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Research Article

Outcomes of different presentations of complicated Meckel's diverticulum in children

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Abstract

The most prevalent congenital digestive system abnormality is Meckel's diverticulum (MD). Most instances have no symptoms, and in those that do, the surgical strategy may not be clear-cut and the diagnosis might be difficult. The present study's main aim is to assess the surgical technique and diagnostic procedure in light of clinical presentation. Also, evaluating the degree of postoperative complications is the secondary goal. A retrospective analysis was conducted in Raparen Teaching Hospital for children in Erbil/Iraq, and the private clinics of the investigators, reviewing the medical records of 25 children below 12 years of age, who underwent surgery for MD complications, between January 2020 and September 2023. Data on patient characteristics, clinical presentations, diagnostic investigations, surgical interventions, intraoperative findings, postoperative outcomes, and length of hospital stay were collected and analyzed. The mean age of the offspring was 3.482 ± 4.604 years, accompanied by a range of ages spanning from 7 days to 12 years. Out of the total number of children, 14 (56%) experienced rectal bleeding, while 16 (64%) exhibited abdominal distension. Additionally, 17 (68%) endured vomiting and 12 (48%) suffered from abdominal pain. Upon analyzing the therapeutic measures conducted on the children, it was observed that 16 (64%) of them underwent an emergency laparotomy. Remarkably, the most prevalent histopathological discovery was the presence of gastric mucosa in 10 (40%) of the children. According to the diagnostic criteria, surgical interventions are regarded as the foremost therapeutic modality. A vast majority of patients underwent laparotomy as their surgical approach, while a minority of patients underwent laparoscopy.

Keywords: Children, Diverticulitis, Diagnose, Gastrointestinal bleeding, Laparotomy, Laparoscopy, Meckel's diverticulum

Introduction

The most common congenital abnormality of the gastrointestinal (GI) tract is Meckel's diverticulum (MD) (Parvanescu et al., 2018). This syndrome, which affects around 2-4% of the general population, is caused by incomplete omphalomesenteric (vitelline) duct obliteration (Vaabengaard et al., 2020). Based on many studies, it has shown that patients who are male had a larger frequency of it than those who are female (1.5:1–4:1) (Fonseca et al., 2021; Francis et al., 2016; Hansen & Søreide, 2018). This condition is reported to be less frequent in adults, but over 50% of patients with problems from complicated MD are less than 10 years old, making it a major source of morbidity in children (Parvanescu et al., 2018).

The diagnosis of MD is further complicated by its diverse presentations. The diagnostic approach involves a technetium99 scan, ultrasound, CT scan, laparoscopy or laparotomy (Kuru, 2018).

Meckel's diverticulum can present with symptoms such as gastrointestinal bleeding, volvulus, diverticulitis, intussusception, Littre's hernia, small bowel blockage, peritonitis, or bloody stool (Fonseca et al., 2021; Keese et al., 2019). The main side effects of Meckel's diverticulum, according to Choi et al. (2017), include perforation, inflammation, bowel blockage, and gastrointestinal bleeding (Choi et al., 2017). Also, the most common symptom observed in pediatric patients is abdominal pain, and the most common indication for surgery is intestinal obstruction. In many cases, MD is identified incidentally during surgery for other reasons or upon radiological workup while investigating another disease (Kocaman & Günendi, 2022). Despite extensive diagnostic work-out, MD is recognized in only a few patients preoperatively (Vaabengaard et al., 2020).

Around 6% of MD cases result in death and delayed diagnosis and treatment are frequently linked to this proportion. Furthermore, 5% of symptomatic MD patients die, compared to 0% of asymptomatic MD patients who have elective surgery (Gunadi et al., 2021). Hence, to prevent morbidity and death, pediatric surgeons must identify the disease's many clinical presentations as soon as possible and execute surgical therapies appropriately (Kadian, Verma, Rattan, & Kajal, 2016; Keese et al., 2019). Previous studies have evaluated specific presentations such as intestinal obstruction, gastrointestinal bleeding, or peritonitis, but few studies have analyzed the spectrum of Meckel's diverticulum presentations in children comprehensively (Huang et al., 2014). In addition, very limited studies have simultaneously examined the diagnostic process and surgical approach in relation to clinical manifestations and the severity of postoperative complications.

Therefore, it was necessary to conduct this study with the main objective of investigating the diagnostic process and surgical approach in relation to clinical manifestations, and also with the secondary objective of investigating the severity of postoperative complications.

Sample Collection

Data were collected from electronic medical records, surgical databases, and pathology reports. The following variables were recorded for each patient: age, gender, clinical presentation, symptoms, duration of symptoms, physical examination findings, laboratory investigations, diagnostic imaging reports (ultrasound, CT scan, Meckel's scan), surgical notes, intraoperative findings, surgical interventions, postoperative complications, histopathology reports, and length of hospital stay. The choice of investigation depended on the clinical presentation, the surgeon's assessment, and the availability of resources.

The surgical procedures performed for each patient were documented. These included emergency laparotomy and laparoscopy. The choice of surgical intervention depended on the preoperative clinical assessment, investigations, and the surgeon's experience. The intraoperative findings of each patient were carefully reviewed. These findings included the characteristics of the MD, such as size, location, presence of ectopic mucosa, fibrous bands, inflammation, and other associated complications.

Material and methods

Study design and setting

This retrospective analysis involved the review of medical records of pediatric patients at Raparen Teaching Hospital for Children, and private clinics of the investigators, who underwent surgery for MD complications between January 2020 and September 2023. This study was conducted in compliance with ethical guidelines and was approved by informed written consent, obtained from the participants' legal guardians.

Patient Selection

A comprehensive search was performed in the hospital's electronic medical records system to identify all children below the age of 12 years who had a diagnosis of complicated MD during the study period. Complications of MD included: gastrointestinal bleeding, intestinal obstruction, diverticulitis, perforation, intussusception, and patent omphalomesenteric duct with discharging umbilicus. The inclusion criteria were as follows: pediatric patients, aged below 12 years, with a

confirmed diagnosis of complicated MD based on clinical presentations, diagnostic investigations, intraoperative findings, and Informed consent. Patients with incomplete medical records or inadequate information were excluded from the study.

Statistical Analysis

Descriptive statistics were used to summarize the collected data. Categorical variables were expressed as frequencies and percentages, while continuous variables were presented as means with standard deviations or medians with interquartile ranges, depending on their distribution. Statistical analysis was performed using SPSS 26.

Results and Discussion

The mean age of the children was 4.604 ± 3.482 years, ranging from 7 days to 11 years. The distribution among infants was as follows: 7 (28%) children were under one year old and 18 (72%) children were over one year old. Among the participants, 17 (68%) were boys, and 8 (32%) were girls (Table 1).

Table 1. Demographic characteristics in infants

Characteristic		Frequency	Percent
Age		4.604 ± 3.482	
Age group	< 1 year	7	28%
	≥ 1 year	18	72%
Sex	Male	17	68 %
	Female	8	32 %

The analysis of the children who were examined revealed that 14, out of 25 (56%) experienced symptoms such as rectal bleeding. Moreover, 16 children (64%) had distension. Among the children observed for vomiting symptoms, it was found that 17 (68%) experienced vomiting Abdominal pain was reported by 12 children (48%).

Table 2. Clinical Characteristics in infants

Characteristic		Frequency	Percent
Rectal bleeding		14	56%
Abdominal distention		16	64%
Vomiting		17	68%
Abdominal pain		12	48%

Regarding interventions in children, emergency laparotomy was performed on 16 out of the total number (64%), while the other 9 (34%) did not require this procedure, but laparoscopy was conducted instead on these children as shown in Figure 1. The detailed results can be found in Table 3.

Table 3. Therapeutic interventions performed in infants

Characteristic		Frequency	Percent
Emergency laparotomy		16	64%
laparoscopy		9	36%

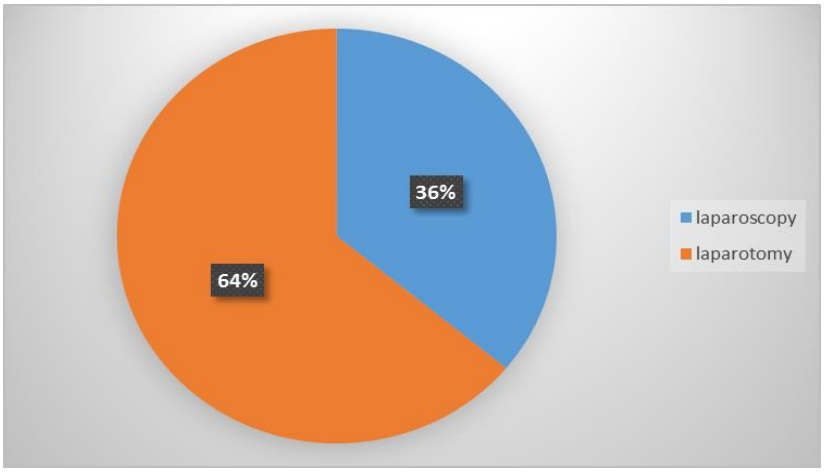

Figure 1. The Frequency of Operative Intervention.

The histopathological findings revealed the presence of isolated gastric mucosa in 10 children (40%). Mixed Gastric and pancreatic mucosa were observed in 7 cases (28%), isolated pancreatic mucosa in 3 cases (12%), and 5 cases (20%) exhibited no ectopic mucosa(Figure 2).

Table 4. Histopathology finding

Histopathology	Frequency	Percent
Gastric mucosa	10	40%
Gastric and pancreatic mucosa	7	28%
Pancreatic mucosa	3	12%
No ectopic mucosa	5	20%

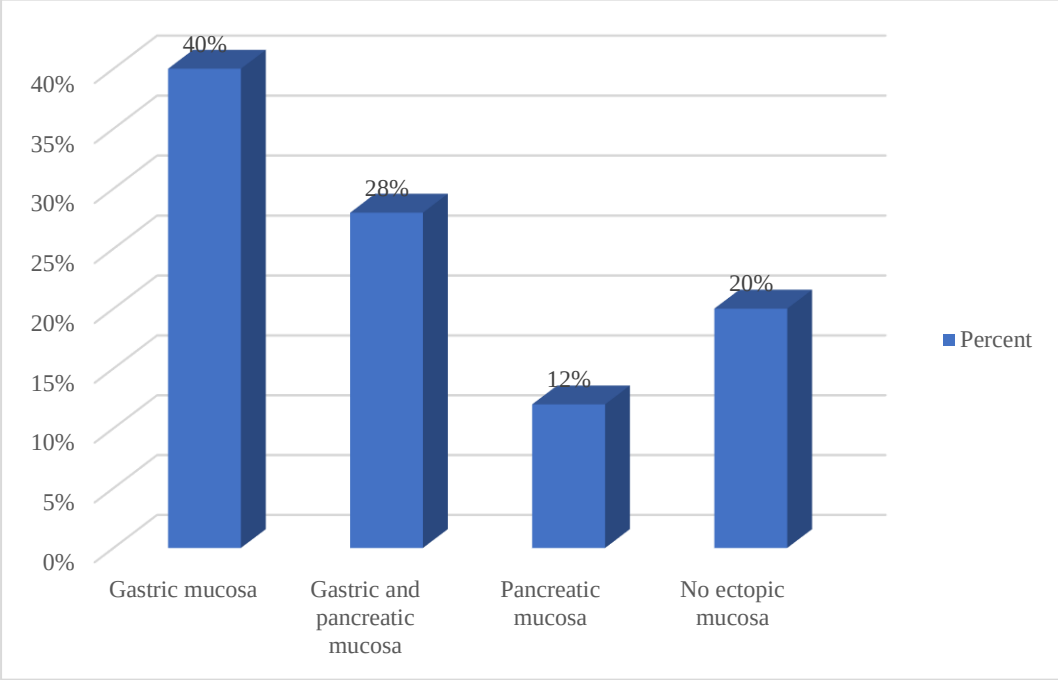

Figure 2. Histopathology finding

This study investigated 25 children who had Meckel's diverticulum (MD) to examine their symptoms, medical treatments, and histopathological findings. The majority of cases were observed in male children. The frequently reported clinical symptoms included vomiting, abdominal distention, rectal bleeding, abdominal pain, and further vomiting. Out of the

participants 16 infants (64%) underwent emergency laparotomy while 9 infants (34%) underwent laparoscopy. The common histopathological finding was gastric mucosa.

Analysis of the gender distribution of the studied children revealed a nearly 2:1 ratio, indicating a higher prevalence of the disease in males. This aligns with studies conducted in Germany by Keese et al. (2019), and in Singapore by Devi et al. (2022), both reporting a higher occurrence of the disease in males. The results of this study indicated that most affected children were over 1 year old, corroborating findings from other studies involving children above 1 or 2 years old (Hu et al., 2021; Lequet et al., 2017), affirming the outcomes of this investigation. The MD manifests with varying clinical manifestations and complications (Pearson et al., 2020). Rectal bleeding, abdominal pain and vomiting, abdominal distention, vomiting, and abdominal pain were identified as the most common manifestations of the disease. Gastrointestinal bleeding stands out as one of the prevalent complications, observed in 40% of patients (Gyzha et al., 2022), a finding corroborated in this study as one of the prominent complications of the disease. Moreover, abdominal distention was observed as a common manifestation, appearing with a seemingly higher frequency compared to other studies, necessitating further investigation into the reasons for this disparity. Studies conducted by Kumar et al. (2022), and Garza et al. (2022), also reported abdominal distention as a recognized complication of the disease. Additionally, abdominal pain emerged as a common symptom, consistent with findings from other studies (Bhattarai et al., 2022; Soto et al., 2021).

In this study, 16 patients (64%) underwent emergency laparotomy as the procedure while the remaining patients underwent laparoscopy. It is interesting to note that in studies laparoscopy was predominantly used as the surgical method. However due, to the number of cases requiring laparotomy in this study compared to others further investigation is warranted. Ezekian et al. (2019) proposed laparoscopy surgery as a reliable approach in their study highlighting its importance as a primary treatment goal. Skertich et al. (2021) also introduced laparoscopy as a better method. Another study conducted in Turkey showed that laparoscopy was considered the first-line treatment method (Kuru, 2018). The occurrence of gastric mucosa in MD is notably high, reported in up to 50% of cases (Devi et al., 2022). In this study, gastric mucosa emerged as the most prevalent histopathological finding, consistent with the findings of S. Vaabengaard et al. (2020). Similarly, the presence of "no ectopic mucosa," as indicated in the present study, aligns with findings from previous research. Additionally, the identification of gastric and pancreatic mucosa as well as pancreatic mucosa in patients corresponds to similar histopathological findings

reported in the United States (Rowan et al., 2021). The present study highlights different presentations of MD. Preoperative diagnosis of complications of MD is difficult, and it demands a high degree of suspicion. despite the availability of recent advanced imaging studies, Surgical interference is the main key to the treatment of symptomatic MD. In the majority of patients, the surgical method employed was laparotomy, while laparoscopy was performed in a smaller subset of patients. Complications of the disease were observed in most patients.

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