Acute abdominal pain: Unexpected intraoperative findings following inconclusive CT studies

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Authors: S. Solanas Alava, J. M. Mellado, R. Larrosa López, N. Yanguas Barea, J. Martín Cuartero, I. Tolosa Arrieta; Tudela/ES
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Purpose

To review, illustrate and discuss selected clinical cases of acute abdominal pain with inconclusive CT studies and unexpected intraoperative or postoperative diagnosis.
Methods and Materials

We retrospectively reviewed and correlated clinical charts and MDCT findings of selected patients suffering acute abdominal pain who required emergent surgery before a precise diagnosis could be achieved.

All imaging studies but one were performed using state-of-the-art multidetector CT equipment (Aquilion 64, Toshiba Medical Systems). In all patients, 120 cc of iodinated contrast material (Ultrajet Optiray 320, Mallinckrodt) was intravenously administered using a power injector (OptiVantage DH, Mallinckrodt) at a rate of 3 cc/sec. In selected patients, endorectal administration of meglumine diatrizoate (Gastrografin®) was also performed.
Results

Multiple technical, clinical and radiological issues may lead to inconclusive or indeterminate findings on abdominal MDCT. Suboptimal patient preparation and imaging protocol may originate non-diagnostic images. Failure to correctly use tridimensional displays may difficult identification of key findings. Unusual diseases, or atypical presentations of common pathologies, are occasionally hard to characterize. Finally, lack of clinical suspicion or deficient familiarity with specific entities will typically cause underestimation of pathologic findings. In many of these cases, an unexpected diagnosis is reached in the operating room, or at histopathological evaluation.

Selected pathologic conditions were classified as inflammatory (Fig. 1-4), infectious (Fig. 5-8), neoplastic (Fig. 9-12), occlusive (Fig. 13-16), vascular (Fig. 17-20) and miscellaneous (Fig. 21-23)

IMAGING FINDINGS:

JEJUNAL DIVERTICULITIS (Fig. 1 on page 7, 2 on page 7):

Jejunal diverticulosis is characterized by herniation of mucosa through sites of weakening on the mesenteric side, resulting in the development of outpouchings from the small bowel loop. Inflammation and infection of jejunal diverticulosis may occur, leading to inflammatory mesenteric reaction, diverticular perforation, perforation or small bowel obstruction. Acute diverticulitis is an uncommon type of acute abdomen, usually presenting with non-specific symptoms, or mimicking other acute inflammatory disorders.

CROHN’S DISEASE (Fig. 3 on page 8, 4 on page 9):

As with ulcerative colitis, Crohn's disease can affect various parts of the digestive system, including the descending colon. Acute perforation of the colon is an unusual complication of Crohn's disease. Lesions or sores on the mucosa characterize Crohn's disease, although left-sided colitis is believed to be more common in ulcerative colitis.

GASTRIC PERFORATION BY A FISHBONE CAUSING A LIVER ABSCESS (Fig. 5 on page 10, 6 on page 11):

Perforation of the gastrointestinal tract by ingested foreign bodies is rare; the diagnosis of pyogenic liver abscess resulting from such perforations is usually made at post-mortem. In this patient, surgery was followed by uneventful recovery.
ABDOMINAL ACTINOMYCOSIS (Fig. 7 on page 12, 8 on page 13):

Actinomycosis is an infectious bacterial disease caused by Actinomyces species such as Actinomyces israelii or A. gerencseriae. The condition is likely to be polymicrobial. Preoperative diagnosis of abdominal actinomycosis is uncommon, particularly if no risk factors, such as penetrating injury or long-standing IUD, are present.

SMALL BOWEL AND MESENTERIC METASTASIS OF BRONCHOPULMONARY CANCER (Fig. 9 on page 14, 10 on page 15):

Metastases of primary pulmonary carcinoma to small bowel occur late in the course of the disease, are more common than thought and may be associated with serious clinical complications. When symptomatic, patients usually present with a small bowel perforation, obstruction or haemorrhage.

COLLISION TUMOR OF THE ILEUM: ADENOCARCINOMA AND NEUROENDOCRINE TUMOR (Fig. 11 on page 16, 12 on page 17):

Collision tumors including a combination of adenocarcinoma and carcinoid tumors are very rare tumors. Very few similar cases are described in the small bowel, whereas others are described in the ampullary and/or common bile duct region, where adenocarcinomas are more frequent. Collision tumors can also be also depicted in other areas including the stomach.

SMALL BOWELL OBSTRUCTION SECONDARY TO INTERNAL HERNIA (Fig. 13 on page 18, 14 on page 19):

Preoperative diagnosis on internal hernia remains problematic. CT signs common to all types of internal herniations includes evidence of small-bowel obstruction; clustering of small bowel; stretched, displaced, crowded, and engorged mesenteric vessels; and displacement of other bowel segments.

ACUTE SMALL BOWEL OBSTRUCTION SECONDARY TO ILEAL ENDOMETRIOSIS (Fig. 15 on page 20, 16 on page 21):

The preoperative diagnosis of small bowel endometriosis is very difficult due to the vagueness of symptoms and similarity in presentation to other causes of obstruction. However, endometriosis should be considered in the differential diagnosis of women of child-bearing age who present with symptoms of obstruction.

MESENTERIC ISCHEMIA WITHOUT TRANSMURAL INFARCTION (Fig. 17 on page 22, 18 on page 23):
Bowel ischemia severity ranges from mild (generally transient superficial changes of intestinal mucosa) to more dangerous and potentially life-threatening transmural bowel wall necrosis. In patients with acute mesenteric vein thrombosis. In a recent study, the most valuable MDCT findings for characterizing transmural infarction or necrosis were (1) bowel segments with homogeneous enhancement, (2) decreased enhancement, and (3) indistinct outer margins.

LEFT FEMORAL HERNIATION AND ACUTE SMALL BOWEL VOLVULUS (Fig. 19 on page 24, 20 on page 25):

Acute torsion of the small bowel mesentery is a diagnostically challenging cause of acute abdominal pain, and represents a rare but life-threatening surgical emergency. At CT, an acute small bowel volvulus may present with the spoke wheel sign (formed by dilated bowel loops that are radially arranged around converging, thickened and stretched mesenteric vessels).

PERFORATION OF THE CECUM BY A TOOTHPICK MIMICKING APPENDICITIS (Fig. 21 on page 26, 22 on page 27):

Perforation of the colon is most commonly caused by carcinoma or diverticulitis. Inflammatory colitis may also result in colonic perforation. Other possibilities are iatrogenic perforation, traumatic perforation, and ingestion of a foreign body. The case of perforation of the caecum by a toothpick has been rarely reported, but may clinically resemble acute appendicitis.

INTRAHEPATIC HEMATOMA AND BILIOMA (Fig. 23 on page 28):

In this case intraoperative observations revealed intrahepatic hematoma and bilioma associated with liver laceration. Injury was thought to derive from postoperative blunt abdominal trauma (after the patient suffered a casual fall from bed).
Fig. 0: Coronal reformatted contrast-enhanced MDCT scan (a) and coronal MIP (b) show a dilated jejunal loop with increased mucosal enhancement and local mesenteric edema. The key finding, an inflamed jejunal diverticulum (arrow in a) was overlooked.

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**Fig. 0:** Intraoperatively, diverticulitis of a proximal jejunal loop was identified and resected.

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Fig. 0: Coronal reformatted contrast-enhanced MDCT scan (a) and coronal MIP (b) show mural thickening of the descending colon, with increased mucosal enhancement and dilatation of vasa recta. Distal ileitis was ruled out. Weeks later, the patient presented acute abdominal pain and radiologic evidence of pneumoperitoneum

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Fig. 0: Intraoperatively, a small perforation of the descending colon was found to be the cause of fecal peritonitis. Histological evaluation of the resected colon revealed Crohn's disease.

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**Fig. 0:** Axial contrast-enhanced CT image (a) shows a septated fluid collection within the left liver lobe, which was correctly characterized as a liver abscess. On spite of proper percutaneous treatment, the patient failed to improve. Follow-up CT scan was performed (b), although the causative agent, a small foreign-body (circle), remained undetected.

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**Fig. 0:** Intraoperatively, a posterior perforation of the stomach was found. A large fishbone (a, b) was found to have caused both the gastric perforation and the liver abscess

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Fig. 0: Axial contrast-enhanced (a) and coronal-reformatted (b) MDCT images show a solitary omental mass with heterogeneous attenuation and cystic components, deep to the rectus abdominis muscle. A diagnosis of infected omental infarction was suggested.

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Fig. 0: Intraoperatively, an inflammatory process of the omentum and transverse colon was found. Culture of the resected specimen led to a final diagnosis of abdominal actinomycosis.

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Fig. 0: Axial contrast-enhanced MDCT scan (a) shows segmental thickening of the jejunal wall, and contiguous mesenteric lymphadenopathies. Coronal-reformatted MDCT image (b) shows pathologic lymph nodes at the right hilum and mediastinum. A number of potential diagnosis was considered, including various infectious and neoplastic diseases. Shortly after, an episode of acute abdominal pain prompted exploratory laparotomy.

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Fig. 0: Intraoperatively, neoplastic infiltration of a jejunal loop and mesenterium was found. Histopathological evaluation of the resected specimen revealed small bowel and mesenteric metastasis of a primary undifferentiated bronchogenic tumor.

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**Fig. 0:** Axial contrast-enhanced entero-CT (a) shows mural thickening of an ileal loop. The corresponding coronal-reformatted MDCT image (b) shows a retained enteroscopy capsule proximal to the pathological loop.

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Fig. 0: Intraoperatively, neoplastic infiltration of an ileal loop was found and a segmental resection was performed. Histopathological evaluation of the resected specimen revealed a rare association of two different contiguous tumors: a rare ileal adenocarcinoma and a small neuroendocrine tumor.

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Fig. 0: Axial contrast-enhanced CT scan (a, b) shows signs of small bowel obstruction of a jejunal loop, which presents abnormal proximal dilatation and abrupt change in caliber. With the presumptive diagnosis of small bowel obstruction secondary to small bowel adhesions, a laparoscopic procedure was performed.

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**Fig. 0:** Intraoperatively, a superior paravesical small-bowel herniation was found. The herniation was reduced, and the mesenteric foramen was repaired.

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Fig. 0: Axial contrast-enhanced (a) and coronal-reformatted (b) MDCT images in a 26-year-old woman with no prior history of abdominal surgery. The images reveal signs of small bowel obstruction of uncertain etiology.

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Fig. 0: Intraoperatively, multiple endometriotic implants were found in the pelvic peritoneum, causing adhesions which required segmental resection of an ileal loop. Histopathological evaluation of the resected specimen confirmed surgical observations.

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**Fig. 0:** Coronal-reformatted contrast-enhanced MDCT image (a) shows mural thickening of small bowel loops, along with mildly hyperemic mucosa. Coronal MIP (b) reveals superior mesenteric vein thrombosis. There is mild mesenteric edema but no portal neumatosis.

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Fig. 0: An exploratory laparotomy was performed, which ruled out transmural necrosis of the pathologic bowel loops. The patient recovered uneventfully, and was discharged on anticoagulation therapy. Months later, the follow-up MDCT study reveals superior mesenteric vein obstruction and collateral circulation through the marginal arcade.

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Fig. 0: Coronal-reformatted contrast-enhanced MDCT image (a) shows a strangulated left femoral herniation. The corresponding coronal MIP projection (b) shows abnormal displacement of mesenteric vasculature, which was preoperatively overlooked.

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**Fig. 0:** Intraoperatively, a left femoral hernia was reduced and repaired. Unexpectedly, an acute torsion of the small bowel mesentery was also found, with early signs of transient bowel ischemia which rapidly resolved.

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Fig. 0: Axial contrast-enhanced (a) and coronal reformatted (b) MDCT images show dilatation and eccentric mural thickening of the caecum. A tynx extraluminal gas bubble (arrowhead in a) and a foreign body perforating the cecal wall (arrows in b) were preoperatively overlooked.

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**Fig. 0:** Intraoperatively, a perforation of the caecum by an impacted toothpick was found. Toothpicks are commonly used in Spanish tapas, and remain the mainstay of the "pay by toothpick" modality.

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Fig. 0: Acute abdominal pain following complete gastrectomy. Axial (a) and coronal reformatted (b) MDCT images show an hepatic fluid collection with internal neumatosis, suggesting a liver abscess.

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Conclusion

- Although MDCT is rapidly becoming the gold standard for diagnostic imaging of acute abdominal pain, a preoperative accurate diagnosis is not possible in all cases.
- Routine correlation of imaging findings and intraoperative observations remains instrumental for improving the diagnostic accuracy of MDCT findings in the acute abdomen.
References