CT Findings of Unusual Causes of Acute Abdomen

Akut Karın Ağrısının Nadir Sebepleri ve BT Bulguları

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ABSTRACT

Acute abdomen is one of the most common problems that radiologists face in daily practice. Imaging is used as the last stop before laparotomy, and computed tomography (CT) is now almost always the first step both in helping solve various difficult, urgent cases and in deciding on the management for the pain. In this study, we review a number of rare cases of abdominal pain in which the preliminary diagnosis could not be made clinically, but where CT images revealed the causes.

Key Words: Acute abdomen, Differential diagnosis, Multidetector computed tomography

ÖZ

Akut karın ağrısı radyologların günlük pratiklerinde karşılaştıkları ve çözmeleri istenen en sık problemdir. Laparotomiden önce sıklıkla görüntüleme yapılması gerekir. Bilgisayarlı tomografi (BT) zor ve aciliyeti olan olguların etiyolojisinin aydınlatılmasında ve ağrıya yönelik tedaviye karar vermede ilk başvurulan radyolojik yöntemdir. Çalışmada akut karın ağrısına sebep olan, klinik tanı koymada güçlük yaşanan ve BT görüntüleme ile sebebin ortaya çıkarıldığı sık karşılaşılmayan sebepler gözden geçirilmiştir.

Anahtar Sözcükler: Karın, Akut, Ayırıcı tanı, Çok kesitli bilgisayarlı tomografi

INTRODUCTION

Acute abdomen is one of the most common problems that radiologists face in daily practice because it is caused by various kinds of accidents and numerous diseases. Imaging is used as the last stop before laparotomy, and computed tomography (CT) is now almost always the first step both in helping solve various difficult, urgent cases and in deciding on the management for the pain. Well-known causes of acute abdomen, clinically and radiologically, include acute appendicitis, acute cholecystitis, acute pancreatitis, and bowel obstruction. The radiologic spectrum of these entities has been extensively described in the literature.

In this study we review a number of rare cases of abdominal pain in which the preliminary diagnosis could not be made clinically, but where CT images revealed the causes.

Abdominal Hernia

External Hernias

Various types of abdominal wall hernias are commonly encountered in abdominal imaging (1). In cases of acute pain, obstruction and strangulation or incarceration of herniated intestinal segments are the main concern of clinicians and radiologists. Some unusual entities may be seen in a hernia sac, and inflammation or ischemia of these contents could be

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the primary cause of symptoms. Anterior abdominal wall hernias include umbilical, paraumbilical, hypogastric and epigastric hernias. Among them, umbilical and hypogastric hernias are commonly related with incarceration and strangulation (2,3). Groin hernias consist of femoral hernias (more frequently seen in women) and inguinal hernias. The two types of inguinal hernias are direct, which pass medially to the inguinal fossa, and indirect. Indirect inguinal hernias may cause torsion of the omentum (2); the twisted portion of the omentum may herniate into the inguinal canal (Figure 1A,B). Hernia sacs may contain mesenteric fat, intestinal segments, or colon parts. Rarely, the urinary bladder, a Meckel's diverticulum (Littré hernia) or an appendix vermiformis (Amyand's hernia) may be included in a hernia sac. Amyand's hernia refers to herniation of both an inflamed and noninflamed appendix (4). On CT, the appendix is identified, generally in the right lower quadrant, as a blind-ended tubular structure connected to the cecum and entering the inguinal canal (Figure 2A-D).

The only iatrogenic hernias are incisional hernias, a late complication of laparotomy, and are primarily encountered after midline incisions (2). They necessitate urgent surgical intervention when obstruction symptoms occur. Omental fat generally protrudes into the defect (5). Large bowel obstruction secondary to an incisional hernia is not as common because the ascending and descending colon lie retroperitoneally (Figure 3).

Internal Hernias

An internal abdominal hernia is described as the protrusion of a visceral organ through a normal aperture (such as the foramen of Winslow) or an acquired one (e.g., after a gastric by-pass operation). Due to its low incidence of less than 1%, physicians may not consider the possibility of internal hernias, which can then be easily overlooked. As they cause fatal complications when left untreated, internal hernias require a sufficiently knowledgeable radiologist not to miss it.

Internal hernias are classified according to location: paraduodenal, pericecal, transmesenteric, foramen of Winslow, intersigmoid, and paravesical (6). Paraduodenal hernias account for approximately 55% of all internal hernias and consist mostly of left paraduodenal hernias (Figure 4A,B). The key feature of a right paraduodenal hernia is anterior displacement of the superior mesenteric artery (SMA). The typical population for transmesenteric hernias is children, plus adults who have had surgery (Figure 5A,B) (7).

Volvulus

Volvulus is an obstructing twisting of luminal organs around the mesenteric axis, which leads to ischemia and necrosis. Gastric volvulus occurs organoaxially or mesenteroaxially. Midgut volvulus is a congenital abnormality of the bowel segment supplied by SMA. Midgut volvulus is common in children but extremely rare in adults (8). CT detects twisting of the small bowel around its mesenteric root (9) (Figure 6A-C). Cecal volvulus constitutes 25-40% of colonic volvulus cases (10). Two types of cecal volvulus are defined. If the rotation is in the axial plane, the volvulus occurs in the right lower quadrant (Figure 7). In the second type, the cecum twists itself to the left lower quadrant. The 'whirl' sign and tapering of the lumen at the site of twisting are diagnostic on CT imaging.

Adult Age Intussusception

Jejunal intussusception is known to be the least common complication of gastroenterostomy (11). Jejunal

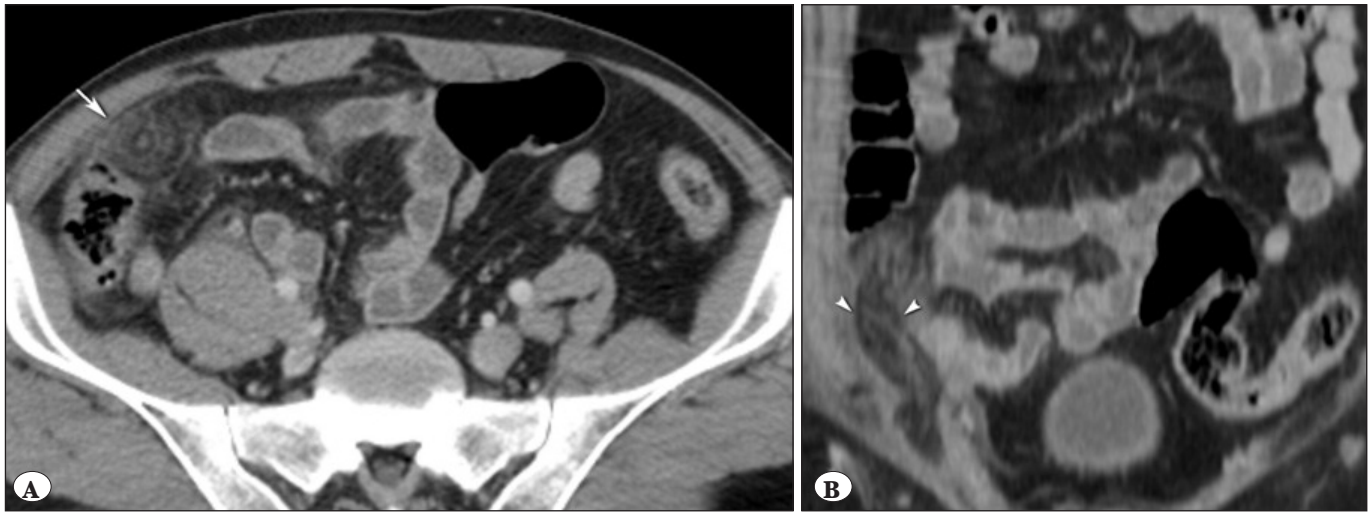

Figure 1: Omental torsion. Intravenous contrast-enhanced CT scan shows a 42-year-old man with right lower quadrant pain. **A)** Axial image through the pelvis shows hyperdense stranding and circular contrast enhancement in the omental fat anterior to the ileal segments (arrow). Note the prominent vascular structure in the center of the lesion. **B)** In the coronal image, omental fat is seen as herniating into the right inguinal canal (arrowheads) in a whirling pattern. The patient relieved after medical therapy without surgical intervention.

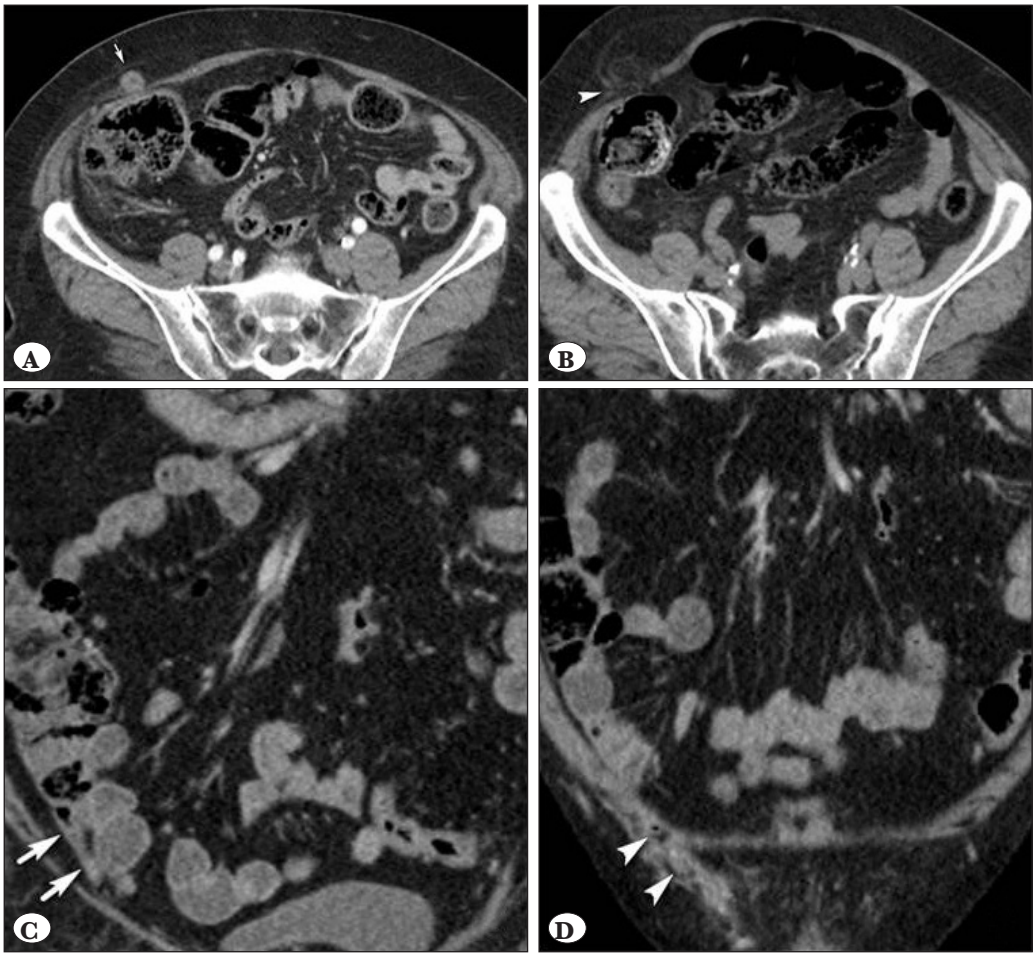

Figure 2: Amyand's hernia. The enhanced abdominal CT image of a 26-year-old man was obtained due to a painful mass in the right inguinal region. In the axial **(A,B)** and coronal reformatted **(C,D)** CT images, the vermiform appendix is arising from the posterior wall of the cecum (arrows) and descends in the right inguinal canal (arrowheads).

Figure 3: Transverse colon herniation and incarceration. A 47-year-old woman who had been operated on for an umbilical subcutaneous mass 6 months before was referred to ER with abdominal pain and vomiting. In this contrast-enhanced axial CT image, the transverse colon is seen herniated through an 8 cm abdominal wall defect (arrow), dilated and surrounded by a small amount of fluid (arrowhead). The ascending colon and intestinal segments (not shown) are dilated due to incarceration of the herniated segment.

intussusception causes acute abdominal pain when invaginated loops become incarcerated or strangulated in the stomach (Figure 8A,B). The process is blamed on gastric acid, which precipitates strong peristaltic action around the jejunogastric anastomosis (12). Like mesenteric lymph nodes in cases of pediatric intussusception, a tumor may be the lead point. An upper GI series and gastroscopy are basic diagnostic tools for this condition; however, an abdominal CT is generally satisfactory in emergency conditions (13).

Meckel's Diverticulitis

A Meckel's diverticulum is a congenital true diverticulum generally located on the distal 40-100 cm of the ileum (14). A Meckel's diverticulum is a blind-ended ileal loop which normally contains small bowel mucosa and may be lined with heterotopic gastric mucosa. Colonic and biliary mucosa are present less often. The most common complication is obstruction by the strangulation of the bowel due to a diverticular ring or intussusception of the diverticulum into the ileum. Hemorrhage and perforation may also occur (15, 16), yet only 25% of the cases become symptomatic. Bleeding mostly occurs in the pediatric group; increased activity in the right lower quadrant is diagnostic on Tc-99m pertechnetate scintigraphy. Acute diverticulitis makes up 30% of symptomatic cases (Figure 9A-C). CT

Figure 4: Left paraduodenal hernia. In the axial **(A)** and coronal reformatted **(B)** contrast-enhanced images of a 44-year old male patient, in the left upper quadrant in the lateral of the 4th part of duodenum, jejunal segments are observed gathered together (arrows, b), the inferior mesenteric vein (arrowhead) which empties to the splenic vein (arrow) is anterior to the hernia sac and mesenteric vessels show engorgement compatible with a left paraduodenal hernia, as proven by laparotomy.

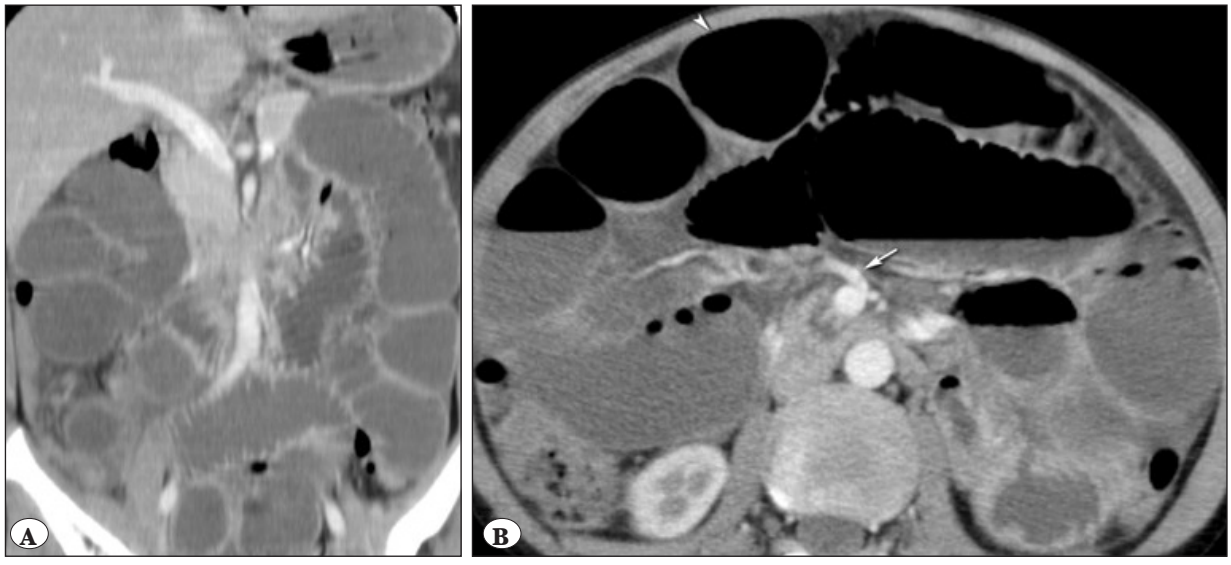

Figure 5: Transmesenteric hernia. On coronal reformatted **(A)** and axial **(B)** CT images of a ten-year-old boy, small bowel segments are shown to be markedly dilated without a significant encapsulation. There is no fatty plane between obstructed bowel loops and the abdominal wall (arrowhead). Note acute right angulation of the superior mesenteric artery (arrow). On laparotomy a Meckel's diverticulum was found to adhere to the mesenteric root, and small bowel loops were herniated through this bizarre gap.

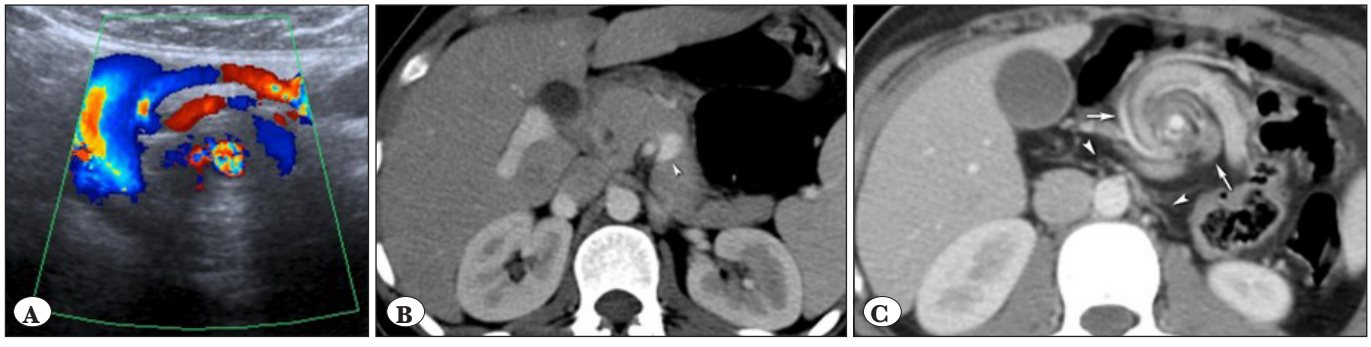

Figure 6: Midgut volvulus. A 16-year-old teenage girl with a 3-day history of left upper quadrant pain and vomiting was imaged on the suspicion of splenic infarct. **A)** On the transverse US image through the level of the SMA, mesenteric vessels are seen in a spiral shape. **B)** On this contrast-enhanced axial image, the superior mesenteric vein is seen to the left of the SMA (arrowhead). Its usual location is to the right of the artery. **C)** The axial CT image below view b shows twisting of the vessels in the clockwise direction. Venous engorgement is notable (arrowheads).

Figure 7: Cecal volvulus. A 37-year-old man applied to E.R. with abdominal pain and distention. The contrast-enhanced axial CT image shows collapsed and spiraled cecum and distal ileum with engorged vessels in the midline of the lower abdomen (arrowheads).

imaging is diagnostic when a normal appendix is seen and Meckel diverticulitis is considered during the differential diagnosis (17).

Abdominal Cocoon

Abdominal cocoon is a synonym for sclerosing encapsulating peritonitis. The small bowel becomes partially or totally encased by thickened, fibrotic peritoneum, which results in an obstruction. Peritoneal thickening can be idiopathic, secondary to peritoneal dialysis, or recurrent peritonitis (18). Clinical features include recurrent abdominal pain, vomiting, and distension. A CT scan is the method of choice for definitive diagnosis of this condition among other causes of intestinal obstruction and peritoneal thickening, and to detect complications such as small bowel necrosis and enterocutaneous fistula (19, 20). The most remarkable

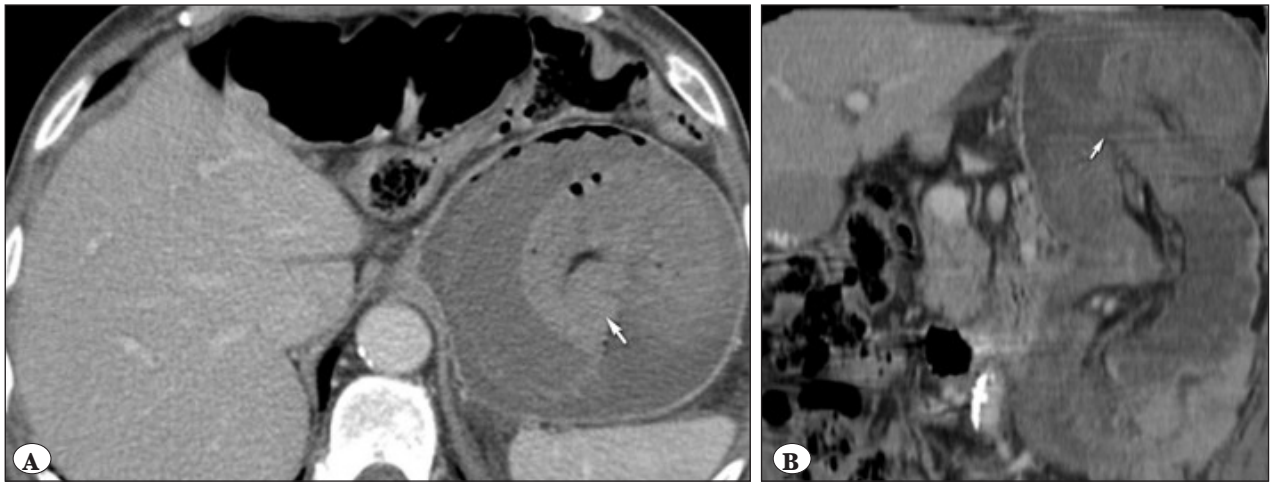

Figure 8: Jejunal intussusception. A 63-year-old man, who had had a Billroth-2 procedure 40 years before, had rebound tenderness in the whole abdomen. In axial **(A)** and coronal reformatted **(B)** contrast-enhanced CT examination, the stomach is markedly distended and superiorly displaced. A whirling appearance inside the stomach is consistent with jejunal segments (arrows) retrogradely moved into the stomach. On explorative laparotomy, a 30 cm long jejunal segment was found to be invaginated into the stomach at the 15th cm of the gastroenterostomy.

Figure 9: Meckel's diverticulitis. **A)** On this transverse US image of a 36-year-old woman, in the right vicinity of the uterus is an intestinal segment with diffuse wall thickening (arrowheads) and increased wall echogenicity. Inflammation in the surrounding mesentery was thought to be due to diverticular disease of the sigmoid colon. **B,C)** These axial CT images show a blind-ending tubular structure at the level of the distal ileum (arrow) and stranding in the adjacent mesenteric fat (arrowhead) compatible with acute Meckel's diverticulitis.

finding on CT is encapsulation of the intestinal segments in the center of the abdomen. The thickened peritoneum may show enhancement and ascites may be present (Figure 10A,B).

Infected Mesenteric Dermoid Cyst

Mesenteric dermoid cysts (or mature cystic teratomas) are rare mesenteric tumors that contain cell types from the endoderm, mesoderm, or ectoderm (21). They are usually present with ovarian dermoid cysts and are rarely encountered in men (22). These tumors generally have no clinical importance unless torsion, rupture or inflammation occurs. Ratan et al. reported a case of intestinal obstruction caused by a benign cystic teratoma of the mesosigmoid (23). Verswijvel et al. also reported one case of rupture of a dermoid causing acute abdomen (24). To the best of our knowledge, abdominal pain due to the inflammation of a mesenteric dermoid cyst in a male (Figure 11A-C) has not been presented in the literature. A preoperative diagnosis of a mature teratoma results in choosing conservative treatment (25). CT features are usually diagnostic when combined with clinical history. A differential diagnosis may propose mesenteric masses such as lymphangioma, mesenteric cysts, and enteric duplication cysts. The characteristic appearance of a mesenteric dermoid is as a well-circumscribed oval mass that may sometimes contain calcification. In our case, presence of the previous CT examinations of the patient and HU measurements were helpful in making a diagnosis. In the patient mentioned above, medical treatment and observation were the preferred medical options.

Figure 10: Abdominal cocoon. These axial **(A)** and coronal-reformatted **(B)** contrast-enhanced CT images of a 50-year-old male patient show intestinal segments gathered (arrows) and surrounded by thickened peritoneum (arrowheads). The peritoneal contrast enhancement is remarkable. A small amount of ascites and intestinal wall edema is in this region.

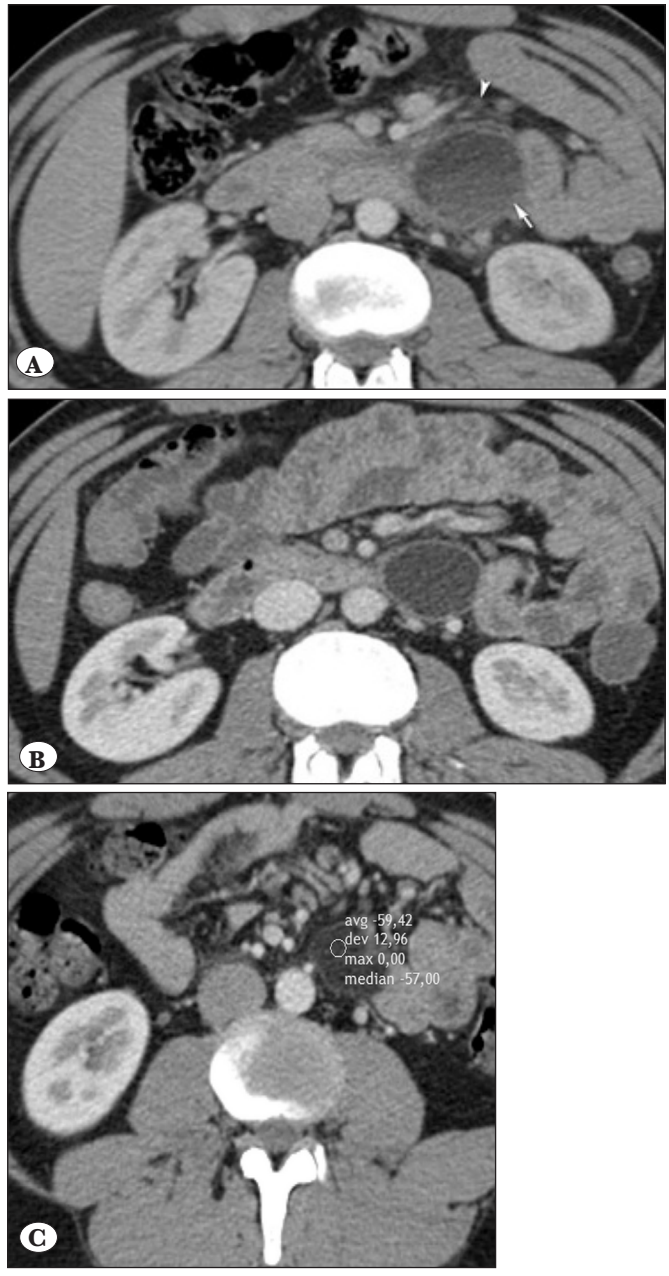

Figure 11: Infected mesenteric dermoid cyst in a 32-year-old male patient before and after treatment. **A)** On this initial contrast-enhanced CT image on the left vicinity of the aorta is a thick walled cystic lesion (arrow) with a diameter of 5 cm with fat density areas. Linear increased densities around the lesion suggest inflammatory changes (arrowhead). **B,C)** Two months after the initial CT, the inflammation has disappeared and the fat density lesion in the mesenteric root is clearly seen.

Gastrointestinal Stromal Tumor Perforation

Gastrointestinal stromal tumors (GISTs) are the most common mesenchymal tumors of the gastrointestinal tract, particularly of the stomach and small intestine, but also of the mesentery (26,27). Due to exophytic growth patterns and nonspecific clinical symptoms, delayed diagnosis is common. Tumors larger than 5 cm have higher risk of malignancy (28). Small bowel GISTs have peripheral enhancement and central areas of low attenuation on CT imaging (29) (Figure 12). The presence of ascites with a heterogeneous tumor is a suggestive feature of a ruptured GIST (30).

Acute Splenic Venous Infarction

A splenic infarct is a rare condition even among patients with predisposing comorbidities (31). Sickle cell disease (32), coagulapathies, such as antiphospholipid syndrome (33), infections, etc. are well known causes for splenic infarction (34). Infarction due to embolic occlusion is mostly seen in the elderly. Venous thrombosis as a reason of infarction is not commonly encountered in daily radiology practice. Deep vein thrombosis of the legs is generally expected postsurgically, which is why patients are mobilized as soon as possible. What is unexpected, however, is splenic vein thrombosis (Figure 13), for which the best non-invasive diagnostic tool is contrast-enhanced CT examination.

Figure 12: GIST perforation. This axial contrast-enhanced CT image of a 61-year-old man shows a big, solid, pelvic mass located in the midline and displacing intestinal segments. The lesion has low density necrotic parts in the center and peripheral contrast enhancement. The invasion of the mesenteric fatty tissue and the small bowel wall was proved by pathologic evaluation. The irregularity in the left contour indicates the perforation site (arrowhead).

Figure 13: Acute splenic venous infarction. An axial contrast-enhanced abdominal CT image of a 60-year-old male patient who had a left inguinal hernia repair 6 days before reveals a hypodense thrombus in the distal part of the splenic vein (arrow) and a wedge-shaped hypodense area of 5 cm in diameter (arrowheads) suggesting venous infarct.

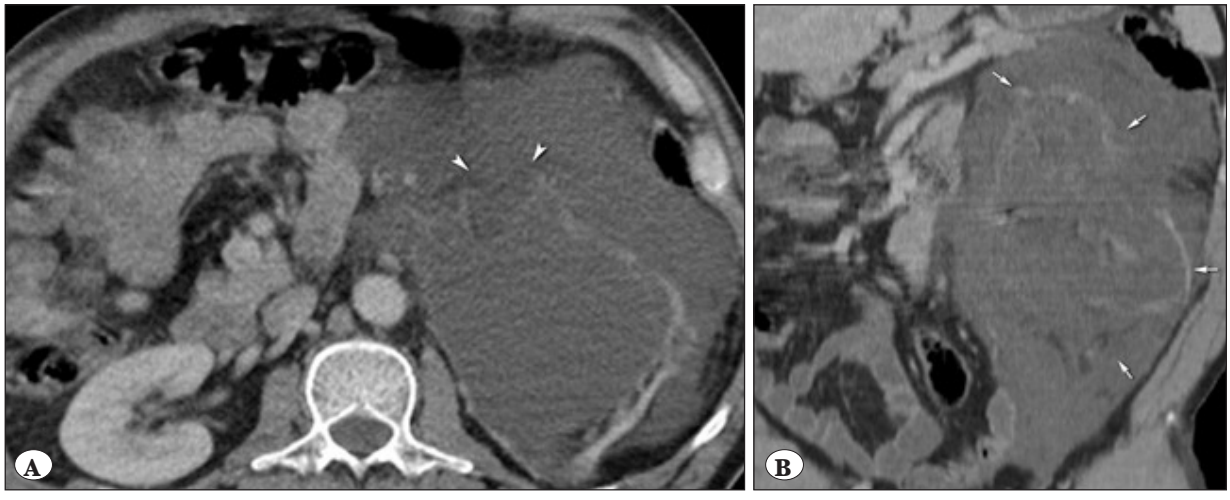

Figure 14: Urinoma rupture. A 50-year-old man fell down when crossing the street and his severe abdominal pain began. **A)** This axial contrast-enhanced CT image shows significant parenchymal thinning and hydronephrosis in the left kidney. Note discontinuity of the parenchyma in the anterior aspect of the kidney (arrowheads). **B)** The coronal image demonstrates the retroperitoneal extension of the urinoma. Arrows point the borders of the kidney.

A wedge-shaped unenhanced focal area is often seen in contrast-enhanced abdominal CT (35).

Extensive Urinoma Following Simple Trauma

Urogenital system injuries constitute 10% of abdominal trauma (36). Blunt or penetrating trauma may cause a range of pathologies from a small renal injury to vascular pedicle avulsion. Collecting system disruptions may induce urinoma formation. Most urinomas leak into the perirenal space (Figure 14A,B), but extensive urine leakage may extend along the retroperitoneal space, or even intraperitoneally (37). CT is the basic imaging method to assess the extent of the urogenital system injury and the location of the urinoma (38).

Figure 15: Gossypiboma. This axial contrast-enhanced abdominal CT image of a 34-year-old male patient who had a prior cholecystectomy shows a well-defined soft tissue mass (arrow) adjacent to the second part of the duodenum that causes narrowing (arrowheads). Hyperdense thin tubular parts are distinguishing radioopaque markers.

Foreign Bodies

Acute abdomen may be caused by foreign bodies that were ingested, intentionally or not, such as a fishbone, needle, or hair. Another cause is retained surgical materials, for example, a retained surgical sponge, which can cause a granulomatous reaction, abscess formation, intestinal obstruction, or fistulization (39). Non-absorbable sponges contain radioopaque markers identifiable on radiographs and scout CT images. Retained materials manifest as well-defined soft tissue masses containing hypodense gas bubbles centrally (Figure 15) (40). An intraluminal stent such as placed in esophageal strictures, especially self-expanding metallic esophagus stents, may migrate (41). When caught in a narrow site, metallic materials may cause obstruction and also cause dilatation in the proximal gastrointestinal tract (Figure 16A-C). Bariatric surgery is a widely accepted treatment of obesity, but a complication of restrictive procedures is used metallic clamps, which can become a source of GI tract obstruction (Figure 17A-C) (42).

Acute Attack in Familial Mediterranean Fever

Familial Mediterranean fever (FMF) is an autosomal recessive disorder characterized by attacks of fever and sterile, self-limiting serositis. As can be inferred from its name, FMF is common among people living in the Mediterranean and Middle East; however, due to population movement, incidences of FMF have increased in Europe and the United States. The diagnosis is made according to some clinical criteria, but DNA analysis is also possible (43). The abdominal attacks of FMF have an acute onset, but resolve in a few days. During an acute abdominal attack, CT images can highlight engorged mesenteric vessels, thickened peritoneal folds, varying degrees of

Figure 16: Foreign body in gastrointestinal system. A 71-year-old woman applied to E.R. with abdominal pain, nausea, and vomiting. She had a history of esophagectomy and gastric tube reconstruction due to cancer. She also had a 20-cm long esophageal stent placement because of stenosis after reconstruction. This non-contrast CT scan **(A,B)** shows distension of the proximal jejunal segments (arrows) and the metallic stent material in the lumen of the distal jejunum (arrowheads). **(C)** On the coronal thick maximum intensity projection image the stent material is better demonstrated. The stent came out from the anus approximately in 10 hours.

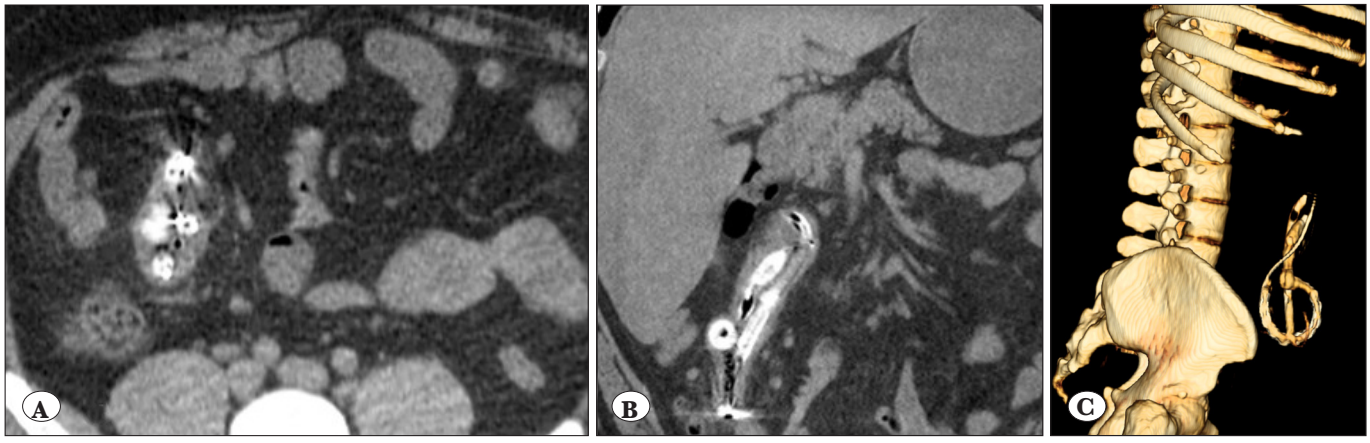

Figure 17: Foreign body in gastrointestinal system. On axial (**A**) and coronal (**B**) CT images of an obese patient, a gastric balloon that had migrated to the region of terminal ileum is seen. (**C**) The gastric balloon appeared like a G-clef in the volume rendered CT image.

ascites, mesenteric lymphadenopathies, and small bowel obstruction (Figure 18) (44-45).

CONCLUSION

With its wide range of possible causes, acute abdominal pain is a challenging pathology for both clinicians and radiologists. Besides the well-known etiologies, keeping unusual causes in mind might facilitate the correct diagnosis of difficult cases.

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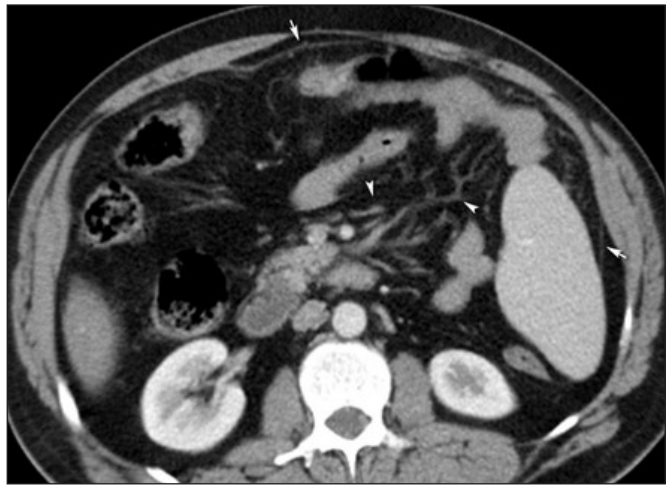

Figure 18: Acute FMF attack. This axial contrast-enhanced CT scan of a 40-year-old male patient with FMF demonstrates significant mesenteric vessels (arrowheads), peritoneal thickening (arrow), and mesenteric lymph nodes at the time of acute attack.

REFERENCES

1. Aguirre DA, Casola G, Sirlin C. Abdominal wall hernias: MDCT findings. Am J Roentgenol 2004;183:681–90.
2. Aguirre DA, Santosa AC, Casola G, Sirlin CB. Abdominal wall hernias: Imaging features, complications, and diagnostic pitfalls at multi–detector row CT. Radiographics 2005;25:1501–20.
3. Ianora AA, Midiri M, Vinci R, Rotondo A, Angelelli G. Abdominal wall hernias: Imaging with spiral CT. Eur Radiol 2000;10:914–9.
4. Constantine S. Computed tomography appearances of Amyand hernia. J Comput Assist Tomogr 2009;33:359–62.
5. Lassandro F, Iasiello F, Pizza NL, Valente T, Stefano ML, Grassi R, Muto R. Abdominal hernias: radiological features. World J Gastrointest Endosc 2011;3:110–7.
6. Mathieu D, Luciani A; GERMAD Group. Internal abdominal herniations. Am J Roentgenol 2004;183:397–404.
7. Martin LC, Merkle EM, Thompson WM. Review of internal hernias: Radiographic and clinical findings. Am J Roentgenol 2006;186:703–17.
8. Emanuwa OF, Ayantunde AA, Davies TW. Midgut malrotation first presenting as acute bowel obstruction in adulthood: A case report and literature review. World J Emerg Surg 2011;6:22.

9. Sodhi KS, Bhatia A, Saxena AK, Rao KL, Menon P, Khandelwal N. Anticlockwise swirl of mesenteric vessels: A normal CT appearance, retrospective analysis of 200 pediatric patients. Eur J Radiol 2014;83:710–4.
10. Peterson CM, Anderson JS, Hara AK, Carenza JW, Menias CO. Volvulus of the gastrointestinal tract: Appearances at multimodality imaging. Radiographics 2009;29:1281–93.
11. Carucci LR, Turner MA. Radiologic evaluation following Roux-en-Y gastric bypass surgery for morbid obesity. Eur J Radiol 2005;53:353–65.
12. Saleni MH, Coffman SE, Postlethwait RW. Retrograde intussusception at the gastrojejunal stoma. Ann Surg 1959;150:864–71.
13. Zenooz NA, Holz SP, Robbin MR. Jejunogastric intussusception: A case report with the review of literature. Emerg Radiol 2007;13:265–7.
14. Rossi P, Gourtsoyiannis N, Bezzi M, Raptopoulos V, Massa R, Capanna G, Pedicini V, Coe M. Meckel's diverticulum: imaging diagnosis. Am J Roentgenol 1996;166:567–73.
15. Elsayes KM, Menias CO, Harvin HJ, Francis IR. Imaging manifestations of Meckel's diverticulum. Am J Roentgenol 2007;189:81–8.
16. Satya R, O'Malley JP. Case 86: Meckel diverticulum with massive bleeding. Radiology 2005;236: 836–40.
17. Levy AD, Hobbs CM. From the archives of the AFIP. Meckel diverticulum: radiologic features with pathologic correlation. Radiographics 2004;24:565–87.
18. Tannoury JN, Abboud BN. Idiopathic sclerosing encapsulating peritonitis: Abdominal cocoon. World J Gastroenterol 2012;18:1999–2004.
19. Serter A, Kocakoc E, Cipe G. Supposed to be rare cause of intestinal obstruction; Abdominal cocoon: Report of two cases. Clin Imaging 2013;37:586–9.
20. Choi JH, Kim JH, Kim JJ. Large bowel obstruction caused by sclerosing peritonitis: Contrast-enhanced CT findings. Br J Radiol 2004;77:344–6.
21. Kirtland HB Jr. Dermoid cyst of the omentum, with report of a case. Calif Med 1951;75:44–5.
22. Yoshida A, Murabayashi N, Shiozaki T. Case of mature cystic teratoma of the greater omentum misdiagnosed as ovarian cyst. J Obstet Gynaecol Res 2005;31:399–403.
23. Ratan SK, Ratan J, Kalra R. Large benign cystic teratoma of the mesosigmoid causing intestinal obstruction: Report of a case. Surg Today 2002;32:922–4.
24. Verswijvel G, Janssens F, Vanboven H, Palmers Y. Spontaneous rupture of mesenteric dermoid cyst: A rare cause of abdominal pain. Eur Radiol 2004;14:1517–8.
25. Dufay C, Abdelli A, Le Pennec V. Mesenteric tumors: Diagnosis and treatment. J Visc Surg 2012;149: e239–51.
26. Chourmouzi D, Sinakos E, Papalavrentios L. Gastrointestinal stromal tumors: A pictorial review. J Gastrointestin Liver Dis 2009;18:379–83.
27. Kochhar R, Manoharan P, Leahy M. Imaging in gastrointestinal stromal tumours: Current status and future directions. Clin Radiol 2010;65:584–92.
28. Choi YR, Kim SH, Kim SA, Shin CI, Kim HJ, Kim SH, Han JK, Choi BI. Differentiation of large (≥ 5cm) gastrointestinal stromal tumors from benign subepitelial tumors in the stomach: Radiologists' performance using CT. Eur J Radiol 2014;83:250–60.
29. O'Sullivan PJ, Harris AC, Ho SG, Munk PL. The imaging features of gastrointestinal stromal tumours. Eur J Radiol 2006;60:431–8.
30. Cegarra-Navarro MF, Corral de la Calle MA, Girela-Baena E. Ruptured gastrointestinal stromal tumors: radiologic findings in six cases. Abdom Imaging 2005;30:535–42.
31. Antopolsky M, Hiller N, Salameh S. Splenic infarction: 10 years of experience. Am J Emerg Med 2009; 27: 262–5.
32. Abeysekera WYM, de Silva WD, Pinnaduwa SS, Banagala AS. Acute massive splenic infarction with splenic vein thrombosis following altitude exposure of a Sri Lankan male with undetected sickle cell trait. High Alt Med Biol 2012;13:288–90.
33. Wunnava RV, Hunt TM. An unusual cause of acute abdominal pain- a case presentation. BMC Blood Disord 2006;6:1.
34. Beeson MS. Splenic infarct presenting as acute abdominal pain in an older patient. J Emerg Med 1996; 14: 319–22.
35. Urban BA, Fishma EK. Helical CT of the spleen. Am J Roentgenol 1998;170:997–1003.
36. Bent C, Iyngkaran T, Power N, Matson M, Hajdinjak T, Buchholz N, Fotheringham T. Urological injuries following trauma. Clin Radiol 2008;63:1361–71.
37. Titton RL, Gervais DA, Hahn PF, Harisinghani MG, Arellano RS, Mueller PR. Urine leaks and urinomas: diagnosis and imaging-guided intervention. Radiographics 2003;23:1133–47.
38. Goldman SM, Sandler CM. Urogenital trauma: Imaging upper GU trauma. Eur J Radiol 2004;50: 84–95.
39. O'Connor AR, Coakley FV, Meng MV, Eberhardt SC. Imaging of retained surgical sponges in the abdomen and pelvis. Am J Roentgenol 2003;180:481–9.
40. Gayer G, Petrovitch I, Jeffrey RB. Foreign objects encountered in the abdominal cavity at CT. Radiographics 2011;31:409–28.
41. da Costa Martins B, Medrado BF, de Lima MS, Retes FA, Kawaguti FS, Pennacchi CM, Maluf-Filho F. Esophageal metallic stent fixation with dental floss: A simple method to prevent migration. Endoscopy 2013;45(S 02):E342.

42. Chandler RC, Srinivas G, Chintapalli KN, Schwesinger WH, Prasad SR. Imaging in bariatric surgery: A guide to postsurgical anatomy and common complications. Am J Roentgenol 2008;190:122-35.
43. Berkun Y, Eisenstein EM. Diagnostic criteria of familial Mediterranean fever. Autoimmun Rev 2014;13:388-90.
44. Zissin R, Rathaus V, Gayer G, Shapiro-Feinberg M, Hertz M. CT findings in patients with familial Mediterranean fever during an acute abdominal attack. Br J Radiol 2003;76:22-5.
45. Aharoni D, Hiller N, Hadas-Halpern I. Familial Mediterranean fever: Abdominal imaging findings in 139 patients and review of the literature. Abdom Imaging 2000; 25:297-300.