemia. Duplex imaging serves as a screening test; further investigations with angiography are needed. The biggest limitation of duplex scanning is body habitus; in obese patients, imaging is poor yield. However, in patients with chronic disease, "food fear" often leads to a decreased appetite and therefore less abdominal fat, and duplex imaging is very high yield. The endoscopic techniques using visible light spectroscopy can be used in the diagnosis of chronic ischemia. When suspecting mesenteric ischemia involving the colon, performing an endoscopy to evaluate up to the splenic