Complications of Meckel's Diverticulum in Adults: Diagnostic Approach and Therapeutic Strategies

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ABSTRACT

Introduction: Meckel's diverticulum (MD) is a congenital gastrointestinal malformation generated by the involution of the omphalomesenteric duct in embryonic life. It has an incidence of 0.6 to 4%, is the primary etiology of lower gastrointestinal bleeding in pediatrics, and constitutes a diagnosis of exclusion in adulthood.

Objective: To perform a literature review on Meckel's diverticulum in adults and its complications based on the current literature.

Methods: We conducted a bibliographic review in the electronic databases PubMed, SciELO, and Elsevier; 30 articles were analyzed, in English and Spanish, published in the last ten years.

State of the art: generally, DM is asymptomatic until adulthood and may present as symptoms suggestive of acute appendicitis, intestinal obstruction, or lower gastrointestinal bleeding. Its finding is usually incidental. Diagnostic methods include computed tomography, Technetium-99m pertechnetate scintigraphy, video capsule endoscopy, and surgical options such as laparoscopy and laparotomy.

Discussion: according to the analysis of the scientific literature, surgery is not recommended in the absence of complications and risk factors, including male sex, age less than 40 years, diverticulum greater than 2 centimeters long, and macroscopic alteration of the mucosa seen intraoperatively. Resection plus anastomosis seems preferable to the other techniques due to the lower risk of leaving abnormal heterotopic mucosa.

Conclusion: due to its low incidence and multiple complications with a clinical picture similar to other diverticular pathologies, Meckel's diverticulum is a diagnostic and therapeutic challenge.

Keywords: Meckel's diverticulum, complication, gastrointestinal bleeding, surgery.

Complicaciones del divertículo de Meckel en el adulto: orientación diagnóstica y estrategias terapéuticas

RESUMEN

Introducción: el divertículo de Meckel (DM) es una malformación congénita gastrointestinal que se genera por la involución del conducto onfalomesentérico en la vida embrionaria. Presenta una incidencia del 0,6 al 4%, es la principal etiología de hemorragia digestiva baja en pediatría y constituye un diagnóstico de exclusión en la edad adulta.

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Objetivo: realizar una revisión bibliográfica sobre el divertículo de Meckel en el adulto y sus complicaciones sobre la base de la literatura actual.
Método: se realizó una revisión bibliográfica en las bases de datos electrónicas: PubMed, SciELO y Elsevier; se analizaron 30 artículos, en idiomas inglés y español, publicados en los últimos diez años.
Estado del arte: generalmente, el DM es asintomático hasta la edad adulta y puede presentarse como cuadros sugerentes de apendicitis aguda, obstrucción intestinal o hemorragia digestiva baja. Su hallazgo mayoritariamente suele ser incidental. Los métodos de diagnóstico incluyen tomografía computarizada, cintigrafía con pertecnetato de tecnecio-99m, videocápsula endoscópica y opciones quirúrgicas como laparoscopia y laparotomía
Discusión: según el análisis de la literatura científica, la cirugía no está ampliamente indicada en ausencia de complicaciones y factores de riesgo, que incluyan sexo masculino, edad menor de 40 años, divertículo mayor de 2 centímetros de largo y alteración macroscópica de la mucosa vista intraoperatoriamente. La resección más anastomosis parece preferible ante las otras técnicas, por el menor riesgo de dejar mucosa heterotópica anormal.
Conclusión: debido a su incidencia baja y múltiples complicaciones con cuadro clínico similar a otras patologías diverticulares, el divertículo de Meckel supone un reto tanto diagnóstico como terapéutico.

Palabras clave: divertículo de Meckel, complicación, hemorragia digestiva, cirugía.

INTRODUCTION

Meckel's diverticulum (MD) is the most common congenital malformation of the gastrointestinal tract, with an incidence ranging between 0.6% and 4%, and represents one of the leading causes of lower gastrointestinal bleeding in pediatric patients[1].

It was first described in 1598 by the German surgeon Wilhelm Fabricius Hildanus; later, in 1801, it was named in honor of the German anatomist Johann Friedrich Meckel, who described its embryological origin[2,3].

MD consists of a remnant of the omphalomesenteric (or vitelline) duct; its wall contains all the layers of the intestine, making it a true diverticulum[2]. It is known as the "rule of twos" condition: it occurs in 2% of the general population, is located 2 feet (60 cm) from the ileocecal valve, measures about 2 inches (5 cm), has a male-to-female ratio of 2:1, is most commonly diagnosed during childhood –especially around the first 2 years of life– and may contain two types of tissue: most commonly duodenal, ileal, colonic, gastric, or pancreatic[4,5].

Although Meckel's diverticulum (MD) typically remains asymptomatic in adults, its presence should be considered, as a symptomatic presentation can be indistinguishable from other gastrointestinal conditions and may lead to a range of complications. The most frequent complications include lower gastrointestinal bleeding, intestinal obstruction, perforation, or diverticular inflammation[4-6].

Since this pathological condition often poses challenges for definitive diagnosis and can mimic other clinical presentations, early recognition combined with the prompt initiation of appropriate treatment is essential to support rapid patient recovery. Therefore, the objective of this article is to review the available literature on the key aspects related to Meckel's diverticulum in adults and its complications, as a relevant topic for medical practice.

METHOD

Descriptive study. An electronic search of scientific literature on the subject was conducted in the digital journals PubMed, SciELO, and Elsevier, covering the last ten years, in both English and Spanish. The search used the descriptors: "Divertículo de Meckel," "Complicación," "gastrointestinal bleeding," "Cirugía" from the Health Sciences Descriptors (DeCS), and "Meckel diverticulum," "Complication," "Digestive bleeding," "Surgery" from Medical Subject Headings (MeSH), combined using the Boolean operator AND. Out of all the studies found, 30 articles were selected and analyzed.

STATE OF THE ART

Meckel's diverticulum (MD) is a remnant of the proximal portion of the omphalomesenteric (vitelline) duct and represents the most common congenital anomaly of the gastrointestinal tract. Anatomically, it is a true diverticulum composed of the three layers of the gastrointestinal wall and appears as a single tubular structure located on the antimesenteric border of the ileum, approximately 60 cm from the ileocecal junction. In nearly 15% of cases, the omphalomesenteric ligament may also persist, forming a fibrous band that connects the MD to the umbilicus[7].

It is generally asymptomatic in adulthood and is mostly discovered incidentally through imaging or

surgical procedures. Complications trigger the diagnosis in approximately 7% of cases[6].

We have not found any ethnic factors linked to a higher prevalence of MD; however, several studies report an association between MD and Crohn's disease in approximately 5% of cases[2].

The histology is the same as that of the ileum; however, MD may contain various types of ectopic tissue, primarily gastric, though pancreatic, duodenal, colonic, endometrial, Brunner's gland, or even hepatobiliary tissue may also be found[2-6].

Clinical Presentation

Meckel's diverticulum (MD) usually presents asymptomatically, which is why diagnosis is generally incidental-discovered during a laparotomy or laparoscopy performed for other reasons, or through a barium study of the small intestine[8-9].

Symptoms are mainly due to complications such as bleeding from peptic ulcers, Meckel's diverticulitis, or intestinal obstruction, which can lead to febrile episodes accompanied by moderate abdominal pain and bloody stools. MD rarely appears within a hernia sac, and malignant transformation is rare[9].

Complications

1. Gastrointestinal bleeding: This is the most frequent complication, primarily affecting the pediatric population, with an incidence ranging from 25% to 50%. In most cases, it is associated with peptic ulceration due to the presence of ectopic gastric and/or pancreatic tissue within the diverticulum. Other less frequent causes include neoplastic processes or bezoars. Clinically, it presents as melena, hematochezia, diffuse abdominal pain, and anemia syndrome[10-11].

In 80% of cases, bleeding involves ulceration of the ectopic mucosa of gastric tissue by secreted acid. In adults, bleeding is the initial manifestation of symptomatic MD in approximately 60% of cases[2].

2. Intestinal obstruction: With an incidence of 20% to 40%, this is the second most frequent complication. It primarily affects adults, with ileocolic intussusception as the leading cause. Other possible causes include a mesodiverticular band, ileobiliary disorders, tumors, bezoars, or volvulus. The clinical picture is characterized by diffuse abdominal pain, distension, nausea or vomiting, and constipation[10-12].

Littré's hernia occurs when Meckel's diverticulum is found inside an inguinal hernia sac and, less commonly, within a femoral or umbilical hernia[13-14]. It can become strangulated, incarcerated, or perforated. Diagnosing Littré's hernia before surgery is very challenging and is usually confirmed during the operation[14].

Intestinal obstruction caused by Meckel's diverticulum during pregnancy is extremely rare. CT scans are highly sensitive and specific for diagnosing the obstruction and determining its cause[2].

3. Diverticulitis: Accounts for up to 58% of clinically manifest MD cases in adults[2]. The most common causes include fecaliths, parasites, or foreign bodies, though it can also result from diverticular torsion or immune response triggered by ulceration of ectopic gastric tissue. Its clinical presentation often mimics acute appendicitis, with right lower quadrant abdominal pain, fever, nausea, and vomiting.

Meckel's diverticulitis has been found to be more common in patients with Crohn's disease. Distinguishing Meckel's diverticulitis from appendicitis –either clinically or through imaging– is highly challenging. Contrast-enhanced CT is useful for making an accurate diagnosis[15]. When surgery is performed for suspected appendicitis and a normal appendix is found, signs of Meckel's diverticulitis should be investigated[2].

4. Perforation: it is extremely rare. The progression of diverticulitis to intestinal perforation is generally attributed to ulceration of the serous layer caused by acid produced by ectopic mucosa, trauma, or tumors. Perforation presents with a clinical picture that includes generalized abdominal pain, abdominal distension, fever, nausea, and vomiting[16].

Exceptionally, vesicodiverticular fistulas have been described[16,17].

5. Neoplastic processes (tumors): this is the least common complication, with an incidence of 0.5 to 2%. Carcinoid metaplasia is the most common neoplasm and represents approximately two-thirds of the tumors that develop in MD[2]. Other tumors include hamartomas, lipomas, adenocarcinomas, sarcomas, lymphomas, mesenchymal tumors, and desmoplastic tumors. The clinical picture suggestive of a neoplastic process includes diffuse abdominal pain, occult blood in stool, intussusception, and constipation, along with general symptoms such as asthenia, adynamia, or unexplained weight loss[10].

Diagnosis

The preoperative diagnosis of MD is difficult to establish since the clinical symptoms and imaging characteristics of complicated MD resemble many pathological disorders that generate acute abdominal pain or gastrointestinal bleeding[9].

Generally, MD diagnosis occurs incidentally (33%), although it is also a finding of preoperative studies for other causes (4-6%) or suspected etiology in the presence of any of its complications. Likewise, its presence can result from an incidental finding during surgical exploration by laparotomy or laparoscopy[9].

1. Abdominal X-ray: useful in the presence of an MD complicated with intestinal obstruction, where it will be possible to visualize dilated intestinal loops plus the presence of hydro-aerial levels in the diverticular interior[18].

2. Abdominal ultrasound: allows visualization in the lower right abdominal quadrant of the diverticulum

as a tubular structure with fluid inside. With Doppler sequencing, it is possible to visualize abnormal vessels, although it is hard to differentiate between DM and other inflammatory processes.[19]

3. Computed tomography (CT): it is notably superior to other imaging techniques in obtaining a better visualization of uncomplicated MD. When complications are present, it can reveal gas or fluid inside the diverticulum, as well as intestinal invagination, diverticulitis, or obstruction. The contrast medium reveals extravasation of the intravenously injected agent when active intestinal bleeding is present.[18,19]

4. Angiography: The angiography of the superior mesenteric artery is an effective method for determining the location of the hemorrhage with a high accuracy rate (approximately 59%)20.

5. Computed tomography angiography (Angio-CT): Computed tomography angiography (angio-CT) has a sensitivity of 85% and specificity of over 90%; it also allows for prompt localization of the active hemorrhagic site, by contrast extravasation, in hemodynamically unstable patients[20,21].

6. Endoscopic videocapsule: authorized by the United States Food and Drug Administration (FDA) in 2001, it is an innovative, safe, and non-invasive tool for diagnosing occult gastrointestinal bleeding. Silva et al.[22] and Lin et al.[23] describe the efficacy of this diagnostic technique after determining microbleeds and the anatomical location of the DM.

7. Laparotomy or laparoscopy: They allow for an accurate diagnosis of the pathology; however, they are not recommended as an initial diagnostic method. Surgical treatment is indicated in the presence of high clinical suspicion and the presence of gastrointestinal bleeding that does not yield to conventional management[24]. Other diagnostic options such as nuclear medicine with the use of scintigraphy or technetium-99m pertechnetate (Tc-99m) scintigraphy have a sensitivity and specificity of over 80% in pediatric patients. They are not recommended for adults, possibly due to the lower level of gastric-type ectopic tissue in adulthood, which causes a marked decrease in the sensitivity and specificity of this diagnostic method[20].

Therapeutic strategies

1. Complicated Meckel's Diverticulum: Treatment is surgical, involving resection via laparoscopy or laparotomy, using wedge or segmental resection of the adjacent small intestine, plus end-to-end intestinal anastomosis[24].

Several authors state that diverticula larger than 2 cm with inflammatory features, active bleeding, or those found incidentally should be treated with simple diverticulectomy. In contrast, diverticula smaller than 2 cm presenting with intestinal obstruction or perforated diverticulitis should be managed with segmental and/or wedge resection. In the presence of malignant neoplasia, segmental resection based on oncologic criteria is recommended[25].

2. Incidental Meckel's Diverticulum: Currently, there is no consensus on whether to resect incidentally discovered MD identified through imaging techniques[26]. Żyluk's systematic review[27] proposes preventive resection of MD based on the following criteria: age under 50 years, male sex, specific anatomical characteristics of the diverticulum (greater than 2 cm, short neck, macroscopic findings suggestive of ectopic tissue), and the relative indication of a fibrous band connecting the MD to the umbilicus.

Postoperative care is essential to prevent complications such as surgical site infection, postoperative ileus, and anastomotic leakage. Long-term complications such as bowel obstruction due to stenosis or adhesions should also be considered[8].

DISCUSSION

Sometimes referred to as "the great imitator" in abdominal pathology, MD can be responsible for a wide range of nonspecific symptoms, with clinical manifestations ranging from abdominal pain to hemodynamic instability due to severe complications. Investigating unusual childhood history, such as umbilical discharge or the presence of persistent umbilical tissue, may help suggest the diagnosis[2].

The probability of complications is approximately 4% in childhood, peaking before the age of 2, decreasing to 1% around age 40, and progressively declining to nearly zero after age 70[2].

The origin of the gastrointestinal bleeding often associated with MD complications is the presence of heterotopic gastric mucosa.

A study analyzing 8,393 cases of MD-related bleeding found heterotopic gastric mucosa in 98% of cases. Acid secretion from this ectopic gastric mucosa is the main cause of gastrointestinal bleeding due to MD; the role of *Helicobacter pylori* appears to be negligible[2].

A study analyzing the histological characteristics of 1,476 resected MDs in adults found that 43% of symptomatic MDs contained ectopic tissue, most commonly gastric (33%), pancreatic (5%), and carcinoid (2%). Among asymptomatic MDs, 14% contained ectopic tissue, including gastric (8%), pancreatic (3%), and carcinoid (2%)[20].

The study by Hernández et al.[28] included a sample of 27 patients who underwent surgical resection and were later diagnosed with MD. In the symptomatic group (22 patients), only 9% had a perioperative diagnosis of MD, while the majority were diagnosed intraoperatively.

In the absence of symptoms, complementary studies have limited diagnostic value. Ultrasonography has little value in adults[2].

Because MD is rarely diagnosed in adults, there is no consensus on the appropriate therapeutic strategy for

symptomatic MD or on whether incidental MD should be resected[20].

The decision to perform resection is relatively straightforward when symptoms are present, and a complication occurs, or when there is suspicion of malignant transformation. However, the real dilemma arises in cases where MD is found incidentally during surgery for another reason. The low incidence of neoplastic transformation does not, by itself, justify resection in all cases where MD is discovered as an incidental finding[29].

Rahmat et al.[30] conducted a systematic review on the resection of incidental MD. After analyzing 31 studies, they found that four articles recommended against resection, twelve studies recommended resection, ten suggested performing resection when risk factors were present, and five studies did not provide a clear recommendation. Currently, the literature leans toward recommending resection of MDs with features suggestive of a higher risk of future complications.

Definitive treatment is surgical and includes diverticulectomy, wedge resection, and segmental resection. The choice of procedure depends on the integrity of the diverticular base and the presence and location of ectopic tissue within the diverticulum[20].

CONCLUSION

Meckel's diverticulum is the most common gastrointestinal malformation; however, it is usually asymptomatic in adults. Due to its possible pathophysiological processes, it can mimic other gastrointestinal conditions and may evolve into potentially life-threatening complications such as intestinal obstruction, gastrointestinal bleeding, intestinal perforation, or eventual neoplastic transformation. Diagnosis poses a real challenge both clinically and in imaging, as MD is most often identified as an incidental finding.

Treatment is medical-surgical, and the development of minimally invasive techniques has helped reduce mortality from MD-related complications. The preferred surgical technique is segmental resection with end-to-end anastomosis to ensure complete removal of ectopic mucosa.

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