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 present at birth and it is an embryological remnant of the omphalomesenteric duct. It is the most common malformation of the gastrointestinal tract.

Background of Meckel’s Diverticulum

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

Pathophysiology of Meckel’s Diverticulum

The Vitelline duct is responsible for nourishing the gut in utero and connects the midgut to the yolk sac ventrally. The Vitelline duct usually narrows and vanishes by the 7th week of gestation, initially being a passage for the flow of nutrients from the mother to the fetus. When the duct, for some reason, does not disappear, certain abnormalities of the development 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
- Cyst of a vitelline duct
- Meckel diverticulum in almost 100%

The diverticulum is nourished by the **omphalomesenteric artery**. The majority 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 in the age of 2 years
- Male children are twice as likely susceptible to Meckel’s diverticulum
- Half of the cases 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 type 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 %, 60 % of which with developed symptoms. Complications account for 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, then only 4.7 % African American, 16.4 % of Hispanic, 3.9 % Asian and 11.6 % other.

Gender

Apparently, 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 kids younger than 2 years old. A third of the toddlers 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 while barium examination or laparotomy, as it usually has 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, differ from appendicitis as it has a wider mouth, little lymphoid tissue, and self-emptying, so less prone to inflame)
- 10 % umbilical fistula
- 1 % of other umbilical disorders.

There is rarely abdominal pain caused by the diverticulum, which 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 the perforation of the diverticulum. Meckel’s diverticulum occasionally may become the cause of the 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 that makes up 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 due to other mechanisms of manifestation.

Complications include:

- The most common complication is an omphalomesenteric band.
- An internal hernia through the remnant vitelline duct
- Iliac passion/volvulus taking place 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, lipomas. Moreover, diverticulum can be affected by TB and may be involved in Crohn disease.

Physical examination

There are 3 hallmarks for Meckel's diverticulum:

- Gastrointestinal bleeding
- Intestinal obstruction of different genesis
- Acute inflammation of a diverticulum

Meckel's diverticulum is frequently accompanied by painless spontaneous rectal bleeding (hematochezia), in severe cases leading to hemorrhagic shock. The appearance of the rectal blood has 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.
- Palpable abdominal mass with prolonged obstruction.

If the condition has not been detected timely, 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-Schonlein Purpura

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

For the patients with Meckel’s diverticulum, these laboratory examinations are indicated:

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

Imaging studies

Simple radiography, together with a barium study, are outdated methods of diagnostics, which exposed patients to radiation and caused lots of inconveniences while the procedure in case of little children.

Thus, a **Meckel scan** is a better choice as 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 complications, rather than in mucosal (intussusception,
obstruction, diverticulitis).

A **bleeding scan** is used in order to 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 claim. Also, Meckel’s diverticulum with **gastric heterotopia** causes frequent abdominal pain, nausea, and vomiting, and rectal bleeding in comparison with the presence of pancreatic heterotopia.

It is alleged that, in most of the cases of resected diverticulum due to the penetration of the extra growth, malignant cells are often histologically confirmed and sometimes they are ruined.

**Medical Management of Meckel’s Diverticulum**

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

The measures that have to be taken in the first order upon admission:

- Intravenous line
- Crystalloid fluids
- Nothing in mouth status (NPO)
- Blood examinations (all mentioned above)
- Nasogastric decompression in case of obstruction, followed by radiography of the abdomen
- Gastric lavage in case of the 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 if there is a lot of evidence for 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 with the implementation of an endoscopically designed auto stapling device. A quarter of all cases are handled through laparoscopy, which is a very cost-effective method for the hospitals.

Diagnostic laparoscopy is applied in those cases when perforation of the intestine is suspected by the emergency department team.

Double-balloon enteroscopy (DBE) is successfully used in the diagnostics of a bleeding Meckel's diverticulum (assists in the 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. The only disadvantage of this examination is that the upper small bowel is not assessable.

Prophylactic ectomy of the diverticulum is a plain operation, which prevents various complications affiliated with high morbidity and mortality levels. However, recent research states that only among the patient’s younger than 50 years prophylactic excision of the diverticulum, accidentally discovered, was beneficial.

References

Pediatric Meckel Diverticulum via medscape.com

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