Meckel’s diverticulum is named in honor of Johann Friedrich Meckel, who, in 1809, described the intrauterine origin of the condition, which is one of the most common inborn defects of the baby’s small intestine stipulated by the partial obliteration of the vitelline duct (omphalomesenteric duct).
Definition

Meckel’s diverticulum is a congenital bulge in the small intestines that is present at birth. It is an embryological remnant of the Vitelline duct.

It is the most common malformation of the gastrointestinal tract.

Background of Meckel’s Diverticulum

Despite advanced modern examination methods and imaging techniques, it is sometimes quite difficult to establish the diagnosis. In most cases, the condition is subtly complicated, with two types of after-effects: involvement of ectopic mucosal tissue, leading to gastrointestinal bleeding in children under 2 years old. The other is obstruction, inflammation in severe cases, and, rarely, bowel perforation.

Pathophysiology of Meckel’s Diverticulum

The Vitelline duct, also known as the omphalomesenteric duct, nourishes the gut in utero and connects the midgut to the yolk sac ventrally. It is a passage for the flow of nutrients from the mother to the fetus. It usually narrows and vanishes by the 7th week of gestation. If, for some reason, it does not, certain developmental abnormalities occur.

The types of defects include:
Persistent vitelline

- The connection between the ileum and the inner surface of the umbilicus in the form of a fibrous band
- Obvious vitelline sinus under the umbilicus
- Obliteration of the bowel portion
- Vitelline duct cyst
- Meckel diverticulum

The diverticulum is nourished by the **omphalomesenteric artery**. Most of the diverticulum is allocated on the **antimesenteric border of the ileum**, though a mesenteric location is also possible.

**There is a rule of 2s:**

- 2 feet distance to the ileocecal valve
- 2 cm wide/3 cm long
- 2% of the population may be affected by the condition
- Manifests at the age of 2 years
- Male children are twice as likely to be susceptible to Meckel's diverticulum
- Half of the cases are associated with the presence of **ectopic mucosa**

Usually, the diverticulum contains ileal mucosa; however, other tissues may be found there as well:

- Heterotopic mucosa, mostly gastric, accounts for 62%.
- Pancreatic tissue 6%.
- 5% is marked by the first and second types of tissues.
- Jejunal mucosa, both gastric and duodenal, as well as Brunner's tissue, was detected in 2% of cases.
- Rarely rectal, colonic, rectal, endometrial, and hepatobiliary tissue is determined in the diverticulum lining.
Epidemiology of Meckel’s Diverticulum

United States

It is estimated that the frequency of cases of Meckel’s diverticulum is 2%. However, some sources allege that it ranges from 0.2% to 4%, and 60% of them with developed symptoms. Complications occur in 5% of the children with this abnormality.

International

The data for the prevalence is the same in the US, Europe, and Asia.

Race

Some researchers state that 63.4% of affected children are white, 4.7% are African American, 16.4% are Hispanic, 3.9% are Asian, and 11.6% other.

Gender

Studies indicate boys are twice as likely to contract Meckel’s diverticulum. Also, male children constitute 74% of primary cases, and boys tend to develop various complications.

Age

Meckel’s diverticulum manifests as rectal bleeding in children younger than two years old. A third of the toddlers have had surgery before their first birthday; over 50% had the operation by the age of four.

Clinical Presentation of Meckel’s Diverticulum

History

Meckel’s diverticulum is usually found accidentally during a barium examination or laparotomy since it usually has an asymptomatic flow.

An asymptomatic diverticulum is always fraught with complications due to its anatomic specialties (4-16% of patients). The complications in this condition are stipulated by:

- 35% obstruction of the bowel
- 32% bleeding (peptic ulceration, resulting in the vessel erosion, painless rectal hemorrhage), which is more common in little kids, rather than in adults
- 22% inflammation of the diverticulum (diverticulitis is often seen in adults; it differs from appendicitis since it has a wider mouth, little lymphoid tissue, and is self-emptying, so it is less prone to inflammation)
- 10% umbilical fistula
- 1% of other umbilical disorders.

The diverticulum rarely causes pain. Pain that does occur is not associated with intussusception; it occurs in the periumbilical area, radiating to the right lower quadrant. Also, blunt abdominal trauma may become a reason for diverticulum perforation.
Meckel’s diverticulum may, occasionally, cause liver abscess and abdominal abscess when it is perforated, which is a direct indication for abdominal surgery.

**Obstruction** is the most common complication in children, constituting 25-40% of all complex cases in pediatric practice. The reasons for this condition may be bone fragments 58%, wood splinters 14%, food 12 %, pin/needles 9 %, and other 7 %. However, adults may have this condition for other reasons and mechanisms of manifestation.

**Complications** include:

- The most common complication is an **omphalomesenteric band**.
- An **internal hernia** through the remnant vitelline duct
- **Iliac passion/volvulus**, occurring around the remnant vitelline duct
- Efferent and afferent loop T-shaped prolapse of the intestine through a permanent vitelline duct fistula at the umbilicus in a newborn baby.
- **Intussusception**

Malignancy of Meckel’s diverticulum is a very rare phenomenon. However, it occurs. Usually, it is represented by **carcinoids, sarcoma, adenocarcinoma, Burkett’s lymphoma**; and there may be **benign tumors**: leiomyomas, angiomas, neuromas, or lipomas. Moreover, the diverticulum can be affected by **TB** and may be involved in **Crohn’s disease**.

**Physical examination**

There are three hallmarks for Meckel’s diverticulum:

- **Gastrointestinal bleeding**
- Intestinal obstruction of different origin
- Acute inflammation of a diverticulum

Meckel’s diverticulum is frequently accompanied by **painless, spontaneous rectal bleeding (hematochezia)**. In severe cases, it may lead to **hemorrhagic shock**. The rectal blood may have various shades:
- 40% dark red
- 35% bright red (rapid bleeding) – currant jelly
- 12% mixture of bright and dark red
- 6% tarry or dark red (slow bleeding)
- 7% tarry

**Features of Intestinal obstruction** include:

- Severe abdominal pain.
- Bilious vomiting.
- Tenderness of abdomen
- Abdominal distention
- Hyperperistalsis that may be visible sometimes.
- A palpable abdominal mass with prolonged obstruction.

If the condition has not been detected in a timely manner, it leads to **intestinal ischemia or infarction**, causing acute pain and GI bleeding.

**Differential Diagnosis of Meckel’s Diverticulum**

- Colonic vascular malformations
- Emergent treatment of gastroenteritis
- Gastrointestinal duplications
- Henoch-Schönlein Purpura

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![Image: “Scheme of bowel intussusception. The trapped part of the intestine is visible as a section in the center part of the picture.” by Olek Remesz (wiki-pl: Orem, commons: Orem) – Own work. License: CC BY-SA 3.0](image_url)

- Intestinal duplication
- Intestinal polyposis syndromes
- Juvenile polyps
- Pediatric appendicitis
- Pediatric constipation
- Intussusception (see figure)
- Pediatric Crohn’s disease
- Necrotizing enterocolitis imaging
- Pediatric urolithiasis
- Peptic ulcer disease
- Postoperative adhesions
- Ulcerative colitis in children
- Peutz-Jeghers syndrome
Workup of Meckel’s Diverticulum

Laboratory studies

Patients being screened for Meckel’s diverticulum should have the following blood tests:

- **CBC** (hemoglobin and hematocrit levels would be low while bleeding). Patients with hemorrhagic syndrome develop **anemia** (8.8 g/dL) in 58% of cases. Iron deficiency anemia, vitamin B12 deficiency anemia, or foliate deficiency anemia, as well as low albumin and ferritin levels, are detected in such patients due to inflammatory bowel disease.
- **Electrolyte, glucose level**
- **BUN**
- **Creatinine level**
- **Coagulation screen** (especially for patients with bleeding)

Imaging studies

Simple radiography, together with a barium study, are outdated diagnostic methods; they expose patients to radiation and are challenging to perform with young children.

Thus, a **Meckel scan** is a better choice since it is not as harmful to the growing body and more precise (sensitivity 94% and specificity 97%). A **CT scan** also may detect enterolith, intussusception, or diverticulitis.

**Ultrasound** is useful in anatomic, rather than mucosal, complications (intussusception, obstruction, diverticulitis).
A **bleeding scan** will determine the source of bleeding if the patient loses 0.1 ml/min of blood.

**Histological findings**

*Helicobacter pylori* were associated with **ectopic gastric mucosa** in this condition, as some studies indicate. Also, Meckel’s diverticulum with **gastric heterotopia** causes frequent abdominal pain, nausea, vomiting, and rectal bleeding in comparison with the presence of pancreatic heterotopia.

**Medical Management of Meckel’s Diverticulum**

The most important part of correcting the condition is the appropriate diagnosis and management of the patients in the emergency department.

The following measures must be taken, in this order, upon admission:

- Intravenous line
- Crystalloid fluids
- Nothing by mouth status (NPO)
- Blood tests (mentioned above)
- Nasogastric decompression in case of obstruction, followed by abdominal radiography
- Gastric lavage, in case of tarry stool, to rule out upper GI bleeding
- Upper endoscopy or flexible sigmoidoscopy in the gastric lavage is negative
- Meckel scan may not be informative even with substantial evidence of the condition
- **Surgery** should be considered if the condition exacerbates dramatically, even without nuclear diagnostics.
Surgical intervention

Indications for immediate surgical intervention are:

- Presence of peritoneal signs
- Hemodynamic instability
- Bowel obstruction
- Bleeding Meckel diverticulum has to be excised along with the adjacent ilial segment.

Efficient resection of Meckel's diverticulum is conducted, with the help of laparoscopy, by implementing an endoscopically designed auto stapling device. A quarter of all cases are handled through laparoscopy, which is a very cost-effective method.

Diagnostic laparoscopy is applied in those cases where the emergency department team suspects intestinal perforation.

Double-balloon enteroscopy (DBE) is used successfully in diagnosing a bleeding Meckel's diverticulum (assists in minimal surgical interventions). This method is very informative for doctors as it provides a clear visualization of the distal small bowel lumen and helps to identify the source of bleeding. This examination's only disadvantage is that the upper small bowel is not accessible.

Prophylactic ectomy of the diverticulum is a simple operation, which prevents various complications associated with high morbidity and mortality levels. However, recent research states that prophylactic excision of the diverticulum, accidentally discovered, was only beneficial for patients under 50 years old.

References

Pediatric Meckel Diverticulum via medscape.com

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