

Rare Mesenteric Location of Meckel's Diverticulum, A Forgotten Entity: A Case Study Aboard USS Kitty Hawk

SCOTT D. SEGAL, D.O.,* DAN S. ALBRECHT, D.O.,† KRIS M. BELLAND, D.O., ERIC A. ELSTER, M.D.*,‡,§

From the *Medical Department, USS Kitty Hawk (CV-63), Yokosuka, Japan; †Laboratory Medicine Department, Naval Medical Center, Portsmouth, Virginia; ‡The Department of General Surgery, National Naval Medical Center, Bethesda, Maryland; §Radiation and Combat Injury Repair Department, Combat Casualty Care, Naval Medical Research Center, Silver Spring, Maryland

The traditional understanding of Meckel's diverticulum has always emphasized its antimesenteric location, ever since its original description in 1809. We report the finding of an acutely inflamed mass located on the mesenteric aspect of distal ileum, which was discovered during a celiotomy performed aboard a U.S. Navy aircraft carrier. Pathological features of this unusual mass, including focal submucosal abscess formation, proximity to the ileocecal valve, and heterotopic gastric tissue are all characteristic of inflammatory Meckel's diverticulum. The atypical intraoperative finding of a desmoplastic reaction associated with this lesion is discussed within the context of a pertinent differential diagnosis. In addition, both the pathological characteristics and the unusual location of this mass are the basis for a discussion that revisits a 50-year-old surgical controversy regarding Meckel's diverticulum.

MECKEL'S DIVERTICULUM was first described in 1809 by Johann Friedrich Meckel as an embryological remnant caused by failure of the vitelline duct to involute by the seventh or eighth week of gestation.^{1,2} Approximately 90 per cent of all vitelline duct anomalies are Meckel's diverticula, which are considered to be the most prevalent congenital anomalies of the gastrointestinal tract.³ Infrequently, vitelline duct anomalies are associated with mesodiverticular bands thought to be derived from persistent left vitelline artery.⁴ As early as 1941, Chaffin described a case of Meckel's diverticulum attached close to the mesenteric border of the gut and postulated that this atypical location may have resulted from traction induced by a persistent vitelline artery.⁵ Less than a decade later, however, Jay and co-workers developed conservative diagnostic criteria for Meckel's dictating that the diverticulum must arise from the antimesenteric border of the gut proximal to the ileocecal valve, contain all five layers of small intestine, and have a separate mes-

entery for blood supply.⁵ The following case presentation challenges these strict criteria, which have served as a mainstay of modern surgical practice for more than half a century.

Case Report

A 19-year old white male presented while onboard USS Kitty Hawk with a 24-hour history of diffuse abdominal pain that subsequently localized to the right lower quadrant. This pain was associated with two episodes of nausea and vomiting. Prior to presentation, the patient was without anorexia, diarrhea, hematochezia, or melena. He denied having any urinary symptoms of dysuria, hematuria, urgency, or frequency. His past medical history was significant only for long-standing nodular acne treated chronically with 100 mg oral doxycycline twice daily. The remainder of the patient's medical and surgical history was noncontributory.

On physical exam, the patient was afebrile, normotensive, and had a normal pulse and respiratory rate. His abdominal exam was remarkable for right lower quadrant tenderness, Rovsing's sign, and general rebound tenderness. Laboratory studies included a white blood cell count of $14.6 \times 10^3/\mu\text{L}$ with a significant left shift secondary to marked bandemia. Urinalysis, electrolytes, liver function tests, and amylase were all within normal limits. Ultrasound of the abdomen revealed no free peritoneal fluid or abdominal abscess. The appendix was not visualized on ultrasound. With a presumptive diagnosis of acute appendicitis, the patient was taken to USS Kitty Hawk's shipboard operating room for exploration.

The views expressed in this article are those of the authors and do not reflect the official policy of the Department of the Navy, the Department of Defense, or the U.S. Government.

Address correspondence and reprint requests to Eric A. Elster, M.D., Radiation and Combat Injury Repair Department, Combat Casualty Care, Naval Medical Research Center, 503 Robert Grant Ave., Silver Spring, MD 20910-7500.

Report Documentation Page				Form Approved OMB No. 0704-0188	
Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.					
1. REPORT DATE 2004		2. REPORT TYPE N/A		3. DATES COVERED -	
4. TITLE AND SUBTITLE Rare Mesenteric Location of Meckel's Diverticulum, A Forgotten Entity: A Case Study Aboard USS Kitty Hawk				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Naval Submarine Medical Research Laboratory Naval Submarine Base New London Box 900 Bldg 148, Trout Avenue Groton, CT 06349-5900				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release, distribution unlimited					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT SAR	18. NUMBER OF PAGES 4	19a. NAME OF RESPONSIBLE PERSON
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified			

After the induction of general anesthesia, a standard exploration was performed through a low transverse right lower quadrant abdominal incision. An abnormal mass was palpated in the midileum during the routine abdominal exploration. This inflammatory mass was 3.5 cm $\times$ 2.5 cm, originating from the mesenteric border of ileum approximately 63.5 cm (25 in.) proximal to the ileocecal valve. The adjacent mesentery was foreshortened with mesenteric thickening and adenopathy 7.5 cm proximal and 5 cm distal to the mass. After a small bowel resection with wide local excision of the mesentery was performed, the small bowel was examined from the ligament of Trietz to the ileocecal valve to ensure no additional lesions were present. Palpation of the colon and liver revealed no obvious masses. An appendectomy was performed, and the incision was closed in a routine fashion. This patient's subsequent postoperative course was unremarkable.

Pathological Findings

Gross examination revealed a portion of previously opened small bowel with two stapled ends and a nodule that was located at the midportion. This nodule measured 3.5 $\times$ 4.0 cm and protruded from the serosal surface of the small bowel 2 cm in width. The mucosal lining appeared grossly unremarkable and had a pale tan variegated surface. There was one area of the mucosal surface adjacent to the subserosal surface of the mass that appeared edematous. Blunt probing of the entire mucosal surface adjacent to the mass revealed no obvious communication of the mass with the mucosal surface in the form of a diverticulum.

Serial sectioning of the resected nodule revealed a whorled gray-tan mass with some cystic spaces that appeared to surface beneath the submucosa but did not appear to communicate with the mucosal surface. The remaining nodule was notable for an area of light brown to tan whorled tissue that revealed cystic yellow-green material. There was also a second small nodule that was attached to the predominant nodule tissue that was cystic in character (Fig. 1). Focal submucosal abscess formation within the walls of the nodule was present. Both acute and chronic transmural inflammatory infiltrate was noted along with serositis.

Microscopic imaging of this lesion yielded additional evidence of the inflammatory nature of the resected mass. There were areas of diffuse subserosal acute and chronic inflammatory infiltrate on microscopy (Fig. 2). Gastric metaplasia was found within the resected mass adjacent to identifiable small bowel mucosa (Fig. 3). Gastric mucosa, glands, and pits adjacent to small bowel mucosa were associated with submucosal edema and scattered inflammatory cell infiltrate (Fig. 4). Of note, during pathological review of this mass, on microscopy no communication between the inner lumen of the mass and the adjacent small bowel could be demonstrated.



FIG. 1. Gross view of resected small bowel mass demonstrating focal submucosal abscess formation.



FIG. 2. Area of diffuse subserosal acute and chronic inflammatory infiltrate (Olympus Provis, AX 80, magnification $\times 40$).

The resected vermiform appendix measured 4.5 $\times$ 0.8 $\times$ 2.4 cm and appeared grossly unremarkable. On sectioning, there was impacted fecal material within the proximal aspect of the appendix. The appendiceal wall was focally attenuated, and the bivalved portion of the tip appeared tan-gray without evidence of exudate or obstruction.

Discussion

The foremost concern of this case was the appropriate intraoperative management of such an unusual mass. Consideration of neoplastic processes in the intraoperative differential diagnosis of this mass was paramount to any surgical intervention. The mesenteric desmoplastic reaction that was noted prior to resection of the mass suggested a carcinoid tumor. The differential also included gastrointestinal stromal tumor (GIST), lymphoma, adenocarcinoma, amelanocytic melanoma, and metastatic process. Without preoperative lymphadenopathy or LDH elevation, the

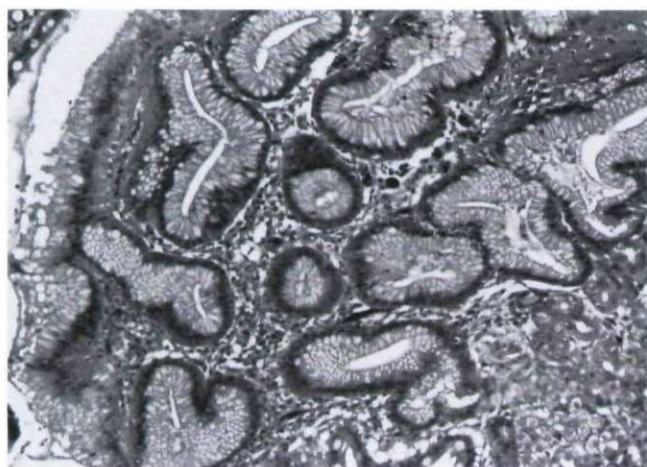


FIG. 3. Area of gastric metaplasia within a portion of the resected mass (Olympus Provis, AX 80, magnification $\times 40$).

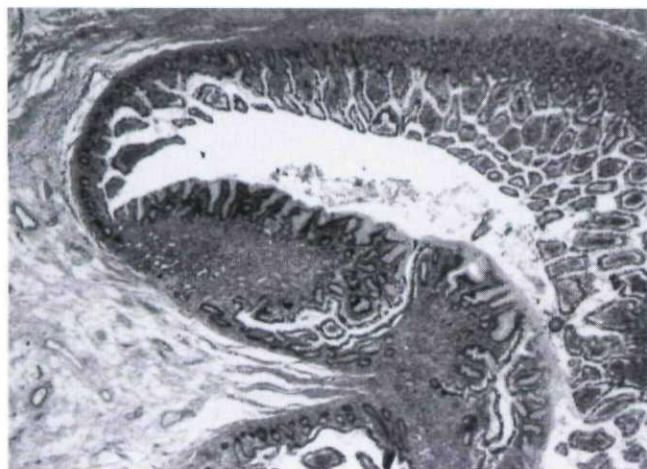


FIG. 4. Gastric mucosa, glands, and pits adjacent to small bowel mucosa with associated submucosal edema and scattered inflammatory cell infiltrate (Olympus Provis, AX 80, magnification $\times 20$).

diagnosis of malignant lymphoma was less likely but not improbable. For the above-mentioned potential diagnoses, wide local excision was the treatment of choice for both diagnostic and therapeutic purposes. Other small bowel tumors such as lipoma, hamartoma, and neurogenic tumors were also included in the differential diagnosis.

Infectious etiologies such as hypertrophic intestinal tuberculosis were considered but deemed highly unlikely given a normal preoperative pulmonary exam and review of systems. Mesenteric abscess from Crohn's disease was also considered unlikely because the patient did not exhibit typical signs and symptoms of inflammatory bowel disease. Foreign body perforation was another consideration, but other diagnoses such as small bowel diverticulum, cystic small bowel duplication, and Meckel's diverticulum were decidedly more probable. The mesenteric location of the

mass was most suggestive of a small bowel diverticulum or enterogenous cyst, but an extensive review of the literature failed to identify a case report of diverticulum or duplication presenting as an inflammatory mass. Congenital diverticula and enterogenous cysts of the small bowel are both extremely rare, and if symptomatic will typically cause only gastrointestinal hemorrhage or obstruction.⁵ Meckel's diverticulum was an immediate consideration as this diagnosis was consistent with the clinical picture and location of the mass with respect to the ileocecal valve; however, the likelihood of that diagnosis was initially questioned when the mass was noted to be on the mesenteric border.

Our case is an obvious example of a small bowel mass that required resection because of its clinical presentation and gross *in vivo* morphology. The exact diagnosis of this mass, on the other hand, is rather ambiguous. The clinical presentation, location from the ileocecal valve, and inflammatory nature of this mass was clearly more typical of Meckel's. The absence of a distinct communication of the mass with the adjacent intestinal lumen, however, suggests an enterogenous cyst or duplication. Theoretically, this mass must have communicated with the lumen of adjacent bowel for it to become a source of inflammation and infection, which may have subsequently obliterated as a result of the inflammatory process. The extent of abscess formation without rupture may have been permitted by the chronic exposure of this patient to doxycycline, a tetracycline that achieves high concentrations in the intestine by virtue of its incomplete intestinal absorption.⁶ Unfortunately, the presence of heterotopic gastric mucosa within the lesion does not distinguish between enterogenous cysts and Meckel's diverticula because both of these diagnoses have been shown to contain this tissue. We favor the diagnosis of Meckel's diverticulum based on the clinical presentation of our patient but cannot rule out the possibility that this was an example of an atypical enterogenous cyst.

Should this mass have been found incidentally in a noninflammatory state, the intraoperative decision to resect the mass would not have been straightforward. The intraoperative diagnosis of an incidental mass located adjacent to the mesentery would most likely have been a small bowel diverticulum or enterogenous cyst. Incidental jejunoileal enterogenous cysts and diverticula are typically not treated surgically unless symptoms or complications are present.⁷ If our patient's mass was an incidental finding in the years prior to its inflammatory state, it may have been mistaken for a small bowel diverticulum or enterogenous cyst and may never have been resected. Some evidence has suggested that incidentally found Meckel's

diverticula should be resected to prevent the long-term inflammatory, hemorrhagic, obstructive, and neoplastic complications of this condition. In a recent epidemiological survey, Cullen et al. demonstrated that the benefits of incidental Meckel's diverticulectomy outweigh the surgical risk of an elective procedure in their study population.⁸

This unusual case is a reminder that Meckel's diverticulum may in fact occur on the mesenteric border of the small bowel. After an exhaustive search through the literature, the only other reported case of a mesenteric-sided Meckel's diverticulum we found was the aforementioned Chaffin article of 1941.⁵ The findings of these two rare cases suggest that revision may need to be made to the classification of Meckel's diverticulum that has been followed since the 1950s. Furthermore, modification of the current surgical management of incidental masses found on the mesenteric side of ileum must be considered. Prophylactic resection of asymptomatic incidental mesenteric-sided masses may be indicated to prevent complications from a missed Meckel's diverticulum in this atypical location.

REFERENCES

1. Edmundson JM. Johann Friedrich Meckel the younger: Meckel's diverticulum. *Gastrointest Endosc* 2001;54:19A-20A.
2. Yahchouchy EK, Marano AF, Etienne JF, Fingerhut AL. Meckel's diverticulum. *J Am Coll Surg* 2001;192:658-62.
3. Turgeon DK, Barnett JL. Meckel's diverticulum. *Am J Gastroenterol* 1990;85:777-81.
4. Rutherford RB, Akers DR. Meckel's diverticulum: a review of 148 pediatric patients, with special reference to the pattern of bleeding and to mesodiverticular vascular bands. *Surgery* 1966;59:618-26.
5. Hollinshead WH. The jejunum, ileum, and colon. In Hollinshead WH, ed. *Anatomy for Surgeons: Volume 2*. New York: Harper and Row, 1971.
6. Sande MA, Mandell GL. Antimicrobial agents [continued] tetracyclines, chloramphenicol, erythromycin, and miscellaneous antibacterial agents. In Goodman LS, Gilman A, eds. *The Pharmacological Basis of Therapeutics*. New York: McGraw-Hill, 1993.
7. Uthoff SMS, Galadiuk S. Diverticular disease of the small bowel. In Cameron JL, ed. *Current Surgical Therapy*. St. Louis: Mosby, 2001.
8. Cullen JJ, Kelly KA, Moir CR, et al. Surgical management of Meckel's diverticulum. An epidemiologic, population-based study. *Ann Surg* 1994;220:564-9.