Complicated Jejunoileal Diverticulosis: An Unexpected Diagnosis

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Learning objectives

This work aims to provide a thorough and comprehensive literary review of jejunoileal diverticulosis (JID) and its most common complications, including diverticulitis, bowel perforation, hemorrhage and intestinal obstruction, with emphasis on the medical imaging aspect of diagnosis.

We also present a case series of complicated JID diagnosed in our tertiary referral hospital.
Background

Introduction:

Acquired jejunoileal diverticulosis (JID) is a relatively rare clinical entity of elderly people. The majority of cases are asymptomatic and found incidentally. Only a few cases present with chronic non-specific abdominal symptoms and acute complications, which include diverticulitis, perforation, hemorrhage and intestinal obstruction. Their relative clinical rarity and varied presentation may make diagnosis both delayed and difficult, resulting in unnecessary morbidity and mortality. Different imaging techniques can be used to demonstrate small bowel diverticula, but CT is mostly used if complications are expected. Clinical presentations, diagnosis, complications and treatment of JID are discussed through a review of the literature and report of a case series.

History and epidemiology:

The JID was first described by Sommering and Baile in 1794, followed by Astley Cooler in 1809, as herniation of the mucosa and the submucosa from the inside of the muscular layer of the bowel wall on the mesenteric side of the intestine. Osler is credited with the initial series of patient reports in 1881 and Gordinier and Sampson described the first patient to undergo an operation for jejunal diverticulosis in 1906 [1].

Early reports were simply presented as findings, anatomical variants of no clinical significance. Little fanfare accompanied these reports until the late 19th century, when some of the fathers of modern surgery including Osler, Virchow and Laterjet added case reports and published notes on the condition [2].

Acquired diverticula of the jejunum and ileum are an uncommon entity, with a reported prevalence of 0.3% - 1.9% on small bowel studies and 0.3% -1.3% at autopsy studies. [3,4]. Their true incidence of the diverticula is unknown, but most likely they are under-diagnosed [5].

The prevalence increases with age, peaking at the sixth and seventh decades. A higher incidence had been reported in men than in women [6], but more recent data suggests a possible reversal in the sex distribution [7]. Because of the small number of patients in any one of the series, it is difficult to collect enough data to determine a clear pattern of gender distribution [8,3].
JID represents a wide spectrum of disease. On one side of the spectrum, it may present as solitary diverticula; on the other extreme, it may present with near pan-intestinal diverticulosis. Approximately two-thirds of patients will have multiple diverticula [1].

Eighty percent of jejunoileal diverticula are localized to the jejunum, 15% to the ileum, and 5% to both. Their size varies from a few millimetres to more than 10 cm. The diverticula have a tendency to be smaller and fewer as one progresses distally in the small bowel, so diverticula in the jejunum tend to be large and multiple, whereas those in the ileum are small and solitary [7]. Complications tend to occur more frequently in patients with multiple diverticula than those with a solitary one [1].

**Pathophysiology:**

JID is considered an acquired abnormality of the small bowel, the pathogenesis is believed to involve an acquired defect of the intestinal smooth muscle or myenteric plexus [7].

These diverticula are characterized by herniation of mucosa and submucosa through the muscular layer at the point where blood vessels penetrate the intestinal wall (pulsion-type pseudodiverticula). This explains their typical location at the mesenteric side [9]. JID is usually multiple, more frequently located in the jejunum and in the terminal ileum, probably due to the larger size of the vasa recta at these areas [5].

Abnormal peristalsis, intestinal dyskinesia and high segmental intraluminal pressure are considered the causes of intestinal diverticulum [10]. On histological analysis, Edwards found disruption of the muscularis mucosae by the vasculature resulting in a weakening in the wall, or as he termed it "locus minoris resistentia" [11], a weak point that allows mucosal extrusion from the lumen, resulting in the "out-pouching."

The current hypothesis focuses on abnormalities in the smooth muscles or myenteric plexus. Careful microscopic evaluation of jejunal specimens with diverticula has shown that these abnormalities are of three types: fibrosis and decreased numbers of normal muscle cells consistent with progressive systemic sclerosis, fibrosis and degenerated smooth muscle cells suggestive of visceral myopathy and neuronal and axonal degeneration indicative of visceral neuropathy. Any of these abnormalities could lead to distorted smooth muscle contractions of the affected small bowel generating increased intraluminal pressure. Consequently mucosa and submucosa would pass through the weakest mesenteric site in the bowel wall [11].

A correlation between intestinal diverticulosis and rare neuro-muscular disorders, such as mitochondrial neurogastrointestinal encephalomyopathy and Elhers-Danlos syndrome,
has been described [12,13]. Furthermore some diseases, such as progressive systemic sclerosis and amyloidosis, are associated with jejuno-ileal diverticulosis. Indeed, lesions of the extracellular matrix lead to intestine dysmotility disorders that cause an increase in intraluminal pressure and, therefore, the formation of bowel diverticula.

Associated diverticula in other parts of gastrointestinal tract and even urinary bladder is another part of the disease. Co-existent diverticula can be present in the colon in 35-75%, of patients; in the duodenum in 15-42%, in the oesophagus in 2%, in the stomach in 2%, and in the urinary bladder in 12% of cases [14, 3].

**Clinical presentations:**

More than 60% of patients with jejunoileal diverticula reported in the literature, have been asymptomatic, another 30% minimally symptomatic, and only 10% have developed serious complications [8,3].

Chronic symptoms included intermittent abdominal fullness, vague abdominal discomfort or pain, passage of oily stool, weight loss, and weakness, which resolve after treatment. These might have been caused by pseudo-obstruction or bacterial overgrowth [15,16].

Usually the disorder is clinically silent until it presents with complications. Acute complications of diverticula include diverticulitis with or without perforation, hemorrhage, and intestinal obstruction [8]. Other complications such as abdominal abscesses, fistulas and hepatic assesses are possible [9]. The signs and symptoms of acute complications of JID are nonspecific, these included abdominal pain, nausea and vomiting, fever and lower gastrointestinal bleeding, among others.

Unless the presence of diverticula is know before the patient becomes ill, the diagnosis will not be evident until discovered by a imaging study or surgical exploration. Diagnosis such as cholecystitis, colonic diverticulitis, complicated peptic ulcer disease and acute appendicitis will be the primary diagnostic considerations in these patients [14].

**Complications:**

The majority of patients with JID are asymptomatic [10]. Complicated JID is relatively rare. Complications related to the diverticula occur in about 15% to 20% of patients and complications or symptoms requiring surgery have been reported to occur in up to 10% [3,5].

1. **Diverticulitis**
The most frequent acute complication of the JID is diverticulitis with or without perforation, occurring in 2.3% to 6.4% of cases [3,17,18].

Inflammation can present with a broad range of severity. There are no pathognomonic signs or symptoms of small-bowel diverticulitis. Instead, the spectrum of complaints can range from mild abdominal discomfort to frank diffuse peritonitis and sepsis [32]. Often, it will mimic other more common inflammatory causes for an acute abdomen such as perforated peptic ulcer, acute appendicitis, acute cholecystitis, or colonic diverticulitis [1,19,20].

CT is the most important method of imaging to both differentiate diverticulitis from the other causes of acute abdomen and detect complications of diverticulitis such as abscess formation or perforation [21].

At CT, small bowel diverticulitis usually presents as a focal area of bowel wall thickening, most prominent on the mesenteric side of the bowel with adjacent inflammation. The inflamed diverticulum could be seen as a focal out-pouching on the mesenteric side of the bowel [22]. When an abscess is present, CT findings may include relatively smooth margins, areas of low attenuation within the mass, rim enhancement after IV contrast administration, gas within the mass, displacement of the surrounding structures, and edema of thickening of the surrounding fat or fascial planes [23]. The findings of a gas-containing mass associated with a nearby diverticulum are suggestive of small-bowel diverticulitis.

The differential diagnosis includes perforated neoplasm, foreign body perforation, small-bowel ulceration from non-steroidal anti-inflammatory drug use, Crohn’s disease, and traumatic hematoma [22,23]:

- **Perforated neoplasms** can be difficult to distinguish from jejunal diverticulitis. The most likely neoplasm to perforate would be lymphoma. However, lymphoma typically presents on CT as a segmental area of abnormality as opposed to a focal lesion.

- **Foreign body perforation** should be considered in the differential diagnosis of a focal inflammatory process affecting the jejunum. In most cases the perforation is due to a fish bone or other ingested material. At CT a thin linear or curvilinear density is usually noted at the site of the perforation representing the foreign body.

- **Small bowel ulcerations** from nonsteroidal anti-inflammatory drug use usually occur in the stomach or ileum but may occur anywhere in the small bowel. The appearance of a focal medication-induced ulceration with adjacent inflammation could look very similar to perforated diverticulitis.

- **Crohn’s disease:** Although usually affects the terminal ileum, isolated small bowel involvement in the jejunum may occur. Usually the process is
segmental and not focal and presents with fibro-fatty proliferation, prominent vasa recta (comb sign), and skip areas are often present.

- **Traumatic hematoma** usually cause marked focal or segmental mural thickening. There may be hemorrhage in the adjacent mesentery and occasionally foci of intraperitoneal gas if the bowel has perforated. Because of the history of recent trauma, acute hematoma is unlikely to be confused with jejunal diverticulitis.

2. Perforation

Simple diverticulitis can progress to frank gangrene with full-thickness necrosis and perforation. Perforation can occur in this setting and carries a mortality rate as high as 40 per cent in some series. However, perforation is not always the result of advanced inflammation. Foreign body and traumatic perforation has also been described [1].

Perforation presents either with localized or generalized peritonitis. The location of these diverticula at the mesenteric border predisposes them to perforation within the leaves of the mesentery, which may lead to localized findings that evade radiographic diagnosis [24]. A high index of suspicion must be maintained in the workup of these findings.

In the presence of perforation, CT is the most effective method for detecting intraperitoneal gas [21]. Although free perforation is easier to diagnose, delay in the diagnosis of contained perforation can lead to sepsis or multi system organ failure, especially in the elderly [24], with a high mortality in up to 40% of patients [25].

3. Diverticular bleeding

In general small bowel bleeding accounts for only 1.4% of all gastrointestinal hemorrhages, and bleeding caused by JID accounts for an even smaller percentage [24]. Gastrointestinal hemorrhage is a well-documented complication of JID [3,18,26]. Bleeding is a consequence of acute diverticulitis, due to the erosive effects of the inflammation and occurs in almost 2% of the cases [26]. It manifests as rectal bleeding or melena, although hematemesis has been reported [24]. The bleeding may also be chronic and present as iron deficiency anaemia. Massive gastrointestinal hemorrhage from jejunal diverticula is extremely rare. However, it has been associated with high mortality rate caused by delayed diagnosis.

The preoperative diagnosis of small-bowel hemorrhage is difficult and the frequent coexistence of colonic diverticulosis contributes to this diagnostic problem [17,18]. Unfortunately, neither the history nor the physical examination are helpful in the diagnosis. Furthermore, the acute hemorrhage is likely to recur if the diagnosis is missed at the initial presentation.
Bleeding source in the small intestine is often impossible to find it endoscopically, although there are some reports showing success with capsule endoscopy and double balloon endoscopy [27]. The utility of these examinations are however limited in emergency situations.

Non-invasive imaging with technetium-99m (Tc-99)-labelled red blood cell scintigraphy can be used to detect and localize gastrointestinal bleeding. It has been reported to have a sensitivity of 93% and specificity of 95% for detecting a bleeding site with bleeding rate as low as 0.2 mL/min [19]. However, Tc-99 scintigraphy has a false localization rate of approximately 22%, which limits its value as a diagnostic test [28].

Mesenteric angiography can detect bleeding rates greater than 0.5 mL/min and has the advantage of therapeutic intervention through transcatheter embolization, but it has a sensitivity of 40% - 86%. Angiographic embolization has been successful in some cases, but carries the risk of ischemia [28].

However, in patients with ongoing lower gastrointestinal bleeding or with negative or inconclusive endoscopy, the preferred diagnostic approach is abdominal CT angiography in attempt to localize the source of hemorrhage [28]. CT angiography is a time-efficient, cost effective, and accurate tool in the diagnosis or exclusion of acute gastrointestinal bleeding. Arterial phase CT angiography can depict active extravasation of contrast material into the intestinal lumen, a finding diagnostic of ongoing gastrointestinal bleeding. CT angiography can thereby pinpoint the location of the bleeding source, and direct further management [28].

4. intestinal obstruction

JID may also be complicated by intestinal obstruction. Mechanical intestinal obstruction occurs in 2.3 to 4.6% of cases of jejunoileal diverticulosis [1,29].

This may be the result of pressure on the intestinal wall from distended diverticula, stricture or adhesion from recent or past diverticulitis, intussusceptions at the site of diverticulum, or volvulus of the diverticula-containing segment. In addition enteroliths developed within the diverticula may apply pressure to the adjacent bowel wall or may escape from the diverticulum causing intestinal occlusion [15,29,30].

Small bowel dyskinesia, caused by bacterial overgrowth, visceral myopathy, or neuropathy may induce pseudoobstruction [31]. Pseudoobstruction is in fact a more common complication than mechanical obstruction and has been reported in 10-25% of cases [32].
**Imaging Diagnosis:**

Suspicion of JID is difficult and often the diagnosis is missed or delayed. Considering that jejunal diverticulosis is asymptomatic for a long time in most of the cases, diagnosis is usually made when the disease becomes symptomatic or complicated [26, 33].

While endoscopy remains a mainstay of evaluation for colonic diverticulosis, the Jejunum is difficult to examine using the endoscopic methods; therefore, the radiographic diagnosis of these diverticula is the diagnostic tool of choice [6]. Diagnosis of complications is often difficult and is performed mainly by imaging studies:

- **ULTRASOUND:** It is possible to detect JID by abdominal ultrasound, an inexpensive and convenient imaging test that can be used as the first screening method for acute abdominal pain. It can reveal thickening of the walls of the intestinal loops in the upper left quadrant, increased echogenicity in the surrounding fat tissues, and diverticula. Free fluids may also accompany to the findings [34]. However, there are limitations to this diagnostic tool like the presence of meteorism or adiposity, furthermore the typical inhomogeneous process located close to the bowel wall with unspecific irregular formation in relation to the small bowel can often not be visualized. Thus, ultrasound alone is not a suitable diagnostic method [35].

- **CT:** Abdominal CT is the diagnostic tool of choice even if it's not possible to identify all small bowel diverticula [14]. It has become the mainstay of diagnosis of JID, secondary to its wide availability [18]. CT should be performed in the abdomen and pelvis with oral contrast to determine the extent of diverticulosis, as well as IV contrast to assess for evidence of complicated JID such as focal areas of outpouching of the mesenteric side of the bowel with localized intestinal wall thickening due to inflammation or edema, fat stranding, abscesses, free abdominal fluids, pneumoperitoneum and hemorrhage [33,26]. CT is usually obtained in patients with acute abdominal pain, especially when a clinical diagnosis is not readily established. When a focal inflammatory process is present in and adjacent to a loop of jejunum, a number of entities should be considered in the differential diagnosis. The most common abnormalities to cause focal thickening and adjacent inflammation of the small bowel are neoplasms with or without perforation, focal Crohn’s disease, foreign body perforation, medication-induced ulceration, traumatic hematoma, and jejunal diverticulitis [22].

- **MRI:** Magnetic resonance imaging (MRI) and enterography (MRE) use is becoming more widespread in the United States [18]. MR has the advantage of improved so tissue evaluation over CT scan, but carries disadvantages of time and cost. Additionally, patients with claustrophobia tolerate MR
poorly due to the smaller tube used during imaging [2]. However particularly in young or pregnant patients, MRI should always be considered as an alternative to prevent ionizing radiation.

- **ENTEROCLYSIS**: Enteroclysis by fluoroscopy, CT or MR carries improved diagnostic accuracy [18]. The infusion of either single or double-contrast with water-soluble fluid and air can demonstrate diverticula throughout the bowel. Despite this, the benefit of enteroclysis over CT scan is limited, as improved delineation of the diverticula is unlikely to change the plan of management. Additionally, enteroclysis requires the placement of a nasoenteric tube, and is poorly tolerated by patients. Owing to these disadvantages; the authors do not recommend the routine use of enteroclysis in the evaluation of JID [2].

- Nuclear medicine tagged red blood cell studies and angiography may be of diagnostic value in the setting of active hemorrhage, but have little value in non-bleeding patients [2].

**Treatment:**

As most people with JID are asymptomatic, reassurance remains the treatment for the majority this patient population.

**Chronic symptoms:**

Conservative treatment of chronic symptoms involves nonspecific measures such as highprotein and low-residue diet, vitamin supplementation, antispasmodics, antidiarrheal agents, antacids, and analgesics [17,15]. However, patients who develop persistent, unremitting symptoms or those who are discovered to have large, dilated diverticula, suggestive of a progressive form of diverticular disease, may benefit from resection [1,15]. In these patients, resection is should be considered as a last resort as resection carries a disproportionally higher morbidity and mortality [18].

Patients with malabsorption, steatorrhea, and megaloblastic anemia resulting from vitamina B12 deficiency secondary to bacterial overgrowth can be treated medically with antibiotics. Tsiotos et al reported that patients with symptomatic malabsorption were treated with a two-week antibiotic regiment resulting in 75% resolution of symptoms [17]. However, a small fraction of patients will eventually require surgical management for refractory symptoms [1].

Patients with known JID should be cautioned with regards to the symptoms previously outlined in situations where acute complications are suspected, including pain, signs of hemorrhage, and infection.
**Acute complications:**

Acute jejunoileal diverticulitis can be treated non-operatively in the absence of sepsis and peritonitis. Antibiotics, fluid resuscitation and bowel rest lead to improvement in symptoms in 75 percent of patients [17], so conservative treatment can be the treatment of choice. In these patients, resection is should be considered as a last resort as resection carries a disproportionally higher morbidity and mortality [18].

Exploratory laparotomy and resection of affected intestinal segment with primary anastomosis is mandatory in case of diverticulitis with peritonitis or severe sepsis, perforation, abscesses and obstruction. The extent of the segmental resection depends on the length of the bowel affected by diverticula. If diverticula involve a long intestinal segment, as commonly happens, the resection should be limited to the perforated or inflamed intestinal segment in order to avoid a short bowel syndrome [33].

Patients with hemorrhage should be admitted, with prompt and goal-directed resuscitation. Reversal of any anticoagulation may lead to spontaneous resolution of the bleeding. Angiography carries the added benefit of allowing either embolization of the site of bleeding, or administration of methylene blue or other compounds to dye the area of hemorrhage and aid surgical resection. In patients with refractory bleeding, operative intervention with either diverticulectomy or bowel resection is mandatory, as endoscopic intervention is unlikely to stop hemorrhage in the small bowel [36].

**Prognosis:**

The diagnosis of complicated JID is often difficult and delayed, resulting in unnecessary morbidity and mortality. Because of its delayed presentation and diagnosis it carries a very high reported mortality of 25 to 40%, considering most of these patients are elderly and have multiple co-morbid diseases [37]. However, the mortality has been minimized because of the amelioration of the diagnostic, pharmaceutical and surgical protocols.

One should also keep in mind that diverticula may recur in a patient undergone a segmental intestinal resection for diverticulosis since the mechanism of diverticula formation (neuropathy, myopathy etc.) still remains [33]. Early diagnosis and prompt treatment decreases the complication incidence and the need for surgical interventions [34].
Findings and procedure details

We retrospectively reviewed 34 cases of complicated JID identified in our tertiary referral hospital between 2010 and 2016 by means of multidetector computed tomography (MDCT), including 18 women (53%) and 16 men (47%), aged between 53 - 87 years (mean age of 77 years).

All patients underwent abdominal and pelvic CT examinations because of acute abdominal pain and other symptoms associated. CT images were routinely obtained with the patient in a supine position during full inspiration. Axial images were obtained at 2mm slice collimations and reconstructed with a soft-tissue algorithm, with coronal and sagittal reformatting of the images.

Clinical presentation:

Clinical symptoms and signs were unspecific, the most common manifestation was abdominal pain that occurs in all patients (100%), followed by nausea and vomiting (53%). Other associated symptoms were: constipation (29%), fever (26%), acute diarrhea (21%), abdominal distension (18%) and lower gastrointestinal bleeding (12%).
At physical examination, most patients had abdominal pain (95%) and abdominal defense (80%) and two patients presented with swelling, erythema, tenderness and focal cutaneous induration, suggestive of abscess.

These results confirms that the signs and symptoms of acute complications of JID are nonspecific and the diagnosis will not be evident until discovered by a imaging study or surgical exploration.

**Imaging findings:**

In all cases of complicated JID, CT delineated the location and extent of disease, and in the case of patients treated with surgery, the diagnosis was suggested preoperatively based on the CT findings.

The main CT findings that allowed a diagnosis of complications were: segmental small-bowel wall thickening (100%), adjacent fat stranding (100%), diverticulum with inflammatory changes (88%), presence of neighbors diverticula (76%), extraluminal air (26%), intra-abdominal free fluid (35%), collections (12%), diverticular bleeding (12%) and hemoperitoneum (3%).
CT scans revealed correctly tomographic findings of JID and its complications. Jejunal in 30 patients (88%) and ileal in 4 patients (12%), This is not surprising since, as described in the literature, jejunal diverticula are more frequent than ileal diverticula. Concomitant diverticula in other locations were also identified: in the colon (85%), duodenum (65%), stomach (9%) and in the urinary bladder (6%).

**Complications:**

The most frequent complication of JID was simple diverticulitis that occurred in 18 patients (53%), while complicated diverticulitis was found in 16 patients (47%), of which nine suffered perforation, four had diverticular bleeding, four formed collections, two had enterocutaneous fistula, and one had hemoperitoneum. These findings are consistent with the literature regarding the most frequent acute complication of the JID is diverticulitis with or without perforation.
1. Simple diverticulitis (Fig. 4 on page 18, Fig. 5 on page 18, Fig. 6 on page 19, Fig. 7 on page 20, Fig. 8 on page 21, Fig. 9 on page 22):

Simple diverticulitis was the main manifestation of the JID. These patients received only medical treatment, some patients were hospitalized and treated with intravenous antibiotics for some days and others patients were discharged and treated with outpatient oral antibiotic, according to medical criteria.

These patients evolved satisfactorily with resolution of their symptoms, except one patient treated with outpatient oral antibiotic who returned eight days later to the emergency room with persistent symptoms, a second CT scan with intravenous contrast was performed showing an increase of inflammatory signs, as well as an increase of free intraperitoneal fluid (Fig. 7 on page 20). Because these findings and to a significant increase in leukocytosis and C-reactive protein (CRP), a surgical intervention was performed with resection of the affected intestinal segment and primary end to end anastomosis.

2. Complicated diverticulitis:

- Perforation: (Fig. 10 on page 23, Fig. 11 on page 24, Fig. 12 on page 25, Fig. 13 on page 26).
Perforation was the main complication observed in patients with complicated jejunoileal diverticulitis. It was identified by the presence of inflammatory changes in relation to diverticulitis, associated with the presence of extraluminal air within the leaves of the mesentery or intraperitoneal free air. These patients were mostly treated by surgery. Only one patient was treated with conservative management due to high surgical risk. All patients had good clinical and radiological outcomes. Only one patient died 6 days after surgery due to medical complications unrelated to surgery (acute decompensated heart failure).

- **Diverticular bleeding:** (Fig. 14 on page 27, Fig. 15 on page 28).

Four patients presented to the emergency room with abdominal pain and lower gastrointestinal bleeding. An abdominal angio-CT scan was performed in each case demonstrating contrast extravasation from a jejunal diverticulum, corresponding to active bleeding. These patients were treated with embolization or surgery according to medical criteria, with resolution of bleeding and a favorable outcome.

- **Collections:** (Fig. 16 on page 29, Fig. 17 on page 30).

Four patients presented focal fluid collections adjacent to the diverticular inflammatory process. These patients were hospitalized and treated with intravenous antibiotics, with resolution of symptoms and good clinical outcome.

- **Enterocutaneous fistula:** (Fig. 18 on page 31, Fig. 19 on page 32, Fig. 20 on page 33).

Although fistulas between the small bowel, colon and bladder have been described as a complication of diverticulitis, we didn't find any patient with these fistulas, nevertheless we found two patients with enterocutaneous fistula secondary to jejunal and ileal diverticulitis. These patients were treated with systemic antibiotic therapy and drainage of abscess, with clinical improvement.

- **Hemoperitoneum:** (Fig. 21 on page 34).

One patient presented to the emergency department with a 4-day history of progressive abdominal pain, diarrhea, nausea, and vomiting. During the first hours after admission presented pallor and hypotension, a CT scan was performed showing signs of jejunal diverticulitis with high-density peritoneal fluid consistent with hemoperitoneum. No active bleeding point was seen. The patient rapidly developed hypovolemic shock and died despite resuscitation attempts.

- **Intestinal obstruction:**

We didn't find any patient with intestinal occlusion compared with the frequency described in previous reviews.
Prognosis

The vast majority of patients (94%) with complicated JID showed good clinical evolution. Only two patients had an unfavorable evolution. Therefore an early diagnosis of complicated JID is important in order to achieve a proper and early treatment.
Fig. 4: Jejunal diverticulitis: A 79-year-old woman presented to the emergency department with abdominal pain for the last 24 hours. CT scan showed an ovoid inflammatory process, in close relation with the jejunum and with surrounding inflammatory changes (green arrows). The patient was diagnosed of uncomplicated jejunal diverticulitis. A barium study after three weeks revealed several duodeno-jejunal diverticula (red arrows) and no other pathological processes.

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Fig. 5: Jejunal diverticulitis: A 83-year-old woman presented to the emergency department with a 48-hour history of generalized abdominal pain, nausea and vomits. CT scan was performed and showed a focal inflammatory process along the mesenteric surface of a loop of the jejunum, surrounding an inflamed jejunal diverticulum (green arrows). The patient was diagnosed of uncomplicated jejunal diverticulitis. Two months later, a barium study was performed and showed multiple diverticula in the proximal jejunum (red arrows).

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**Fig. 6:** Jejunal diverticulitis: A 60-year-old man presented to the emergency department with abdominal pain of three days of evolution accompanied by vomiting and fever. CT scan was performed and showed a 4 cm jejunal diverticula (green arrows) with mural thickening and moderate mesenteric fat stranding. The patient was diagnosed of uncomplicated jejunal diverticulitis and was treated with antibiotic medication. One week later a control CT was performed, demonstrating a decrease in the size of the diverticulum but with persistent inflammatory changes (red arrows). The antibiotic treatment was adjusted with clinical improvement. One month later a control CT scan was performed and showed that diverticulitis findings were regressed. (yellow arrows).

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Fig. 7: Jejunal diverticulitis: A 71-year-old man presented to the emergency room with a 2-day history of abdominal pain. CT scan was performed and showed a 4 x 5 cm jejunal diverticula with mural thickening and mild surrounding fat stranding (green arrows), without free fluid or extraluminal air. The patient was diagnosed of uncomplicated jejunal diverticulitis and was treated with intravenous antibiotic with clinical improvement and was discharged. However, he returned eight days later with worsening symptoms, a second CT scan was performed showing an increase of inflammatory signs, as well as an increase of free intraperitoneal fluid (red arrows).

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**Fig. 8:** Jejunal diverticulitis: A 83 year-old man presented to the emergency department with a 4-day history of progressive left flank pain. Abdominal CT images showed a focal inflammatory process along the mesenteric surface of a loop of the jejunum. The process appears to be centred on an inflamed jejunal diverticulum (red arrows). The patient was diagnosed of uncomplicated jejunal diverticulitis and was treated with intravenous antibiotic with clinical improvement.

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Fig. 9: Ileal diverticulitis: A 65 year-old man presented to the emergency room with a 3-day history of lower abdominal pain, and vomiting. CT scan was performed. Axial, coronal and sagittal CT images show an ovoid inflammatory process (red arrows), in close relation with the ileum, with wall thickening and marked mesenteric fat stranding (green arrow).

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Fig. 10: Perforated jejunal diverticulitis: A 70 years old man presented to the emergency department with a 3-day history of left iliac fossa pain and vomiting. CT scan was performed and showed an ovoid inflammatory process, in close relation with the jejunum (red arrows), with wall thickening, surrounding mesenteric fat stranding and extraluminal air.

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Fig. 11: Perforated jejunal diverticulitis: A 84 year-old woman presented to the emergency department with a 1-day history of severe left flank pain, associated with abdominal distension, nausea and vomiting. CT scan was performed and showed a segment of the jejunum with diverticula involved by an inflammatory process, with mural thickening (red arrows), severe fat stranding (green arrows) and extraluminal air (yellow arrow).

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Fig. 12: Perforated jejunal diverticulitis: A 75 year-old woman presented to the emergency room with acute upper abdominal pain. CT scan was performed and showed several jejunal diverticula (red arrows) with wall thickening of a loop of jejunum (green arrows), mesenteric fat stranding and extraluminal air (yellow arrows).

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Fig. 13: Perforated ileal diverticulitis: A 80-year-old woman presented to the emergency room with a 2-day history of progressive right flank pain. The CT scan showed ileal diverticula (red arrows) in association with bowel wall thickening (green arrows), mesenteric fat stranding and extraluminal air bubbles (yellow arrows).

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Fig. 14: Jejunal diverticular bleeding: A 83 year-old woman presented to the emergency department with acute abdominal pain and lower gastrointestinal bleeding. An abdominal angio-CT scan was performed. Axial and coronal CT angiography images (arterial and venous phase) demonstrate contrast extravasation from a jejunal diverticulum, corresponding to active bleeding (red arrows). Volume rendering image showed the supply to the diverticulum arising from one of the jejunal branches (green arrow) of the upper mesenteric artery.

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Fig. 15: Jejunal diverticular bleeding: A 68 year-old man presented to the emergency department with acute abdominal pain and lower gastrointestinal bleeding. An abdominal angio-CT scan was performed. Axial and coronal CT angiography images (arterial and venous phase) demonstrate contrast material extravasation into the jejunal diverticulum, corresponding to active bleeding (red arrows). coronal MIP image showed the supply to the diverticulum arising from one of the jejunal branches (green arrows) of the upper mesenteric artery.

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Fig. 16: Jejunal diverticulitis with mesenteric fluid collection: A 72 year-old man presented to the emergency department with a 4-day history of progressive left flank pain accompanied by vomiting and fever. An abdominal CT scan was performed and showed a jejunal diverticula with inflammatory changes (red arrows), accompanied by mesenteric fat stranding and mesenteric fluid collection in between the bowel loops (green arrows).

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Fig. 17: Ileal diverticulitis with small fluid collection: A 81 year-old woman presented to the emergency room with a 2-day history of lower abdominal pain, vomiting and constipation. CT scan was performed. Axial an coronal CT images show a an ovoid inflammatory process (red arrows), in close relation with the ileum, with wall thickening, surrounding mesenteric fat stranding, extraluminal air bubbles and small adjacent fluid collection (green arrow).

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**Fig. 18:** Enterocutaneous fistula. A 70 year-old man presented to the emergency department with a 2-week history of abdominal pain, vomiting and fever associated with a painful lump in the left anterior abdominal wall. CT scan was performed and showed wall thickening of a loop of jejunum with multiple jejunal diverticula (red arrows), mesenteric fat stranding and enterocutaneous fistula with fluid collection in the left anterior abdominal wall (green arrows).

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Fig. 19: Enterocutaneous fistula: A 62 year-old man presented to the emergency department with a 3-week history of right flank pain, vomiting and fever associated to swelling, erythema and tenderness in the right abdominal wall. CT scan was performed and showed wall thickening of a loop of ileum (yellow arrows) with multiple ileal diverticula (red arrows), surrounded by marked fat stranding and enterocutaneous fistula with air-fluid collection in the right abdominal wall (green arrows).

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Fig. 20: Enterocutaneous fistula: Coronal, sagittal and axial MRI images of the same patient as Figure 18 (after drainage of the subcutaneous abscess) show a long segment of distal ileitis (green arrows) with multiple ileal diverticula (red arrows) and enterocutaneous fistula (yellow arrows).

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**Fig. 21:** Hemoperitoneum: A 87 year-old woman presented to the emergency department with a 4-day history of progressive abdominal pain, diarrhea, nausea and vomiting. During the first hours after admission the patient presented pallor and hypotension, a CT scan was performed and showed wall thickening of a loop of jejunum with multiple jejunal diverticula (red arrows), mesenteric fat stranding and high-density peritoneal fluid consistent with hemoperitoneum (green arrow). No active bleeding point was seen.

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Conclusion

Although complicated JID is an uncommon entity, it should be considered as a possible cause of acute abdominal pain and lower gastrointestinal bleeding, usually in elderly patients. Signs and symptoms of acute complications are nonspecific and the diagnosis will be reached either by an imaging technique or a surgical exploration.

Most complications of JID require surgery resecting the intestinal segment with diverticula. However, if recognized early, surgery may be avoided in lieu of conservative treatment. Since complications can be severe, awareness of imaging features and potential complications are essential to ensure correct diagnosis and proper treatment.
Personal information

This work comes from the Radiology Department of:

Hospital Universitari Vall d'Hebron
Psg. Vall d'Hebron 119-129
08035 BARCELONA (SPAIN)

Fig. 22: Barcelona/ES

References: -

e-mail address of the first author:
rasecortiz@gmail.com
References


