Meckel’s diverticulum in children, clinical and pathological aspects

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Abstract
Meckel’s diverticulum (MD) represents one of the most common malformations of the digestive tract, being a vestige of the proximal end of omphalo-mesenteric duct, which normally obliterates and atrophiates between the sixth and ninth week of intrauterine life. It is estimated that 2–4% of people are carriers of this malformation. The interest in this organ study lies in the fact that it presents its own non-specific pathology, mimicking a cecal, colon or small intestine pathology. It seems that most MD cases are asymptomatic (AS MD), being arbitrary discovered during surgeries, whereas only a small part are being symptomatic (S MD). MD may be clinically expressed at any age but it is more common in children. In our study, we evaluated a group of 44 children, aged between 0 and 16 years, diagnosed with AS MD (15 cases) or S MD (29 cases). Of the 29 S MD cases, 14 had intestinal obstruction, seven cases showed lower gastrointestinal bleeding, five cases presented acute inflammation (diverticulitis) and three cases were complicated with peritonitis; 15 cases of AS MD were discovered during surgical interventions for acute appendicitis (14 cases) or inguinal hernia (one case). Most cases of MD were recorded between 1–4-year-old and 7–16-year-old.

Keywords: Meckel’s diverticulum, intestinal obstruction, hernia, digestive hemorrhage.

Introduction
Meckel’s diverticulum (MD) represents a vestige of the proximal end of the omphalo-mesenteric duct, which, at a certain moment of development, performs the connection between the primitive intestine and vitelline vesicle, and that normally obliterates and atrophiates itself somewhere between the sixth and the ninth week of intrauterine life [1]. According to some studies, MD is one of the most frequent congenital malformations of the gastrointestinal duct, being present in 2–4% of people [2, 3].

Most often, MD is asymptomatic (AS MD), arbitrary discovered during some surgical interventions for other diseases, but it may give some series of complications: gastrointestinal bleedings, invaginations and obstruction, perforation, strangulation, hernia and, more rarely, malignant degeneration [4, 5]. In these cases, we speak about symptomatic MD (S MD). The risk of developing digestive complications with a clinical manifestation is estimated at about 4.8% of the MD patients, but this risk is being reduced with age [6, 7].

The clinical symptomatology of MD is non-specific and, because of this reason, the diagnosis is difficult to establish. A MD lesion is suspected when the occlusive, inflammatory symptomatology or a gastrointestinal bleeding appears in young male patients [8, 9]. However, the symptomatology is extremely polymorph, going from anemic rebellious syndromes to treatments resulted after some occult repeated hemorrhages with hemorrhagic shock or acute peritonitis. In the present study, our goal was to evaluate a group of children with diagnosed MD in order to correlate present symptomatology to the age of patients and MD complications.

Materials and Methods
We conducted a retrospective study, including all cases of MD hospitalized in the Clinic of Pediatrics of the Emergency County Hospital of Craiova, Romania, between 1985 and 2000. During this period (i.e., 15 years), a total of 44 children diagnosed with MD were hospitalized. The records included in the analysis were clinical observation sheets, laboratory tests, imaging examinations and histopathological records. About one third of the MD cases were symptomatic, whilst the rest were asymptomatic ones.

For the histopathological study, there were analyzed surgical excision parts of the body fragments from where there were collected parts of the organ. The biological material fixing was carried out in 10% neutral formalin and then embedded in paraffin, according to the standard protocol processing of the histopathological material. After microtome sectioning, the histological samples were stained with Hematoxylin–Eosin (HE) and examined under a microscope.

Results
Out of the 44 patients diagnosed with MD, 29 (66%) had various abdominal symptoms, and 15 (34%) patients were incidentally diagnosed during surgery for other diseases. The diverticular pathology was denoted by inflammatory, occlusive or bleeding phenomena. Thus,
of 29 cases, 14 presented intestinal obstruction, seven cases showed lower gastrointestinal bleeding, five cases acute inflammation diverticulitis and three cases were complicated with peritonitis. The 15 cases of asymptomatic MD were diagnosed during interventions for acute appendicitis (14 cases) or inguinal hernia (one case). The gender distribution analysis showed that most cases of MD, 33 (75%) were diagnosed in male patients. Among these, 24 presented abdominal symptoms and nine were asymptomatic. In female patients, there were 11 cases of MD recorded, this representing 25%, of which five had various abdominal symptoms, and six were asymptomatic (Table 1).

### Table 1 – MD distribution according to gender

<table>
<thead>
<tr>
<th>Gender</th>
<th>AS MD</th>
<th>S MD</th>
<th>Total No. of MD cases</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. of cases</td>
<td>%</td>
<td>No. of cases</td>
</tr>
<tr>
<td>Males</td>
<td>9</td>
<td>60</td>
<td>24</td>
</tr>
<tr>
<td>Females</td>
<td>6</td>
<td>40</td>
<td>5</td>
</tr>
</tbody>
</table>

AS MD: Asymptomatic Meckel’s diverticulum; S MD: Symptomatic Meckel’s diverticulum.

Another analyzed aspect was the case distribution by age. The age distribution group was based on childhood periods, namely: infant (0–1-year-old), ante preschool children (1–4-year-old), preschool children (4–7-year-old), schoolchildren (7–16-year-old) and adolescents (16–18-year-old). In our study, the most affected age groups were the 7–16-year-old group with 24 cases and the 1–4-year-old group with 11 cases (Table 2). From the data presented by us, there may be observed that MD can occur symptomatically at any age.

### Table 2 – MD distribution on age groups

<table>
<thead>
<tr>
<th>Age group [years]</th>
<th>AS MD</th>
<th>S MD</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>0–1</td>
<td>0</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>1–4</td>
<td>0</td>
<td>11</td>
<td>11</td>
</tr>
<tr>
<td>4–7</td>
<td>0</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>7–16</td>
<td>15</td>
<td>9</td>
<td>24</td>
</tr>
<tr>
<td>16–18</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>15</td>
<td>29</td>
<td>44</td>
</tr>
</tbody>
</table>

AS MD: Asymptomatic Meckel’s diverticulum; S MD: Symptomatic Meckel’s diverticulum.

Regarding the distribution of MD cases according to the social environment, our study revealed that most cases were from urban areas, 27 (61.4%) cases, while in rural areas there were registered a total of 17 (38.6%) cases (Table 3). The differences between the social environment is coincidental and has no logical explanation, because all patients have had access to medical care at the same level.

### Table 3 – MD distribution according to the social environment

<table>
<thead>
<tr>
<th>Social environment</th>
<th>AS MD</th>
<th>S MD</th>
<th>Total No. of MD cases</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. of cases</td>
<td>%</td>
<td>No. of cases</td>
</tr>
<tr>
<td>Rural</td>
<td>4</td>
<td>26.6</td>
<td>13</td>
</tr>
<tr>
<td>Urban</td>
<td>11</td>
<td>73.4</td>
<td>16</td>
</tr>
</tbody>
</table>

AS MD: Asymptomatic Meckel’s diverticulum; S MD: Symptomatic Meckel’s diverticulum.

The analytical study of diverticular damage symptoms mentioned in the clinical observation sheets showed that the most common symptoms encountered in patients were: abdominal pain, vomiting, nausea, transit disorders, gastrointestinal bleeding. The pain was localized around the umbilicus, especially in the right iliac fossa or in the lower abdominal area. Vomiting had food causes in most of the cases, and in six MD cases associated with intestinal obstruction, they had an incoercible, precipitating occlusive evolution towards the aggravation of occlusive shock. Transit disorders were present in 40 of the 44 cases. Despite the fact that patients also presented digestive symptoms, they also complained of impaired general condition, fever, dyspnea, neurological disorders. The nonspecific symptoms often made the preoperative diagnosis an elusive one, which is why we think that symptomatic MD is the “great simulant” of the abdominal cavity pathology in children.

The histopathological study showed that in most cases the MD wall had an identical structure to that of the ileum, which consists of four layers: mucosa, submucosa, muscle and peritoneal serous to the surface. The mucosa and submucosa showed permanent creases that entered the lumen of the diverticulum, similar to those of the ileum. In addition to these normal aspects, in our study we encountered a number of specific histological aspects characterized by the presence of organized lymphoid follicles structures and areas of tissue heterotopia. The submucosal lymphoid follicles have been frequently observed single or aggregated, similar to those in Peyer’s patches, but in a smaller number (Figure 1). The presence of the heterotopic tissue may explain some severe complications of the lower gastrointestinal bleeding or perforation, encountered in children with MD. The presence of the ectopic tissue was encountered in 15 cases, of which 12 patients with S MD and three patients with AS MD. Ectopic tissue structures found at MD level were mostly represented by islands of gastric mucosa. The gastric mucosa was identified by us of the fundic and pyloric type (Figures 2 and 3). In one case, we observed an association between gastric mucosa and large intestine type (Figure 4). In three cases, there were also noticed inclusions of pancreatic tissue in the MD wall.

**Discussion**

Meckel’s diverticulum is a significant cause of morbidity and mortality. According to some authors [10], only in the USA, there are around four million persons that could present symptomatic and asymptomatic MD. We think that the number of asymptomatic patients is much higher. All data reported so far concern cases who presented a pathology or have been occasionally discovered during surgery performance for other diseases.

MD characteristics can be best shown by the “no two rule”: it appears in 2% of the population; it is usually discovered with age; it usually has a 2 inch length and a 2 cm diameter; it is located at a 2 feet distance from the ileocecal valve, it is twice more frequent in males; only 2% of the persons with MD are symptomatic [11–14]. In our study, the most frequent MD cases have been diagnosed in students aged between 7 and 16-year-old.

Even though it may present its own pathology, the specific MD diagnosis is difficult to establish because of the decreased sensibility and specificity of the used para-
clinical investigation methods. In our study, out of the 44 MD children, 15 (34%) did not present any symptom that should suspect the presence of a MD, the diagnosis of congenital malformations being a usual one.

Being a tubular organ, attached to the digestive tube, the MD pathology is of the inflammatory, occlusive or hemorrhagic type and may appear at any age, predominating in children. In our study, most of the S MD cases manifested through syndromes of the occlusive type. Thus, from the 29 S MD cases, 14 (48.27%) cases presented an occlusive syndrome. The presurgical diagnosis of MD intestinal obstruction was suspected only in three cases, this representing 21.42%. According to some authors, the presurgical diagnosis of MD intestinal obstruction is of only of 6% [15–17].

It is well known the fact that in Littre’s hernia, MD can penetrate the inguinal wall, umbilical or femoral canal, causing incarceration or strangulation and thus triggering an intestinal occlusion [11, 18]. Occlusion by strangulation occurs in situations where a longer diverticulum wraps around the intestinal ring, thus performing an extrinsic stenosis or when a fibrous cord, parting from the diverticle top and fixed on the mesentery or on an intestinal ring, flattens or cudates the intestine [19]. In some cases, an enlarged MD, with a thin base of implantation into the small intestine, can twist around its own axis, resulting a simple diverticular volvulus [20].

In our study, seven patients presented the predominant symptom of MD in the form of inferior digestive hemorrhage. Most authors consider that digestive hemorrhage is due to the existence of heterotopic tissue areas, especially of gastric mucous that produces hydrochloric acid in an unprotected area by gastrointestinal mucous, which leads to necrosis of the diverticular wall. According to some studies, MD may contain a heterotopic tissue, such as gastric mucosa, colon, or pancreatic tissue, with a highly variable incidence up to 50% of the cases [21, 22]. Gastrointestinal (GI) hemorrhage can be one of the main signs denoting the presence of MD. It occurs without any apparent cause, at any age, and the intensity of bleeding depends on the size of the eroded vessels. Usually, MD bleeding emerges spontaneously, it may persist from a few hours to a few days, and it ends up just as it emerged, appearing at irregular time periods [23]. When larger vessels are eroded, the hemorrhage is intense, the blood eliminated through defecation is red, threatening the patient’s life through hemorrhagic shock. Some other times, hemorrhage can occur as a hemoperitoneum following the MD perforation [24, 25].

MD inflammation (diverticulitis), present in five of the patients included in our study, may mimic acute appendicitis. In these cases, the pain location often varied, around the umbilicus or diffuses throughout the abdomen. The pain was accompanied by vomiting or bowel disorders. Periumbilical location or diffuse distribution of pain is due to MD localization, but also to rich peritoneal innervations [26].

One of the peculiarities of the studied cases was gender ratio in patients with MD. Most of the cases, 75% were recorded in male patients and only 25% in female patients. From various studies in the literature
we found that, although there is a slight predominance in males, it is not a scientific explanation. Some authors argue that this is a malformation occurring in both sexes at the same rate [27], and other authors support the idea that there is a higher frequency among males, by a 4:1 ratio [28]. There are authors who even consider that the relationship between the incidence of the two genders may be unitary, being more symptomatic in male patients [9].

Conclusions

MD represents a problem of positive and differential diagnosis, its pathology miming any pathology of abdominal cavity. It clinically expresses itself especially during childhood, generally affecting males, through occlusive, hemorrhagic or inflammatory phenomena. The presence of islands of heterotopic tissue in its wall structure explains the various pathological manifestations.

References


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