

# **Computed Tomographic Findings of Abdominal Complications of Crohn's Disease—Pictorial Essay**

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Crohn's disease (CD) is a chronic, transmural, inflammatory disease of the gastrointestinal tract (GIT), most often affecting the terminal ileum and colon. Diarrhea, abdominal pain, anorexia, nausea, and weight loss are the most common clinical symptoms.<sup>1</sup> Abdominal complications of CD, both intestinal and extraintestinal, are frequent and variable. The most common intestinal complications include ileocolitis with external or internal fistulas and abscess formation, strictures, and bowel obstruction. Less common are free perforation, intussusception, and malignancy. The extraintestinal complications include nephrolithiasis, cholelithiasis, fatty liver, portal vein gas, and thromboembolic events.<sup>1-4</sup>

Nowadays, computed tomography (CT) provides superb anatomic detail and diagnostic accuracy of various intra-abdominal pathological processes, and it thus has become an essential diagnostic tool in the evaluation and management of patients with known CD for the assessment of bowel wall involvement, the mesenteric extent of the disease, and intra-abdominal complications.<sup>1,5,6</sup> In addition, as CT is frequently performed to evaluate patients with acute abdomen, it may encounter clinically unsuspected complications in patients with CD. This article reviews the CT features of various intra-abdominal complications of CD.

## **CT Technique**

Standard abdominal CT scanning for evaluating patients suspected of having CD-related abdominal complications is usually obtained following the administration of orally dilute water-soluble contrast as well as intravenous contrast. Dynamically enhanced helical scanning of the entire abdomen is then carried out during the portal venous phase with contiguous imaging acquired from the diaphragm to the symphysis pubis. Optimized assessment of the enteric continuity may have to include subsequent additional scanning for better luminal opacification and distention (Figure 1) and, occasionally, further rectal insertion of contrast medium. Subsequent multiplanar reconstructions improve the anatomic appearance, with orientations similar to those of conventional imaging.

Recently, several spiral-CT enterography techniques with various contrast materials have been reported as accurate and practical ways for detecting the intestinal manifestations and extraenteric complications in patients with CD.<sup>7</sup>

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## Acute Ileocolitis

CD may affect any portion of the GIT, but most commonly the terminal ileum and the proximal colon are involved (Figures 1 to 4). Following the earliest mucosal changes in CD, thickening of the bowel wall by edema and inflammation are frequently seen in these segments of the bowel during the acute phase of the disease. A layering pattern of enhancement in the thickened bowel wall (Figure 4) is regarded as a sign of disease activity, while a homogeneous enhancement often predicts inactivity and irreversible fibrosis.<sup>5,6</sup> Submucosal fat deposition has been reported as an infrequent finding in chronic CD (Figure 5). Another CT feature found to correlate with disease activity is prominent perienteric vasculature within the mesentery at the mesenteric side of the affected segment. These vascular changes known as “comb sign,” reported by Meyers and McGuire, represent dilated and tortuous vasa recta (Figure 2).<sup>8,9</sup>

Toxic, fulminant colitis is a severe infrequent complication of extensive CD, occurring in about 6% of patients during the course of the disease or as its initial manifestation.<sup>3</sup> The clinical presentation includes toxic signs of high fever, tachycardia and leukocytosis, abdominal pain and tenderness, and bloody diarrhea. On CT, total or segmental dilatation of a thickened-wall colon is seen (Figure 6).

## Intra-Abdominal Abscess

Since the pathological process in CD involves all the layers of the bowel wall, the deep fissures cause gradual perforation to other organs situated in the vicinity of the diseased bowel (intra- or retroperitoneal), resulting in fistula, phlegmon, or abscess formation. This explains the relatively high incidence of intra-abdominal abscesses in patients with CD, occurring in up to 30% during the course of their disease, with associated fistulas in 40%.<sup>1,3,5,10</sup> Clinically, the abscesses most often present with a history of ongoing active disease that is nonresponsive to conservative therapy and less frequently with acute abdominal pain and sepsis.<sup>10</sup> CT is highly accurate in diagnosing an interloop or abdominal wall abscess and is the preferred imaging modality in assessing its presence, location, and size; the possible presence of a defined wall or internal septations; and a possible associated enteric fistula, found in up to 40% of CD-related abscesses.<sup>3,10</sup> On CT, a phlegmon appears as a poorly defined soft-density mass, whereas an abscess is seen as a well-circumscribed fluid collection with low attenuation values or an air–fluid level that may have a peripheral enhancing rim or as a soft-tissue density mass containing gas bubbles, within inflamed peritoneal planes displacing adjacent structures (Figure 2).

The conventional therapy in CD complicated by an abscess has been surgical drainage followed by resection of the diseased portion of the bowel and the fistula, if present.<sup>10</sup> Postoperative fistulas and abscesses, however, are common complications seen within the first 3 months after resective bowel surgery,

**Figure 1** Ileopsoas abscess. A 17-year-old man with Crohn's disease (CD) presented with fever and left lower quadrant pain.

**A:** Computed tomography (CT) shows an area of low density within an enlarged left iliac muscle with numerous gas bubbles (A). The arrow points toward the unopacified descending colon.

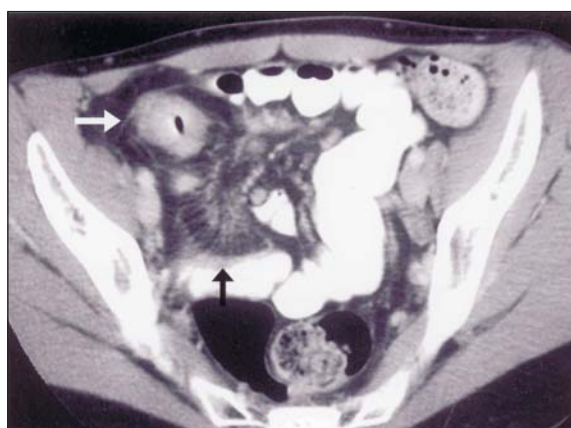


**B:** A repeat scan 1 hour later shows the orally ingested contrast material within the ileopsoas abscess (A), compatible with fistula. Note the surrounding fat infiltration and the thickened wall of the descending colon (arrow) abutting the muscle. (Reprinted with permission from Zissin et al.<sup>11</sup>).



**Figure 2** Acute ileitis with abscess formation. A 28-year-old woman with acute exacerbation of CD.

**A and B:** CT shows mural thickening of the terminal ileum (white arrow) with associated mesenteric lymphadenopathy and prominent perienteric vasculature (black arrow) within the mesentery of the affected segment.



**C:** Repeat CT, performed 10 days later for clinical deterioration, shows a small interloop abscess (black arrow) within the mesentery of the significantly affected segment (white arrow).



**Figure 3** CD involving the duodenum. A 37-year-old man with known CD and vomiting. CT shows mural thickening of the horizontal portion of the duodenum with tubular stricture (black arrow), causing prestenotic duodenal dilatation. Note slightly enlarged mesenteric nodes (white arrows).



arising from suture leakage (Figure 7).<sup>2</sup> Therefore, with the advent of percutaneous imaging-guided drainage techniques, a more conservative approach by CT-guided abscess drainage, when accessible, is recommended in patients with long-term remission on medical treatment, mainly those with previous multiple intestinal resections or postoperative complications.<sup>10</sup>

### Abdominal Wall Abscess

Abdominal wall abscesses comprise a subgroup of CD-related abdominal abscesses and affect the psoas muscle or the abdominal wall muscles (Figures 1, 8, and 9). A psoas muscle abscess is usually an extension of a mesenteric abscess through the mesentery into the retroperitoneum, and rarely, it may be the first manifestation of CD.<sup>11</sup> The presentation of psoas abscess is variable and frequently goes undiagnosed clinically. The classic triad of psoas abscess is fever, back pain, and femoral neuropathy associated with pain on flexion of the hip and weakness of the muscles flexing the thigh and extending the knee. This clinical picture, however, is found in a minority of patients, and even with such presentation the diagnosis can be delayed, often depending on imaging findings.<sup>11</sup> A rectus sheath abscess will manifest itself as an abdominal wall mass with fever and leukocytosis. An abdominal wall abscess requires surgical resection of the diseased portion of bowel intestine feeding it, along with appropriate drainage of the abscess.<sup>12</sup>

### Small Bowel Obstruction

Bowel obstruction is the most common complication requiring surgical intervention in CD.<sup>2</sup> CD-related small bowel obstruction (SBO) is often a manifestation of long-standing disease

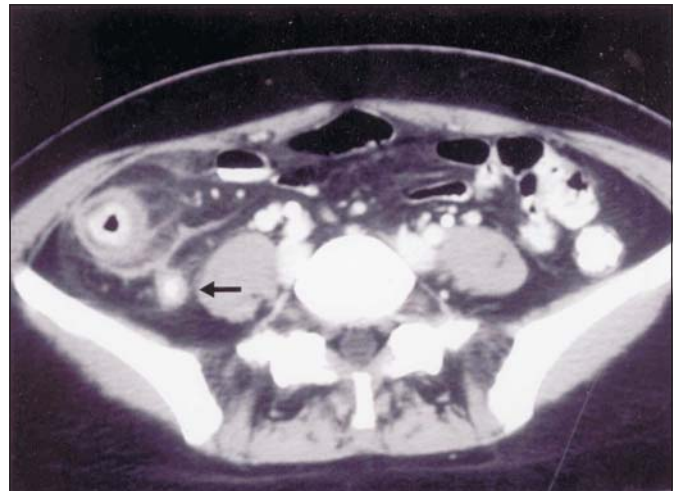


**Figure 4** Active CD of the cecum involving the appendix. A 34-year-old woman with CD and right lower abdominal pain and peritoneal signs, clinically suspected of having acute appendicitis.

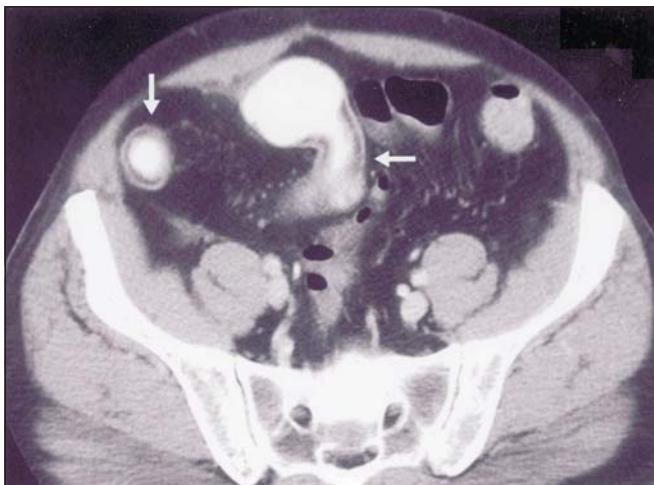
**A:** CT shows marked mural thickening of the cecum with a target appearance (arrow) due to a layering pattern of enhancement as a sign of disease activity. Note the inner hyperdense layer representing the enhancing mucosa, encircled by a hypodense layer of submucosal edema, surrounded by an outer hyperdense ring representing the enhanced inflamed serosa.



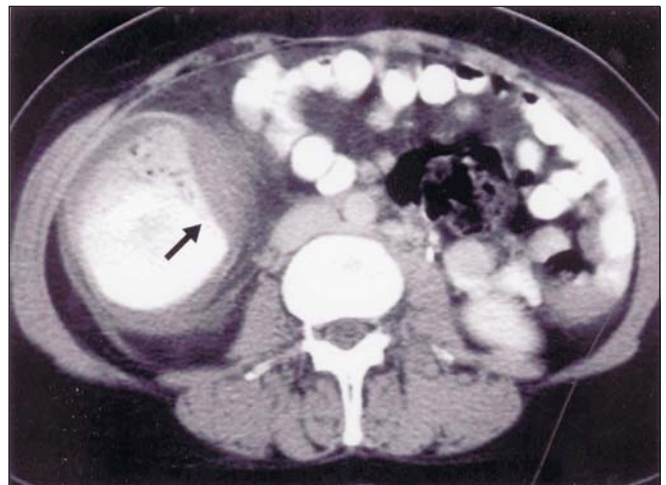
**B:** A scan 4 cm caudal to Figure 4A clearly demonstrates the layered-appearing thickened-wall cecum, reactive pericecal fat stranding, and thickening of Gerota's fascia, as well as mural thickening of the appendix (arrow) causing narrowing of its lumen, which is filled with the orally ingested contrast material.



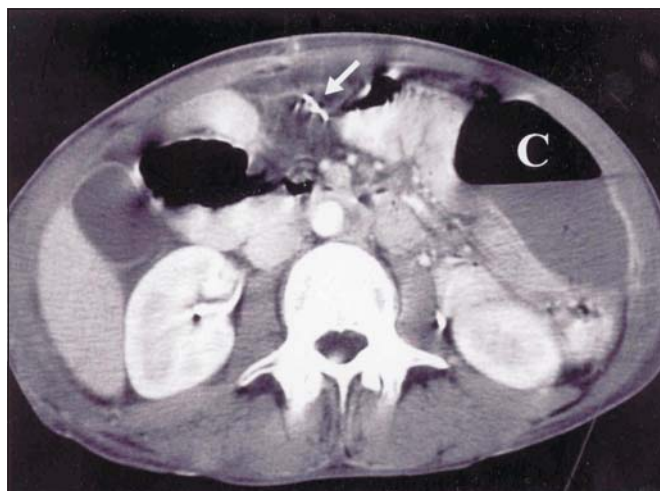
**Figure 5** Inactive CD. A 52-year-old man with known CD in remission. CT shows mural thickening of a segment of distal ileum causing prestenotic dilatation. Note the submucosal fat deposition, related to the inactivity of the disease, encircled by a higher density ring representing the muscularis mucosae and serosa (arrows).



**Figure 6** Acute Crohn's colitis. A 47-year-old woman with known CD presented with abdominal pain and tenderness associated with high-grade fever and leukocytosis. CT shows mural thickening of the ascending colon (arrow) with pericolic stranding and reactive thickening of the lateroconal fascia.



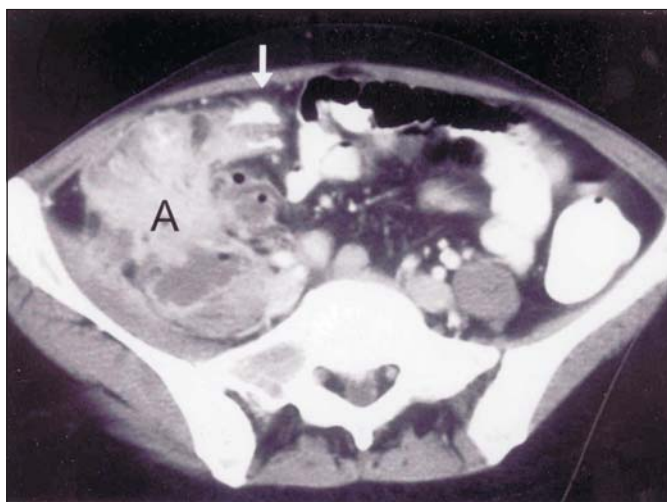
**Figure 7** Postoperative abscess. A 36-year-old man with fever after ileal resection for active, fistulizing CD. CT shows a well-circumscribed fluid collection (C) with an air–fluid level in the left mid-abdomen compatible with a postoperative abscess. Note the anastomotic surgical clips (arrow).



**Figure 8** Abdominal wall abscess. A 36-year-old man (same as in Figure 7) with CD presented with fever and a tender, right-sided abdominal wall mass. CT shows a thickened wall intestinal loop with surrounding mesenteric changes (black arrow) as well as hypodense, right-sided, enlarged abdominal wall muscles containing gas bubbles and the orally ingested contrast material (white arrow).



**Figure 9** Ileopsoas abscess. A 26-year-old woman with known CD and right-sided femoral neuropathy. CT shows a multiloculated collection within the right iliopsoas muscle with indistinct margins and minute gas bubbles, compatible with an abscess (A). Note the adjacent thickened-wall small bowel loops nearby the collection (arrow).



causing a cicatricial luminal stenosis leading to fibrotic strictures (Figures 10 and 11).<sup>1</sup> Obstructing complications requiring surgery have been reported in up to 54% of patients with known CD who presented with SBO.<sup>3</sup> Less frequently, SBO is caused by bowel luminal narrowing owing to an acute inflammatory process and may be the first presentation of previously unrecognized CD.

In a patient with known CD presenting with SBO, the CT findings are often typical of both SBO and active CD (Figure 10),<sup>13</sup>

as the obstructing strictures always have an inflammatory component.<sup>2</sup> SBO in patients with CD after intestinal resection may, however, be caused not only by exacerbation of the inflammatory condition but also by adhesive bands or incisional hernias, and CT can often differentiate between these conditions. CT has a high diagnostic accuracy in detecting SBO and in defining its severity and etiology. The latter is determined by meticulous analysis of the transition zone, which allows for the correct diagnosis of the cause of the obstruction in 73% to 95%.<sup>14</sup>

Alternatively, in patients with SBO who undergo CT the radiologist may suggest a clinically unsuspected CD by detecting a layering pattern of enhancement of a thickened bowel wall at the transition zone associated with prominent perienteric vasculature.

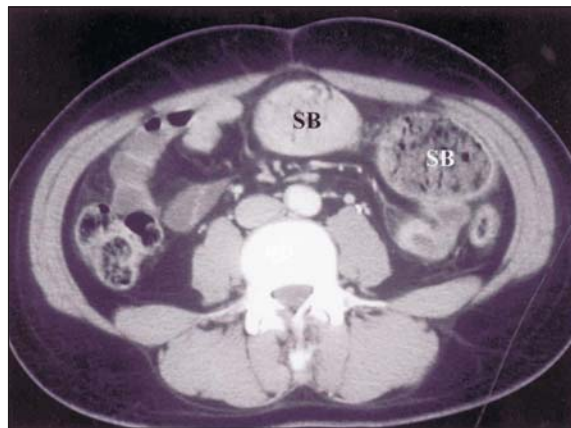
## Perforation

Perforating complications in patients with CD include abscess formation, fistulas, or free perforation with generalized peritonitis. The usual ileal perforations are often sealed off by interloop adhesions ensuing from the transmural nature of the disease, leading to phlegmon and abscess formation with localized peritonitis (Figure 12). Free perforation, although rare, is a life-threatening complication of CD reported in up to 3% of patients (Figures 13 and 14).<sup>3</sup> It is often related to a postoperative anastomotic leak occurring mainly when surgery was performed for a septic condition or to an attack of toxic colitis.



**Figure 10** CD-related small bowel obstruction (SBO). A 39-year-old man with known CD presented with abdominal pain with nausea and vomiting.

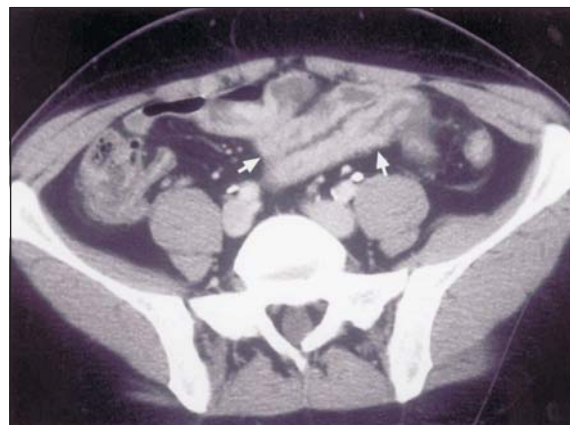
**A:** CT shows dilatation of small bowel loops (SB) filled with the small bowel feces sign, which is most often related to mechanical SBO.



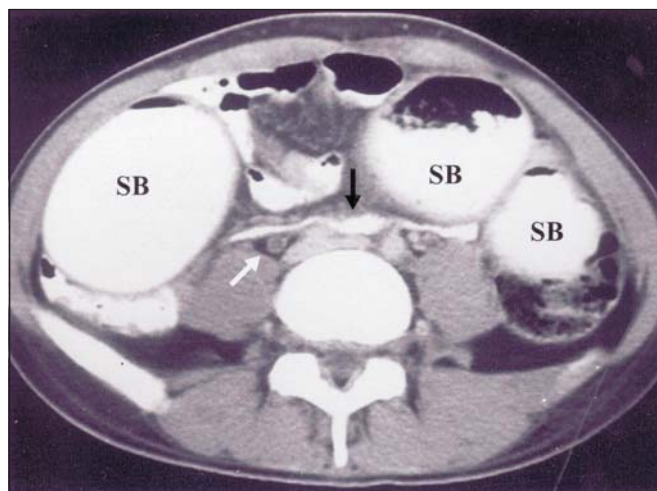
**B:** Lower down, prominent perienteric vasculature (arrows) are seen within the mesentery.



**C:** More caudally, 3 areas of thickened wall ileal segments are seen (arrows) as the cause of the SBO.



**Figure 11** CD-related SBO. A 29-year-old man with known CD presented with abdominal cramps, vomiting, and active peristalsis. CT shows marked stenosis of a small bowel segment without a visible wall (black arrow). Marked dilatation of prestenotic small bowel loops (SB) is seen with passage of the orally ingested contrast medium into the colon, compatible with an incomplete SBO. Note mild right-sided hydronephrosis (white arrow) (reprinted with permission from Zissin et al.<sup>13</sup>).



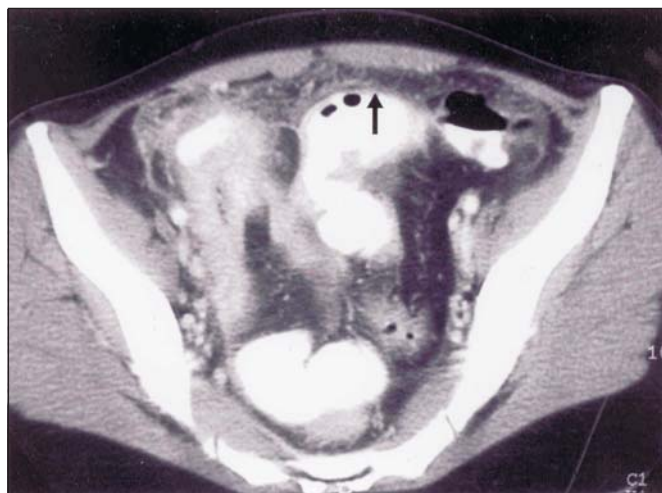
## Intussusception

Intussusception, the invagination of a segment of the gastrointestinal tract into an adjacent one, most commonly occurs in childhood. Ninety percent of intussusceptions in children are idiopathic. In adults, however, intussusception is rare, constituting only 5% to 16% of all intussusceptions, and in contrast to the phenomenon in childhood, an underlying cause, which acts as a lead point, is found in up to 90% of those.<sup>15</sup> The exact cause of intussusception in CD is unclear; the inflamed bowel segment probably alters the normal peristalsis of the intestine and permits its displacement into a distal segment of bowel (Figure 15), while transient enteroenteric intussusception, remote from the inflamed bowel segment, has also been reported in CD (Figure 16). Clinically, intussusception in adulthood is most often manifested by chronic abdominal symptoms such as episodes of cramps with nausea and vomiting, suggesting intermittent, transient intussusceptions, and less frequently by melena or weight loss. Intussusception has a characteristic CT appearance as a sausage-like or target-like mass with alternating rings of soft tissue and fat, depending on the angle of the CT beam relative to the intussusception's axis, with oral contrast material frequently seen trapped between the opposing walls of the intussusceptum and intussusciens.<sup>15</sup>

## Thromboembolic event

Venous thromboembolism, at various sites, is a known, rare complication of CD, occurring mainly during the active phase of the disease in young patients. It is related to the intrinsic

**Figure 12** Localized peritonitis in acute exacerbation of CD. A 25-year-old woman with known CD presented with severe abdominal pain. CT shows extensive stranding within the peritoneal fat and thickening of the parietal peritoneum compatible with localized peritonitis (arrow). Ileal mural thickening represents the affected segment.



prothrombotic state present in inflammatory bowel disease.<sup>16</sup> Overall, the incidence of thromboembolism in patients with inflammatory bowel disease is significantly higher than in the general population, with potentially serious sequelae. The incidence reported in autopsy studies is as high as 39%. Contrast-enhanced CT may detect unexpected venous thrombosis (Figure 17).

Rarely peripheral arterial thrombosis may also occur in patients with inflammatory bowel disease (Figure 18).<sup>17</sup>

### Nephrolithiasis and Cholelithiasis

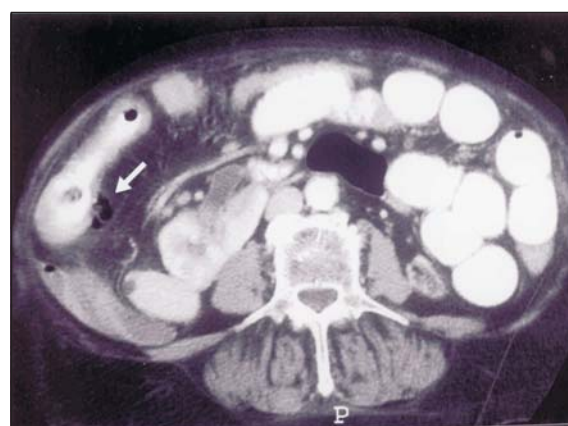
The reported incidence of nephrolithiasis in CD is up to 10%, with most calculi containing calcium oxalate. Renal calculi mainly appear in patients after ileal resection and in patients with ileostomies and are related to increased intestinal absorption of dietary oxalate, with resultant hyperoxaluria.<sup>2,5</sup> Gallstones develop in about 30% to 50% of patients with CD, especially those with extensive ileal disease or after ileal resection, resulting in bile salts malabsorption and increased lithogenesis.<sup>2,5</sup> Periodic sonographic studies of patients at risk are therefore recommended.

### Bowel Neoplasms Complicating CD

There is growing evidence that CD is one of the triggering factors for the development of intestinal tract carcinoma. The prevalence of intestinal cancer observed during the course of CD is reported to be higher than in the normal population, occurring more often in younger patients than do sporadic cancers and having a poor prognosis. The overall reported

**Figure 13** Ileal perforation. A 75-year-old woman presenting with right lower quadrant pain and tenderness is clinically suspected of acute appendicitis.

**A and B:** CT shows mural thickening of an ileal segment with adjacent engorged mesenteric vessels (arrow, Figure 13A) and extraluminal gas bubbles indicating perforation (arrow, Figure 13B).



**C:** More cranially, a free peritoneal air bubble is seen (arrow). Note the smaller and contracted left kidney and the malrotated right kidney with two hypodense lesions probably representing cysts. At laparotomy, transmural perforation was found in the terminal ileum, which was resected. Histology revealed changes of active CD.



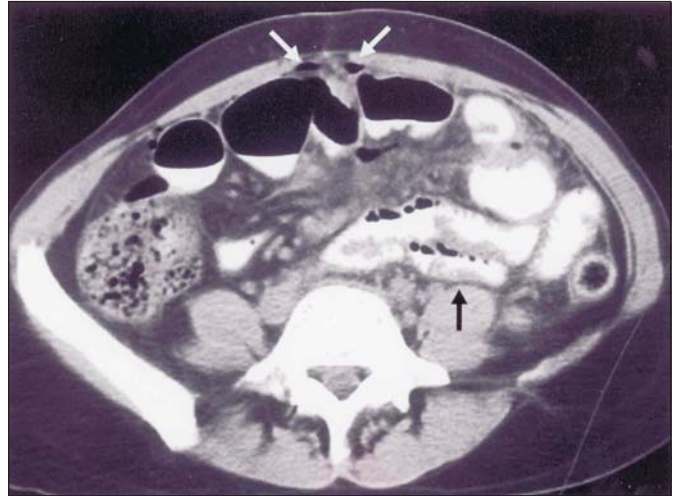


**Figure 14** Enteric perforation. A 31-year-old woman with known CD presented with acute abdomen with peritoneal irritation.

**A:** CT shows thickening of the parietal peritoneum and increased markings within the mesenteric fat related to peritonitis. Small extraluminal air bubbles indicate perforation (arrows).



**B:** A scan 6 cm cranial to Figure 14A demonstrates the affected intestinal loops with mural thickening and mesenteric changes (black arrow), as well as free extraluminal gas bubbles (white arrows).



**Figure 15** CD-related enteroenteric intussusception. A 67-year-old woman with CD and past resection of the terminal ileum presented with abdominal pain.

**A:** CT shows a mass with target appearance consisting of several layers of different densities (white arrow) with a peripheral rim of contrast material entrapped between the opposing walls of the intussusceptum and the intussusciens. Enlarged mesenteric lymph nodes are also seen (black arrow).



**B:** Lower down, thickening of the neoterminal ileum is seen (black arrow) proximal to the anastomotic clips (white arrow), compatible with disease exacerbation, proved on colonoscopy. A repeat CT scan 2 months after treatment demonstrated resolution of the pathological findings.



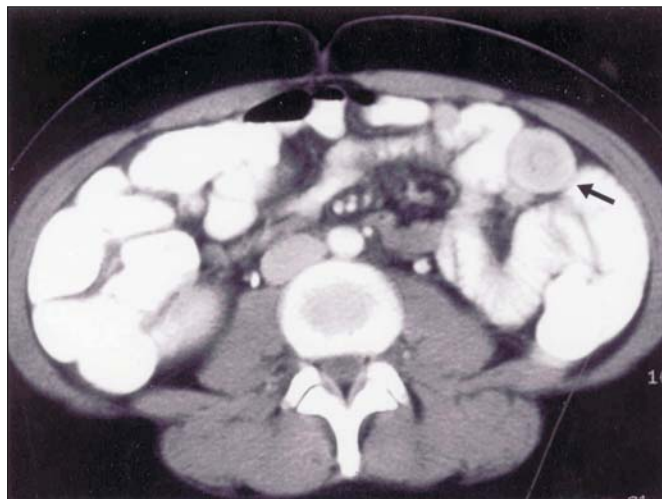


**Figure 16** Enteroenteric intussusception. A 26-year-old woman with clinical exacerbation of CD.

**A:** CT shows the terminal ileum with a thickened wall and perienteric engorged vasa recti (arrow) compatible with active CD.



**B:** A more cranial scan shows a round, target-shaped mass consisting of different densities in the left midabdomen compatible with enteroenteric intussusception (arrow). The fatty density seen in the centre of the lesion represents the intussuscepted mesenteric fat. Rescanning of the same area after some hours was normal, compatible with transient intussusception.

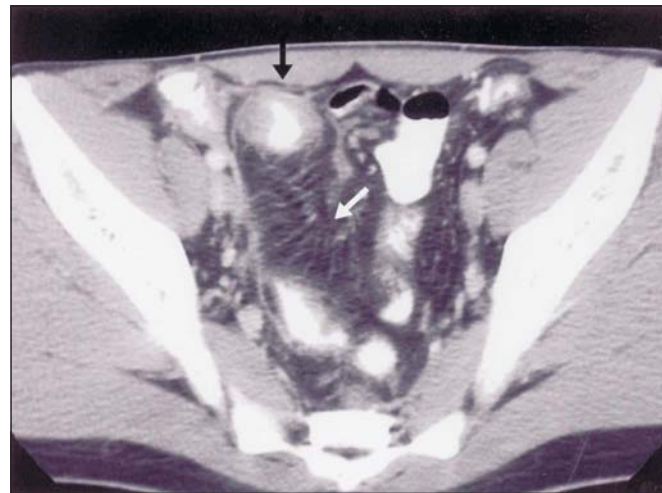


**Figure 17** Venous thrombosis. An 18-year-old man with exacerbation of CD.

**A:** CT shows filling defect within the right common iliac vein.



**B:** More caudally, mural thickening of the terminal ileum (black arrow) with prominent perienteric vasculature (white arrow) within its mesentery are seen, compatible with active CD.



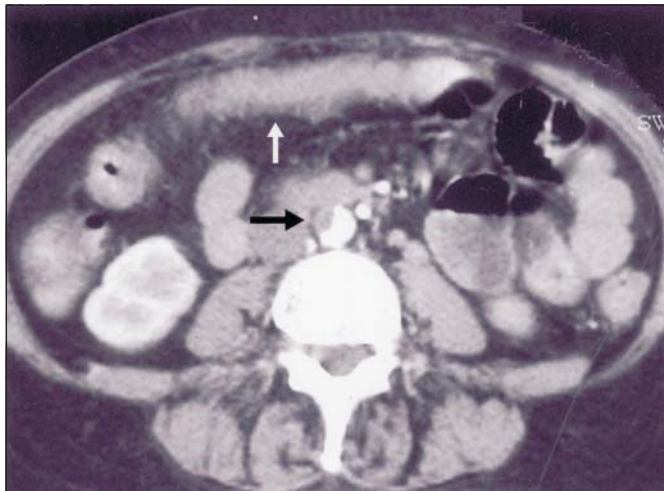
incidence of small intestine and colonic cancer complicating CD is 0.13% and 0.32%, respectively.<sup>1,18,19</sup> An increased risk for colorectal carcinoma, particularly of the mucinous type, is reported in patients with Crohn's colitis of more than 10 years' duration, with a prevailing increased risk in those who were diagnosed prior to age 30 years.<sup>1,18,19</sup> Multiple colonic carcinomas appear in up to 12% of cases and are associated with a higher incidence of mucinous or colloid cancer. In addition,

carcinoma in CD is frequently of the schirrous, infiltrative type, and hence its imaging or surgical diagnosis may be very difficult if not impossible.<sup>18</sup>

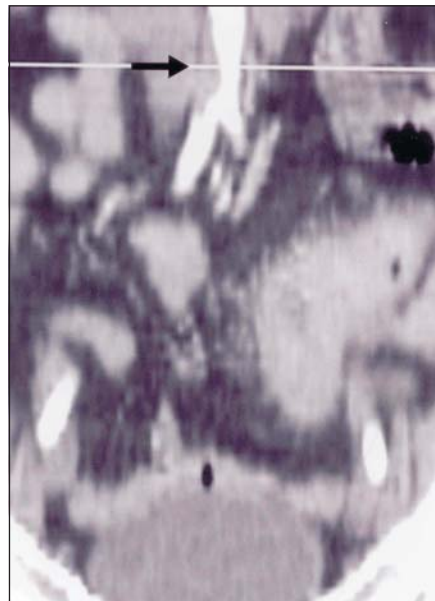
Small bowel adenocarcinoma in Crohn's ileitis develops in a location that mirrors the distribution of the disease, that is, more distally in the small intestine, in contrast to sporadic de novo cancers that occur in a proximal location.<sup>19</sup> The risk factors include male sex, disease duration of 20 years or longer,

**Figure 18** Arterial thrombosis. A 51-year-old woman with exacerbation of known CD.

**A:** CT shows a filling defect in the distal abdominal aorta (black arrow), as well as mural thickening of the transverse colon and pericolonic fat stranding (white arrow), signs of active CD.

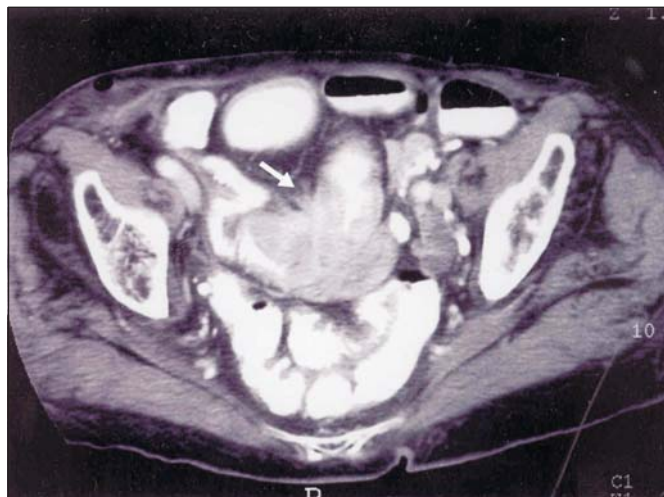


**B:** Coronal reconstruction clearly demonstrates the right-sided mural thrombus in the distal aorta (arrow).

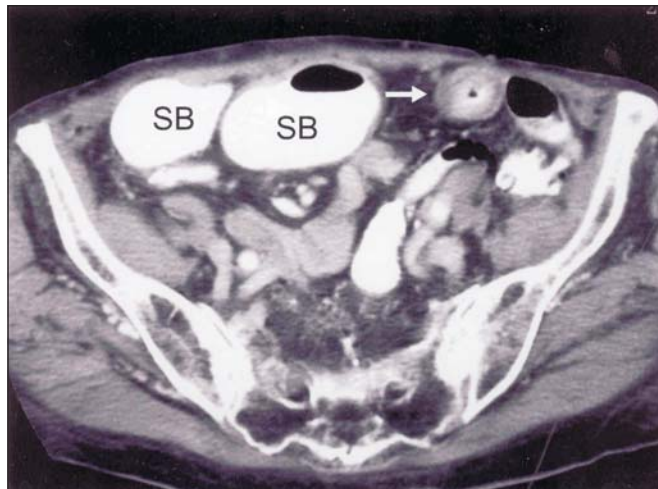


**Figure 19** Adenocarcinoma complicating CD. An 82-year-old woman with CD was examined for recurrent episodes of incomplete SBO.

**A:** CT shows marked, inhomogeneous mural thickening of a distal ileal loop (arrow) causing luminal narrowing and prestenotic dilatation. Malignancy was suspected.



**B:** A scan 3 cm cranial to Figure 19A shows dilated small bowel loops (SB) proximal to the obstructing mass, as well as circumferential mural thickening with submucosal fat deposition in another ileal segment (arrow), related to chronic CD. The resected specimen proved to be an adenocarcinoma.





chronic enteric fistulas, and previous surgical intestinal bypass surgery (carcinoma may arise in the bypassed bowel).<sup>1,18,19</sup> The possibility of malignancy should be considered in patients with known longstanding CD who present with severe or recurrent symptoms or when mesenteric lymph nodes larger than 1 cm or markedly segmental mural thickening are found on CT (Figure 9).

Both non-Hodgkin's and Hodgkin's lymphomas, in intestinal as well as extraintestinal locations, have been reported in patients with CD of more than 10 years' duration.<sup>2</sup>

## Conclusion

Various findings representing extraenteric abdominal complications can be demonstrated on CT studies of patients with CD. The radiologist plays an important role in their diagnosis, and familiarity with these features, coupled with knowledge of the clinical setting, should lead to early recognition of these complications and their management.

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