

# ACQUIRED DIVERTICULAR DISEASE OF THE JEJUNUM AND ILEUM, IMAGING FEATURES AND PITFALLS



P. LEBERT<sup>1</sup>, O. ERNST<sup>1</sup>, M. ZINS<sup>2</sup>

*1 CHRU Lille, 2 Groupe Hospitalier Paris Saint-Joseph*



# LEARNING OBJECTIVES

To present radiological features of :

- Jejunioileal diverticulosis
- Its complications such as diverticulitis, diverticular hemorrhage or bowel obstruction
- Its pitfalls such as extraintestinal gas without perforation or pseudoischemic appearance
- Meckel's diverticulum as main differential

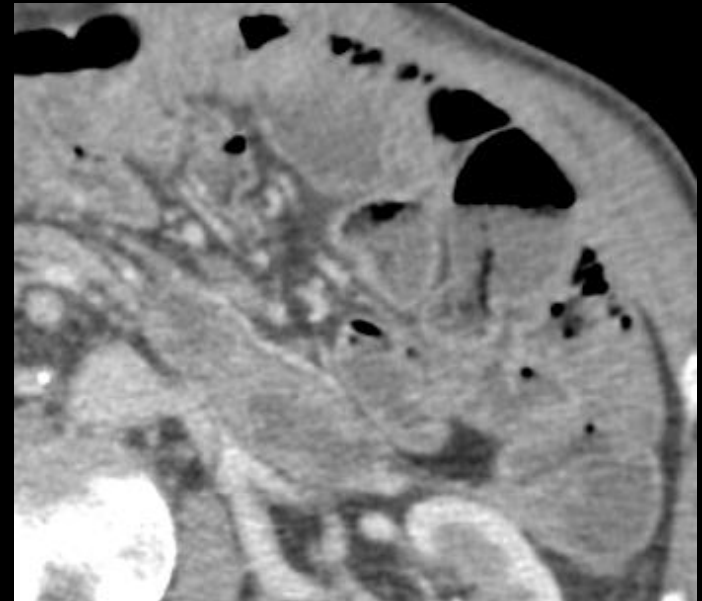
# INTRODUCTION

- **Jejunioileal diverticulosis** is not newly discovered., as the first report was published by Sir Astley Cooper in 1807.
- However it remains a **rare** and underestimated condition, involving mostly the **elderly**.
- It is frequently **asymptomatic** but can lead to significant complication requiring surgical treatment.
- The clinical diagnosis is difficult because of the **lack of specificity** of the symptoms.
- **Radiologist plays a major role** in assessment of the acquired jejunioileal diverticular disease.

# JEJUNOILEAL DIVERTICULOSIS

## BACKGROUND

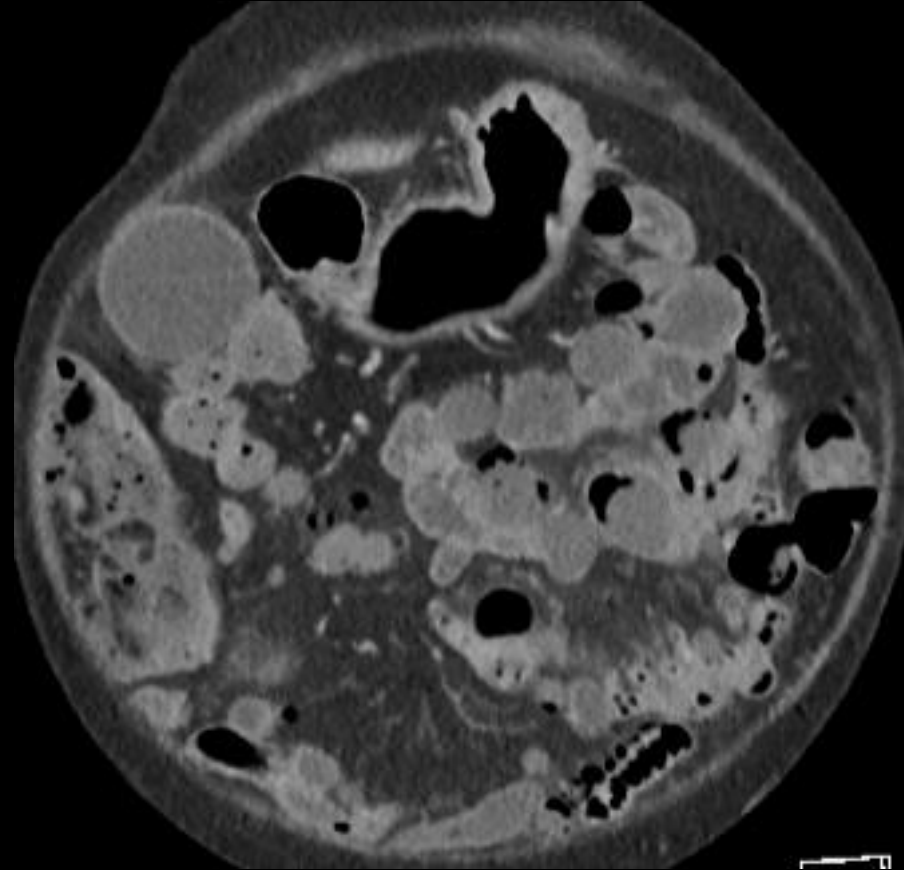
- Acquired diverticula of the jejunum and the ileum has a reported **incidence of 0.3-2.3 %**.
- These are way less frequent than duodenal diverticula (6-20 %) and colonic diverticula (ranging from 5 % to 65 % depending on the age).
- 80-90 % of involved patients are **older than 40**, without gender predominance.



# JEJUNOILEAL DIVERTICULOSIS

## BACKGROUND

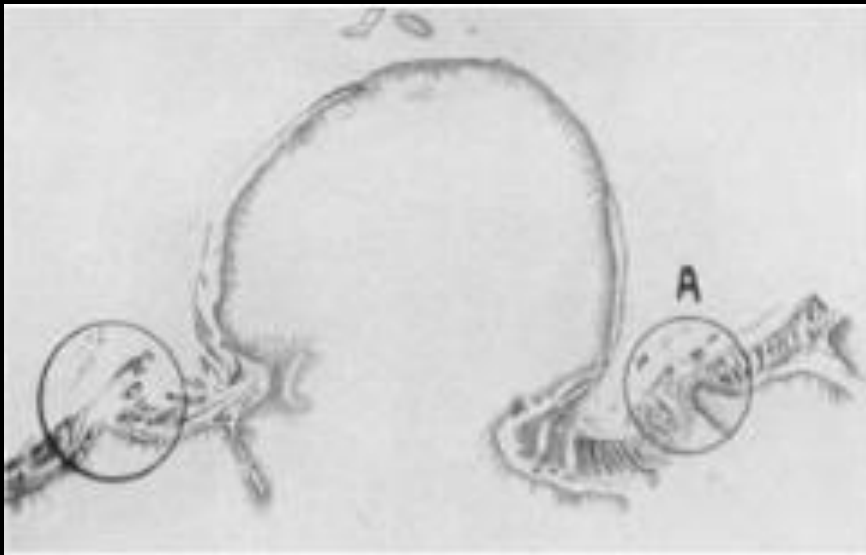
- Jejunoileal diverticulosis is most often **asymptomatic**.
- 15-20% of patients exhibit **minimal chronic symptoms** which may be related to pseudo obstruction or bacterial overgrowth (such as abdominal discomfort or pain, diarrhea, weight loss, and weakness).
- Serious **complications** (requiring surgery) are rare (6-15 %).



# JEJUNOILEAL DIVERTICULOSIS

## FROM ANATOMY TO PHYSIOPATHOLOGY

- Like in colonic diverticular disease, acquired small bowel diverticula are **pseudodiverticula**, consisting in herniations of the mucosa and the submucosa through the musculosa.
- These are considered to be **pulsion type** diverticula, occurring in localized small bowel areas of weakness created by smooth muscle abnormalities, in close proximity to the **penetrating mesenteric vessel branches**.



Edwards. Diverticulosis of the small intestine. Ann Surg 1936.

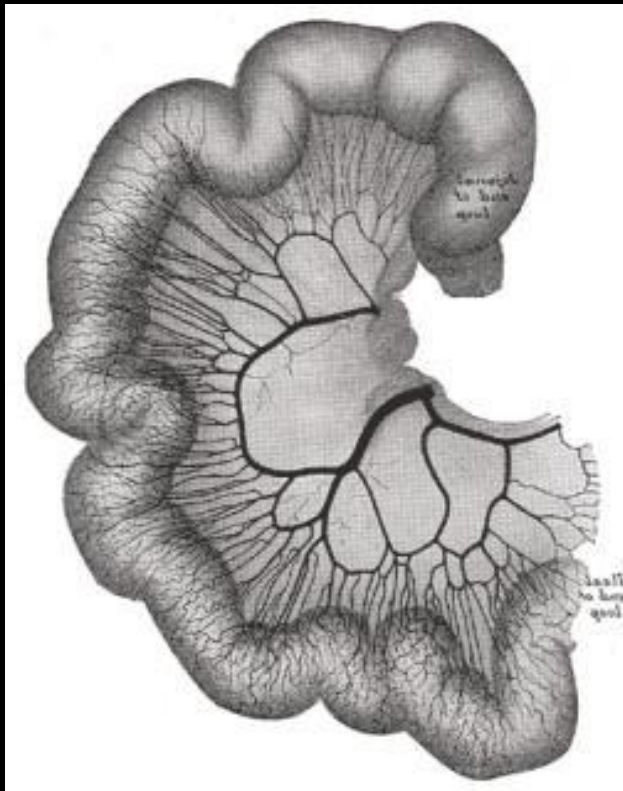




# JEJUNOILEAL DIVERTICULOSIS

## FROM ANATOMY TO PHYSIOPATHOLOGY

- This explains the topography of these diverticula, which arise almost always at the **mesenteric side** of the small bowel wall.



H. Vandyke Carter, H. Gray. *Anatomy of the Human Body*. 1918.



# JEJUNOILEAL DIVERTICULOSIS

## FROM ANATOMY TO PHYSIOPATHOLOGY

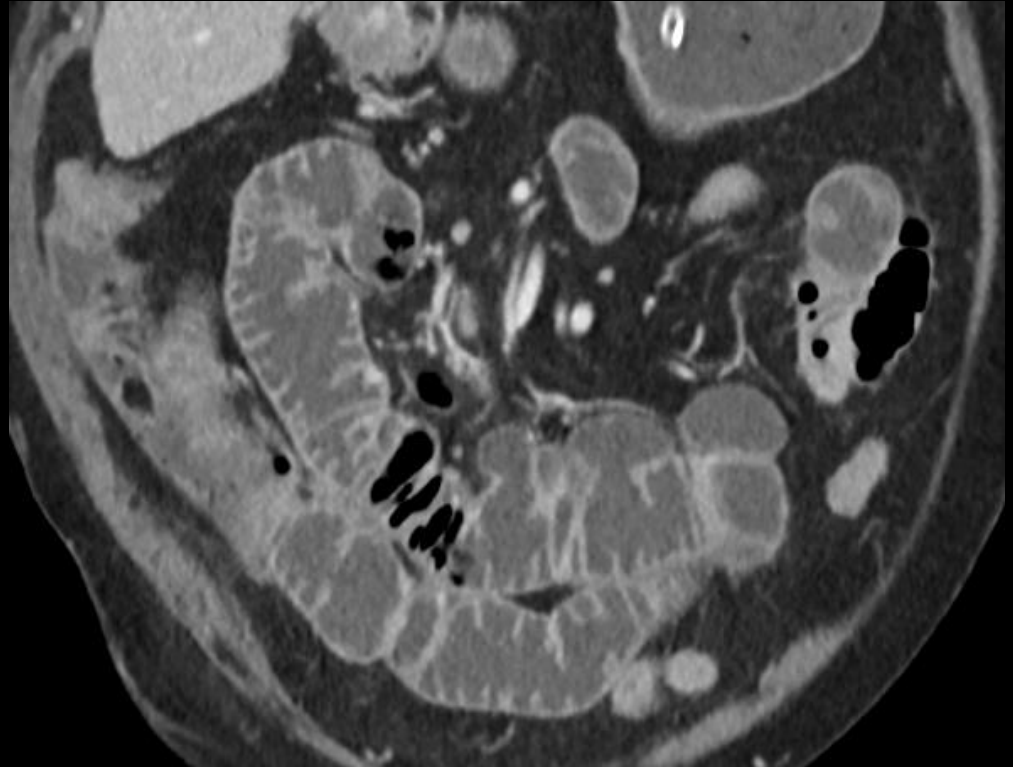
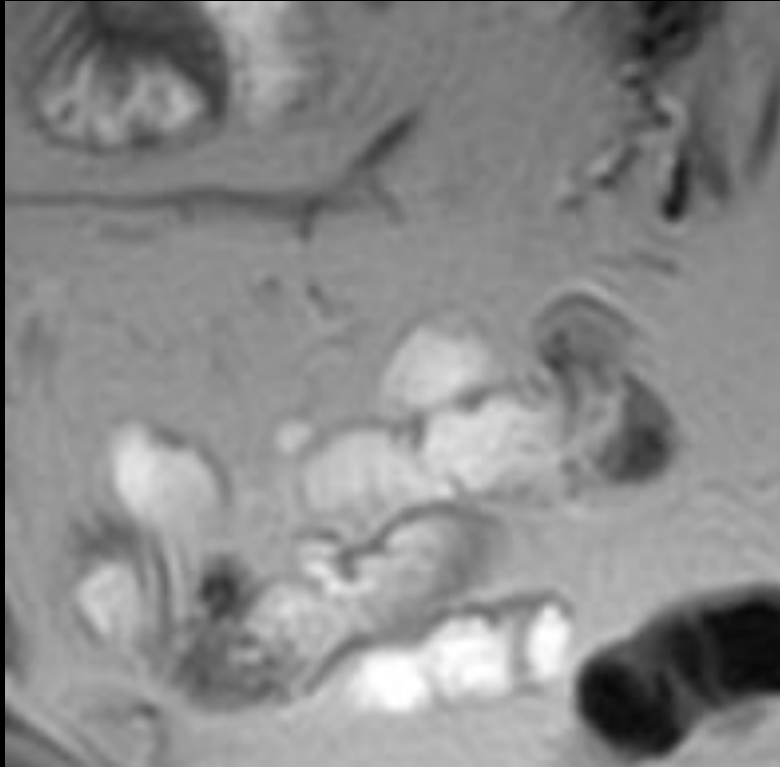
- The physiopathology of the jejunoileal diverticulosis is unknown. Current hypothesis focus on **abnormalities in the smooth muscle or myenteric plexus**, on **intestinal dyskinesia** and on **high intraluminal pressures**.
- Many rare diseases have been associated with small bowel diverticulosis (including Fabry's disease, Cronkhite-Canada syndrome, and familial visceral myopathy).
- Some authors have described **familial cohorts** of jejunoileal diverticulosis which could be consistent with a genetic predisposition.



# JEJUNOILEAL DIVERTICULOSIS

## IMAGING

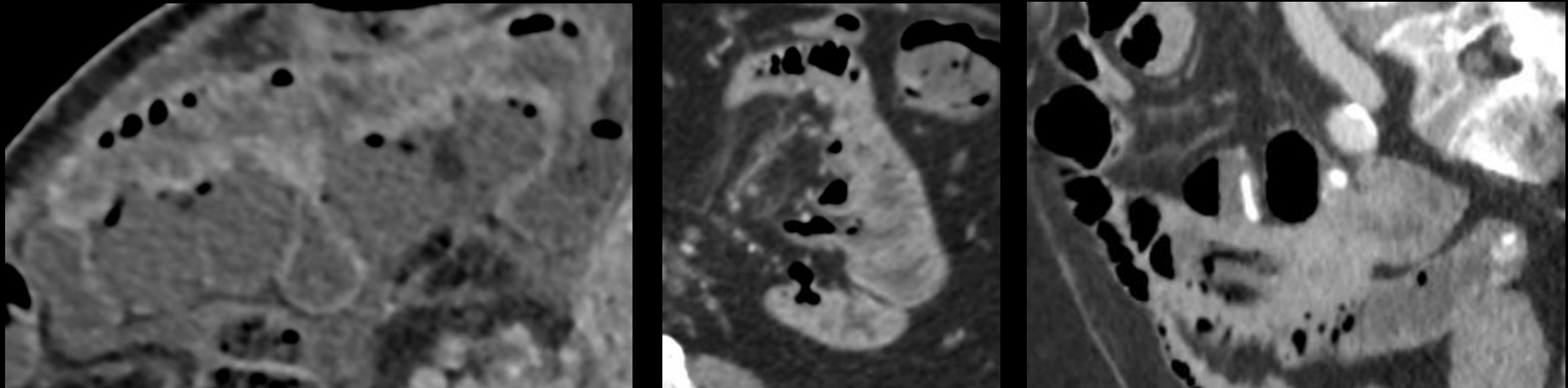
- Some authors mentioned the interest of MRI in jejunoileal diverticulitis, but **CT scan** remains the best exam to detect complications such as pneumoperitoneum and acute bleeding.



# JEJUNOILEAL DIVERTICULOSIS

## IMAGING

- **Imaging features** of normal jejunoileal diverticula:
  - Round or ovoid outpouchings arising from bowel with a **neck** (better visualized on coronal or sagittal reformations)
  - Unvisible or **thin wall**, without bowel folds
  - Contain a combination of **fluid**, **gas** and **feces-like material**
  - **Variable size** (ranging from a few millimeters to greater than 5 centimeters), depending on the location (smaller and fewer in the ileum) and the intestinal repletion



- The diverticula are usually numerous and the diverticulosis is extensive on the small bowel

# COMPLICATIONS

## BACKGROUND

- The exact prevalence of complication in jejunoileal diverticulosis is difficult to assess, ranging from 6 % to 40 % in the reported literature.
- Its most frequent complication is the diverticulitis, followed by the bleeding and the bowel obstruction.
- Leiomyosarcoma has been histologically described in small bowel diverticula, but it could rather be Meckel's diverticula. Even if it existed, the relationship between both diverticula and tumor appears to be difficult to establish.
- Therapeutic strategy raises particular goals in elderly patients with possible comorbidities.
- Surgery should be avoided when possible, but sometimes it is a better option than a long-stay hospitalization because of the iatrogenic complications.

# COMPLICATIONS

## DIVERTICULITIS

- Diverticulitis is the **most frequent** complication of jejunoileal diverticulosis (2-6 %).
- Infection could be explained by the **stasis** of the intestinal content in the diverticulum and the **neck's obstruction** by the mucosal edema.
- Most cases are **mild**, but perforation can rarely occur (2-7 % of the diverticulitis) by necrotizing inflammatory reaction or progressive ulceration.
- **Mortality** can be high (ranging from 9 % to 40 %).
- Poor **prognostic factors** are advanced age, associated comorbidities, peritonitis, delayed diagnosis and treatment.
- Symptoms are not specific: acute abdominal **pain** (predominantly in the **left flank** in 39 %), abdominal guarding, fever.
- Leukocytosis and elevated C-reactive protein are frequent.

# COMPLICATIONS

## DIVERTICULITIS

- **Uncomplicated** acute diverticulitis are treated **medically** with success, while **severe** forms with perforation require **surgery**.
- The small bowel raises **different therapeutic issues** in comparison with the colon :
  - Segmental small bowel resection and one-stage anastomosis is most often possible, without the need for stoma.
  - Conservative treatment of mesenteric abscesses may not be easy because of intestinal flow and difficult percutaneous access.
- Surgical treatment is not recommended to prevent the **recurrences**, which are rare and seem rather to occur at different sites.

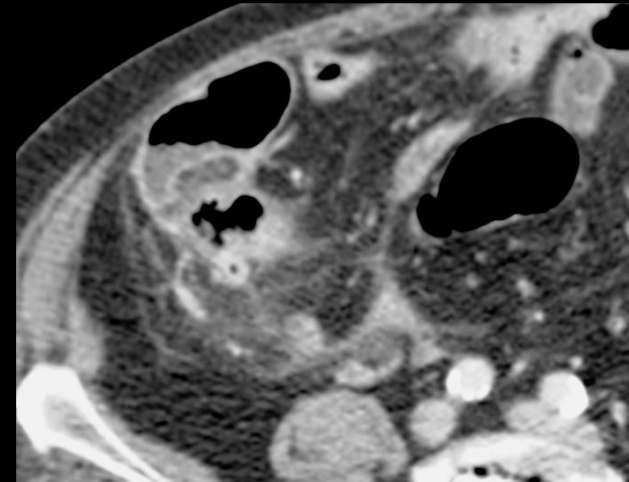
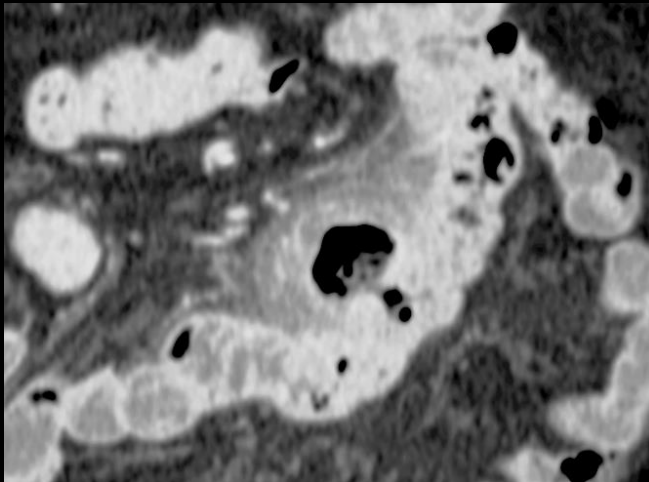
# COMPLICATIONS

## DIVERTICULITIS

### IMAGING FINDINGS

#### *Uncomplicated diverticulitis*

- The most reliable sign is the **direct visualization of the pathologic diverticulum**, which can be jejunal (87 %), or less commonly ileal (13 %) and presents inflammatory changes :
  - Diverticular wall thickening
  - Surrounding by mesenteric fat stranding
  - An association with a small bowel wall thickening is possible



- Other jejunal or ileal diverticula are almost always seen and help the diagnosis of the acquired form.

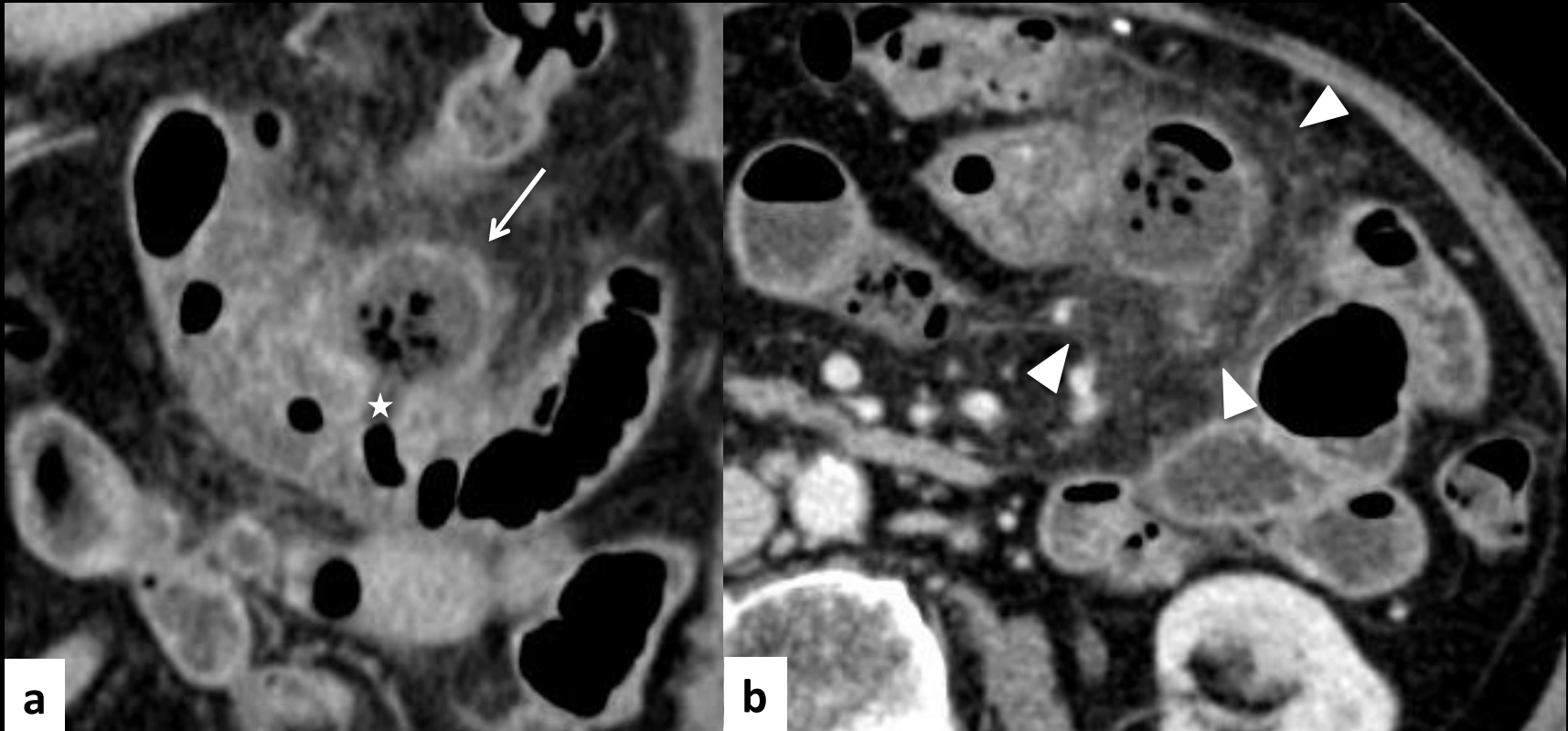


# COMPLICATIONS

## DIVERTICULITIS

### IMAGING FINDINGS

*Uncomplicated diverticulitis*



***Mild acute jejunal diverticulitis in a 87-year-old female.*** The coronal view (b) shows a jejunal diverticulum (arrow), containing gas and an enterolith, and communicating with the small bowel through a neck (star). Note the fat stranding on the mesenteric edge (arrowheads) on the axial view (b).

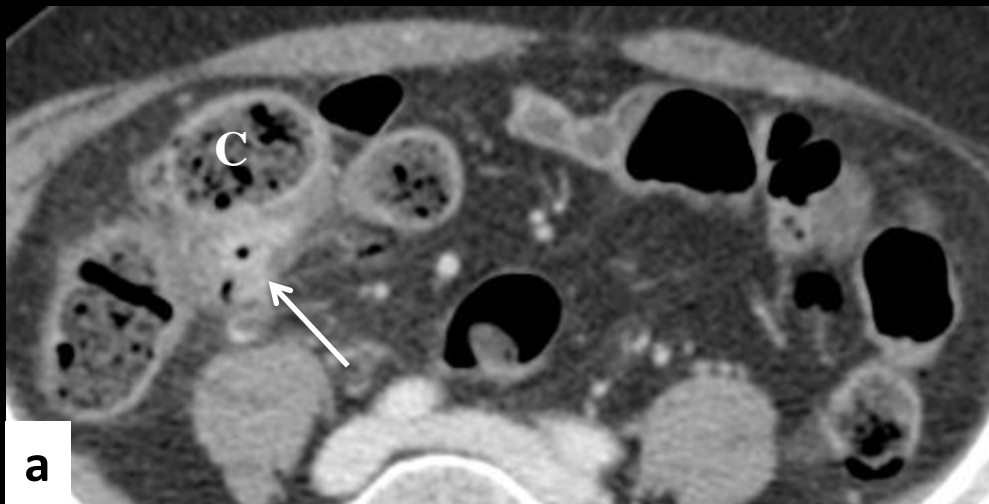
# COMPLICATIONS

## DIVERTICULITIS

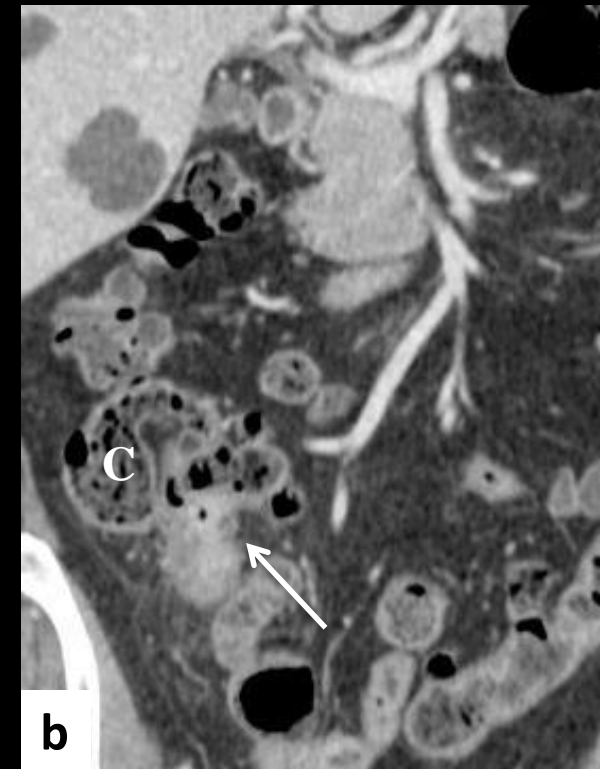
### IMAGING FINDINGS

#### *Uncomplicated diverticulitis*

- Diverticulitis of the terminal ileum is **less common**, and its diagnosis is considered less often, in part because of the **small size** of the diverticula and challenging **differential diagnoses** (cecal diverticulitis and acute appendicitis) at this site.



**Acute diverticulitis of the terminal ileum.** The axial (a) and the coronal (b) views show an ileal diverticulum (arrows) at inferior aspect of last ileal loop. Note the adjacent fat stranding and other diverticula. The cecum is indicated (C) and the appendix is normal.



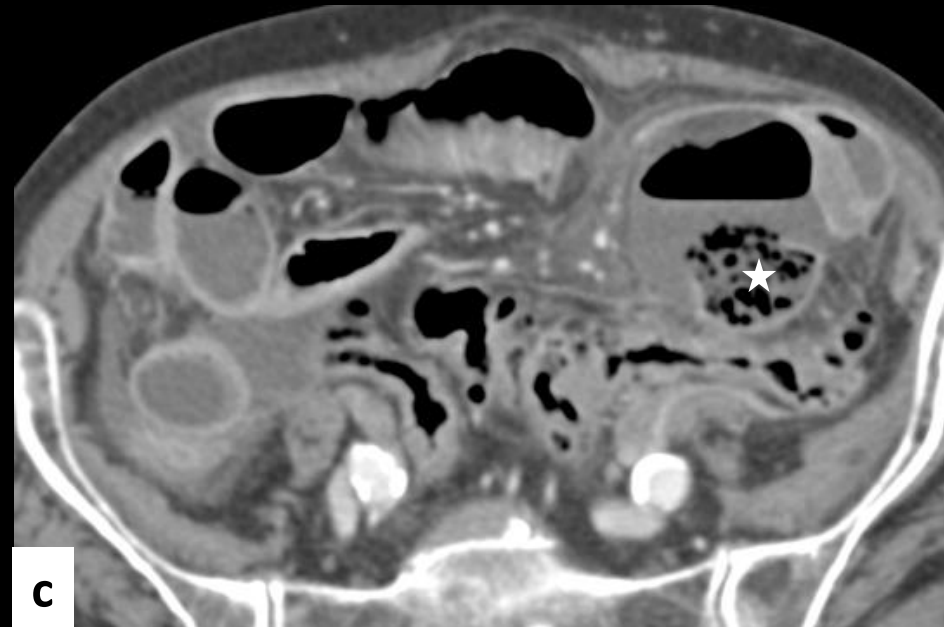
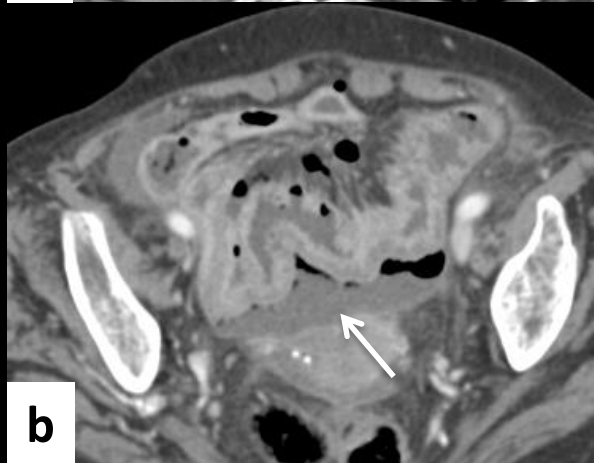
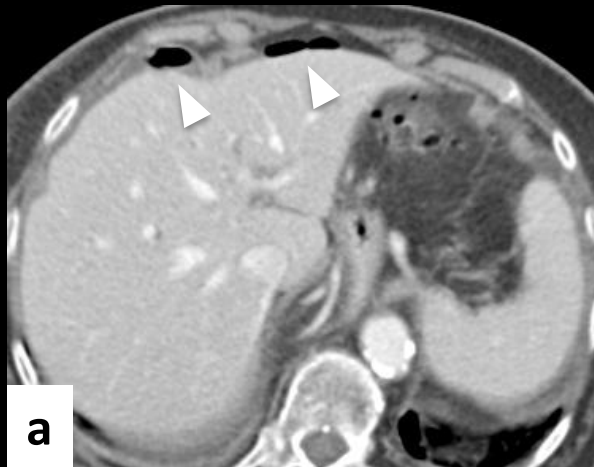
# COMPLICATIONS

## DIVERTICULITIS

### IMAGING FINDINGS

#### *Complicated diverticulitis*

- **Marked mesenteric abnormalities** (fluid and gas) are the most relevant signs of **perforation**.



#### ***Severe acute jejunoileal diverticulitis with peritonitis.***

The axial views (a, b) show a large amount of extra-intestinal gas (arrowheads) and free fluid (arrows). The inflammatory diverticulum (star) is seen on another axial view (c) and is surrounded by loculated fluid and gas.

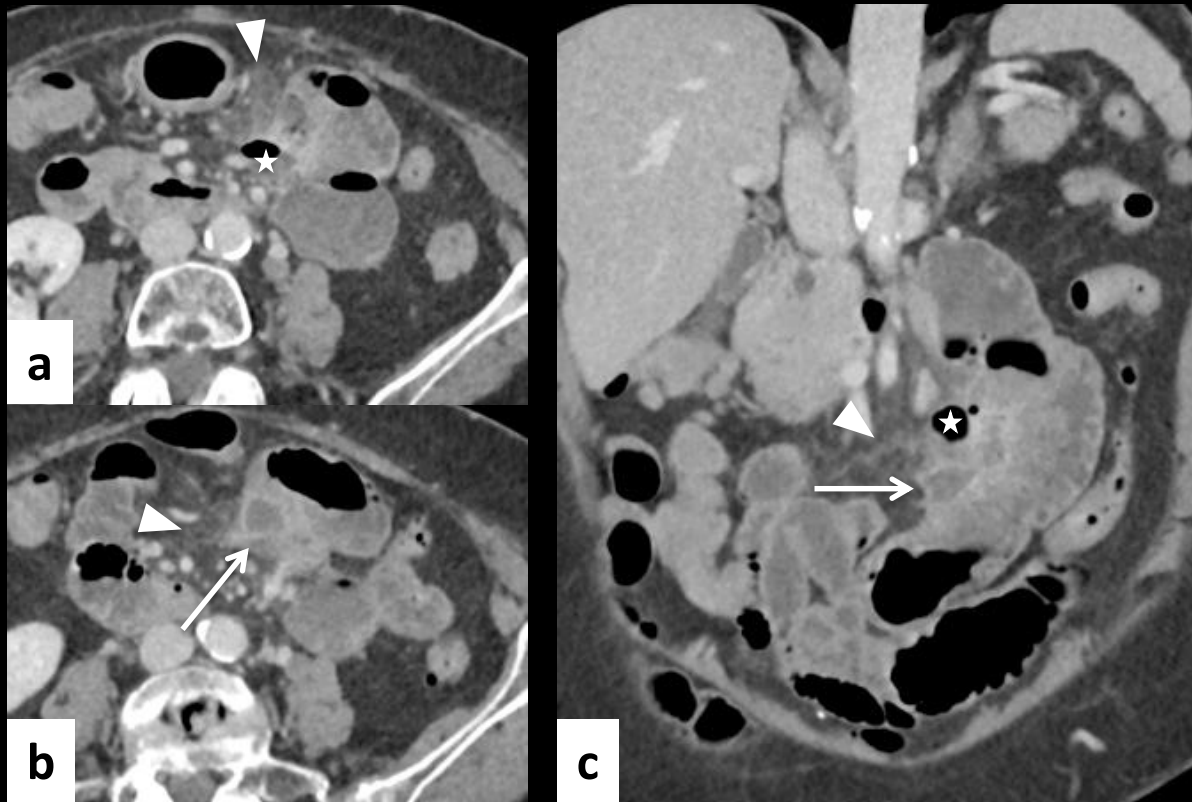
# COMPLICATIONS

## DIVERTICULITIS

### IMAGING FINDINGS

#### *Complicated diverticulitis*

- Non operative management of the **mesenteric abscesses** may be efficient, mostly depending on their size and clinical assessment.



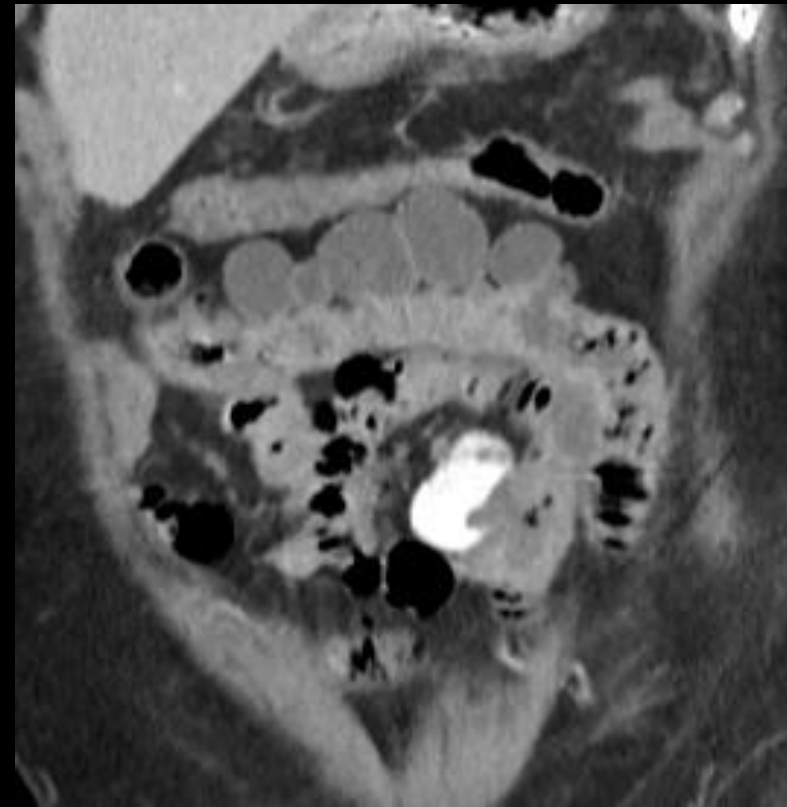
***Complicated jejunal diverticulitis with mesenteric abscess.*** The axial views (a, b) and coronal view (c) show a jejunal diverticula (star) surrounded by a mesenteric fat stranding (arrowheads). The axial (b) and coronal (c) views show a small mesenteric abscess (arrow), next to the pathologic diverticulum.

- Other complications** such as portal vein thrombosis, liver abscess or fistula can be found.

# COMPLICATIONS

## DIVERTICULAR HEMORRHAGE

- Diverticular hemorrhage manifests as **acute or chronic** bleeding and symptoms consists of rectal bleeding, melena or **shock**.
- Mechanisms are unknown and may be related with mesenteric vessels trauma, mucosal ulceration or diverticulitis.
- **CT scan** is the diagnostic exam of choice when acute bleeding because of the **limits of endoscopic exploration** in small bowel.
- **Surgery** still remains the best treatment in case of acute bleeding. Without surgery mortality and recurrences risks are high.

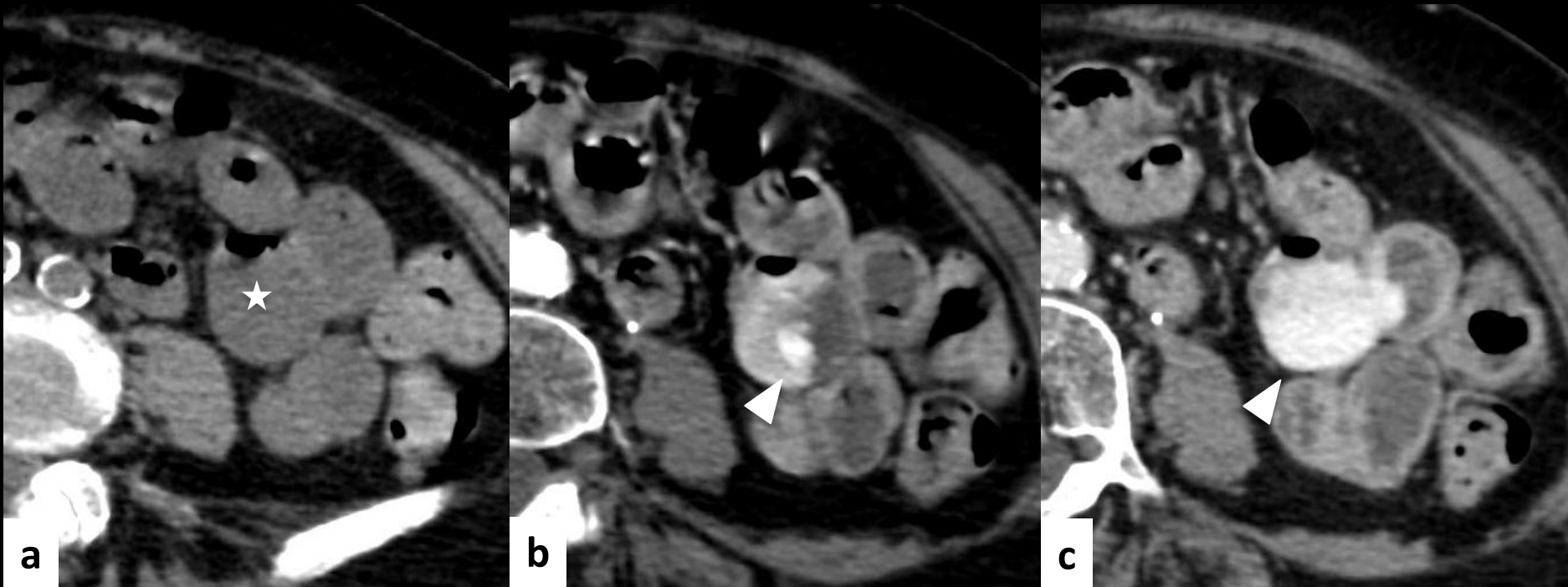




# COMPLICATIONS

## DIVERTICULAR HEMORRHAGE

- CT examination allows accurate diagnosis of the **bleeding site**.



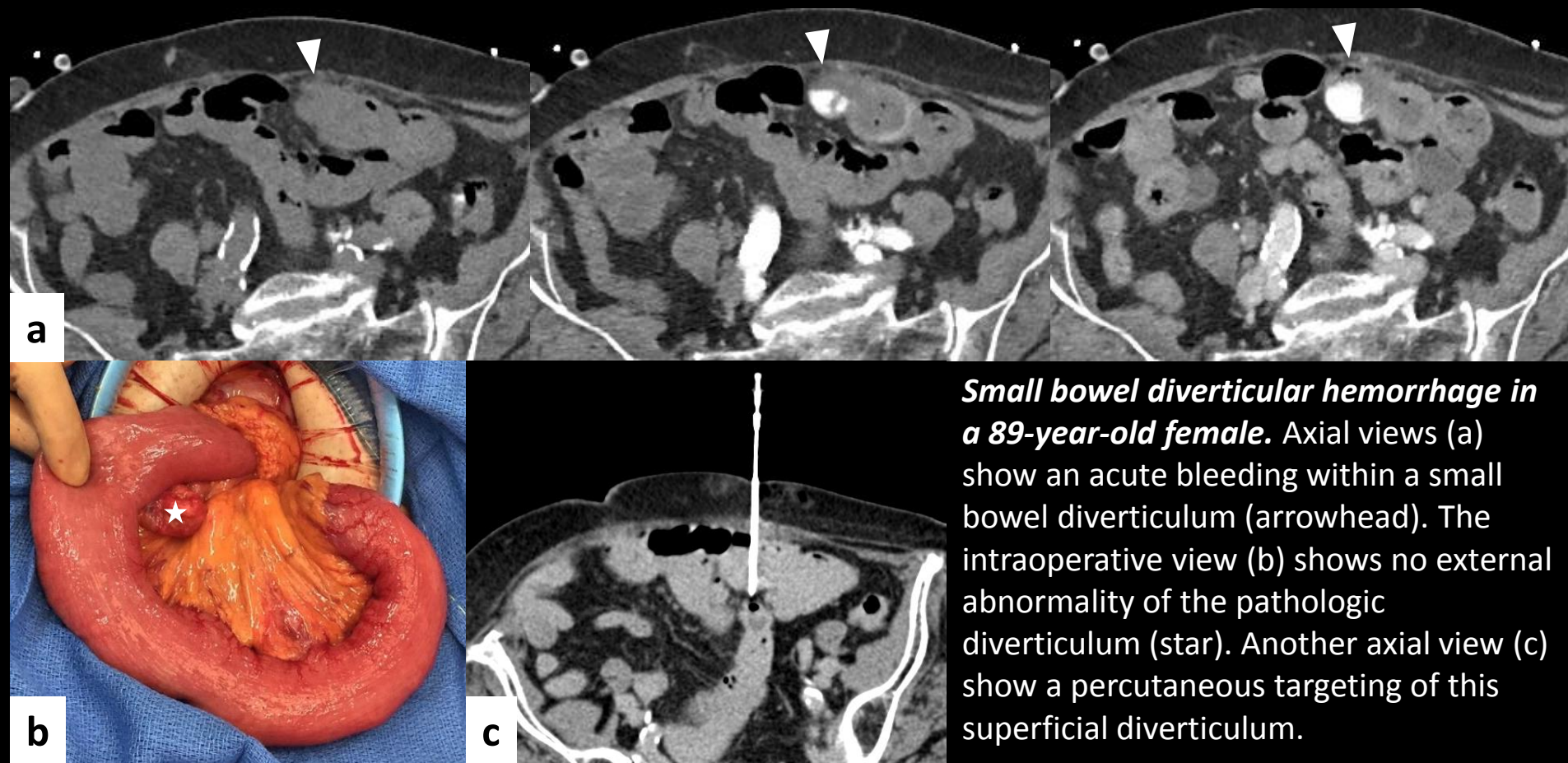
***Jejunal diverticular hemorrhage in a 83-year-old female.*** Axial images show an extravasation of contrast material (arrowhead) at arterial phase (b), increasing at portal phase (c) within a diverticulum. The unenhanced axial view (a) shows the jejunal diverticulum (star).



# COMPLICATIONS

## DIVERTICULAR HEMORRHAGE

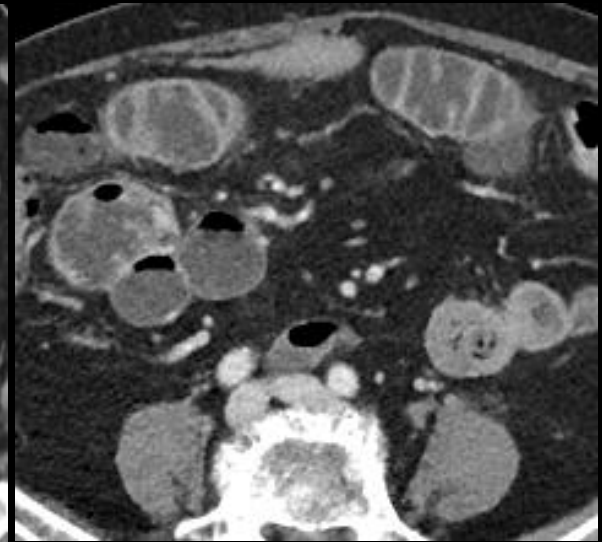
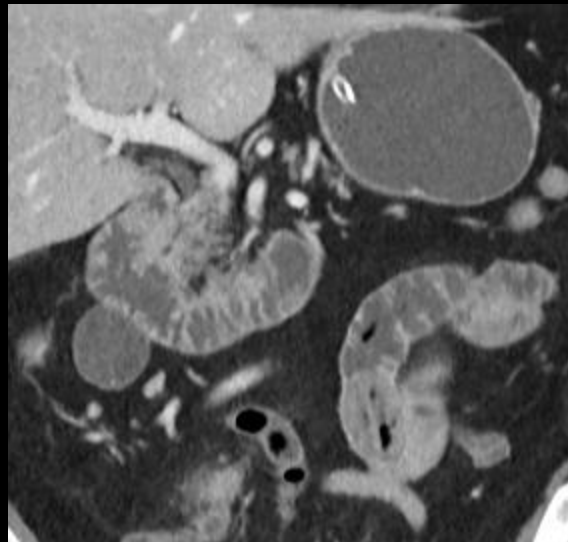
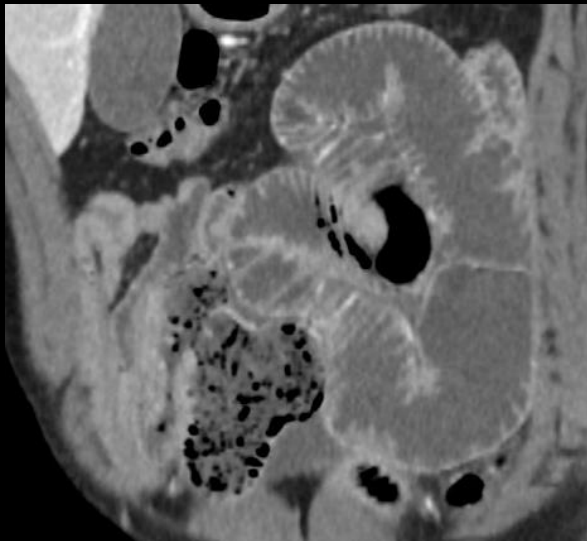
- It can help surgery by **percutaneous targeting** the pathologic diverticulum to allow a mini-laparotomy and a limited bowel resection.



# COMPLICATIONS

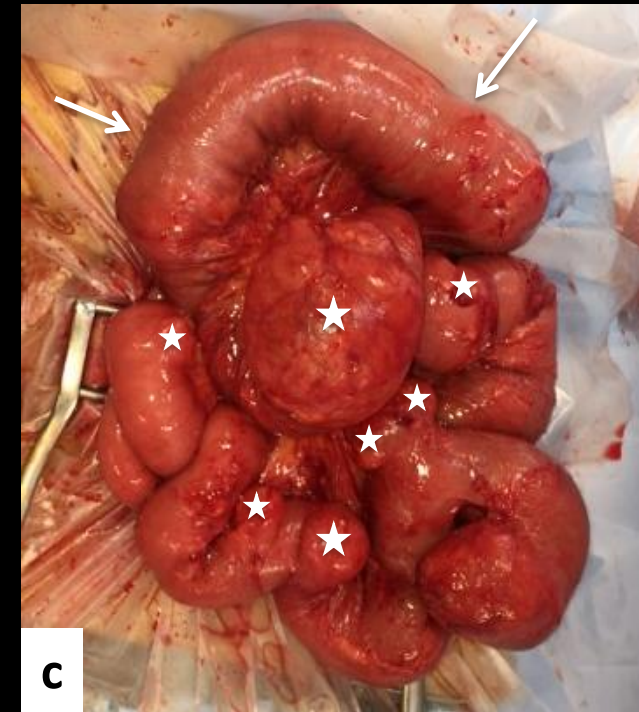
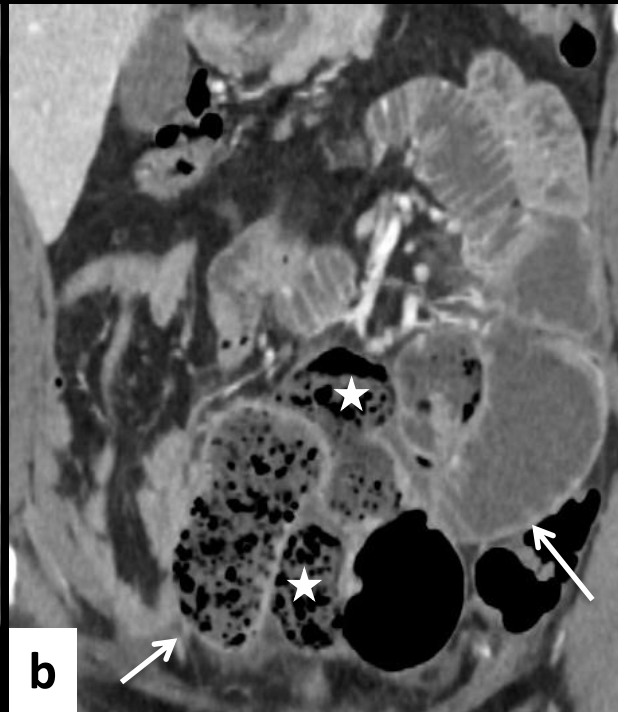
## BOWEL OBSTRUCTION

- Mechanical obstruction may occur by **different mechanisms**:
  - Enterolith ileus
  - Diverticular adhesions, with or without volvulus
  - Intussusception
  - Compression by a large diverticulum
- **CT scans** are challenging to analyze. The transition zone may be difficult to find because the dilated bowel loops and the distended diverticula could be confused.



# COMPLICATIONS

## BOWEL OBSTRUCTION



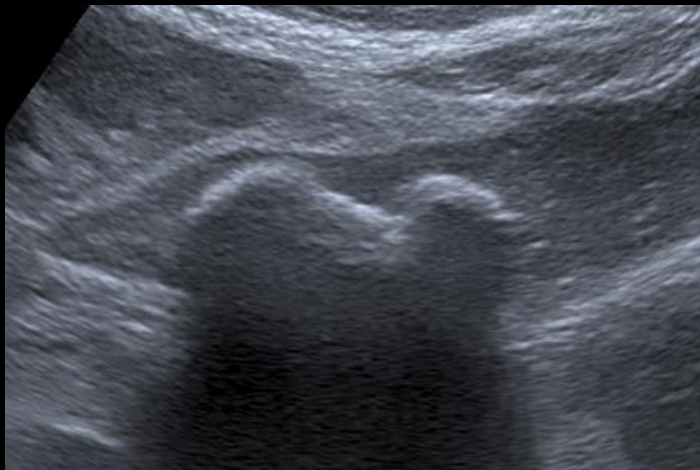
***Adhesive small bowel obstruction in a 33-year-old female with jejunoileal diverticulosis.*** The coronal views (a, b) show dilated small bowel loops partly containing a feces sign (arrows) upstream of a transition zone in right iliac fossa (arrowhead), next to a jejunal diverticulum (point). Some small bowel diverticula (stars) are challenging to individualize. The intraoperative view (c) confirms the adhesive small bowel obstruction (arrows) and the multiple jejunoileal diverticula (stars).



# COMPLICATIONS

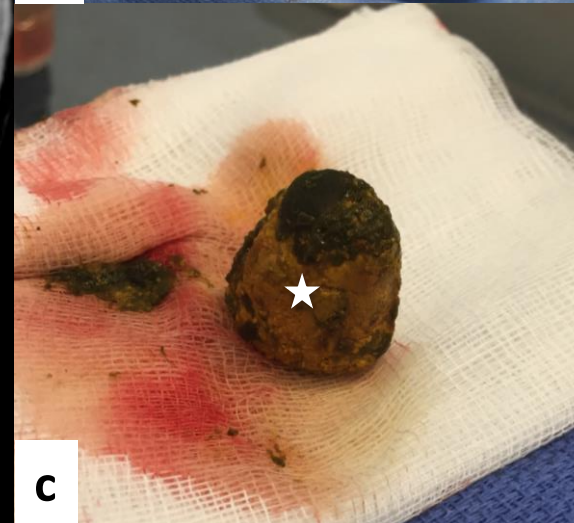
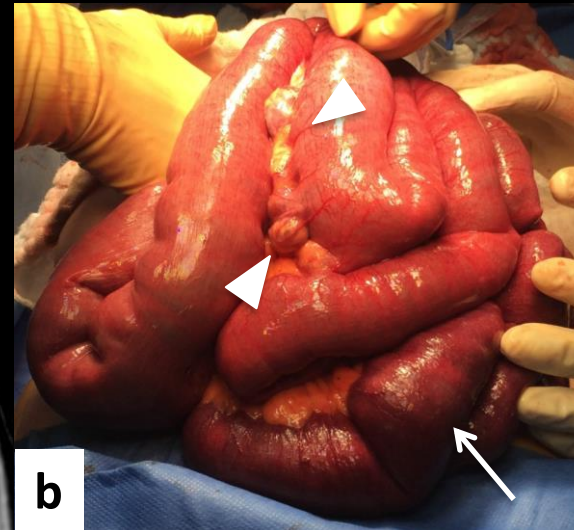
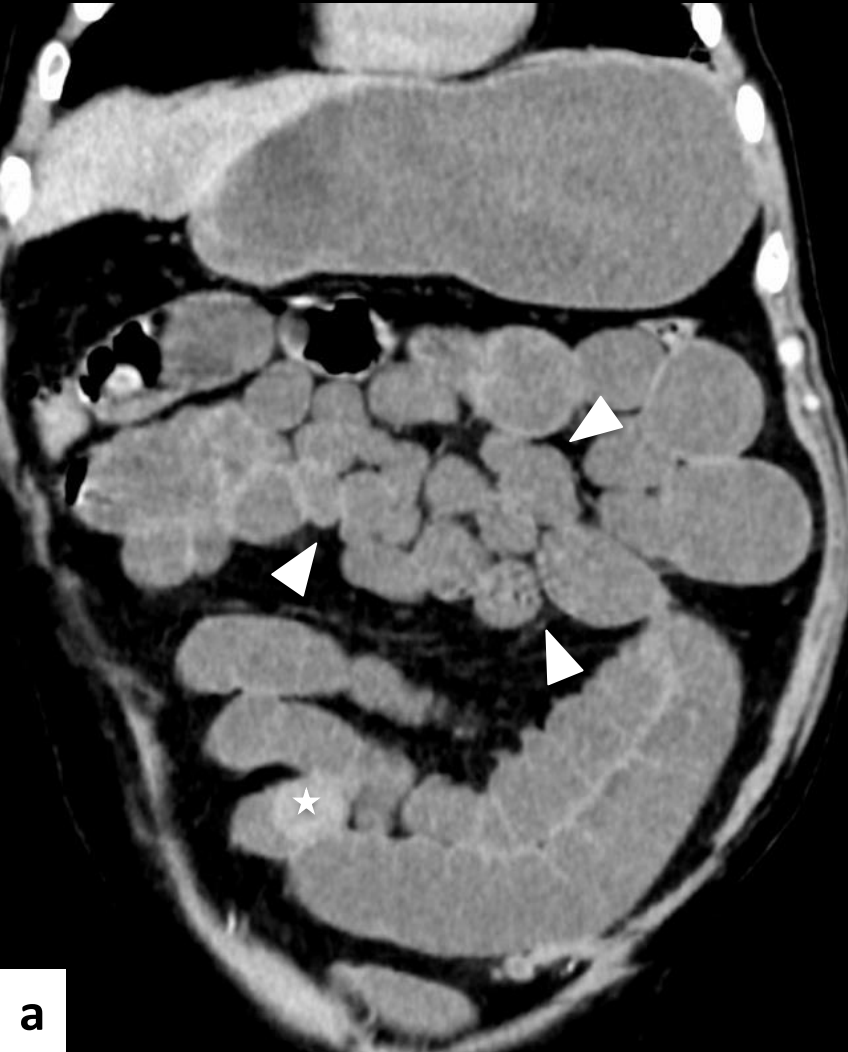
## BOWEL OBSTRUCTION

- **Enterolith ileus** is maybe the most specific mechanism related with jejunoileal diverticulosis.
- Enteroliths in jejunoileal diverticulosis are **true primary enteroliths**, which are formed within the gastrointestinal tract and resulting from the precipitation of substances from the alimentary chyme.
- Concretions formed inside a diverticulum are choleic acid enteroliths, either **de novo or around a bezoar**. Bacterial overgrowth resulting from small bowel dyskinesia may cause deconjugation of bile salts which precipitate to form a nucleus for enterolith formation.
- The **migration of an enterolith** outside a diverticulum can lead to bowel obstruction.



# COMPLICATIONS

## BOWEL OBSTRUCTION



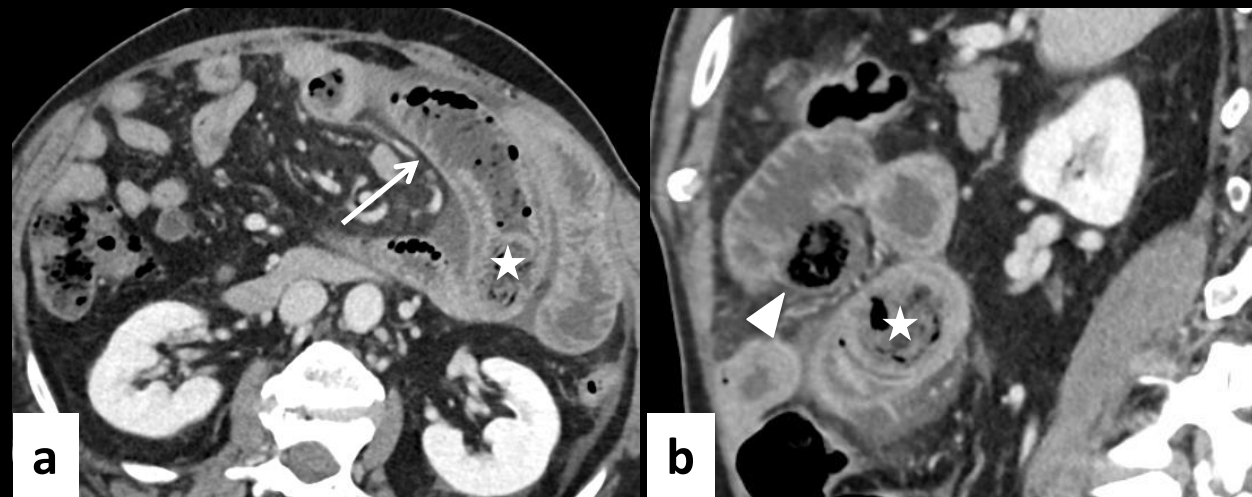
***Enterolith ileus in a 85-year-old male.*** The coronal view (a) shows dilated small bowel loops (arrow) and diverticula (arrowheads) upstream of an endoluminal obstacle (star). The intraoperative view (b) confirms the small bowel obstruction. A surgical enterotomy (c) confirms the endoluminal obstacle corresponding to an enterolith (star).



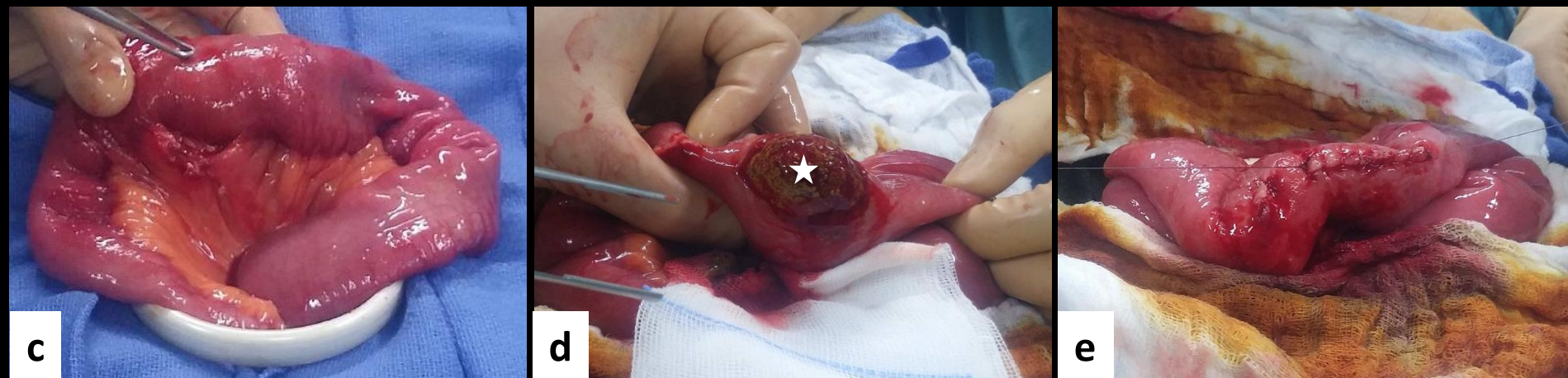
# COMPLICATIONS

## BOWEL OBSTRUCTION

- Surgery** is often necessary, but enterotomy is not mandatory. Manual fragmentation of the enterolith could be enough.



***Enterolith ileus in a 64-year-old male.*** The axial (a) and sagittal (b) CT views show a dilated jejunal loop (arrow) upstream of an enterolith (star), which is probably arising from a jejunal diverticulum (arrowhead). Surgical enterotomy (c, d, e) confirms the enterolith ileus.

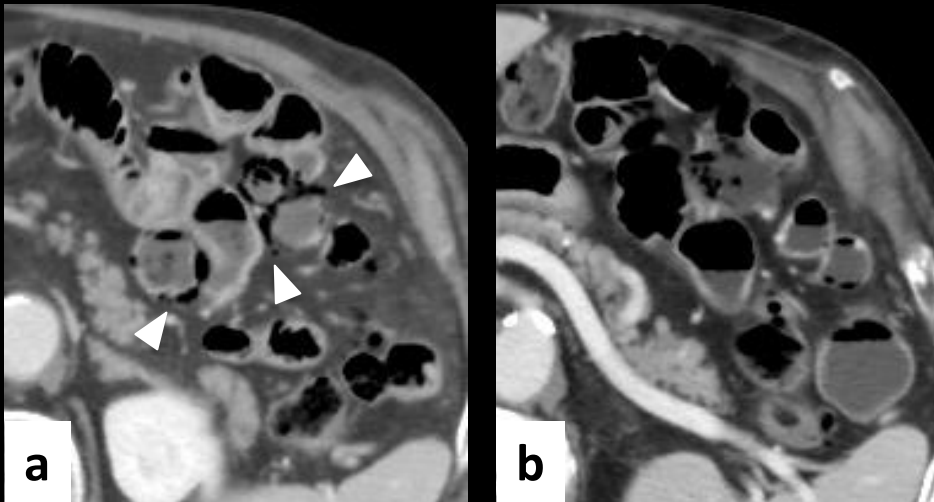




# PITFALLS

## EXTRADIGESTIVE GAS WITHOUT PERFORATION

- Extraintestinal gas can be found in **asymptomatic** patients with jejunoileal diverticulosis.
- Physiopathology remains unclear:
  - The distended diverticular mucosa may function as a **semipermeable membrane** allowing transmural gas equilibration.
  - Some authors explain the gas by a microperforation in the diverticular wall.
- Histological findings close to *pneumatosis cystoides intestinalis* have been found such as subserosal cyst or gas dissection.

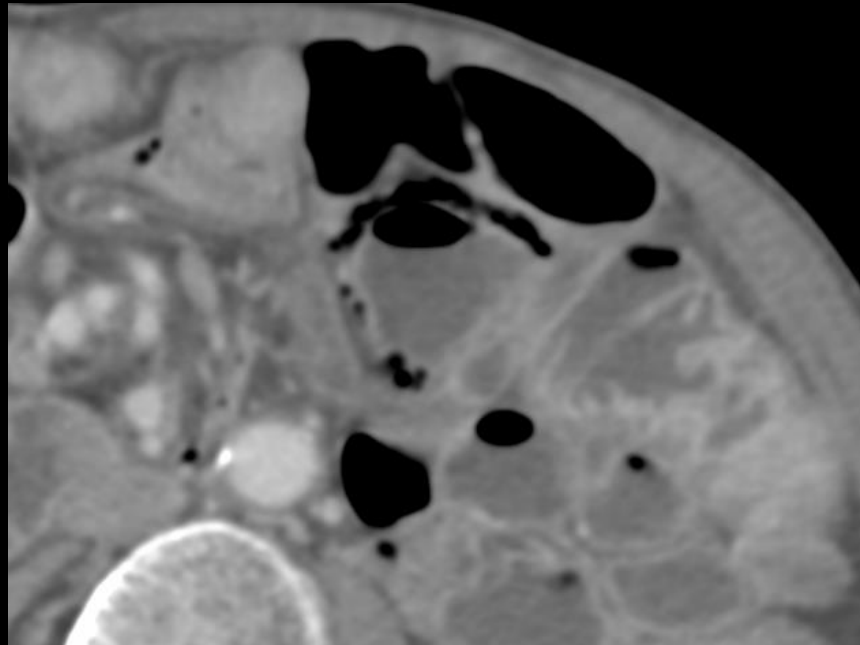


***Extradigestive gas in jejunoileal diverticulosis without perforation in a 79-year-old male.*** The initial axial view (a) shows small gas bubbles (arrowheads) surrounding a small-bowel diverticulum. The diverticular wall is only slightly thickened and the mesentery exhibits no fat stranding or fluid effusion. A CT-scan performed three months later for another indication (b) shows a regression of abnormalities.

# PITFALLS

## EXTRADIGESTIVE GAS WITHOUT PERFORATION

- The most relevant CT sign is **thin gas bubbles surrounding the whole diverticula** without inflammatory changes. Gas bubbles could be rarely seen at a distance also in prehepatic area.

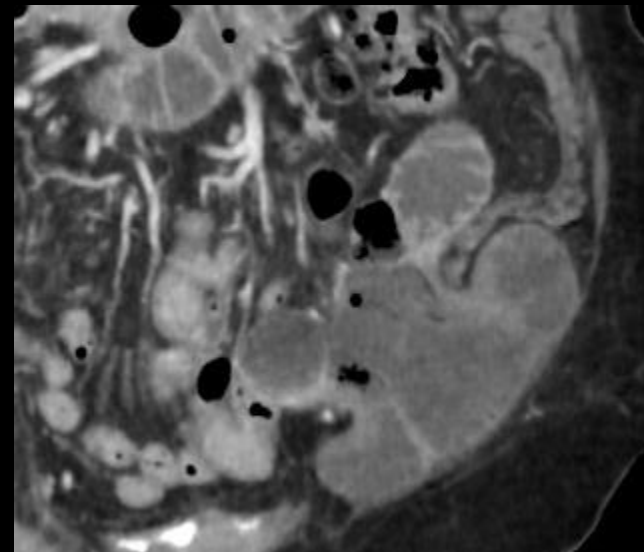
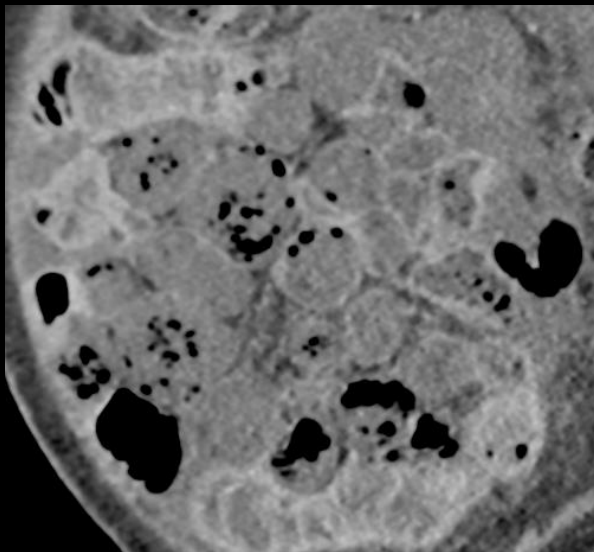


- Precise **clinical assessment** is critical to avoid unnecessary surgery in these cases.
- Most of the time patients are asymptomatic or exhibit non severe symptoms (such as vague abdominal pain or discomfort) without guarding.

# PITFALLS

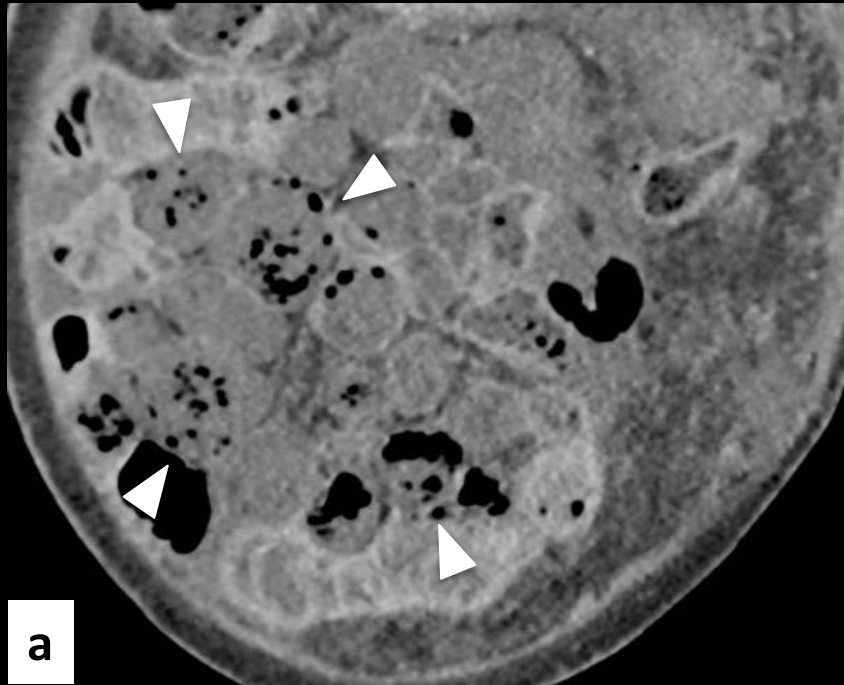
## PSEUDO-ISCHEMIC PRESENTATION

- The **normal wall** of the diverticulum is **virtual** and usually invisible.
- Normal diverticula can **simulate** a lack of enhancement of the small bowel wall.
- Diverticula may contain enteroliths which can **simulate** a feces sign.
- It could be particularly **challenging** when mesenteric ischemia or bowel obstruction are suspected.



# PITFALLS

## PSEUDO-ISCHEMIC PRESENTATION

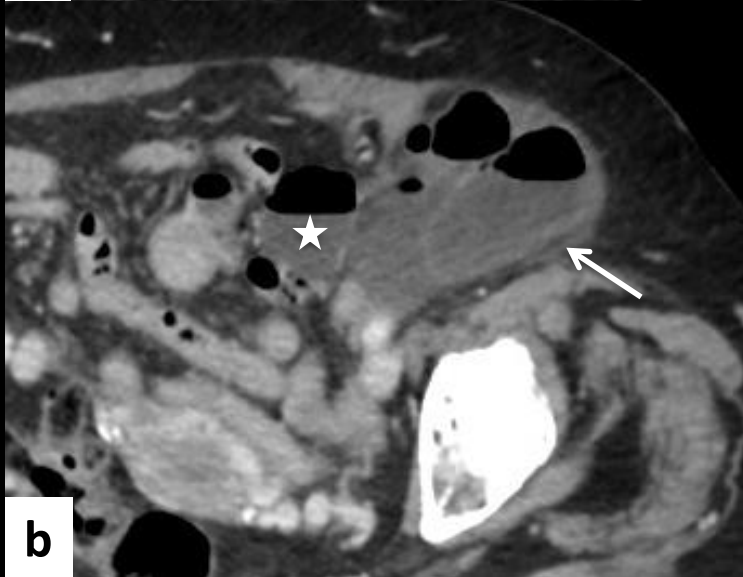
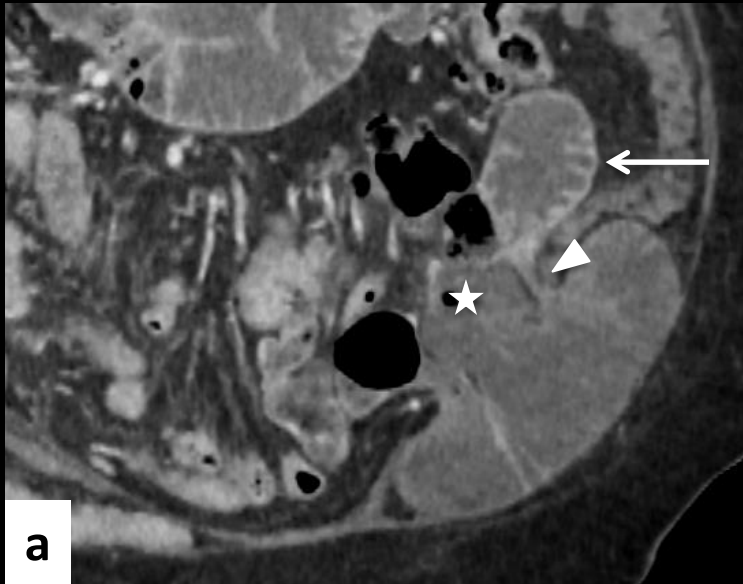


***Non complicated jejunoileal diverticulosis simulating acute mesenteric ischemia in a 73-year-old female with post-cholecystectomy hematoma.*** The coronal view (a) shows multiple jejunal diverticulas (arrowheads) with non enhanced wall. The initial diagnosis was acute mesenteric ischemia. The peroperative view (b) shows a non-ischemic small bowel (arrows) and diverticulas (stars).



# PITFALLS

## PSEUDO-ISCHEMIC PRESENTATION



***Normal jejunal diverticulum simulating bowel ischemia in a 87-year-old female with strangulated external hernia.***

The coronal (a) and axial (b) views show dilated small bowel loops (arrow) upstream of a transition zone in an inguino-interstitial hernia (arrowhead) and a diverticulum with unenhanced wall (stars). The intraoperative view (c) confirms the strangulated inguino-interstitial hernia (arrows) and the jejunal diverticulum (star) without bowel ischemia.

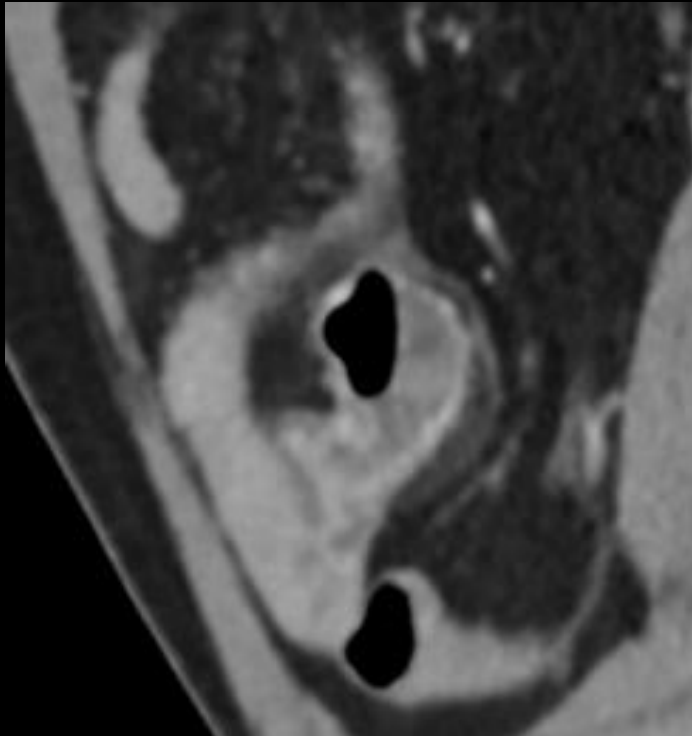
# MAIN DIFFERENTIAL : MECKEL DIVERTICULUM

- Meckel's diverticulum is the most common **congenital** anomaly of the gastrointestinal tract (2-3 % of the population), resulting from an incomplete closing of the **omphalomesenteric duct**.
- It is a **true diverticulum** with all the intestinal layers and can contain heterotopic gastric or pancreatic mucosa in its wall.
- Meckel's diverticulum become most of the time **symptomatic in childhood** (60 % before 10 years of age) and it is admitted that after 20 years of age only 2 % of the Meckel's diverticula will become symptomatic.
- Symptoms are related to **complications**: hemorrhage, diverticulitis, intestinal obstruction, neoplasia within the diverticulum
- The **surgery** is recommended especially in children.



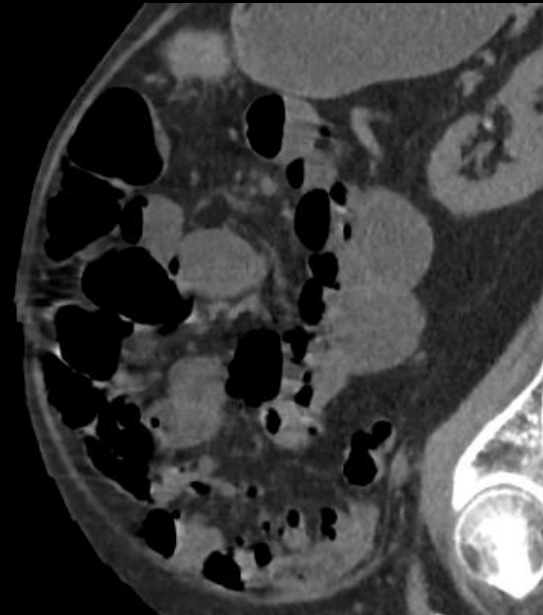
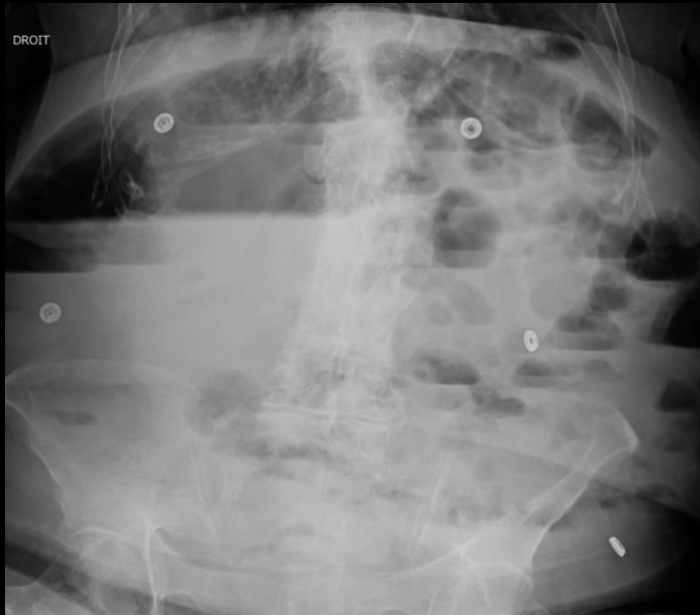
# MAIN DIFFERENTIAL : MECKEL DIVERTICULUM

- Meckel's diverticulum appears on CT scan as a blind-ending outpouching arising from the **antimesenteric side** of the **distal ileum**.
- The visualisation of the **vitellointestinal artery** (which arises from a distal ileal branch of the superior mesenteric artery) is pathognomonic.



# CONCLUSION

- Jejunoileal diverticulosis can lead to life threatening conditions requiring CT-examination. CT-signs of these complications and some pitfalls must be known.
- An accurate CT assessment allows a conservative management of the diseases related to the small bowel diverticula.
- Be aware with jejunoileal diverticulosis. It could simulate many emergencies conditions.



# REFERENCES

- Akhrass et al. Small-bowel diverticulosis, perceptions and reality. J Am Coll Surg 1997.
- Barton et al. Familial jejuno-ileal diverticulitis, a case report and review of the literature. Int J Surg Case Rep 2015.
- Bewes et al. Bile-acid enteroliths and jejunal diverticulosis. Br J surg 1966.
- Chugay et al. Jejunal diverticular disease complicated by enteroliths, report of two different presentations. World J Gastrointest Surg 2010.
- Coulier et al. Diverticulitis of the small bowel, CT diagnosis. Abdom Imaging 2006.
- Dunn & Nelson. Jejunal diverticulosis and chronic pneumoperitoneum. Gastrointest Radiol 1979.
- Edwards. Diverticulosis of the small intestine. Ann Surg 1936.
- Efremidou et al. Enterolith small-bowel obstruction caused by jejunal diverticulosis, report of a case. Surg Today 2006.
- Fintelmann et al. Jejunal diverticulosis, findings on CT in 28 patients. AJR 2007.
- Garnet et al. Enterolith ileus-liberated large jejunal diverticulum enterolith causing small bowel obstruction in the setting of jejunal diverticulitis. Br J Radiol 2011.
- Gurvits et al. Enterolithiasis. World J Gastroenterol 2014.
- Hanna et al. Jejunal diverticulosis found in a patient with long-standing pneumoperitoneum and pseudo-obstruction on imaging, a case report. Gastroenterol Rep 2015.
- Harbi et al. Jejunal diverticulitis, review and treatment algorithm. Presse Med 2017.
- Iwamuro et al. Endoscopic hemostasis for hemorrhage from an ileal diverticulum. World J Gastrointest Endosc 2011.
- Chatterjee et al. Reminiscing on remnants, imaging of Meckel diverticulum and its complications in adults. AJR 2017.
- Kassir et al. Jejuno-ileal diverticulitis: Etiopathogenicity, diagnosis and management. Int J Surg Case Rep 2015.
- Krishnamurthy et al. Jejunal diverticulosis, a heterogenous disorder caused by a variety of abnormalities of smooth muscle or myenteric plexus. Gastroenterology 1983.
- Kwak et al. Uncomplicated jejunal diverticulosis with pneumoperitoneum. Ann Surg Treat Res 2016.

# REFERENCES

- Lacalamita et al. Role of CT in the diagnosis of jejunal-ileal perforations. Radiol Med 2014.
- Lebert et al. Acute Jejunoileal diverticulitis, multicenter descriptive study of 33 patients. AJR 2018.
- Lempinen et al. Jejunal diverticulosis, a potentially dangerous entity. Scand J Gastroenterol 2004.
- Levy et al. Meckel diverticulum, radiologic features with pathologic correlation. Radiographics 2004.
- Liu et al. Analysis of clinical manifestations of symptomatic acquired jejunoileal diverticular disease. World J Gastroenterol 2005.
- Longo et al. Clinical implications of jejunoileal diverticular disease. Dis Colon Rectum 1992.
- Maglinte et al. Acquired jejunoileal diverticular disease. Radiology 1983.
- Makris et al. Small intestinal nonmeckelian diverticulosis. J Clin Gastroenterol 2009.
- Mansoori et al. Magnetic resonance enterography/enteroclysis in acquired small bowel diverticulitis and small bowel diverticulosis. Eur Radiol 2016.
- Meagher et al. Jejunal diverticulosis. Aust N Z J Surg 1993.
- Palder & Frey. Jejunal diverticulosis. Arch Surg 1988.
- Park & Lee. The management of terminal ileum diverticulitis. Am Surg 2009.
- Transue et al. Small bowel diverticulitis, an imaging review of an uncommon entity. Emerg Radiol 2017.
- Yen et al. Diagnosis and management of jejunoileal diverticular hemorrhage, a decade experience. J Dig Dis 2012.

# AUTHORS INFORMATIONS

Dr. Paul LEBERT, MD (plebert17@gmail.com)

Department of Gastrointestinal Imaging, Lille University  
Hospital, Rue Michel Polonoski, Lille Cedex 59037, France