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Acute diverticulitis of the small bowel: CT findings

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Abstract
We present the computed tomographic (CT) findings in two cases of small bowel diverticulitis, one affecting the jejunum and the other a Meckel's diverticulum. The main CT finding was that of a mass with an air–fluid collection in contiguity with small bowel loops.

Key words: Small bowel diverticulitis—Meckel's diverticulitis—Computed tomography.

Small bowel diverticulosis occurs in 2–4% of the population and predominantly involves the jejunum [1–3]. Diverticulitis of the small bowel with perforation is rare and necessitates resection of the involved segment [1]. It is associated with high mortality if unrecognized, with an ensuing delay in treatment [4, 5]. The symptoms of perforated diverticulitis are, however, not specific, and a plain abdominal radiograph usually does not contribute to the diagnosis [5]. Therefore, these patients might be referred to computed tomography (CT) in the course of evaluation of acute abdominal pain. Hence, the importance of recognizing the CT appearance of this unusual entity.

Case reports

Case 1

A 62-year-old man was admitted with acute diffuse abdominal pain and a temperature of 38°C. His past medical history was unremarkable except for left inguinal hernia repair a year earlier. Physical examination showed diffuse abdominal distention and tenderness in the left lower quadrant.

Abnormal laboratory data included a white cell count of 16,000/mm^3 and hemoglobin of 9 gr%, with indices indicating iron deficiency anemia. A plain film of the abdomen showed a few dilated loops of small bowel in the left upper and left mid-abdomen (Fig. 1A). The assumed clinical diagnosis was sigmoid diverticulitis or a necrotic tumor of the colon. A CT study demonstrated a 3-cm round mass containing a mixture of air and small fecallike particles in contiguity with adjacent small bowel loops, situated in the left mid-abdomen. The bowel loops were slightly dilated, and their walls were thickened. A thin hypodense rim, probably representing mesenteric fat, separated the mass from the bowel wall (Fig. 1B, C). Although the diagnosis of an abscess secondary to a covered perforation of the small bowel was suggested, the patient was treated conservatively with antibiotics for 4 days. A repeat CT study demonstrated contrast material within the mass, in addition to the mixture of air and fecallike particles seen previously (Fig. 1D). At laparotomy 1 day later, multiple diverticula in the proximal jejunum and perforation of one of them surrounded by a small inflammatory mass were found. A long segment of small bowel was resected with end-to-end anastomosis. Microscopically, there was an ulcer within the diverticulum, with acute on chronic inflammation and fibrosis. The postoperative course was uneventful.

Case 2

A 69-year-old man was hospitalized with right abdominal pain. He had an elevated white cell count but no fever. Physical examination showed rebound and tenderness in the right upper quadrant. A supine abdominal radiograph was interpreted as normal but on retrospective review showed an 8-cm rounded collection of air in the right mid-abdomen. The following day, signs of intestinal obstruction appeared. CT demonstrated an air–fluid collection, 4.5 cm in diameter, in the right mid-abdomen in contiguity with dilated small bowel loops. A thin hypodense rim, probably representing mesenteric fat, separated the collection from the adjacent bowel wall. Mild inflammatory changes were present in the surrounding mesenteric fat (Fig. 2A). Oral contrast material appeared within the dependent part of the collection after a 1-h delay (Fig. 2B). The presumed diagnosis was of an intraperitoneal abscess due to a covered perforation causing small bowel obstruction.

Exploratory laparotomy showed an inflammatory diverticulum contiguous to ileal loops, which had caused the bowel obstruction. A 12-cm segment of ileum was resected. On gross pathology, there was a 6-cm

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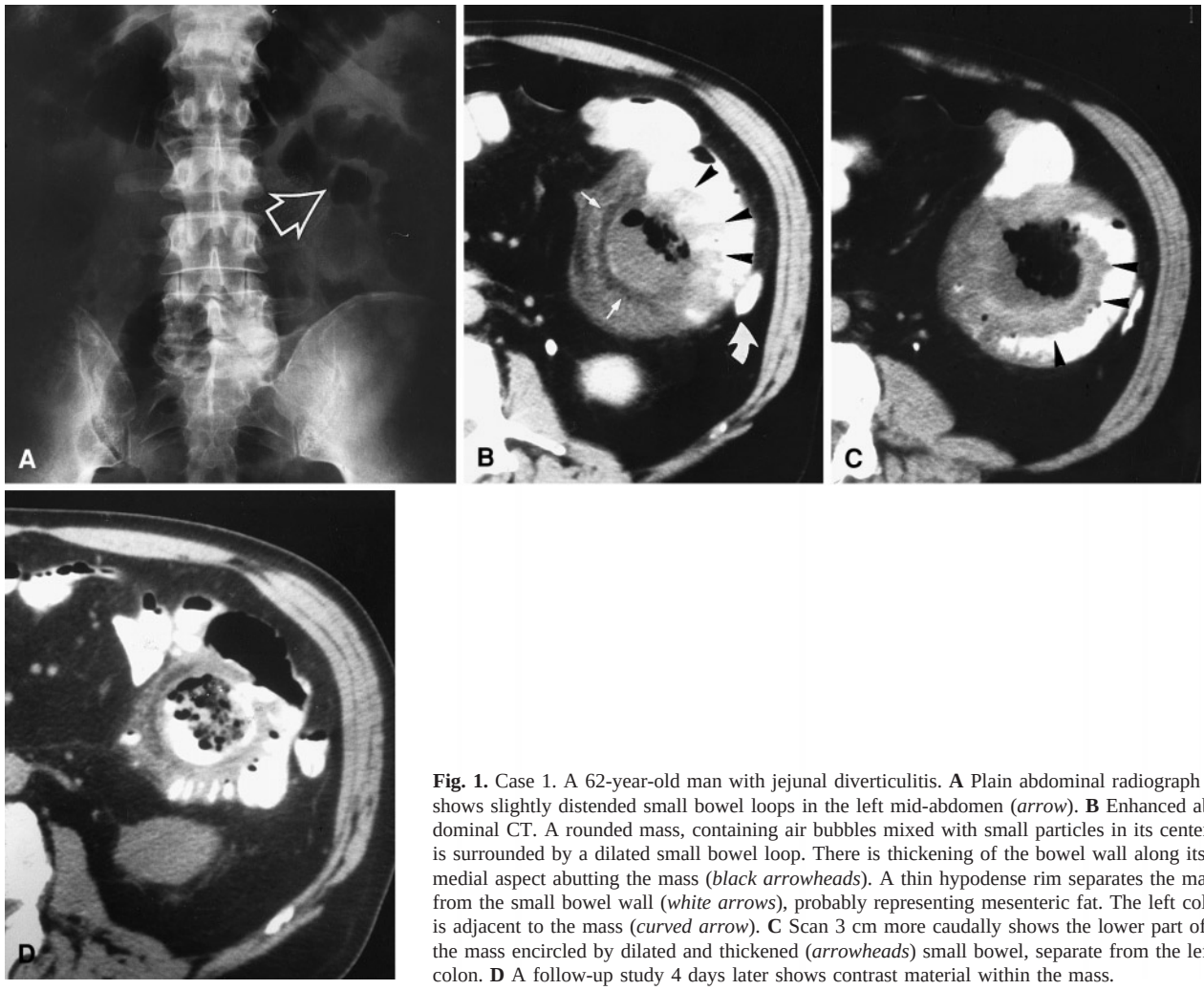

Fig. 1. Case 1. A 62-year-old man with jejunal diverticulitis. **A** Plain abdominal radiograph shows slightly distended small bowel loops in the left mid-abdomen (*arrow*). **B** Enhanced abdominal CT. A rounded mass, containing air bubbles mixed with small particles in its center, is surrounded by a dilated small bowel loop. There is thickening of the bowel wall along its medial aspect abutting the mass (*black arrowheads*). A thin hypodense rim separates the mass from the small bowel wall (*white arrows*), probably representing mesenteric fat. The left colon is adjacent to the mass (*curved arrow*). **C** Scan 3 cm more caudally shows the lower part of the mass encircled by dilated and thickened (*arrowheads*) small bowel, separate from the left colon. **D** A follow-up study 4 days later shows contrast material within the mass.

diverticulum with an inflamed and ulcerated wall containing a 3.5-cm enterolith, which had not been apparent on CT. Microscopic examination demonstrated a diverticulum, with a wall composed of small intestinal mucosa and with a muscular layer. The diverticular wall and the surrounding fat were infiltrated by leukocytes. The final pathological diagnosis was acute Meckel's diverticulitis with enterolith. The patient's postoperative course was uneventful.

Discussion

Small bowel diverticula are either congenital or acquired. A congenital diverticulum contains all three intestinal wall layers and occurs in 2–3% of individuals, usually as a Meckel's diverticulum located on the antimesenteric aspect of the ileum 30–60 cm from the ileocecal valve [6]. Acquired diverticula have only mucosal and submucosal layers that herniate through the muscular and serosal layers. It is thought that they result from either raised intraluminal pressure or an underlying visceral myopathy. Their reported incidence varies between 0.5% and 2.3%. They are found almost exclusively in individuals older than age 40 years and are twice as frequent in men as in women. Jejunal diverticula are up to seven times more common than ileal diverticula and tend to be larger [1].

Most small bowel diverticula are asymptomatic and are incidentally discovered during autopsy, laparotomy, or barium studies [1, 7, 8]. The type, incidence, and severity of complications differ in the two types of diverticulum.

Complications of jejunal diverticula are uncommon but of clinical importance. Complications include stasis, obstruction (both acute and chronic), and hemorrhage of the small bowel and inflammatory disturbances varying from mild inflammation to gangrene, resulting in perforation and peritonitis [1]. Gangrene is the most serious complication, with a reported mortality of up to 40% [7]. The high mortality is attributed in part to a delay in the correct diagnosis [5].

The CT findings of a perforated jejunal diverticulum have been described to the best of our knowledge in nine

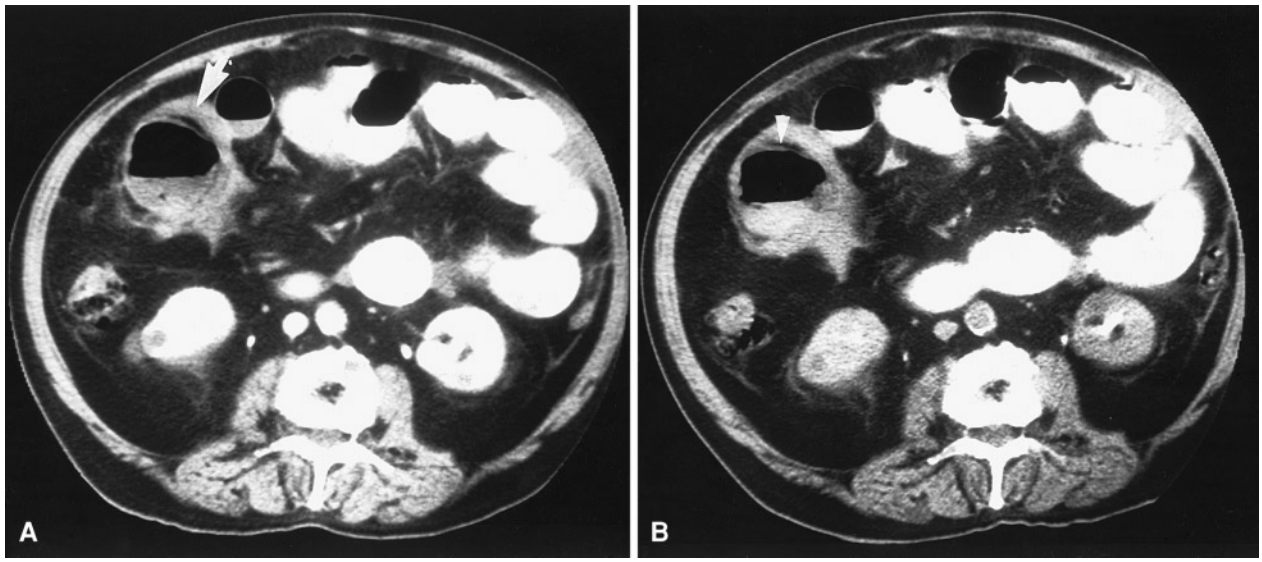

Fig. 2. Case 2. A 69-year-old man with acute Meckel's diverticulitis. **A** Contrast-enhanced CT demonstrates an air–fluid collection in the right mid-abdomen adjacent to small bowel loops (*arrow*), surrounded by strands indicating inflammatory changes. The proximal small bowel is dilated. **B** Delayed CT at the same level shows contrast material within the collection separated from the adjacent small bowel wall by a thin hypodense rim (*arrowhead*), probably representing mesenteric fat.

previous cases [2, 3, 5–7]. In all these cases, the provisional diagnosis based on clinical grounds, prior to the radiological investigation, was either sigmoid diverticulitis or acute appendicitis but did not include a perforated small bowel diverticulum [5]. The correct diagnosis was made preoperatively based solely on CT findings in two cases of perforated jejunal diverticula [5, 7]. In five other cases, the correct diagnosis was suggested preoperatively when a small bowel study was performed in addition to CT [2, 3, 6]. In eight cases, CT showed an inflammatory mass adjacent to small bowel loops. Small air bubbles within the mass were seen in three of them [5, 6], and a straightforward demonstration of a contrast-filled jejunal diverticulum was visible in three cases [5–7].

In our case 1, the plain abdominal radiograph did not contribute to the diagnosis, similar to the previously described cases. CT showed a soft tissue mass with small air bubbles mixed with small particles in its center. This space was filled with oral contrast material on the follow-up study 4 days later, suggesting a sealed intestinal perforation because there was neither free intraperitoneal air nor any leakage of contrast material beyond this space.

Regarding Meckel's diverticulum, complications are reported to occur in 19% of cases. Complications include, in order of decreasing frequency, bleeding, intestinal obstruction, perforation, bowel strangulation, diverticulitis, intussusception, volvulus, tumors originating in the diverticulum, and enterolith formation [8, 9]. Meckel's diverticulitis usually results from the effect of peptic acids, produced by the heterotopic gastric mucosa, on the surrounding ileal mucosa. Heterotopic mucosa was, however, not found in our case. Enteroliths obstructing the lumen is another cause for diverticulitis, as was found at surgery in our case. Clinically, Meckel's diverticulitis may mimic the symptoms of acute appendicitis.

The CT findings of an inflamed Meckel's diverticulum have been described in two previous case reports [9, 10]. In one patient, a collection of air and fluid in the right mid-abdomen was demonstrated [9], similar to our case, and in the second, a tubular fluid-filled structure abutting the anterior abdominal wall, adjacent to the umbilicus, was seen [10]. The underlying cause, an impacted calcified enterolith, was demonstrated in the first case [9].

In our case 2, a 3.5-cm enterolith was found in the pathologic specimen, although it had not been demonstrated on CT and could not be definitely recognized retrospectively, possibly because it was not calcified. In a review of eight patients with pathologically proven Meckel's enteroliths in whom abdominal radiographs were available, opaque stones were seen in seven of the eight patients. However, the number of stones found at surgery exceeded the number found at radiography in half of these patients. In that study, out of a total of 18 stones in eight patients, two types of enteroliths were seen. The majority had dense peripheral calcification with softer feceslike material in the center. The less common type consisted of multiple layers of soft feceslike material. The researchers concluded that most of these stones would calcify from the periphery and progress toward the center [11].

The CT findings in both cases we describe are quite similar, in spite of the different etiology and pathology of the diverticula.

In conclusion, the preoperative diagnosis of an inflamed small bowel diverticulum should be suggested when a collection containing air and encircled by thickened dilated small bowel is detected in an unusual location, distant from the area of the ileocecal valve and from the sigmoid colon, where most spontaneous abscesses arise secondary to either appendicitis, Crohn's disease, or sigmoid diverticulitis.

With the increased use of CT in the evaluation of patients with acute abdominal pain, it is important to recognize the CT appearance of a complicated small bowel diverticulum and to include the appearance in the differential diagnosis because this diagnosis is often not suspected clinically.

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