



CASE REPORT

Mid-jejunal diverticulitis with closed-loop bowel obstruction, strangulation, and contained perforation

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Key Clinical Message

Closed-loop bowel obstruction and contained perforation secondary to acute on chronic jejunal diverticulitis is rare and should be included in the differential diagnosis of acute abdomen. The association between polymyalgia rheumatica and diverticular disease requires further research but may prompt clinicians to consider appropriate therapies in patients with both diseases.

Abstract

Jejunal diverticulosis is a sac-like outpouching of the intestinal wall that can cause complications such as diverticulitis, obstruction, abscess, perforation, or fistula formation. Complicated jejunal diverticulosis may present with acute abdomen and nonspecific symptoms which can lead to misdiagnosis and delayed treatment. A 76-year-old male with a remote history of polymyalgia rheumatica (PMR) presented with sudden onset abdominal pain, fever, nausea, vomiting, and inability to pass flatus. Physical exam revealed a distended and diffusely tender abdomen with signs of peritonitis. Laboratory test results were significant for neutrophil-dominant leukocytosis and elevated inflammatory markers. CT scan of the abdomen with IV contrast revealed a contained perforation and a closed-loop small bowel obstruction in the mid-abdomen. The patient underwent emergent exploratory laparotomy and resection of 100 cm of mid-jejunum which was found to have numerous diverticula surrounding the closed-loop obstruction and contained perforation. Pathology findings showed evidence of acute on chronic jejunal diverticulitis. Jejunal diverticulosis with complications may present with an acute abdomen and peritonitis. Closed-loop bowel obstruction and contained perforation secondary to acute on chronic jejunal diverticulitis is uncommonly thought of and should be considered in the differential diagnosis. Additionally, the association between PMR and diverticular disease is notable. While the patient had a remote history but no active PMR on presentation, studies suggest a possible association between gut inflammation and rheumatologic disease. This association should prompt clinicians to consider appropriate therapies and bear in mind the potential risk for diverticular perforation if glucocorticoids are given

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to treat PMR. Jejunal diverticulosis with multiple complications such as closed-loop bowel obstruction and contained perforation secondary to acute on chronic jejunal diverticulitis is rare and may present with an acute abdomen and nonspecific symptoms. Including rare pathologies as such in the differential diagnosis may prevent misdiagnosis and delayed treatment. While further investigation is needed, the association between diverticulosis and PMR is noteworthy as patients who present with both diseases would require mindful management due to the potential risk of diverticular perforation after treatment with steroids.

KEYWORDS

diverticular diseases, diverticulitis, intestinal obstruction, intestinal perforation, jejunal diseases, polymyalgia rheumatica

1 | INTRODUCTION

Diverticulosis is a sac-like out-pouching of the intestinal wall that can affect both the small intestine and colon.¹ The prevalence of diverticulosis is highest in the colon with 50% of patients developing colonic diverticula at around 60 years of age and the prevalence further increases with age.² The duodenum is the second most common site of diverticula with a prevalence of 23%.³ The least common location for diverticulosis is the jejunum.⁴ It has a prevalence ranging from 0.6–4.6% and is typically found incidentally on computed tomography (CT).⁴

Diverticulitis is a complication that can occur in diverticulosis and is more common in the colon than in the small intestine. Diverticulitis of the colon is a common condition in which lumen material accumulates in the diverticulum causing inflammation and infection of the mucosa and the wall.² Approximately 25% of patients with colonic diverticula will develop clinical manifestations and about 12% of patients develop complications such as perforation, abscess, obstruction, or fistula formation.² Jejunal diverticulitis, while rare, is the most common complication of jejunal diverticulosis with an incidence of 2%–6%.⁴ This disease can present with several nonspecific symptoms, mimicking diseases like appendicitis, colonic diverticulitis, or Crohn's disease⁵ which can then lead to delayed diagnosis and treatment as well as misdiagnosis.⁶

Other complications of jejunal diverticulosis include bleeding, intestinal obstruction, bacterial overgrowth, and biliary obstruction.⁷ Mechanisms of small bowel obstruction complicating small bowel diverticulosis may include volvulus, intussusception, enterolith impaction, and strictures or adhesions from previous episodes of diverticulitis.⁷ A closed-loop obstruction is a specific type of

mechanical obstruction in which a segment of the intestine is obstructed at two points along its course at a single location, thus forming a closed-loop.⁸ 19% of small bowel obstructions involve a closed-loop and this is associated with a high risk of strangulation.⁸

This case report details a 76-year-old male who presented to the emergency department with sudden onset abdominal pain and diffuse abdominal tenderness, found to have a closed-loop small bowel obstruction and contained perforation on CT. Exploratory laparotomy confirmed the exam and imaging findings and pathological analysis revealed acute on chronic jejunal diverticulitis to be the inciting cause of his symptom complex. Here we discuss the pathogenesis, presentation, workup, diagnostic imaging, treatment options, and potential association with rheumatic diseases.

2 | CASE HISTORY AND EXAMINATION

A 76-year-old male presented to the emergency department with a 24-h history of sudden onset abdominal pain that progressively worsened. Associated symptoms included a fever up to 101.4°F (38.6°C) at home, nausea, multiple episodes of vomiting, and inability to pass gas per rectum. His past medical history was significant for atrial fibrillation on Apixaban, polymyalgia rheumatica (PMR), gastroesophageal reflux disease, and other comorbidities. His vital signs were unremarkable with a blood pressure of 128/73 mmHg, pulse of 76 bpm, respiratory rate of 16 breaths per minute, and afebrile temperature of 99.3°F (37.4°C). On the physical exam, the patient was mildly distressed due to pain. His abdomen was distended, diffusely tender on palpation with slight guarding, and showed signs of peritonitis.

3 | DIFFERENTIAL DIAGNOSIS, INVESTIGATIONS, AND TREATMENT

An initial broad differential diagnosis for acute abdomen includes perforated diverticulitis, appendicitis, perforated peptic ulcer, aortic aneurysm rupture, volvulus, organ rupture from traumatic or atraumatic causes, and ischemic bowel disease.⁹

Upon workup, laboratory tests revealed an elevated white blood cell count of 18.59 (Reference range (RR): 4.5–11), absolute neutrophil count of 16.45 (RR: 2.5–7 neutrophils/mL), C-reactive protein 158.96 mg/L (RR: <3 mg/L), total bilirubin 2.0 mg/dL (RR: 0.1–1.2 mg/dL), direct bilirubin 0.7 mg/dL (RR: <0.3 mg/dL), PT 22.1 s (RR: 11.0–12.5 s), and INR 1.9 (RR: less than or equal to 1.1). Creatinine, lactate, and blood urea nitrogen were within normal limits.

CT scan of the abdomen and pelvis with IV contrast revealed a closed-loop small bowel obstruction in the mid-abdomen, a decompressed loop of the small intestine, and small bowel dilation with fecalization. There was also a contained perforation with associated phlegmon and extraluminal fecal content and free air posterior to the margin of the small intestine (Figures 1–5).

The patient was given IV piperacillin and tazobactam. Two units of frozen fresh plasma were given due to elevated INR. The patient had not taken Apixaban that morning. Given the emergent nature of his condition and INR reversal with frozen fresh plasma, he was brought

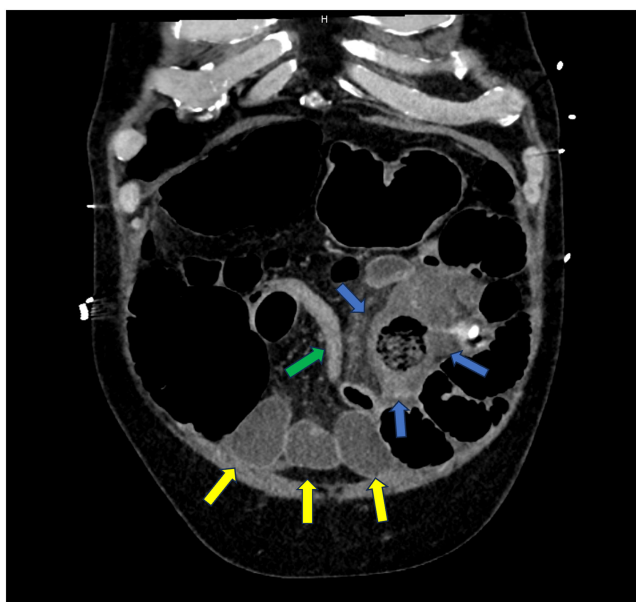


FIGURE 1 CT abdomen and pelvis with IV contrast, coronal view, showing a decompressed loop of small intestine (green arrow), phlegmon and contained perforation (blue arrows), and dilated fluid-filled small intestine (yellow arrows).

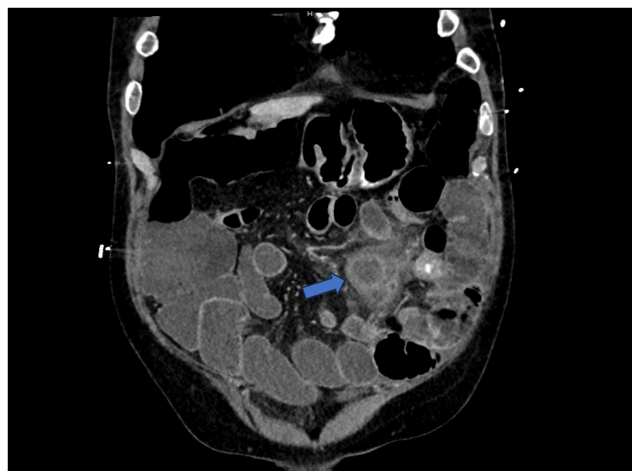


FIGURE 2 CT abdomen and pelvis with IV contrast, coronal view, showing contained perforation with inflammatory changes (blue arrow) located posteriorly and to the left of the decompressed loop of the small intestine in Figure 1.

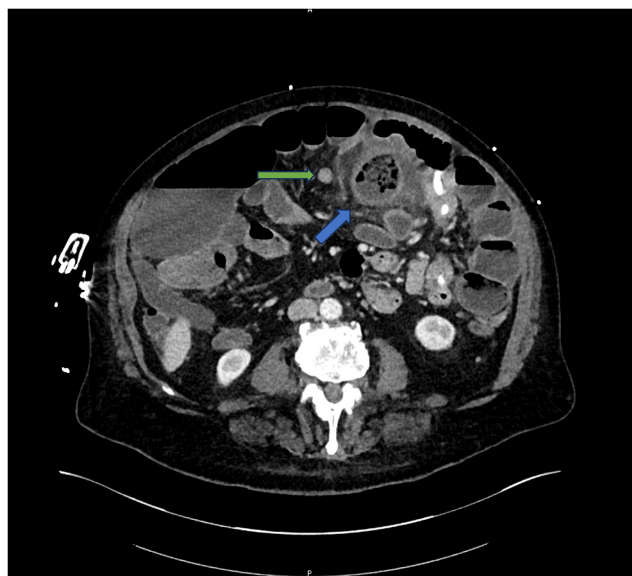


FIGURE 3 CT abdomen and pelvis with IV contrast, axial view, showing the decompressed small bowel loop as seen in Figure 1 (green arrow). There is also a contained perforation with extraluminal fecal content and free air posterior to the margin of the small intestine and associated phlegmon (blue arrow).

emergently to the operating room without Apixaban reversal.

The patient underwent exploratory laparotomy, lysis of adhesions, and small bowel resection with primary anastomosis via a midline incision. Upon entering the abdomen and peritoneum, the small intestine, approximately 500 cm in length, was examined from the ligament of Treitz to the terminal ileum. About 50 cm from the ligament of Treitz, a segment of the mid-jejunum, approximately 100 cm in length, was found to have numerous diverticula surrounding

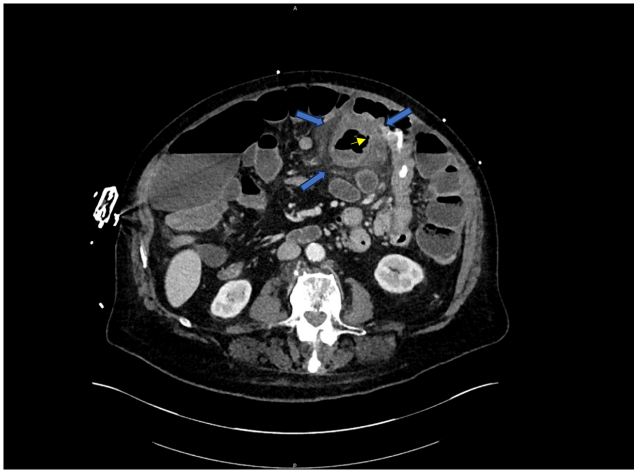


FIGURE 4 CT abdomen and pelvis with IV contrast, axial view, showing contained perforation with phlegmon (blue arrows) and diverticulum (yellow arrow).

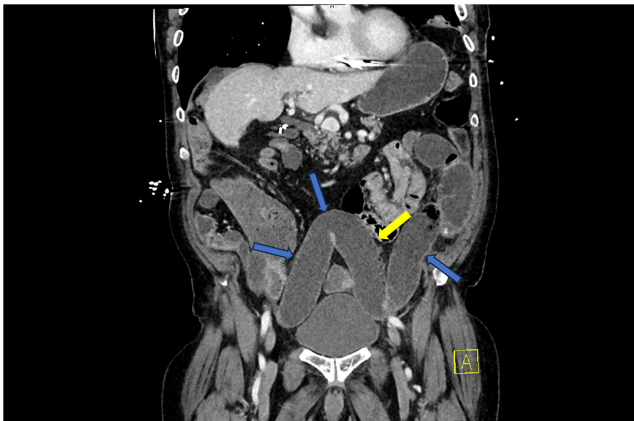


FIGURE 5 CT abdomen and pelvis with IV contrast, coronal view, showing severely dilated small bowel (blue arrows) and fecalization (yellow arrow) of the small bowel from the closed-loop obstruction.

the closed-loop obstruction. The walls of several of these diverticula appeared extremely thin, the serosa was dull and covered with fibrinopurulent exudate. Other diverticula that had perforated appeared to be walled off by the small bowel mesentery with small amounts of succus leaking from the area. Approximately 100 cm of small bowel were resected including the closed-loop obstruction and the surrounding jejunum which contained multiple diverticula. About 400 cm of small intestine were left after the enterectomy. Stapled side-to-side functional end-to-end anastomosis was then performed before irrigating the abdomen and closing the fascia. The skin was left open to heal by secondary intention due to the contaminated nature of the case.

On gross examination, the segment of mid-jejunum measured 49.7 cm in length and 2.2 to 3.5 cm in diameter (Figure 6). The mid-segment of the specimen showed nodular



FIGURE 6 Gross appearance of the resected segment shows a mass-like lesion consisting of multiple diverticula with fibrous adhesions (arrows); proximal and distal segments of the jejunal wall are thickened and congested (arrowheads). The serosal surface is covered by fibrinopurulent exudates.

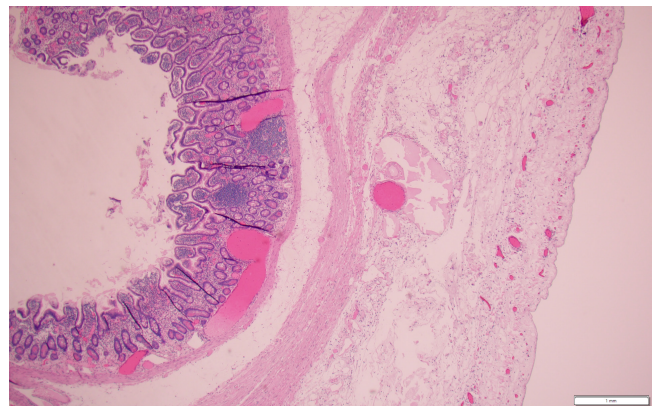


FIGURE 7 Histologic examination of the wall of the jejunal diverticulum shows vascular congestion, absent muscularis propria, serosal edema, and acute inflammation (Hematoxylin and eosin stain. Magnification X 100).

induration of the intestinal wall and adjacent mesentery covered by fibrinopurulent exudate. Multiple diverticula identified in this region contained intestinal contents within their lumens and there was thickening of the jejunal wall with diverticula up to 4.0 cm. Microscopic examination of the specimen showed transmural suppurative inflammation, acute serositis, and focal transmural necrosis (Figures 7–10).

The postoperative course (Table 1) was significant for atrial fibrillation with rapid ventricular response and tachycardia on postoperative days 2–3, although the patient was asymptomatic. IV metoprolol and dofetilide were administered and he regained normal sinus rhythm. Heparin was also started for deep vein thrombosis prophylaxis. On postoperative day 5, the patient had a return of bowel function and was on a regular diet the next day. On postoperative day 7, he developed hypotension, nausea, and coffee

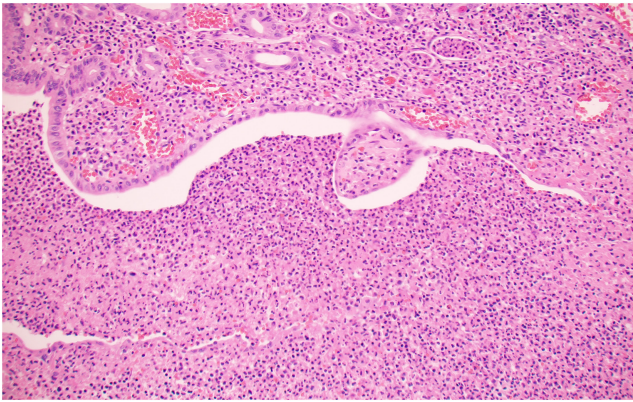


FIGURE 8 Histologic examination shows inflammatory changes in the diverticulum with abundant neutrophils and edema, indicative of acute diverticulitis (Hematoxylin and eosin stain. Magnification X 200).

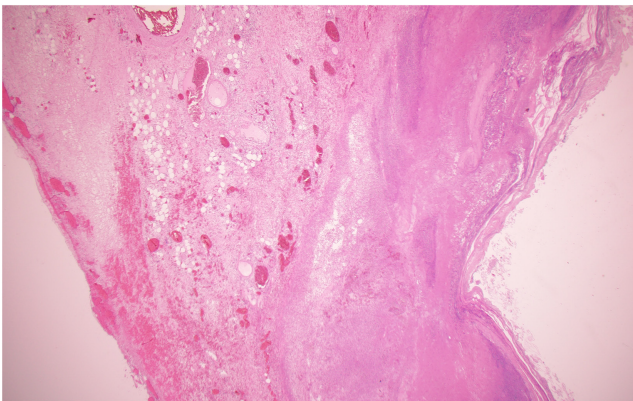


FIGURE 9 Transmural necrosis of the diverticular wall visualized on histologic examination (Hematoxylin and eosin stain. Magnification X 100).



FIGURE 10 Immunostaining for smooth muscle Actin at the neck of the diverticulum shows the presence of the muscularis mucosa around the diverticulum, but the absence of the muscularis propria (Immunoperoxidase stain. Magnification X 100).

ground emesis. IV fluids were given, and heparin was held. On postoperative day 8, the patient reported experiencing melena and his hemoglobin trended down to a low of 7.2. The patient received 1 unit of packed red blood cells. On postoperative day 9, the patient underwent esophagogastroduodenoscopy and was found to have a gastric ulcer with a visible vessel in the greater curvature of the stomach. Arterial bleeding was noted from the ulcer. A scope clip was placed and coagulation grasper and Hemospray were used to achieve hemostasis. The patient recovered and was discharged to a short-term rehabilitation center on postoperative day 13. He was able to return home a month later.

4 | OUTCOME AND FOLLOW-UP

The patient had postoperative follow-up appointments with the general surgery and wound clinic. The wound developed excessive granulation tissue which was treated with silver nitrate. Otherwise, there were no other complications. The incision line fully healed, and the patient was discharged from the clinic without further concerns.

5 | DISCUSSION

In reviewing the literature, the authors find no other case reports that describe closed-loop small bowel obstruction with contained perforation as a complication of acute or chronic jejunal diverticulitis. This case highlights a rare but serious complication in a rather infrequently seen clinical entity. Moreover, this patient had ischemic changes in the small intestine indicative of strangulation. It is important to share this case with the medical community as it presents an example of how uncommon pathologies may present with nonspecific symptoms and acute abdomen.

The pathogenesis of small bowel diverticulosis involves weakening of the muscularis propria leading to herniation and formation of outpouchings that include only the mucosa and muscularis mucosa layers of the small intestine.⁷ Increases in intraluminal pressure or intestinal dyskinesia have been hypothesized to be the inciting events that lead to diverticular formation.⁷ Neuromuscular dysfunction has also been speculated to participate in the etiology of diverticulosis as histologic examination of small bowel diverticula has shown evidence of abnormal myenteric plexus, smooth muscle fibrosis, and abnormal smooth muscle cells.⁷ Although these changes may be the result of diverticulitis, rather than the cause of the diverticula, these defects can lead to stasis and accumulation of intestinal contents and diverticulitis which is a common complication of

TABLE 1 Postoperative Hospital Course.

Postoperative day	Significant events
1	<ul style="list-style-type: none"> • Nothing by mouth (NPO) • Nasogastric tube to low continuous suction • IV Piperacillin/Tazobactam
2	<ul style="list-style-type: none"> • Heparin started for deep vein thrombosis prophylaxis • Hypokalemia (3.4, replacement not tolerated due to the pain with infusion) • Atrial fibrillation with rapid ventricular response (Pulse rate of 140-150). IV Metoprolol was given immediately with plan for scheduled IV Metoprolol and cardiology consult
3	<ul style="list-style-type: none"> • Atrial fibrillation with rapid ventricular response (Pulse rate of 120–140, patient is asymptomatic) • Continued heparin and IV Piperacillin/Tazobactam • Peripherally inserted central catheter line placement • Hypokalemia (3.1, continued to replace as tolerated) • Transthoracic echocardiogram showed no major abnormalities
4	<ul style="list-style-type: none"> • Atrial fibrillation mostly controlled • Discontinued IV Piperacillin/Tazobactam • Hypokalemia resolved (3.6) • Continued heparin
5	<ul style="list-style-type: none"> • Nasogastric tube removed • Return of bowel function • Clear liquid diet started • Continued heparin
6	<ul style="list-style-type: none"> • Regular diet started • Continued heparin • Negative pressure dressing placed
7	<ul style="list-style-type: none"> • An episode of coffee ground emesis (30 mL) with blood pressure of 89/67. The patient was given 1 L of IV crystalloid, Gastrointestinal (GI) consult placed, and heparin held. • Hemoglobin: 10.3 • NPO • Elevated white blood count of 5.9 to 13.5 on this day. Blood cultures x2 drawn, urinalysis, and urine cultures obtained (all returned negative)
8	<ul style="list-style-type: none"> • Dark brown bloody stool reported with no hemodynamic changes • Heparin held • NPO • Hemoglobin trended down from 10.3 to 8.1. The patient had multiple episodes of melena. Hemoglobin dropped to 7.2 • Transfused 1 unit of packed red blood cells • Systolic blood pressure remained in the 120s and heart rate in the 80s
9	<ul style="list-style-type: none"> • No further episodes of melena • Hemoglobin stable at 8.1 • Leukocytosis resolved (5.9) • Continued NPO and IV fluids • Endoscopy performed by GI. Gastric ulcer with visible vessel discovered and is now status post clip placement, cautery, and Hemospray. Heparin planned to be held for 72-hour post GI procedure
10	<ul style="list-style-type: none"> • Hemoglobin: 8.5 • Advanced to a clear liquid diet • IV fluids continued • Hypomagnesemia (2.1; replacement given)
11	<ul style="list-style-type: none"> • Hemoglobin: 8.7 • Advanced to regular diet • Transitioned to oral metoprolol
12	<ul style="list-style-type: none"> • Discontinued IV fluids • Magnesium replacement given (2.1) • Subcutaneous heparin started
13	<ul style="list-style-type: none"> • Hemoglobin: 9.7 • Discharged to short-term rehabilitation center

small bowel diverticulosis. Other complications of small bowel diverticulosis include hemorrhage, intestinal obstruction, bacterial overgrowth, and biliary obstruction.⁷ Contrast-enhanced CT imaging is a useful diagnostic tool in symptomatic small bowel diverticulitis with obstruction.⁷ Management of symptomatic, complicated small bowel diverticulosis requires surgical resection of the diseased segment of the small intestine.⁷

Previous cases of jejunal diverticulitis managed operatively have been reported in the literature,^{4,10,11} but to the authors' knowledge, this case is the first of its kind with a closed-loop small bowel obstruction related to active jejunal diverticulitis. Moreover, it is the first to report a contained intramesenteric perforation in the same clinical scenario. There has been one slightly similar case report that details a patient with jejunal diverticulosis and closed-loop obstruction in the literature.¹² However, in that case, there was no diverticulitis or contained perforation as seen in our case. There is also a case of jejunal diverticulosis causing closed-loop obstruction and mesenteric volvulus due to a fibrotic mesodiverticular band formation.¹³ Treatment involved emergent exploratory laparotomy to de-torse the volvulus, lyse the fibrotic bands, and decongest intestinal contents within the diverticula without any bowel resection as no gangrene, diverticulitis, or perforation had ensued. Other previously published cases highlight a failure in nonoperative management leading to subsequent small bowel obstruction that required operative management,¹⁴ and chronic diverticulosis that eventually resulted in volvulus without evidence of diverticulitis at the time of small bowel resection.⁶

Previous episodes of diverticulitis can lead to fibrosis and adhesions, resulting in closed-loop obstruction as seen in our patient. Increases in intraluminal pressure from the obstruction and intestinal dyskinesia likely caused the accumulation of fecal content in the jejunal diverticula leading to distention, inflammation, and contained perforation within the mesenteric border. Histologic examination of the diverticula showed an absence of muscularis propria, focal transmural necrosis, and extensive acute inflammation and fibrosis, indicative of acute and chronic diverticulitis. Therefore, we conclude that the reported patient must have had previous episodes of diverticulitis that perhaps were asymptomatic as he had evidence of chronic fibrotic adhesions and acute inflammation related to the closed-loop obstruction.

This case with its findings, while unique, represents one of a variety of ways that jejunal diverticulitis may present with an acute abdomen. The nuances of this case may inform others and assist them in forming differential diagnoses when similar findings are present. Frequently considered causes of closed-loop bowel obstruction include malrotation, internal hernia, volvulus, and adhesions.

Acute on chronic jejunal diverticulitis is not frequently considered in this differential diagnosis.

Another aspect of this case report worth discussing is the patient's remote history of PMR and its association with diverticular disease. A study in 1996 reported an increased incidence of PMR occurring in close concurrence with *Mycoplasma pneumoniae*, *Parvovirus B19*, and *Chlamydia pneumoniae* epidemics in Denmark suggesting a link between infectious diseases and PMR.¹⁵ There have also been cases of PMR onset post-influenza vaccination and following influenza B infection further supporting this hypothesis.^{16,17} Several studies have also investigated the seasonal trend in the onset of PMR. A study observed increased PMR development in the summer months and suggested that environmental factors may be involved in PMR onset from triggers such as microbial infections or increased actinic damage from sun exposure.¹⁸ Other studies had contradictory findings.^{19,20} Despite the mixed findings, there continues to be literature providing evidence to support the hypothesis that environmental factors are involved in PMR pathogenesis. A recent case series reported PMR occurrence in two married couples who suffered from diverticular disease.²¹ The husband of the second couple was prescribed glucocorticoids for PMR with symptomatic improvement and gradual tapering over 18 months.²¹ While the patient was on methylprednisolone taper, he experienced diverticular perforation and was treated with a surgical operation.²¹ The potential relationship between diverticulitis and PMR is intriguing and further studies may be needed to better understand whether there is an association between PMR, diverticular disease, and infectious diseases in general and the complications involved with its management.

Indeed, following the case series, a case-control study examined the association between PMR and common comorbidities seen in the PMR patients and the control group.²² Ten comorbidities were studied and the researchers found the strongest association between PMR and diverticular disease compared to the other comorbidities.²² There is a known association between gut inflammation and rheumatologic diseases in the current literature with discussions on the gut-joint-axis.^{22,23} An example is the strong association between inflammatory bowel disease and spondyloarthritis.²³ While there is still much work to be done to establish a stronger link between diverticular disease and PMR, it is notable that our reported patient had both. The mechanism behind this association is not completely understood but is thought to be related to gut inflammation in the setting of dysbiosis leading to either the development or exacerbation of PMR.²² This association leaves room for further scientific investigation and should prompt the clinician to consider therapies that would be appropriate should

the two present simultaneously and to bear in mind the potential risk of diverticular perforation in patients with PMR on glucocorticoids.

6 | CONCLUSION

We have presented a rare and interesting case of acute on chronic jejunal diverticulitis with closed-loop small bowel obstruction, strangulation, and contained perforation. Consideration of this clinical entity will help to broaden the differential diagnosis for clinicians caring for patients in emergency settings and may prompt future studies regarding the association of rheumatologic inflammatory disorders such as PMR with other disease processes not commonly thought to be associated with them, such as diverticulitis.

AUTHOR CONTRIBUTIONS

Tzu Han Huang: Conceptualization; writing – original draft; writing – review and editing. **Madeline Marker:** Writing – original draft; writing – review and editing. **Torben Urdahl:** Writing – original draft; writing – review and editing. **Juan Manivel:** Supervision; writing – review and editing. **Anthony T. Rezcallah:** Conceptualization; supervision; writing – review and editing.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

DATA AVAILABILITY STATEMENT

Data sharing is not applicable. No new data were created or analyzed.

CONSENT

Written informed consent was obtained from the patient to publish this report in accordance with the journal's patient consent policy.

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