

Contents lists available at [ScienceDirect](http://ScienceDirect.com)

## Journal of Pediatric Surgery CASE REPORTS

journal homepage: [www.jpascasereports.com](http://www.jpascasereports.com)

## Case report of idiopathic cecal perforation presenting as acute appendicitis on ultrasound

Calista Harbaugh<sup>a,\*</sup>, Sabina Siddiqui<sup>a</sup>, Cabrini Sutherland<sup>a</sup>, Raja Rabah-Hammad<sup>b</sup>, Ronald Hirschl<sup>a</sup><sup>a</sup>Section of Pediatric Surgery, Department of Surgery, The University of Michigan Medical School, C.S. Mott Children's Hospital, Ann Arbor, MI, USA<sup>b</sup>Department of Pathology, The University of Michigan Medical School, C.S. Mott Children's Hospital, Ann Arbor, MI, USA

## ARTICLE INFO

## Article history:

Received 15 May 2016

Accepted 30 May 2016

## Key words:

Surgery

Intestinal perforation

Histology

## ABSTRACT

Cecal perforation is an uncommon phenomenon in a pediatric population. It has been linked to a number of underlying medical conditions, which may result in focal inflammation or relative ischemia including hematologic malignancy, infection, and inflammatory bowel disease. We present an otherwise healthy 16-year-old male diagnosed with acute uncomplicated appendicitis on ultrasound, who was found to have cecal perforation with normal appendix intraoperatively, ultimately requiring ileocectomy. With this report, we aim to present the numerous pathophysiologic etiologies of cecal perforation, and to promote a comprehensive differential diagnosis despite the clinical and radiologic findings consistent with uncomplicated appendicitis.

© 2016 The Authors. Published by Elsevier Inc. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Cecal perforation is an uncommon phenomenon in a pediatric population. It has been linked to a number of underlying medical conditions, which may result in focal inflammation or relative ischemia including hematologic malignancy, infection, and inflammatory bowel disease, among others [1,2]. We present here an otherwise healthy 16-year-old male with right lower quadrant pain and ultrasound findings consistent with acute uncomplicated appendicitis. Intraoperatively, he was found to have cecal perforation with a normal appendix, but no pathologic evidence as to etiology of perforation. With current trends towards non-operative management of appendicitis [3,4], this case highlights the importance of recognizing limitations of diagnostic testing and the need to maintain a level of suspicion for alternate diagnoses. Further, with this case report, we aim to review the potential etiologies of cecal perforation in a pediatric population in order to encourage a broad differential even in a patient without prior medical diagnosis.

## 1. Case report

A 16-year-old male with no past medical history presented to the Emergency Department with progressively worse right lower quadrant pain over the previous 48 h. He had no complaints of fevers, nausea, vomiting, diarrhea, or constipation. Laboratory evaluation revealed a mild leukocytosis with left shift: white blood cell (WBC) count 11,700/ $\mu$ L with 76.6% neutrophils. Abdominal radiograph showed only mild fecal loading of the descending colon and rectum. Abdominal ultrasound findings were consistent with acute appendicitis with a retrocecal appendix, appendicolith and minimal free fluid. He was started on intravenous cefoxitin at three hours from presentation and was taken to the operating room for laparoscopic appendectomy six hours later. Upon exploration, a phlegmon was noted attached to the cecal wall, opposite a normal appearing appendix at the ileocecal junction (Fig. 1). A limited right lower quadrant incision was made in order to deliver the mass. On inspection, it was clear this was secondary to cecal perforation thus ileocecal resection with a hand-sewn anastomosis was performed. The patient's postoperative course was uncomplicated and he was discharged to home on postoperative day 3 with return of bowel function.

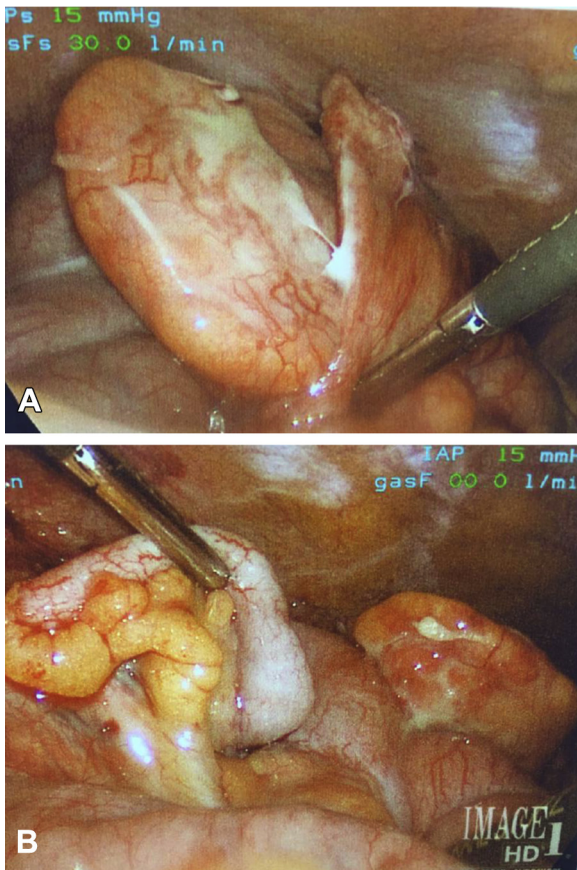
Pathologic examination revealed significant submucosal edema of the resected ileum and colonic segment with prominent lymphoid tissue in the ileal mucosa and multiple small superficial mucosal ulceration in the ileum, cecum and appendix. The

*Abbreviations:* WBC, white blood cell; NE, neutropenic enterocolitis; AIDS, acquired immune deficiency syndrome.

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

\* Corresponding author. Department of General Surgery, Taubman Center Rm. 2110, 1500 E Medical Center Dr., Ann Arbor, MI 48109-5346, USA. Tel.: +1 248 985 9858.

E-mail address: [calistah@med.umich.edu](mailto:calistah@med.umich.edu) (C. Harbaugh).

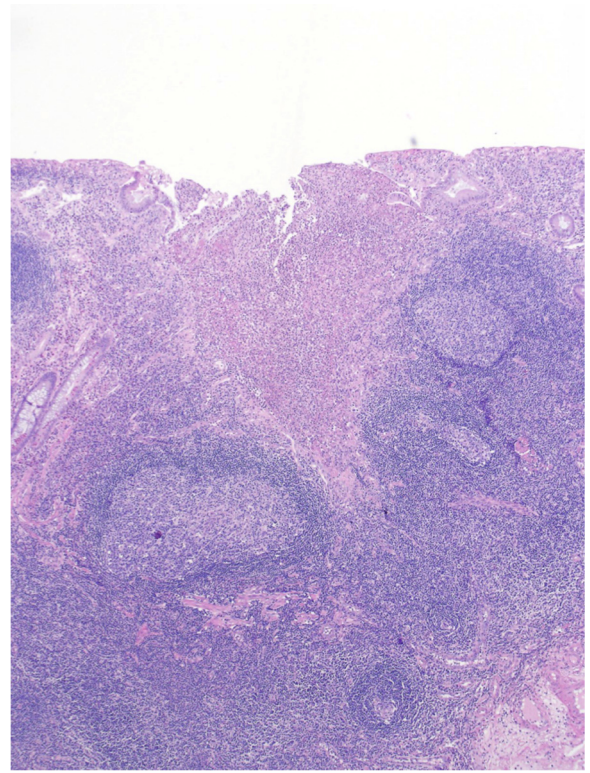


**Fig. 1.** (A) Phlegmon adherent to the cecum at site of perforation. (B) Normal appearing appendix.

ulcerated mucosa showed neutrophilic infiltrate in the lamina propria and some cryptitis but no significant lymphoplasmacytic infiltrate, chronic architectural changes, transmural fibrosis or granulomas were seen. The cecal wall at the site of perforation was thin and showed transmural acute inflammation without fibrosis, granulomas or significant chronic inflammation. An organizing abscess with small amount of fecal material was identified in the surrounding mesenteric tissue. No malignant infiltration was noted in the bowel wall and multiple lymph nodes were sampled and were all reactive with no evidence of granulomas, necrosis or neoplastic cells. No viral inclusions, organisms, vasculitis or vascular thrombosis was noted in the examined tissue and multiple special stains for organisms were non-revealing including Gram, Giemsa, cytomegalovirus and adenovirus immunostains (Fig. 2).

## 2. Discussion

Cecal perforation is an uncommon phenomenon in the pediatric population, although it has been well described in the setting of a number of underlying medical conditions. The most common among these are hematologic malignancy resulting in infection such as tuberculosis and typhoid fever, inflammatory bowel disease, and neutropenic enterocolitis (NE) [1,2]. Additional mechanisms, which will not be discussed in this forum, include vasculitis, mechanical strangulation (i.e. hernia, volvulus), over-distension secondary to adynamic ileus, and foreign body. Little data exists as to the overall incidence of cecal perforation or reports of idiopathic perforation. A ten-year review of 44 patients with non-traumatic colon perforation by Chang et al. describes 91.4% of



**Fig. 2.** Section of the terminal ileum with prominent lymphoid tissue and superficial mucosal ulceration with acute inflammation. Similar ulcers seen adjacent to the cecal perforation.

colon perforations occurring in children under the age of 5, with no cases occurring in children over 10 years. With this review, we aim to assess the presentation and mechanisms leading to cecal perforation of known etiologies to aid in evaluation of this rare case of adolescent cecal perforation with no known underlying etiology.

Worldwide, infection is the most common etiology of cecal perforation with *Salmonella* species, typhi and non-typhi, as some of the most common culprits [2,5,6]. Though incidence may vary by age and location, a series of 44 pediatric patients by Chang et al. found that 29.5% of the non-traumatic colon perforations had documented bacterial infection and 69.2% of those revealed non-typhoid salmonella. The cecum was perforated in 27.3% of cases [2]. Similarly, typhoid fever, caused by *Salmonella typhi*, remains a major public health concern in developing countries and carries with it a risk of intestinal perforation with an incidence of 0.5–3% [6]. The most common site of perforation is in the ileum, but may rarely occur in the colon. Among colonic perforations, the cecum is the most common site reported at 46.7% of colonic perforations in one series reporting 24 pediatric patients [6]. Presentation of typhoid fever typically includes spiking fever, abdominal distension, and watery or bloody diarrhea. Despite initiation of antibiotics, progressive abdominal distension and sudden onset of tenderness may develop as bacilli invade the intestinal wall resulting in edema, ulceration, and ultimately intestinal perforation.

Abdominal tuberculosis is another well-known infectious cause of cecal perforation worldwide, seen more commonly in the developing world and in immigrant communities in major cities of the Western world. Abdominal tuberculosis is classically described by its peritoneal, mesenteric, gastrointestinal, or solid organ (liver, spleen) involvement. Clinical presentation can be exceedingly variable, raising difficulty in diagnosis [7]. The gold standard for diagnosis is by culture and/or positive Ziehl-Neelsen stain of the

surgical specimen; however, this may not be present in every case. Characteristic colonoscopic findings may include circumferential ulceration with steep edges and multiple nodular lesions and histology may demonstrate granulomas with caseation [7,8]. Perforation can result after initiation of anti-tuberculin treatment due to natural progression of disease or secondary to immunologic response with increased exposure to mycobacterial antigens released by the killed bacilli [8]. This case, while an immigrant from India, had no identifiable tuberculosis exposure or characteristic findings on histology as described above.

NE, also known as typhlitis or ileocecal syndrome, has been well implicated in development of cecal perforation in a pediatric population [9–12]. Pathogenesis of NE is predominantly a result of the neutropenia, allowing rapid proliferation of bacteria within the bowel wall after mucosal breach occurs. Mucosal breach may be a direct result of mucosal injury by certain chemotherapeutic agents (arabioside cytosine) or secondary to paralytic ileus leading to cecal distension as a result of pharmacologic side effects (i.e. oncovin) and serious illness. Further, there is gastrointestinal involvement in 25% of leukemias [9] and rapid regression of lymphomatous or leukemic infiltrates may result in necrosis, facilitating bacterial translocation. The patient typically presents with acute right lower quadrant abdominal pain, fever, and/or watery diarrhea. Radiologic findings include adynamic ileus with air-fluid levels, thickening of the cecal wall, pneumatosis and/or intramural hemorrhage. As pathology progresses, NE may result in wall ischemia, perforation, gastrointestinal bleed, fistulization, and sepsis. NE has also been reported in the setting of immunosuppression from alternate sources including infectious mononucleosis [10], acquired immune deficiency syndrome (AIDS), immunosuppression following organ or bone marrow transplantation, and aplastic anemia [12].

Spontaneous free perforation is an uncommon though highly morbid event in the natural history of inflammatory bowel disease. It is more commonly seen in ulcerative colitis due to toxic dilation, though it may also occur in the intestine or colon in the absence of intestinal distension in Crohn's disease. There is a 1–3% reported incidence of free perforation among patients hospitalized for Crohn's disease [13], though it may be as high as 8.1% among populations with a higher overall propensity towards Crohn's disease [14]. Free perforation as a first sign of disease was seen in 23% [14] to 52% [15] of patients among data currently available.

In review of this patient's history, the overall findings suggest infection as the most likely diagnosis. The patient has no prior personal or family history of malignancy and no evidence of malignancy on histopathology, making perforation secondary to lesion associated with lymphoma or leukemia less likely. Similarly, in the setting of a leukocytosis, NE is ruled out. Without evidence of caseating granulomas on histopathology, abdominal tuberculosis is an unlikely diagnosis. It is possible that cecal perforation occurred secondary to bacterial infection; however, this has been seen much more commonly in a younger age group and no definite organisms were noted on staining. In regards to inflammatory bowel disease, there were no granulomas, transmural fibrosis, or chronic architectural changes noted and the patient has no clinical history to suggest Crohn's disease as a likely diagnosis. The presence of

lymphoid hyperplasia and reactive epithelial changes suggest viral infection. It raises the possibility of transient mechanical cause such as intussusception resulting in focal ischemia, which self-reduced prior to ultrasound imaging. Though viral infection associated with possible transient intussusception is currently the leading diagnosis, this remains a diagnosis of exclusion, thus the patient has been referred for endoscopic rule-out of inflammatory bowel disease in the presence of concomitant terminal ileal ulceration on histopathology.

### 3. Conclusion

With presentation of this case, our goal is to present the numerous pathophysiologic etiologies of cecal perforation, and to promote a comprehensive differential diagnosis despite the clinical and radiologic findings leading to a diagnosis of appendicitis in an otherwise healthy patient. There is increasing evidence that uncomplicated appendicitis may be treated conservatively with antibiotics only. However, in the setting of free perforation, one worries that the natural history might lead to systemic sepsis in this patient should this patient have undergone non-operative management. Fortunately, cecal perforation was identified early in the operating room and treated appropriately with resection and primary anastomosis.

### References

- [1] Ara C, Coban S, Kayaalp C, Yilmaz S, Kirimlioglu V. Spontaneous intestinal perforation due to non-Hodgkin's lymphoma: evaluation of eight cases. *Dig Dis Sci* 2007;52:1752–6.
- [2] Chang YJ, Yan DC, Kong MS, Chao HC, Huang CS, Lai JY. Non-traumatic colon perforation in children: a 10-year review. *Pediatr Surg Int* 2006;22:665–9.
- [3] Minneci PC, Mahida JB, Lodwick DL, Sulkowski JP, Nacion KM, Cooper JN, et al. Effectiveness of patient choice in nonoperative vs surgical management of pediatric uncomplicated acute appendicitis. *JAMA Surg* 2015:1–8.
- [4] Hartwich J, Luks FI, Watson-Smith D, Kurkchubasche AG, Muratore CS, Wills HE, et al. Nonoperative treatment of acute appendicitis in children: a feasibility study. *J Pediatr Surg* 2016;51:111–6.
- [5] Mahajan G, Kotru M, Sharma R, Sharma S. Usefulness of histopathological examination in nontraumatic perforation of small intestine. *J Gastrointest Surg* 2011;15:1837–41.
- [6] Chang YT, Lin JY, Huang YS. Typhoid colonic perforation in childhood: a ten-year experience. *World J Surg* 2006;30:242–7.
- [7] Saczek KB, Schaaf HS, Voss M, Cotton MF, Moore SW. Diagnostic dilemmas in abdominal tuberculosis in children. *Pediatr Surg Int* 2001;17:111–5.
- [8] de Benedictis FM, Nobile S, Lorenzini I. Electronic clinical challenges and images in GI. Abdominal tuberculosis. *Gastroenterology* 2008;134:e3–5.
- [9] Ebert EC, Hagspiel KD. Gastrointestinal manifestations of leukemia. *J Gastroenterol Hepatol* 2012;27:458–63.
- [10] Sigirci A, Akinci A, Ozgen U, Ozen M. Neutropenic enterocolitis (typhlitis) associated with infectious mononucleosis. *Pediatr Radiol* 2006;36:155–7.
- [11] Wach M, Dmoszynska A, Wasik-Szczepanek E, Pozarowski A, Drop A, Szczepanek D. Neutropenic enterocolitis: a serious complication during the treatment of acute leukemias. *Ann Hematol* 2004;83:522–6.
- [12] Wall SD, Jones B. Gastrointestinal tract in the immunocompromised host: opportunistic infections and other complications. *Radiology* 1992;185:327–35.
- [13] Greenstein AJM, Mann D, Heimann T, Sachar DB, Lachman P, Aufses AH. Spontaneous free perforation and perforated abscess in 30 patients with Crohn's disease. *Ann Surg* 1987;205:72–6.
- [14] Werbin NH, Haddad R, Greenberg R, Karin E, Skornick Y. Free perforation in Crohn's disease. *Isr Med Assoc J* 2003;5:175–7.
- [15] Doh YS, Kim YS, Bae SI, Im JP, Cheon JH, Ye BD, et al. The clinical characteristics of patients with free perforation in Korean Crohn's disease: results from the CONNECT study. *BMC Gastroenterol* 2015:15.