

in the central nervous system is the result of a combination of disruption of the blood-brain barrier, high vascularity, and contrast leakage into the lymphatic system⁽³⁻⁶⁾. After one week, infarcts show parenchymal enhancement, due to breakdown of the blood-brain barrier⁽⁷⁾.

New imaging techniques, such as DWI and perfusion-weighted imaging, have increased the accuracy of the diagnosis of acute cerebral ischemia, although there are some cases in which it cannot be distinguished from other entities^(8,9). In addition, because of pseudonormalization, subacute infarcts may not show restricted diffusion on DWI.

FLAIR is highly sensitive for the detection of ischemic lesions. Although it is considered to be heavily T2-weighted, rendering cerebrospinal fluid as dark, it also shows mild contrast enhancement on T1WI, which is responsible for the increased conspicuity of gadolinium enhancement. Pathologic conditions that present contrast enhancement on T1WI usually show marked enhancement on contrast-enhanced FLAIR⁽¹⁰⁾. This is exactly what occurred in the case presented here, in which DWI pseudonormalization did not help reveal the subacute cortical infarct. When a subacute cortical infarct is suspected, delayed contrast-enhanced FLAIR imaging is the best choice for demonstrating the lesion and for differentiating it from an older lesion with gliosis.

REFERENCES

1. Yuh WT, Crain MR, Loes DJ, et al. MR imaging of cerebral ischemia: findings in the first 24 hours. *AJNR Am J Neuroradiol.* 1991;12:621-9.
2. Weinmann HJ, Brasch RC, Press WR, et al. Characteristics of gadolinium-DTPA complex: a potential NMR contrast agent. *AJR Am J Roentgenol.* 1984;142:619-24.
3. Bozzao A, Floris R, Fasoli F, et al. Cerebrospinal fluid changes after intravenous injection of gadolinium chelate: assessment by FLAIR MR imaging. *Eur Radiol.* 2003;13:592-7.
4. Fukuoka H, Hirai T, Okuda T, et al. Comparison of the added value of contrast-enhanced 3D fluid-attenuated inversion recovery and magnetization-prepared rapid acquisition of gradient echo sequences in relation to conventional postcontrast T1-weighted images for the evaluation of leptomeningeal diseases at 3T. *AJNR Am J Neuroradiol.* 2010;31:868-73.
5. Sage MR, Wilson AJ, Scroop R. Contrast media and the brain. The basis of CT and MR imaging enhancement. *Neuroimaging Clin N Am.* 1998;8:695-707.
6. Smirniotopoulos JG, Murphy FM, Rushing EJ, et al. Patterns of contrast enhancement in the brain and meninges. *Radiographics.* 2007;27:525-51.
7. Karonen JO, Partanen PL, Vanninen RL, et al. Evolution of MR contrast enhancement patterns during the first week after acute ischemic stroke. *AJNR Am J Neuroradiol.* 2001;22:103-11.
8. Beaulieu C, de Crespigny A, Tong DC, et al. Longitudinal magnetic resonance imaging study of perfusion and diffusion in stroke: evolution of lesion volume and correlation with clinical outcome. *Ann Neurol.* 1999;46:568-78.
9. Sorensen AG, Copen WA, Ostergaard L, et al. Hyperacute stroke: simultaneous measurement of relative cerebral blood volume, relative cerebral blood flow, and mean tissue transit time. *Radiology.* 1999;210:519-27.
10. Lee EK, Lee EJ, Kim S, et al. Importance of contrast-enhanced fluid-attenuated inversion recovery magnetic resonance imaging in various intracranial pathologic conditions. *Korean J Radiol.* 2016;17:127-41.

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Transmural migration of a gossypiboma: a rare cause of intestinal obstruction

Dear Editor,

An 83-year-old man presented to the emergency department with an approximately one-month history of diffuse abdominal pain, nausea, bilious vomiting, and abdominal distension, the symptoms worsening in the last three days. He reported having lost 6 kg since the onset of symptoms. Six months prior, he had undergone cholecystectomy at another facility. On physical examination, the abdomen was slightly rounded, with increased bowel sounds, and was painful to superficial palpation in the mesogastrium. No organomegaly or palpable masses were observed. Upper gastrointestinal endoscopy showed gastric antral vascular ectasia, with a large amount of undigested food. The pylorus was lateralized, retracted, and stenotic, which precluded the passage of the endoscope into the duodenal bulb. An abdominal X-ray (Figure 1A) showed marked dilation of the gastric antrum, with an air-fluid level and serpiginous radiopaque areas in the duodenal region, characteristic of a foreign body (gossypiboma). An abdominal CT scan with intravenous contrast administration (Figures 1B and 1C) confirmed the X-ray findings and better characterized the intraluminal mass in the first portion of the duodenum, showing metallic wires within the mass and confirming upper gastrointestinal obstruction, as well as enhancement of the duodenal and gastric walls, probably due to an inflammatory reaction. There were no signs of pneumoperitoneum or cavitory fluid collections/abscesses. The patient underwent laparotomy, with laparoscopic suture closure of the duodenum and jejunostomy for feeding access. The presence of a foreign body

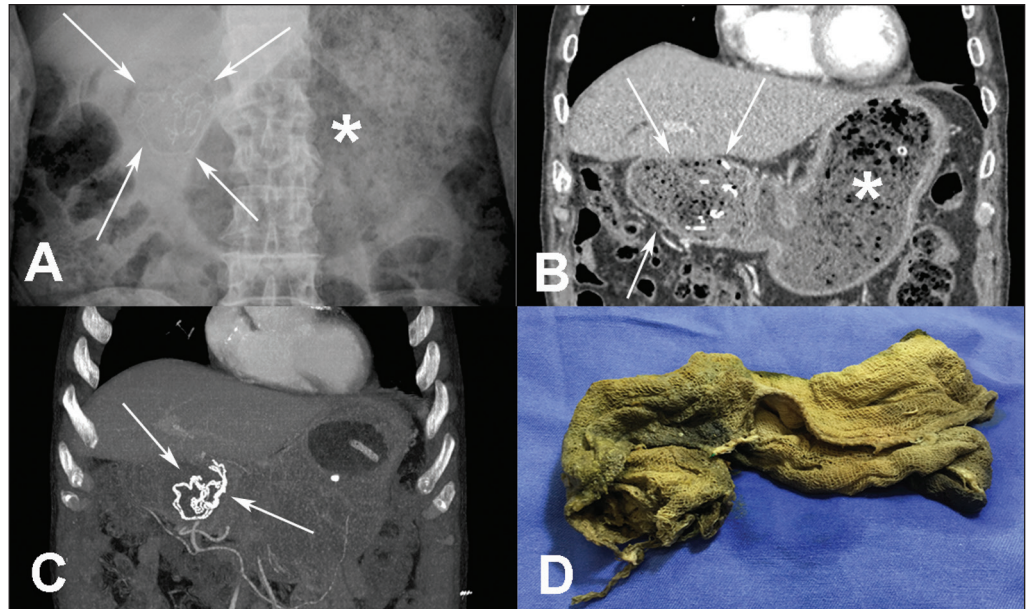
(gossypiboma) was confirmed intraoperatively (Figure 1D). The gossypiboma, which was located in the first portion of the duodenum, resulted in gastric outlet obstruction and gastric dilatation.

Acute abdominal conditions have been the subject of various recent studies in the radiology literature of Brazil⁽¹⁻⁴⁾. Gossypibomas have been identified in 0.02-0.1% of patients undergoing abdominal surgery⁽⁵⁾. Transmural migration of a gossypiboma is extremely rare. When it does occur, it is typically in the bowel, bladder, or chest. Spontaneous expulsion of a gossypiboma has been reported in only a few cases, the mean time from surgery to diagnosis being 2.2 years^(5,6).

Two types of reactions to foreign bodies have been described in the literature: fibroblastic and exudative. An aseptic fibrous response results in adhesion, encapsulation, and granuloma, usually remaining asymptomatic or causing chronic progressive symptoms over months to years. An exudative reaction causes the formation of a cyst or abscess that can establish fistulas to adjacent organs, the symptoms being more severe in such cases^(5,7). The increase in intra-abdominal pressure caused by a gossypiboma can result in partial or total necrosis of the intestinal wall^(6,7). The risk factors associated with the increase in the incidence of gossypiboma include emergency surgical procedures, prolonged surgical procedures, unplanned changes in the course of a procedure, the involvement of more than one surgical team, and a higher patient body mass index⁽⁷⁾.

The imaging findings preceding transmural migration of a gossypiboma are variable, depending on the nature of the sponge, its radiopaque marker, the length of time the foreign body has been present, and the type of reaction to it. A CT scan can reveal a poorly defined, heterogeneous mass, containing metallic wires

Figure 1. A: Conventional X-ray of the abdomen (with the patient in supine position) showing marked gastric distention (asterisk) and material containing hyperdense serpiginous lines in the region of the first portion of the duodenum (arrows). **B,C:** Contrast-enhanced coronal CT scan of the abdomen (**B**), with maximum intensity projection (**C**), confirming the X-ray findings and better characterizing the intraluminal mass in the duodenum (arrows) as heterogeneous, containing gas and dense linear structures, as well as showing thickening of the gastric wall and duodenal bulb. **D:** Surgical specimen showing a compress (gossypiboma) impregnated with biliary content (greenish-yellow coloring).



and air, with a spongiform appearance. On contrast-enhanced CT scans, there can be edge enhancement, which is likely attributable to inflammation of the wall adjacent to the mass. A high-density capsule with a low density core is found in the majority of cases, making it difficult to distinguish between abscesses and hematomas. Calcification is a rare finding and is more common in long-standing cases⁽⁵⁾.

REFERENCES

1. Miranda CLVM, Sousa CSM, Cordão NGNP, et al. Intestinal perforation: an unusual complication of barium enema. *Radiol Bras.* 2017;50:339–40.
2. Pessôa FMC, Bittencourt LK, Melo ASA. Ogilvie syndrome after use of vincristine: tomographic findings. *Radiol Bras.* 2017;50:273–4.
3. Niemeyer B, Correia RS, Salata TM, et al. Subcapsular splenic hematoma and spontaneous hemoperitoneum in a cocaine user. *Radiol Bras.* 2017;50:136–7.
4. Naves AA, D'Ippolito G, Souza LRMF, et al. What radiologists should know about tomographic evaluation of acute diverticulitis of the colon. *Radiol Bras.* 2017;50:126–31.
5. Williams M. Transduodenal migration of a retained surgical swab causing

- small bowel obstruction—imaging findings in the acute setting and prior to onset of symptoms. *J Radiol Case Rep.* 2015;9:43–8.
6. Lal A, Gupta P, Sinha SK. An unusual cause of intestinal obstruction in a young female. Transmural migration of gossypiboma with small bowel obstruction. *Gastroenterology.* 2015;149:e7–8.
7. Rafie BA, AbuHamdan OJ, Trengganu NS. Intraluminal migration of retained surgical sponge as a cause of intestinal obstruction. *J Surg Case Rep.* 2013;(5).

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The main radiologic findings in annular pancreas

Dear Editor,

A female infant was born at term without complications. At 12 days of life, she presented to a pediatric emergency department for investigation of frequent postprandial vomiting, weight loss, and irritability. According to the mother, she was eliminating urine and feces. Physical examination revealed abdominal distention. The laboratory findings were consistent with iron-deficiency anemia. An X-ray of the abdomen showed gaseous distention of the stomach and proximal duodenum, without gas in the distal portion, characterizing the typical double-bubble sign (Figure 1A). The findings were suggestive of duodenal obstruction. Abdominal ultrasound confirmed the X-ray findings, revealing distention of the stomach and duodenum. In addition, the ultrasound showed tissue surrounding the duodenum, suggesting a diagnosis of annular pancreas as the cause of the duodenal obstruction (Figures 1B and 1C). The patient underwent exploratory laparotomy, during which the diagnosis of duodenal

obstruction caused by an annular pancreas was confirmed (Figure 1D). A diamond-shaped duodenoduodenostomy was performed, and the postoperative evolution was favorable. Acute abdominal conditions are the subject of a number of recent studies in the radiology literature^(1–4). Congenital duodenal obstruction is relatively common during the neonatal period. It can be categorized as complete or partial and as intrinsic or extrinsic. Extrinsic duodenal obstruction has many causes, including annular pancreas, malrotation, and anterior portal vein⁽⁵⁾.

Annular pancreas is a rare congenital malformation, characterized by the development of a band of pancreatic tissue that completely or partially surrounds the second duodenal portion, resulting in varying degrees of obstruction⁽⁶⁾. Its embryological origin begins between the fifth and seventh gestational weeks, when the two pancreatic buds (dorsal and ventral) rotate as part of the process of intestinal rotation^(6,7). During that period, the duodenum rotates from left to right, the ventral pancreatic bud typically migrates posteriorly and inferiorly, merging with