Key points about gallstone ileus that all resident doctors should know

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Learning objectives

To check the main radiological findings with different imaging tests of gallstone ileus that all radiologists should know.
Background

Gallstone ileus is an uncommon cause of mechanical bowel obstruction. However, it is associated with high morbidity and mortality (8-30%) [1-3], and usually affects elderly patients, who often had other concomitant medical-surgical diseases. It is crucial an early and precise preoperative diagnosis, where different imaging tests play an important role. We will review the most important aspects of this entity, particularly the main radiological findings, and illustrate it with a series of 5 cases of our center.

PATHOGENESIS
The gallstone ileus is defined as the intestinal impaction of a gallstone passing through a bilioenteric fistula mainly cholecystoduodenal (60%) [1,4,5]. There may be other fistulous communications (cholecysto-colonic, cholecysto-jejunal, cholecysto-gastric, and more rarely, choledocus-duodenal [6]. The 1-15% of bileoenteric fistulas produce gallstone ileus [6,7].

Probably the responsible process for most cases of fistula formation is due to the impaction of a large stone in the gallbladder, causing pressure, ischemia and necrosis of the wall of it that leads to the development of a inflammatory adhesion between gallbladder and intestine, and then an erosion of gallstones on adjacent structures, causing a cholecystoenteric fistula, with the subsequent evacuation of the stone to the intestinal tract.

The entrance to the small gallstone may also occur by natural pass through the bile duct due to Oddi’s sphincter disorders, especially after surgical enlargement of it.

Usually, the gallstone that go into the digestive tract are expelled in the feces [7], but if the stone size exceeds the diameter of the bowel segment, it could impact and cause obstruction. Most of the obstructing stones are bigger than 2.5 cm. diameter [1-8] unless there is some preexisting intestinal pathology that alters the dynamics or causes stenosis, where a smaller size gallstone can locked it.

The most gallstones impact at the terminal ileum (50-70%) [4-7], due to its relative minor diameter and peristaltic activity [6], followed by jejunum (15-31% of cases) [6,7], stomach (14%) [6], duodenum (3 - 5%, [6,7] which is known as Bouveret's syndrome) and colon (2.5 - 8% of cases [6,7]. Usually as a result of a preexisting pathology).
We can find multiple gallstones along obstructed bowel, that is an important fact to keep in mind in surgery of this entity, to prevent future recurrences.

INCIDENCE

Gallstone ileus is a rare complication of cholelithiasis (less than 0.5% of patients) [2-4,6,7], and involve a 1-4% of mechanical intestinal obstruction [1,4,6,7,9,10], increasing to 25% over 65 years [1,3,4,6,7,10].

Usually affects elderly patients, between 65 and 75 years of age [2,4,5,7,8], with a higher prevalence in females (ratio 5:1) [3,6,8] (4 of 5 cases from our center), attributed to the higher frequency of gallbladder disease (cholelithiasis or cholecystitis) [7].

PREOPERATIVE DIAGNOSIS

The classic clinical presentation is a elderly woman with prior biliary disease, that presents a episodic subacute intestinal occlusion ("tumbling obstruction") as a result of continued stone migration. The gallstone impaction produces transient abdominal pain and vomiting, disappearing when the stone moves in the intestinal lumen, and reappear with a new obstruction. Intermittent symptoms may be present several days prior to the medical evaluation (median 4-8 days) [4,6,8].

Hematemesis is an occasional complication due to bleeding at the site of biliary enteric fistula formation.

It is important to have a high clinical suspicion of this entity, being able to suggest it as a preoperative diagnosis based on a plain abdominal film.

Other imaging modalities used are ultrasound and CT being this the most important because it allows a more accurate and early diagnosis, that helps in the therapeutic approach. Only 50-77 % of cases had a correct preoperative diagnosis [4,6]. In other cases the diagnosis is performed by laparotomy [4].

TREATMENT

The main therapeutic goal is to solve the obstruction [3,6], mainly through a surgical procedure: enterolithotomy and stone extraction (4 of our 5 cases).
A one-stage procedure may be considered in patients at low surgical risk [3,4,6]. Consisting in surgical resolution of the obstruction, surgical treatment of biliary-enteric fistula and cholecystectomy.

In patients in a high surgical risk, most of the patients, the main goal is to treat first the intestinal obstruction. The gallbladder can be removed in a two-stage procedure if there is a recurrence or symptoms of cholecystitis [4,6]. Biliary-enteric fistulas may close or shrink spontaneously, especially if the cystic duct is patent or there are no residual stones [4]. The risk of recurrence is 4.7-10% [3-6,9].

The surgeon must inspect the entire intestine in order to rule out further gallstones, which can be found in a proportion of 3-44% [3].

Bowel resection may be needed, when there is a perforation, ischemia, or a gallstone that can not be detached.

Sometimes the entity may resolve spontaneously (7%) [6], as happened in one of our cases.
Gallstone ileus is an entity of complex diagnosis. A better understanding of this condition allows a more precise diagnosis and early treatment, essential in these patients. Thus it is important to know the main radiological findings in the different imaging techniques (plain radiography, ultrasound and CT).

**Plain abdominal films**
Findings suspicious of a gallstone ileus are:

Demonstration of the classic Rigler’s triad (Figure 1), pathognomonic of gallstone ileus [7, 9] (two of our five patients). It is characterized by:

- Air in the biliary tree (pneumobilia) and/or gallbladder (29-69%) [1,4-6,10] (Figure 5 A)
- Signs of partial or complete bowel obstruction (usually the small intestine) (53-86%) [5,6,10] (Figure 5A)
- Visualization of an ectopic gallstone (25-35%) [5,6,10]. Less than 15% of gallstones are visible [1,4] due to their radiolucency or because intestinal gas or bony structures may obscure them.

The triad is present in less than 15% of cases [5,7]. However, only 2 signs (present up to 40-50% of patients) may be enough to point out the diagnosis of the disease [4, 6, 8].

**Abdominal Ultrasound**
Ultrasonography can demonstrate the biliary-enteric fistula, residual choledolithiasis, choledocholithiasis and cholecystitis. It can also visualize pneumobilia and/or air in the gallbladder (Figure 2A), dilated bowel loops (Figures 2B, 3A) and ectopic gallstones (Figure 3A).

**MDCT scanners**

Newer MDCT scanners, using multiplanar or 3D volume-rendering reconstructions, have proved their effectiveness in the detection and evaluation of this entity, with a sensitivity of 93% and specificity of 100% [10].
This technique can demonstrate pneumobilia and/or gas in the gallbladder (Figures 3B, 4A, 5B), dilated bowel loops (Figure 4B) and ectopic gallstones (Figure 7A), and also provide information about:

- Direct visualization of biliary-enteric fistulae (Figures 6A, 6B).
- Number, localization, morphology and size of stones (Figure 7A).
- Signs of probable complication: free fluid, ectopic extraintestinal gas, gas in portal vein or pneumatosis intestinalis.
Fig. 1: CASE 1. A 85 year-old woman with abdominal pain and vomiting of 3-4 days of duration. Plain abdominal radiography shows the classic Rigler's triad: ectopic gallstone in the right lower quadrant of the abdomen (arrowhead), dilated bowel loops and pneumobilia (arrow). Surgery confirmed a 2.5 cm gallstone impacted on the distal ileum. The patient had a good evolution after surgery.

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**Fig. 2:** CASE 2. A 96 year-old woman with vomiting and abdominal pain of 4-5 days of duration. Abdominal ultrasound shows a great quantity of air in the biliary tract (pneumobilia) (Fig. 2A) and signs of intestinal occlusion (jejunum, ileum) (Fig. 2B). Surgery evidenced an impacted stone on terminal ileum. She passed away.

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Fig. 3: CASE 3. A 79 year-old man with abdominal pain of 4 days of duration associated with vomiting and fever, and previous history of cholelithiasis. Abdominal ultrasound shows a dilated loop of small intestine, with an image consisted with a 2,4 cm-stone. (arrow) (Fig. 3A). Axial MDCT image (Fig. 3B), shows a significant dilatation of the gastric cavity with an air-fluid level (asterisk)and a gallbladder full of air(arrow) secondary to a cholecystoduodenal fistula. Surgery confirmed the presence of a gallstone causing intestinal obstruction at the level of middle-distal jejunum, 155 cm away from the angle of Treitz. The patient had a good evolution after surgery.
Fig. 4: CASE 4. A 77 year-old woman with an antecedent of cholecystectomy and choledocholithiasis that underwent ERCP and wide sphincterotomy. She presented with spontaneous abdominal pain and mild jaundice. Axial MDCT images show moderate dilatation of the intrahepatic bile ducts with pneumobilia (Fig. 4A) and dilated small bowel loops (Fig. 4B). CT also depicted a gallstone in the terminal ileum (not shown). The condition resolved spontaneously.

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Fig. 5: CASE 5. A 87 year-old woman with previous cholelithiasis presented at the emergency room with abdominal pain of 5-6 days of duration associated with vomiting, and signs of intestinal obstruction on physical examination. Plain abdominal film (Fig. 5A) shows ectopic gas in the expected location of the gallbladder (arrow) and dilated small bowel loops. Axial MDCT image (Fig. 5B) demonstrates multiple gallstones and confirms the presence of air in the gallbladder (arrow).

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Fig. 6: CASE 5. Axial CT image (Fig. 6A) and coronal reconstruction (Fig. 6B): cholecystoduodenal fistula (arrow).

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Fig. 7: CASE 5. Coronal abdominopelvic CT images. Figure 7A depicts dilated small bowel and a 2.5 cm-stone impacted near the terminal ileum (arrow), as well as moderate ileal submucosal enhancement due to inflammatory changes (arrowhead). Figure 7B shows the gallbladder full of stones. One of the stones (arrow) is similar in appearance to the impacted one, with a tiny peripheral calcification. Surgery confirmed the ectopic gallstone in the terminal ileum. After this episode, the patient developed another bowel obstruction probable due to a recurrent biliary ileus or to postoperative adhesions. Because of high surgical risk it was decided to put her on medical treatment. Unfortunately she died.

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Conclusion

Gallstone ileus is an important but rare cause of mechanical bowel obstruction that we should suspect in elderly patients, mainly women, with previous biliary illness. Early diagnosis is essential because its high morbidity and mortality, emphasizing the role of imaging techniques, particularly CT, which also helps in the therapeutic approach focused on solving the obstruction.
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