Diverticular disease of the small bowel: Computer Tomography (CT) findings.

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Authors: J. Gonzalez Nieto, G. Anguita Martinez, C. García Villafañe, S. Martin Garre; Madrid/ES
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Learning objectives

1. To review the main computer tomography (CT) findings of diverticular disease of the small bowel.

2. To review the clinical presentation, differential diagnosis and complications according to the affected bowel segment.

In this poster we will review the prevalence, pathophysiology, symptoms and complications of this disease, as well as the role of CT not only in identifying the asymptomatic disease but also in the diagnosis of the most frequent complications such as infection, perforation, intestinal obstruction or haemorrhage.

Diverticular disease of the small bowel should be included in the differential diagnosis of abdominal pain, because, although it is a rare cause, it often involves modifications of treatment and secondary complications due to delayed diagnosis.

Background

The diverticular disease of the small bowel is an infrequent abdominal condition, usually asymptomatic, with a reported incidence of 1-10% (5-10% for those located at duodenum and less than 3% for those reported at jejun-ileum) [1].

True diverticula containing all three gut layers are congenital entities essentially represented by the common vermiform appendix and the Meckel’s diverticulum that it’s found in only 2-3% of individuals [1]. It usually affects distal segments of small bowel and, if it’s not complicated, it will resemble a normal loop of bowel (Fig 1). The majority of patients with this anomaly will remain asymptomatic; however, several complications may occur, including obstruction, intussusception, perforation, diverticulitis, and gastrointestinal haemorrhage [2]. Clinically the diagnosis of Meckel's diverticulum is important as the lifetime risk for developing a complication has been calculated to be 4.2-6.4%, with the risks decreasing with increasing age [2].

Acquired diverticular disease is more common in older patients and its incidence decreases distally progressively from the ligament of Treitz. Small bowel diverticula are "pseudodiverticula", which only have mucosa and submucosa [1, 3]. These diverticula are formed by thin walled mucosal herniations through gaps in muscular layers, generally extending along the pathway of supplying blood vessels [1]. They may be the result
from either raised intraluminal pressure, neuromuscular disorders or abdominal surgery, among others [3, 4]. It may cause chronic symptoms like dyspepsia or malabsorption, or acute complications with clinical manifestations that include abdominal pain, infection and bowel obstruction. In these cases, CT is useful not only for ruling out other causes that may lead to these symptoms but also for diagnosing potential life-threatening complications of small bowel diverticulosis.

Images for this section:

Fig. 1: Non complicated Meckel’s diverticulum. Axial (left) and coronal (right) CT scan with oral contrast administration illustrating an uncomplicated ileal Meckel’s diverticulum (arrows) in a young patient, diagnosed as an incidental finding.
Imaging findings OR Procedure details

At CT, non-complicated diverticula appear as sack-like images depending on the small bowel wall.

After the colon, the duodenum is the most common location for gastrointestinal diverticula [5]. The typical CT appearance of a duodenal diverticulum has been described as a thin-walled rounded collection of gas and oral contrast material situated along the medial border of the junction of the second and third portions of the duodenum [1, 5]. (Fig 2)

Misinterpretation of a duodenal diverticulum on CT as a pancreatic tumor, metastatic lymph node, pancreatic pseudocyst, or pancreatic abscess has been reported [5] (Fig 3). Due to the fact that they usually arise from the medial aspect of the periampullary duodenum (Fig 4), duodenal diverticula present a major source of failure for endoscopic retrograde cholangiopancreatography (CPRE) [5] and obstruction of the common bile duct [1]. Most patients with duodenal diverticula are asymptomatic but perforation, bleeding and increased prevalence of choledocholithiasis have been reported [1, 5].

**Diverticula complications**

At CT, small bowel diverticulitis usually presents as a focal inflammatory lesion with asymmetric bowel wall thickening, with hyperdense appearance of the mesenteric fat and/or abscess formation (mass lesion containing extraluminal air bubbles or fluid levels) [1, 3, 6] (Fig 5). Differential diagnosis includes perforated neoplasm, foreign body perforation, medication-induced ulceration and Crohn´s disease [3, 6]. Acute diverticulitis is one of the most common complications of jejuno-ileal diverticulosis, but perforation, (Fig 6, 7), intestinal obstruction and haemorrhage have also been reported [3]. Jejuno-ileal diverticulitis may mimic other more common abdominal conditions like appendicitis, colonic diverticulitis or cholecystitis [1]. In these cases CT is useful for confirming the diagnosis of diverticulitis, specially in those patients who will benefit from a surgical excision of the abnormal segment [6].

Intestinal obstruction is another complication associated to diverticular disease resulting from strangulation due to peridiverticular adhesions, volvulus or invagination of the diverticulum [1] and is the most common presenting symptom of Meckel´s diverticulum in the adult population [7]. (Fig 8, 9)
The appearances of a Meckel's diverticulum on conventional CT will vary according to the complication that precipitated the patient's presentation. If the patient has developed Meckel's diverticulitis, the appearances are of a thick-walled loop of bowel in the region of the terminal ileum with associated inflammatory change in the surrounding mesentry, separate from the appendix [2]. *(Fig 10).*

Meckel's diverticulum is the most common cause of gastrointestinal bleeding in patients under age 30 [8]. The traditional diagnostic test of choice for Meckel's diverticulum has been the Meckel's scan, in which technecium-99 is taken up by ectopic gastric mucosa. With the recent advent of thin slice, highly-sensitive multi-detector CT scan, the role of CT in the diagnosis of bleeding Meckel's diverticulum has emerged [8]. Extravasation of contrast material in cases of active bleeding typically requires bleeding > 0.5 mL/min in order to be visualized [9].

**Images for this section:**
**Fig. 2:** Duodenal diverticulum. CT scan without intravenous contrast. Axial (right) and coronal (left) views illustrating an uncomplicated duodenal diverticulum arising from the medial aspect of the periampullary duodenum (arrows).

**Fig. 3:** Duodenal diverticulum. (Left) Axial CT obtained with IV contrast administration. At the level of pancreatic head there is a milimetric fluid-filled cystic lesion (arrow). Solid arrow identifies the common biliar duct. (Right) Previous CT scan of the same patient shows intradiverticular gas (long arrow) confirming the diagnosis of duodenal diverticulum.
Fig. 4: Duodenal diverticulum. CT scan with IV contrast administration. Coronal view illustrating the common bile duct (arrow) draining directly into a periampulary diverticulum (arrow head).
**Fig. 5:** Duodenal perforated diverticulitis. Axial abdominal CT with oral contrast administration shows multiple duodenal diverticula (arrows), thickening of duodenal wall, extraluminal gas bubbles (arrow heads) and hyperdense appearance of surrounding fat due to diverticula perforation.
Fig. 6: Jejunal perforated diverticulitis. (Left) CT scan with IV contrast administration reveals an ill-defined sacular outpouching at the jejunum wall which is thickened (arrow). (Right) A more caudal image shows hyperdensity of the adjacent fat tissue (arrow head) and extraluminal air bubbles (solid arrow), consistent with jejunal perforated diverticulitis.
Fig. 7: Jejunal perforated diverticulitis. CT scan without IV contrast shows a blind-ending pouch at the jejunum (arrow), surrounding mesenteric inflammation and extraluminal gas bubbles (solid arrow).
Fig. 8: Small bowel obstruction secondary to a Meckel’s diverticulum. Axial (left) and coronal (right) views show small bowel loops dilatation and distal ileal collapse. The patient underwent surgery which revealed a Meckel’s diverticulum with intestinal obstruction due to peridiverticular adhesions.
**Fig. 9:** Small bowel obstruction secondary to a Meckel’s diverticulum. Axial CT scan with oral contrast administration shows a Meckel’s diverticulum with ill-defined wall and air-fluid level inside (asterisk). Surgery showed diverticulitis and herniation of loops through its adhesion to the mesentery as the cause of the obstruction. Note the gas bubbles mixed with particulate matter in the dilated small bowel loops (arrows) proximal to the site of obstruction ("small bowel feces" sign).
Fig. 10: Meckel’s diverticulitis. Abdominal CT with oral and IV contrast administration reveals thick-walled loop of terminal ileum (arrow) and of a Meckel’s diverticulum (arrow head) with inflammatory change in the surrounding fat, findings consitent with Meckel’s diverticulitis.
Conclusion

Diverticular disease of the small bowel is a rare and usually asymptomatic entity that, however, may manifest with an acute abdominal onset. CT is an useful imaging tool for detecting this rare entity and for evaluating its complications, ruling out, at the same time, other entities with similar clinical onsets. In this scenario, the radiologist plays a key role in the diagnosis and the definition of the potential surgical strategy.

Personal Information


mail to: jimenagn@gmail.com

References
