If not properly recognized, the normal postoperative appearance of the pelvis following colorectal surgery can be misinterpreted as disease, including infection or recurrent tumor. However, multidetector computed tomography (CT) with the supplemental use of multiplanar reformation clearly demonstrates the expected postoperative anatomic changes in this setting. The high-resolution images achievable with multidetector CT enable the radiologist to play an important role in the postoperative assessment of patients following colon surgery. Whenever possible, the radiologist should be aware of the specific indication for the study, the type of surgery that was performed (ranging from segmental bowel excision to more extensive radical resection), and what anastomoses were created. This knowledge, as well as familiarity with the normal multidetector CT appearances of various postoperative complications, is critical for prompt diagnosis and appropriate management of these complications and for better differentiation of complications from normal findings.
Introduction

Colorectal surgery is a common procedure that is performed for a variety of benign and malignant colonic diseases, including inflammatory bowel disease (IBD), diverticulitis, and colorectal cancer. The choice of surgical technique is influenced by the severity of disease and the extent of disease spread in the bowel and, to some extent, by the preference and experience of the surgeon (1,2). Recent improved understanding of the cause and progression of various colorectal diseases has led to substantial advances in surgical management (3). Current surgical procedures include segmental bowel excision, sphincter-sparing techniques, and extensive radical resection. Similar to other surgical procedures, colorectal surgery is frequently associated with postoperative complications (1,3,4). Technologic advancements in multidetector computed tomography (CT) have allowed accurate assessment of the expected anatomic changes in the postoperative colon, as well as evaluation of postoperative complications (3–10).

In this article, we review the most common colorectal surgical procedures, including abdominoperineal resection (APR), anterior resection, the Hartmann procedure, restorative proctocolectomy with ileal pouch–anal anastomosis (IPAA), and segmental resection, and describe their expected postoperative appearances at multidetector CT. In addition, we describe the imaging features of the early postoperative complications that are most commonly seen after colorectal surgery, including wound complications, anastomotic leak, fistula, intraperitoneal abscess, pouchitis, small bowel obstruction and pseudo-obstruction, and diversion colitis.

Common Procedures and Expected Findings

Abdominoperineal Resection

APR, also referred to as the Miles procedure, involves excision of a portion of the sigmoid colon and of the entire rectum and anus with use of an abdominal-perineal approach. The abdominal component consists of excision of the distal colon and mobilization of the rectum, with creation of a permanent end colostomy, usually in the left lower abdomen through the rectus abdominis muscles.

Figure 1. CT image obtained in a 68-year-old man who had undergone APR for rectal cancer shows a mottled presacral collection (arrow) representing air and packing material.

The perineal component consists of excision of the anus and distal rectum with removal of the mobilized abdominal bowel (11). APR is commonly indicated for (a) low-lying rectal cancers (either primary or recurrent) less than 8 cm above the pectinate line (1), (b) anal malignancies, and (c) anorectal complications of IBD (12). A postoperative pelvic cavity is created at proctectomy. This open defect is obliterated with either (a) use of drains to eliminate accumulated fluid or blood, or (b) packing using the mobilized pedicle of the greater omentum. Alternatively, the open defect can be closed with a reapproximation of the pelvic peritoneum by means of primary closure of the perineal incision, or reconstructed with a myocutaneous flap (rectus abdominis, gracilis, or gluteal muscle) or a biologic mesh (Fig 1) (13). With development of both sphincter-sparing low anterior resection and the circular stapling technique, along with improvements in adjuvant cancer therapy such as radiation therapy, APRs are being performed less frequently. However, despite the higher incidence of perineal complications associated with APR (eg, wound infections [13]) and the lack of sphincteric preservation (14), APR is often still the ideal procedure for anorectal carcinoma with extensive sphincter involvement and end-stage IBD (12).

The extensive excision performed in APR causes significant alteration in the abdomino-...
pelvic anatomy. Multidetector CT demonstrates the repositioning of this anatomy in the space previously occupied by the excised viscera (Fig 2). The bladder, seminal vesicles, and small bowel typically move posteriorly into a presacral location (Fig 3) (15). In addition, the uterus often drops into the presacral space, particularly if the pelvic peritoneal lining is not reconstructed (10). A presacral soft-tissue mass often represents the newly displaced pelvic structures, postsurgical fibrosis, or postsurgical granulation tissue (Fig 4). The mass can be clearly identified on axial images, but its relationship to other pelvic structures and bony anatomy is better delineated with multidetector CT supplemented with multiplanar reformation.
Difficulty has been reported in distinguishing the characteristic finding of postoperative presacral soft tissue from tumor recurrence (15–17). However, evolution of these changes on serial CT images helps in differentiation (Fig 5). The majority of patients who undergo APR have presacral midline masses with a maximum diameter of 3–5 cm at initial evaluation. The postoperative soft-tissue mass typically demonstrates some decrease in size and change in configuration in
the months following surgery. Masses typically have ill-defined margins at initial studies but more distinct borders at follow-up. The change in size at follow-up can vary from minimal to marked, with only a thin sliver of residual tissue persisting. At other times, the presacral soft tissue remains stable and can persist for up to 2 years after surgery, or even indefinitely. In contrast, a soft-tissue mass due to recurrent disease almost always grows and typically becomes more infiltrative and ill defined over time. Lack of growth over 1–2 years, clinical stability, and normal carcinoembryonic antigen levels are additional evidence that the mass represents normal postoperative changes (10). Causes of false-positive findings of tumor recurrence include uterine fibroids, fibrosis, and postoperative abscess; multiplanar reformatted images can be particularly useful in distinguishing among these entities. Sagittal reformatted images are particularly helpful in ascertaining the position of the uterus and the relationship of the postoperative soft tissue to other pelvic structures. Because of the occasional difficulty in distinguishing this soft tissue from tumor recurrence, a baseline CT evaluation is performed within 2–4 months after surgery, and it is recommended that follow-up CT be performed every 6 months thereafter to exclude recurrent tumor in oncology patients (1). In a study by Even-Sapir et al (18), combined positron emission tomography (PET)/CT played a vital role in detecting recurrent disease and distinguishing it from postsurgical fibrosis. PET/CT allowed differentiation of benign from cancerous lesions with a sensitivity of 100% and a specificity of 96% (Fig 6) (18). Although the role of magnetic resonance (MR) imaging in the local staging of rectal cancer is well known, its role after surgical resection is less well defined. MR imaging has been shown to be a reliable technique for diagnosing pelvic recurrence of colorectal cancer but is not recommended for widespread routine surveillance (19,20).

**Anterior Resection**

Anterior resection, also referred to as abdominal proctosigmoidectomy, involves resection of the rectosigmoid without perineal dissection, and subsequent anastomosis of the descending colon and proximal rectum. Indications for anterior resection include sigmoid diverticular disease and rectal carcinoma more than 8 cm above the pectinate line (1). Because the anal sphincter is preserved, patients can expect a better functional outcome. There are three major types of anterior resection. *High anterior resection* involves excision of the distal descending colon, sigmoid colon, and upper rectum above the peritoneal reflection; *standard low anterior resection* involves excision of the rectosigmoid and the upper and mid rectum below the peritoneal reflection; and *extended low anterior resection* involves excision of the distal sigmoid colon and the distal rectum (8). In the treatment of rectal cancer, standard low anterior resection is commonly accompanied by total mesorectal resection, with resection of the entire mesentry of the mid to lower rectum enveloped within the pelvic fascia containing the lymphatic drainage of the rectal tumor (11). This surgery has been associated with reduced local recurrence of
cancer of the mid to upper rectum (19). Bowel integrity is then restored, typically with creation of a conventional end-to-end coloanal anastomosis (Fig 7), although an end-to-side coloanal anastomosis and even a colonic pouch can be created. Newer surgical techniques that involve fashioning a colonic reservoir have increasingly supplanted the conventional approach. These colonic pouches have been shown to be associated with a reduced incidence of anastomotic complications and better functional outcomes in comparison with the traditional coloanal anastomosis, and may be less likely to develop locally recurrent tumor (9,21,22). With the creation of pouches, however, CT evaluation becomes more difficult due to the complex altered anatomy. In such cases in particular, knowledge of what surgery was performed is imperative to avoid misinterpretation, and a discussion with the surgeon may be warranted.

The imaging findings following anterior resection typically include a midline collection of fluid or a small amount of soft tissue in the presacral space (Figs 8, 9). The suture line is typically identifiable, and there can be wall thickening from postoperative edema at the anastomosis. The presacral space is usually larger, with the rectum displaced up to 2 cm anteriorly from the
Figure 9. CT image obtained in a patient who had undergone anterior resection shows a normal small amount of amorphous soft tissue in the presacral space (black arrow). Mildly prominent bowel loops suggestive of ileus (white arrow) are also seen.

Figure 10. Sagittal reformatted multidetector CT image obtained in an 84-year-old man who had undergone anterior resection for proximal rectal cancer shows a slightly higher-than-expected location of the anastomosis (white arrow), with the expected increase in the size of the presacral space (black arrow).

Figure 11. Axial (a) and sagittal (b) CT images obtained in a patient with recurrent tumor who had undergone anterior resection show extensive infiltrative presacral soft tissue (white arrow) encasing the rectum (black arrow in a) above the anastomosis. Note the dilated loops of small bowel (black arrow in b), a finding that caused concern for associated obstruction secondary to the bulky tumor.

sacrum (Fig 10) (1). More marked displacement (3–5 cm) or an increased amount of soft tissue should raise suspicion for an anastomotic leak or recurrent tumor (Fig 11). Extraperitoneal air or fluid around the iliac vessels has been described at CT and is more likely a benign finding that typically will resolve over a period of months (9). However, a similar finding has been reported in many patients with subclinical leaks after anterior resection and can persist for 6 months or more following surgery. The amount of air can also increase over time if there is increasing bowel lumen distention and pressure (9).

Hartmann Procedure
The Hartmann procedure involves fashioning a temporary diverting colostomy after distal colectomy or sigmoid colon resection, with a sutured rectal or colonic stump left behind for a possible future elective reanastomosis. In contrast, a mucous fistula is created when the stump is brought up to the abdominal wall, although doing so is not always possible owing to the length of the stump. A surgeon may create a mucous fistula when a second anastomotic procedure is contemplated,
since it is typically easier to find. In the Hartmann procedure, the sutured stump varies in length and may be as distal as the rectum and as proximal as the transverse colon (21). The Hartmann procedure is often performed in patients who are at high risk for anastomotic leak or subsequent complications of peritonitis and sepsis following an immediate primary anastomosis (1). The procedure is commonly performed in emergent cases of complicated acute diverticulitis, sigmoid perforation, or obstruction secondary to a carcinoma (21). The diverting colostomy allows time for the bowel to heal before a “takedown” is performed in the second stage of the surgery to restore luminal continuity.

Historically, primary evaluation of the colonic or rectal stump was performed with water-based contrast material–enhanced radiography to assess the integrity of the pouch. Because rupture of the Hartmann pouch is associated with considerable morbidity and mortality, a preliminary pouch study is typically performed after the first stage of the surgical procedure (21) and before surgical planning of the colostomy takedown. Multidetector CT also clearly depicts the location of the temporary diverting colostomy or ileostomy and of the rectal or colonic stump, which is typically closed with metallic staples or sutures at its blind end (Fig 12). The pouch may occasionally be left open, particularly in difficult surgical cases, with a drain left within the pouch. In these cases, if an abscess subsequently develops, it can be drained either through the indwelling drain in the pouch or transgluteally. The length of the pouch and its relation to the colostomy are also important to consider and can be depicted with multidetector CT. It has been reported that the length of the pouch decreases over time, so that its original anatomic position can be altered. Occasionally, the pouch can be sutured to the abdominal wall or brought up to the abdominal wall as a mucous fistula. At multidetector CT, the pouch may contain polyps, diverticula, debris, or inspissated mucus (Figs 13, 14). In addition to radiography or CT, endoscopy is often used to evaluate the pouch prior to surgery. At this time, diversion (or diversional) colitis can be a common and even expected endoscopic finding, typically resolving later with reanastomosis (discussed later).

**Restorative Proctocolectomy with IPAA**

Restorative proctocolectomy is the definitive surgical treatment in patients with ulcerative colitis, familial adenomatous polyposis, multiple colon cancers, or Lynch syndrome (1). The procedure involves a total proctocolectomy and creation
of an ileal pouch and an IPAA. Common contraindications for the procedure include Crohn disease (due to the possibility of recurrence in the ileal pouch), significant anorectal disease, and preexisting incontinence (23). Restorative proctocolectomy consists of an ileoanal anastomosis with an ileal reservoir fashioned from the terminal ileum. There are three main types of ileal pouches—J, S, and W pouches—whose names refer to the shape of the reservoir (24). The most commonly created pouch is the J pouch, since its creation involves a relatively less complex technique. The ileal J pouch is created by folding 15 cm of terminal ileum and fashioning a side-to-side anastomosis with a linear stapler. The anastomosis to the anus is created along the pectinate line (25). Newer techniques may leave more anoderm in place, as well as a transitional zone of epithelium. These pouches can then be complicated with recurrent active ulcerative colitis and resemble postoperative pouchitis. The newly created pouch is allowed to heal by fashioning a proximal temporary loop ileostomy, which is taken down in the second stage of the procedure after approximately 8–12 weeks (26). Sometimes the procedure consists of a single stage, without the creation of an ileostomy, thereby preventing the possible complications associated with a loop ileostomy. A disadvantage is the associated increased risk of pelvic and peritoneal sepsis from a pouch or anal anastomotic leak (11). Although the creation of an ileoanal pouch anastomosis is associated with a low mortality rate of less than 1%, a morbidity rate ranging from 18% to 70% has been reported (26). In patients with ulcerative colitis, approximately 20% of pouches have to be removed owing to complications (27).

Typically, fluoroscopic pouchography has routinely been performed after IPAA before closure of the ileostomy. Rectal administration of a watersoluble contrast agent allows evaluation of the integrity of the ileal pouch and IPAA before take-down of the temporary ileostomy. The distended pouch should be visualized in different imaging planes. In addition, postevacuation views should be obtained to detect subtle leaks or strictures that could have been obscured (25). However, multidetector CT is currently the favored modality for postoperative assessment of the IPAA in symptomatic patients with clinical suspicion for infection or other complications. Intravenous contrast material is used, as well as retrograde administration of water-soluble contrast material to adequately distend the pouch. A typically fluid-filled structure with a row of metallic staples in the blind-ending ileum and a double row of staples at the ileoileal anastomosis helps identify the pouch (Figs 15, 16) (24). The ileoanal anastomosis is characterized by radiodense staples oriented 180° from each other (28). The pouch has clear margins and is located close to the sacrum posteriorly and the bladder anteriorly (29). Following takedown of the temporary diverting loop ileostomy, oral contrast-enhanced multidetector CT can be performed to exclude any extraluminal fluid, contrast material, or air (28). Mild stranding in the peripouch fat is another finding that is normally seen in the immediate postoperative period. This finding may be related to preexisting chronic inflammation from long-standing ulcerative colitis and does not necessarily indicate acute infection (25). Post-IPAA pouch bleeding has been reported in a minority

Figure 15. Axial (a) and sagittal (b) multidetector CT images obtained in a 48-year-old woman who had undergone restorative proctocolectomy with IPAA for ulcerative colitis show the configuration of the J pouch. Note the linear row of staples (white arrow in a), the terminal blind-end staple line (black arrow in a), and the anastomosis between the ileal pouch and the anus (arrow in b).
of patients and is usually managed nonoperatively with clot evacuation and other noninvasive techniques of hemostasis.

**Segmental Resections**

Segmental resections of the colon include ileocecal, right, transverse, and left colectomies and are based on the location of the pathologic condition. Crohn ileitis is a common indication for ileocecal resection (2). Indications for right and transverse colectomies include carcinoma and complications of IBD. Left colectomies are typically performed for left-sided tumors or complicated diverticular disease (8). Segmental resections for malignant neoplasms require wide margins with an extended segmental colectomy, as well as mesenteric and omental resections with excision of the lymphatic drainage of the tumor.

Following these segmental resections, a straight anastomosis is usually fashioned. There are three types of anastomoses. The **end-to-end** type is indicated when the bowel lumina are of roughly equal circumference (eg, in rectal resection). The **end-to-side** type is used when the proximal end is a smaller lumen that is connected to the side of the larger lumen (eg, in an ileocolic anastomosis after a right hemicolectomy) (Fig 17). The **side-to-side** type involves the connection of two antimesenteric borders of the bowel. It has the advantage of forming a large, well-vascularized anastomosis and is commonly used in ileocolic and small bowel anastomoses (8). A side-to-side stapled anastomosis is usually avoided on the left side, since it can make subsequent colonoscopy difficult. Multidetector CT findings following segmental resection may include absence of excised bowel segments, anastomotic surgical clips, and displacement of the adjacent viscera into the unoccupied postoperative spaces (1).

**Common Postsurgical Complications**

Postsurgical complications are not uncommon after bowel resection surgery. The complications vary according to (a) the surgical procedure that was performed, (b) the indication for the surgery, (c) the length of the postoperative period (1), and (d) the presence of any underlying concomitant disease entities (2). As mentioned earlier, common specific postoperative complications include wound complications, anastomotic leak, fistula, intraperitoneal abscess, pouchitis, small bowel obstruction and pseudo-obstruction, and diversion colitis. Multidetector CT with the use of multiplanar reformation provides good anatomic detail and allows early evaluation of the location, extent, and type of postsurgical complications after colon resection (3–10).
Wound Complications

About 5%–10% of patients who have undergone major abdominal surgery develop wound infections (4). Despite adequate bowel preparation and prophylactic antibiotics, the risk for infection remains high and is often due to contamination by anaerobic microbes. This can lead to inflammation, infection, and necrosis at or adjacent to the wound site (4). Wound dehiscence, abdominal incisional hernia, peritonitis, and systemic sepsis are potential sequelae (30–32). Perineal resections in APRs are specifically associated with varying degrees of wound complications, from minor wound dehiscence to fistula formation, sinuses, and perineal hernias. Risk factors associated with wound complications include an increased patient body mass index and preexisting chronic medical conditions, including IBD, malnutrition, and steroid use (13). Treatment options include administration of broad-spectrum antibiotics or incision and drainage of potentially infected fluid collections (30–32).

Early CT findings of wound dehiscence include accumulations of fluid with air within the wound and adjacent tissues (Fig 18). Careful observation of the abdominal wall layers around the incision site—including the skin, subcutaneous tissue, linea alba, anterior and posterior fascial sheaths, extraperitoneal fat, and peritoneum—is important to evaluate for separation between the layers of tissue (33). Fascial separation in wound dehiscence should be distinguished from overt wound evisceration, which represents an emergent surgical indication. Secondary intention wound closure and wound packing with surgical dressing may also mimic wound dehiscence (Fig 19).

Incisional hernia is more common with vertical than with horizontal incisions, with a reported prevalence of 0.5%–50% in abdominal surgery patients (30). A stomal or parastomal hernia is a common form of incisional hernia of bowel or mesenteric fat that occurs at the site of or adjacent to the stoma (Fig 20). It may be an expected
Anastomotic Leak
An anastomotic leak after bowel surgery is associated with high morbidity and mortality, and may result in complications, including peritonitis and sepsis (34,35). The treatment of leaks often requires further invasive procedures, including percutaneous drain creation, diverting ostomies, and repeat open surgery. The mortality rate can be as high as 50% (3) if anastomotic leaks are not identified and treated appropriately.Leaks have been reported to account for one-third of deaths after colorectal surgery, with a reported incidence ranging from 2% to 51% (36). No significant difference in the incidence of leaks has been reported between “hand-sewn” and “stapled” surgical techniques (37). Risk factors have been implicated in the development of leaks, including malnutrition, male gender, smoking, and steroid use. Perioperative factors such as intraoperative sepsis, perioperative bleeding, and excessive anastomotic tension also increase the risk for an anastomotic leak (38).
A low anterior rectal anastomosis carries the highest risk for developing an anastomotic leak (35). In IPAA, anastomotic leaks most frequently occur at the pouch-anal anastomosis but can also occur at the ileoileal staple line of the pouch (pouch dehiscence) or from the pouch itself (29).

Clinical symptoms suggestive of an anastomotic leak usually manifest in the first 2 postoperative weeks, most commonly between days 5 and 7. Symptoms include fever, intense abdominal pain, tachycardia, guarding, and rebound tenderness (4). Tenesmus or constipation may be present, although these are more nonspecific symptoms that can also occur with tumor recurrence. Oftentimes, early clinical manifestations may be subtle and nonspecific and therefore difficult to recognize. Leak incidence has been reported to range from 3% to 40%, and up to as high as 69% in another study in which leaks were diagnosed with barium enema examination (39,40). It is reported that subclinical leaks have been discovered at routine postoperative radiologic examinations in 5.7%–10.7% of cases (39). These occult leaks can persist for years without significant symptoms. They are commonly seen following procedures in which a temporary loop ileostomy is created to protect the distal anastomosis (eg, IPAA). Although ileostomy creation may decrease the risk of associated complications of anastomotic leak, it does not appear to decrease the overall incidence of leak (37). Subclinical leaks do appear to have a higher incidence of spontaneous healing compared with clinical leaks (41).

Although fluoroscopic imaging of the bowel with rectal administration of water-based contrast material has been shown to be useful in identifying the exact location and features of an anastomotic leak (4), multidetector CT is currently the imaging modality of choice to evaluate for suspected anastomotic leak and has been reported to confirm clinical leakage in 48%–100% of cases (9,36). Multidetector CT should be performed with rectal contrast material, since oral contrast material may not have had time to reach the area of the leak. Administration of rectal contrast material immediately prior to multidetector CT and close evaluation of the multiplanar reformatted images will better define a presacral collection for potential areas of leak. An anastomotic leak can be diagnosed with confidence at multidetector CT when there is frank extravasation of bowel contrast material with air or possibly stool. After anterior resection, this appearance can mimic the true rectum and has been described as the “double rectum” sign (Fig 21) (9). Less definitive but suggestive signs include extraluminal air in a higher proportion relative to fluid in the newly formed postoperative spaces. Accumulation of air in the presacral space beyond 6 months after surgery is suggestive of a leak (9). Perianastomotic loculated fluid containing air or disproportionate fluid and air has been reported to be the most common indicator of an anastomotic leak (Fig 22) (42). These fluid and gas collections can also be associated with anterior displacement of the rectum of more than 5 cm from the sacrum (1).

It should be noted that radiologic findings consistent with an anastomotic leak do not always determine the treatment approach or change the clinical management. Rather, management is often based on clinical findings. Leaks do not always re-
quire surgical management because many of them, including occult leaks, appear to be self limiting. If the leak is contained and the patient is stable without signs of sepsis or peritonitis, initial treatment may be conservative and consist of the administration of antibiotics (39). Multidetector CT can be of use in guiding percutaneous drainage.

Various studies have reported false-negative rates of 35%–49% for radiologic imaging of suspected anastomotic leaks (27,40,43). A false-negative multidetector CT diagnosis for a leak is typically related to the timing of the postoperative radiographic study or to the factors that influence the quality of the study, such as distention of the anastomotic segment, use of rectal contrast agent, and use of thin axial sections and multiplanar reformation. The false-negative rate may be higher in the immediate postoperative period, before the leaked fluid and air have had time to accumulate. A distal anastomotic leak may be missed if the rectal contrast material catheter seals it off, particularly if the anastomosis is low and a balloon is used as opposed to a straight catheter (9). The best way to define a low anastomotic leak is at CT performed with oral, intravenous, and rectal contrast material. Occasionally, the rectum may collapse during CT due to intermittent spasm, which can limit detection of a leak or lead to underestimation of the size of the leak.

Fistula
Ongoing leaks may result in fistulas or abscesses. Fistulas can involve the ileal or Hartmann pouch, anus, vagina, or bladder or extend to the skin (enterocutaneous fistula). After ileoanal reconstruction, fistulas may occur secondary to a leak or develop as a late complication. Multidetector CT is useful in defining perianal and perineal fistulas, which are often complex. Fistulas involving the surgically created pouches can be seen as enhancing tracts of contrast material extending into the peripouch soft tissues with associated surrounding fat stranding (Fig 23). Simple fistulas can be treated with resection or seton placement. Abscess drainage, diversion, and antibiotics may help bring about spontaneous closure. Recurrent fistulas may require a permanent stoma (22).
Intraperitoneal Abscess

Intraabdominal abscesses remain the most common cause of morbidity following colorectal surgery (1) and have a high potential for serious ramifications when associated with systemic sepsis. The morbidity and mortality rate has been reported as 10%–40% (4). Common associations include anastomotic leaks, wound infections, fistulas, and contamination during surgery. The usual causative agents are enteric microbes such as Clostridium, Proteus, Escherichia coli, Klebsiella, and Bacteroides (4). Multidetector CT has been reported to be sensitive and specific—more sensitive than pouchography or fluoroscopy—with an accuracy of 90% in the evaluation of abscess size and location (4). Multidetector CT findings include a well-defined and well-circumscribed, low-attenuation spherical or ellipsoid collection of fluid. There is usually a peripheral enhancing rim, and there can be septations, gas, or gas-fluid levels in the collection (Figs 24, 25). Associated thickening, enhancement, and obliteration of adjacent fascial and peritoneal planes are well delineated (Fig 26). Characterization of the size and location of the abscess at CT will guide either surgical or percutaneous management (4). In a Hartmann pouch, dehiscence of a short stump can result in extraperitoneal leakage and subsequent pelvic abscess formation. In contrast, dehiscence in a longer pouch can lead to intraperitoneal leakage, intraabdominal abscesses, and peritonitis, often necessitating immediate surgical repair.

Pouchitis

Pouchitis, as its name indicates, is nonspecific inflammation of a pouch, and it may be acute or chronic. Pouchitis is usually an early postoperative complication and is the most common indicator of pouch dysfunction (26). It is extremely common after restorative proctocolectomy with IPAA, affecting up to 50% of patients (44–46). In patients with prior ulcerative colitis, the incidence of pouchitis ranges from 20% to 50%, compared with only 0%–10% in patients treated for familial
adenomatous polyposis (44). The specific cause of pouchitis is currently unknown, but dysbiosis (changes in microflora in the pouch lumen), fecal stasis within the pouch, and ischemia have been described as possible causes (44). Patients at increased risk for the development of pouchitis include those with severe ulcerative colitis or extraintestinal manifestations of IBD and those who chronically use nonsteroidal anti-inflammatory drugs (46). Clinical manifestations of pouchitis include increased stool frequency, bright red rectal bleeding, fever, malaise, crampy abdominal pain, diarrhea, and hematochezia (29). However, these clinical signs are nonspecific and can also suggest anastomotic leak or abscess, so that CT is often indicated. A sensitivity of 71% has been reported for CT in the detection of pouchitis (28); however, the features are also nonspecific and include bowel wall thickening, pouch dilatation, peripouch adenopathy, fat stranding, fluid accumulation, and mucosal enhancement (Fig 27) (23). Mild wall thickening may be obscured by poor distention. Evaluation for pouchitis should not be performed until at least 6–8 weeks after surgery to allow resolution of the normal postoperative changes and edema (Fig 28). The actual diagnosis is made with endoscopy and biopsy (25,26). Pouchography with fluoroscopy is usually reserved for evaluating pouch function (defecography and pouch distention).

Small Bowel Obstruction and Pseudo-obstruction
Small bowel obstruction is a common postoperative complication. It is often seen after IPAA (15%–44% of cases) and typically occurs at least 30 days after takedown (28,34). Because the distal ileum is used to make the pouch, when it is pulled into the pelvis, it stretches the mesentery and can cause the proximal small bowel to herniate and become obstructed. Other important causes of postoperative bowel obstruction include adhesions, strictures, and volvulus. Early postoperative small bowel obstruction is treated conservatively with nasogastric tube decompression, whereas later cases often require surgery (29). Multidetector CT of bowel obstruction typically demonstrates distended bowel loops proximal to a transition point. Tumor recurrence or any sign of an inflammatory process should be excluded. Rarely, twisting of the mesenteric vessels is seen at the transition point, a finding that indicates a volvulus (47). Coronal reformatted images have been shown to be valuable in identifying the transition point (39). Anal strictures from fibrosis or anastomotic ischemia are not uncommon after IPAA (34).

In contrast, postoperative ileus (pseudo-obstruction) is a common cause of bowel dilatation in the immediate postoperative period following colon surgery (4). Clinically, patients will appear to have a colonic obstruction, although imaging
Figure 29. CT image of the ileus in a patient who had undergone colonic resection shows diffusely and mildly dilated loops of small bowel (black arrow) and colon (white arrow) with air-fluid levels and no identifiable obstructive lesion.

will fail to show any identifiable physical cause of obstruction (Fig 29). The condition infrequently lasts longer than 48 hours; therefore, persistence of symptoms 2–5 days after surgery should raise suspicion for other causes (48,49). Persistent clinical symptoms after conservative management may require evaluation with multidetector CT (10). Multidetector CT is often the initial test after abdominal radiography for small bowel obstruction and has replaced traditional barium enema examination. A common multidetector CT finding is dilatation of the ascending and transverse colon proximal to the splenic flexure and relative distal colonic decompression without identification of an obstructing lesion (49).

Diversion Colitis

Diversion colitis is a nonspecific mucosal inflammation of any colonic or rectal segment that has been diverted from the fecal stream in a loop or end colostomy (50). The condition is seen to some extent in nearly all patients with diversion and is asymptomatic in the majority of cases. Symptoms (if present) may include abdominal pain, tenesmus, hematochezia, and mucous discharge (51). Symptoms and inflammation promptly subside after reestablishment of bowel continuity, which is the definitive treatment. The cause has not been well defined but has been proposed to be deprivation of the colonic mucosal cells of the diverted segment of essential nutrients and by-products from enteric bacteria in stool (including short-chain fatty acids) (51,52). Alternatively, the inflammation may be caused by stasis within the diverted segment (52). There is little in the literature about the radiologic features of diversion colitis. Features at double-contrast barium enema examination have been reported to include diffuse mucosal nodularity, inflammatory pseudopolyps, punctate ulcerations, and (in more chronic cases) a diffuse granular mucosal appearance (52). Multidetector CT demonstrates features of a nonspecific colitis (Fig 30), and the involved mucosa may mimic ulcerative colitis (Fig 31). Pouchitis, which occurs in continent pouches such as Kock pouches or IPAArs, should be distinguished from diversion colitis, which occurs in blind pouches. Long-standing chronic
inflammation in diversion colitis may increase the risk of developing malignancy (53). Oftentimes, negative cultures can be used to rule out a superimposed bacterial or parasitic infection. Absence of a history of recent antibiotic use and lack of characteristic pseudomembranes at endoscopy exclude a possible C difficile infection. Therefore, diversion colitis should be considered when postoperative nonspecific proctocolitis is seen in an otherwise asymptomatic patient with a colostomy. The patient should then be evaluated for treatment with reanastomosis (51).

Conclusion
Multidetector CT plays an integral role in the evaluation of the postoperative colon. The normal postoperative anatomy and common postoperative complications are well demonstrated with axial multidetector CT supplemented with multiplanar reformation, which can help distinguish benign expected findings from those associated with more worrisome disease entities. When possible, the radiologist should communicate with the surgeon to find out specifically what surgery was performed, what anastomosis was created, and what the indication is for the CT examination. Accurate characterization will facilitate prompt diagnosis of potentially life-threatening complications and aid the surgeon with clinical management.

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At other times, the presacral soft tissue remains stable and can persist for up to 2 years after surgery, or even indefinitely.

However, multidetector CT is currently the favored modality for postoperative assessment of the IPAA in symptomatic patients with clinical suspicion for infection or other complications. Intravenous contrast material is used, as well as retrograde administration of water-soluble contrast material to adequately distend the pouch.

Perianastomotic loculated fluid containing air or disproportionate fluid and air has been reported to be the most common indicator of an anastomotic leak (Fig 22) (42).

It should be noted that radiologic findings consistent with an anastomotic leak do not always determine the treatment approach or change the clinical management. Rather, management is often based on clinical findings.