Mesodiverticular Band of Meckel’s Diverticulum as a Rare Cause of Small Bowel Obstruction: Case Report and Review of the Literature

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Summary
Background: Meckel’s diverticulum, which was first described by Johann Friedrich Meckel, is a congenital anomaly. It results from incomplete obliteration of the most proximal portion of the vitelline or omphalomesenteric duct. Its prevalence is ranging from 1 to 4% of the population. The lifetime risk of complications is estimated at 4–6%. One of them is intestinal obstruction which is a more common presentation among adults. Mesodiverticular band, as presented in this case report, is a rare cause of small bowel obstruction in Meckel’s diverticulum.

Case Report: We report the case of a 17-year-old male who had intestinal obstruction caused by a mesodiverticular band of Meckel’s diverticulum. He presented with severe abdominal pain, nausea, and vomiting. The established diagnosis was mechanical intestinal obstruction. Laparotomy revealed an internal herniation and obstruction caused by a mesodiverticular band of Meckel’s diverticulum. There was no evidence of necrosis or ischemia. The mesodiverticular band was released from the ileal mesentery and the Meckel’s diverticulum was resected. The postoperative period was uneventful and the patient was discharged after 6 days.

Conclusion: The incidence of an internal hernia caused by a mesodiverticular band of Meckel’s diverticulum is rare. It may be overlooked in the case of intestinal obstruction because of non-specific symptoms. Delay in the diagnosis can lead to significant morbidity and mortality. In the case of small bowel obstruction, Meckel’s diverticulum should therefore be kept in mind.

Zusammenfassung


Schlussfolgerung: Interne Hernien, die durch ein mesodivertikulares Band des Meckel-Divertikels verursacht werden, treten selten auf. Im Fall einer intestinalen Obstruktion können diese aufgrund von unspezifischen Symptomen übersehen werden. Verzögerungen bei der Diagnose können mit einer erheblichen Morbidität und Mortalität einhergehen. Im Fall einer Dünn darmobstruktion sollte daher stets das mögliche Vorhandensein eines Meckel-Divertikels mitbedacht werden.
Introduction

Meckel's diverticulum is the most common congenital abnormality of the gastrointestinal tract [1]. It results from an incomplete obliteration of the most proximal portion of the vitelline or omphalomesenteric duct occurring during weeks 5–7 of fetal development [2]. This embryonic remnant arises from the antimesenteric border of the ileum [3]. The majority of Meckel's diverticulum, whose prevalence is ranging from 1 to 4% of the population, is clinically silent and is incidentally identified at surgery or during autopsy [4]. Bleeding and intussusception tend to occur more often under the age of 2 years, while obstruction and inflammation is more common in adults [5]. The frequent complications of Meckel's diverticulum are hemorrhage, intestinal obstruction, and diverticulitis. Intestinal obstruction is the second most common complication of Meckel's diverticulum [6] and can be caused by intussusception, small bowel volvulus around a diverticular band anchored to the anterior abdominal wall, axial torsion of Meckel's diverticulum, Littré's hernia, and incarceration of a bowel loop via a mesodiverticular band [4]. As the last reason is rare, we report a case presenting with small bowel obstruction due to a mesodiverticular band of Meckel's diverticulum as well as a review of the literature.

Case Report

A 17-year-old male who complained of severe abdominal pain and nausea and who had been vomiting for 2 days was admitted to the emergency room of our hospital. His past medical history was not significant, and he had no surgical history. On physical examination, he had a distended abdomen and rebound tenderness in the right lower quadrant. His bowel sounds were hyperactive. He described crampy pain in the periumbilical region. His rectal examination was unremarkable. His vital signs revealed a temperature of 37°C, a blood pressure of 110/70 mm Hg, and a pulse rate of 96/min. The laboratory findings showed a leukocyte count of 11,000/mm³. The patient had normal renal and liver function tests. His hemoglobin value was 13.1 g/dl. Flat films of the abdomen showed multiple mildly distended small bowel loops (fig. 1). An abdominal ultrasound revealed dilated small bowel loops with a small amount of fluid in the right lower quadrant. There were a few hypoechoic lymph nodes, with the largest one of these nodes being 10 × 4 mm in size. Acute appendicitis could not be clearly detected. The abdominal computed tomography (CT) showed many dilated small bowel loops which marked the obstruction. The diagnosis was mechanical intestinal obstruction. Emergency exploratory laparotomy was performed. On exploration, strangulation of the small bowel was seen in an area 50 cm proximal to the ileocecal junction. It was observed that the cause of this internal herniation and strangulation was a mesodiverticular band of Meckel's diverticulum (fig. 2). The mesodiverticular band, which was extended from the tip of Meckel's diverticulum to the ileal mesentery, markedly compressed the distal part of the ileum and was then released from the ileal mesentery (fig. 3). As soon as the mesodiverticular band was separated from the mesenterium with electrocautery, the ileal loop could be released. There was no evidence of necrosis or ischemia. The Meckel's diverticulum was resected along a 3 cm flange of ileum that encompassed the vascular territory of inflamed and friable mesentery. A manual two-layer, end-to-end anastomosis was performed to restore the continuity of the small bowel. A pelvic drain was inserted. The diverticulum was confirmed as Meckel's diverticulum by histological examination. The postoperative period was uneventful. After 6 days, the patient was discharged. At the 3-month follow-up, the patient showed no evidence of complications.

Discussion

Meckel's diverticulum is the most common congenital abnormality of the gastrointestinal tract [7]. Johann Friedrich Meckel first described the embryological origin of congenital diverticulum of the midgut in 1809 [8]. Meckel's diverticulum results from incomplete obliteration of the most proximal portion of the vitelline or omphalomesenteric duct occurring...
during weeks 5–7 of fetal development. It is thought that the terminal band represents an aberration in the developmental vitelline arteries, which in turn arise from the superior mesenteric or the ileocolic artery. Total failure of closure can result in an umbilical fecal fistula. Proximal ductal closure can lead to an umbilical sinus, whereas distal closure leads to Meckel’s diverticulum. 74% of the cases with Meckel’s diverticulum terminate with a blind distal end [4].

A true diverticulum contains all layers of the intestinal wall. This embryonic remnant arises from the antimesenteric border of the ileum [3]. The mean distance from the ileocecal valve seems to vary with age, and the average distance for children under 2 years of age is known to be 34 cm. For adults, the average distance of the Meckel’s diverticulum from the ileocecal valve is 67 cm [9]. Its size is also variable, with the majority being short and wide-mouthed, with a mean length of 2.9 cm and a mean width of 1.9 cm, which is why it is sometimes called an ileal appendix [10]. It is found in about 2% of the population. However, it rarely gives rise to symptoms and its discovery is usually accidental [11].

Meckel’s diverticulum represents a lifetime risk of 4–6% of developing a complication. Hemorrhage is most common below 2 years of age, while intestinal obstruction is a more common presentation among adults [12]. The vitelline duct is known to harbor heterotopic gastric mucosa (50%), pancreatic mucosa (5%), and, less commonly, colonic, endometrial, or hepatobiliary tissue which are mainly responsible for complications such as gastrointestinal bleeding (31%), inflammation (25%), bowel obstruction (16%), intussusception (11%), hernial involvement (11%), umbilical sinus or fistula (4%), and tumors (2%) [13].

There are various mechanisms by which it can cause intestinal obstruction, such as: i) volvulus of small intestine around a fibrous band extending from Meckel’s diverticulum to the umbilicus; ii) intussusception in which Meckel’s diverticulum sags into the bowel lumen and then serves as a leading point to allow telescoping of the small intestine into first the distal ileum and then into the large intestine, causing ileoileal and ileocolic type of intussusception; iii) Littré’s hernia, i.e. incarceration of the diverticulum in the hernia, causing intestinal obstruction; iv) entrapment of small bowel beneath the blood supply of the diverticulum, also known as a mesodiverticular band; v) stricture secondary to chronic diverticulitis; vi) Meckel’s diverticulum lithiasis; vii) band extending between the diverticulum and the base of the mesentery, forming a loop in which a part of the ileum may get stuck, causing obstruction.

Other mechanisms involve rare causes of obstruction like tumors (lipomas, carcinoid tumors, and others), impacted meconium in neonates causing inflammatory adhesions of Meckel’s diverticulum to surrounding structures leading to volvulus, cecal volvulus around the band extending from Meckel’s diverticulum to umbilicus, gallstone ileus, and obstruction secondary to phytobezoar formation in Meckel’s diverticulum [12]. The rates of incidence and causes of complications of Meckel’s diverticulum are documented in Table 1 [12, 14].

Intestinal obstruction due to the mesodiverticular band of Meckel’s diverticulum is seen rarely and is usually not kept in mind in the differential diagnosis of small bowel obstructions. The yolk sac is supplied by two vitelline arteries, one of which degenerates as the yolk sac atrophies, while the remaining artery develops into the superior mesenteric artery [15]. When one of the vitelline arteries fails to degenerate, it develops into a peritoneum-covered fibrous band or a mesodiverticular band [15]. It usually extends from the tip of the Meckel’s diverticulum to the ileal mesentery and sometimes causes intes-

### Table 1. Incidence and causes of complications of Meckel’s diverticulum

<table>
<thead>
<tr>
<th>Complications</th>
<th>Incidence, %</th>
<th>Children</th>
<th>Adults</th>
<th>Cause</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hemorrhage</td>
<td>25–50</td>
<td>the most common presentation</td>
<td></td>
<td>heterotopic mucosa (gastric and pancreatic), neoplasm (carcinoid tumors, adenocarcinomas, benign mesenchymal tumors, melanoma, lymphoma, lipomas), phytobezoars</td>
</tr>
<tr>
<td>Intestinal obstruction</td>
<td>22–50</td>
<td>the second most common complication</td>
<td>the most common complication</td>
<td>intussusception, volvulus, Littré’s hernia, mesodiverticular band, stricture, enteroliths, band extending between the diverticulum and the base of the mesentery, tumors, impacted meconium, cecal volvulus, gallstone ileus, phytobezoars</td>
</tr>
<tr>
<td>Inflammatory process (diverticulitis and perforation)</td>
<td>20</td>
<td>the second most common complication</td>
<td></td>
<td>Diverticulitis: Obstructions due to fecalith or foreign body or parasites; peptic ulceration of ileal mucosa due to ectopic gastric mucosa; diverticular torsion Perforation: Progression of diverticulitis; ulceration of adjacent ileal mucosa secondary to acid produced by ectopic gastric mucosa; secondary to ingested foreign body; traumatic; tumors</td>
</tr>
<tr>
<td>Tumor</td>
<td>0.5–1.9</td>
<td></td>
<td></td>
<td>Malignant group: Carcinoids, mesenchymal tumors, adenocarcinomas, desmoplastic small-round-cell tumor Benign group: Lipoma, neuromuscular and vascular hamartoma</td>
</tr>
</tbody>
</table>

Mesodiverticular Band of Meckel’s Diverticulum
tinal obstruction, i.e. trapping of a bowel loop. In this case presentation, the mesodiverticular band and the entrapment of a small bowel loop beneath it is clearly demonstrated.

Small bowel obstruction is usually visible on plain films of the abdomen; however, the signs on these films are usually nonspecific. They may reveal dilated bowel loops and multiple air fluid levels. Ultrasonography, which may reveal a pelvic abscess, a tubular fluid-distended diverticulum at a site far from the cecum, diverticular wall swelling, segmental thickening of the intestinal walls, and invagination, is not sufficiently specific [16]. On CT, Meckel’s diverticulum is difficult to distinguish from the normal small bowel in uncomplicated cases. However, a blind-ending fluid- or gas-filled structure in continuity with the small bowel may be seen [17]. It may yield a high rate of diagnosis when small bowel obstruction is present (81–96%), but a Meckel’s etiology is difficult to identify as a cause due to the inability of distinguishing a diverticulum amongst loops of small bowel [5]. Abdominal CT seems to be a reliable modality to facilitate a preoperative diagnosis in complicated cases such as intussusception [18]. The characteristic features on the CT scan include an inhomogeneous ‘target’- or ‘sausage’-shaped soft tissue mass with a layering effect [19]. Arteriography and technetium pertechnetate scanning are useful only if there is significant bleeding or ectopic gastric mucosa [20]. Laparoscopy has also been reported as a diagnostic tool in cases of symptomatic Meckel’s diverticulum [21].

The correct diagnosis of Meckel’s diverticulum before surgery is often difficult because a complicated form of this condition may be clinically indistinguishable from a variety of other intraabdominal diseases such as acute appendicitis, inflammatory bowel disease, or other causes of small bowel obstruction [22]. Bani-Hani and Shatnawi [23] reported a preoperative diagnosis in only 4 patients (5.9%) among a symptomatic group of 28 patients. Ueberrueck et al. [24] analyzed the significance of Meckel’s diverticulum in cases diagnosed as appendicitis. 10,000 appendectomies were performed in a 26-year period. The bowel was explored to search for a Meckel’s diverticulum in approximately 80% of these cases. The presence of a Meckel’s diverticulum was discovered in 3% of these cases, while 9% of these diverticula were found to have pathology, including obstruction, diverticulitis, perforation, and intussusception. This study concluded in establishing the importance of exploring the bowel in all appendectomy cases [24].

The management of symptomatic Meckel’s diverticulum comprises surgical resection. A wedge resection of the Meckel’s diverticulum is generally carried out, and occasionally some ileum is resected by end-to-end anastomosis [4]. Diverticulectomy for Meckel’s diverticulum found incidentally has been criticized. The results of surgical excision are generally excellent. Among the patients operated on for complications of Meckel’s diverticulum, the cumulative incidence of early postoperative complications was 12%, including mainly wound infection (3%), prolonged ileus (3%), and anastomotic leak (2%). The mortality rate was 1.5%. The cumulative incidence of late postoperative complications during a 20-year follow-up was 7%. Incidental diverticulectomies are safer, with an overall rate of morbidity of 2% and a mortality of 1% [22]. Due to the difficulty of diagnosing a pathologic Meckel’s diverticulum preoperatively, many surgeons recommend prophylactic diverticulectomy in those found incidentally [5]. This recommendation is based on lower morbidity rates when compared to the resection of pathologic diverticula [5]. The rates of morbidity and mortality of Meckel’s diverticulectomy are documented in table 2 [5].

In conclusion, some authors have reported high mortality rates of Meckel’s diverticulum with a mesodiverticular band and intestinal obstruction [3]. Preoperative diagnosis is often difficult. Delay in the diagnosis of a complicated Meckel’s diverticulum can lead to significant morbidity and mortality. Early surgery is important to prevent strangulation and gangrene of the bowel. In differential diagnosis, Meckel’s diverticulum should be kept in mind concerning patients with the presentation of small bowel obstruction.

Disclosure Statement

The authors did not provide a conflict of interest statement.

References


