

Pediatric Meckel's diverticulum: Experience from a tertiary center in Eastern India

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ABSTRACT

Background. Meckel's diverticulum (MD) is the most common congenital anomaly of the gastrointestinal tract, having a varied clinical presentation in the pediatric age group. It can manifest with life-threatening complications when symptomatic. However, very few studies have been reported from Eastern India. In this study, we aim to analyze the demographics, clinical presentation, associated characteristics, laboratory and histopathological features, various modalities of diagnosis, and treatment for pediatric Meckel's diverticulum.

Results. 18 children were diagnosed with Meckel's diverticulum. Children below five years of age accounted for the majority of cases, with almost 50% presenting before age two. A male predominance was seen in the study with a male-to-female ratio of 4:1. The presentation was usually acute with lower gastrointestinal bleeding being the most common symptom in our study. Open diverticulectomy was the most common surgical procedure performed. MD was found on the mesenteric surface of the distal ileum in two cases. Simultaneous endo colon (upper GI endoscopy & colonoscopy) followed by laparoscopic surgery was done in a single setup in two actively bleeding cases with negative Meckel's scan. There was no mortality, and no complications were noted on follow-up.

Conclusion. MD had an acute presentation with lower GI bleeding being the commonest presenting symptom. It can be found on the mesenteric surface of the distal ileum. Open diverticulectomy was the treatment of choice for symptomatic patients. Surgical removal of incidentally detected MD was not associated with adverse outcomes.

Keywords: Meckel diverticulum, gastrointestinal hemorrhage, pediatric, ectopic

INTRODUCTION

Fabricius Hildanus initially reported Meckel's diverticulum (MD) in 1598, but Johann Friedrich Meckel established its embryological origin in 1809 [1]. It is the most frequent congenital gastrointestinal abnormality in children. It's a true diverticulum, formed when the vitelline duct is partially obliterated. It commonly appears on the middle-to-distal ileum's anti-mesenteric surface. It is caused by a remnant of the omphalomesenteric duct beyond the sixth week of pregnancy [2]. As a result, omphalomesenteric cysts and fistulae drain via the umbilicus, and fibrous bands originating from the diverticulum to the umbilicus cause intestinal obstruction. The embryological origin of the ectopic tissue within the diverticulum is unknown [2]. Meckel's diverticula are often clinically silent. But when symptomatic,

it can cause life-threatening consequences such as intussusception, gastrointestinal bleeding, diverticulitis, intestinal obstruction, hernia, gangrene, and perforation [3]. It is described by the "rule of 2," however this is not always the rule. It includes a prevalence rate of 2% in the general population, a 2:1 male-to-female ratio with a symptomatic MD incidence rate of 2%, two types of common ectopic tissues, a diverticular length of two inches placed within two feet of the ileocecal valve, 2% of patients developing complications and the onset of symptoms before two years of age [3].

METHODS

Retrospectively collected data on consecutive pediatric patients presenting with MD from August 2016 to July 2021 were analyzed. The study was

approved by the institutional scientific and ethics committee and conducted following the Helsinki Declaration of 1975. The study population included all the children admitted to the hospital under the age of 14 years and diagnosed with Meckel's diverticulum. The demographic profile, clinical presentation, and surgical interventions were analyzed. The use of various preoperative modalities in the confirmation of diagnosis including ultrasound of the abdomen & pelvis (USG), CT scan, Tc 99m pertechnetate scan (Meckel's scan), and abdominal X-rays were also studied. Cases presenting to emergency in a hemodynamically unstable state were resuscitated and stabilized as per the hospital protocol followed by surgical intervention. Details of the surgery performed (open laparotomy or laparoscopic procedure), intraoperative findings (location of Meckel's diverticulum, other associated complications like intestinal obstruction, intussusception, volvulus, diverticulitis, peri diverticular abscess, gangrene or perforation) & histopathological results were analyzed. Post-operative complications and duration of hospitalization were also documented. Descriptive statistics such as median, range, mean, standard deviation, and percentages were used to describe the study characteristics.

RESULTS

A total of eighteen children were diagnosed with MD based on intraoperative findings. The median age of the patients at the time of presentation was two years and two months (Range, 1 day – 9 yrs.). Children below five years of age accounted for the majority of the cases (14/18, 77.7% with a significant male preponderance (16/18, 88.8%) (Table.1). The clinical presentation was varied, with lower GI bleeding being the most common presentation (55.5%) followed by vomiting (44.4%) and abdominal pain (33.3%). Five children (27.7%) presented with severe anemia requiring blood transfusion. Abdominal distension and excessive irritability accounted for 22.2% of cases, mostly noted in infants. Incidental detection during surgery for imperforate anus was noticed in a neonate on day one of life (Table 1). In four cases (23.6%), the presentation was chronic, in the form of intermittent pain in the abdomen and bleeding per rectum (Table 1). The chronic bleeding PR was painless, episodic and bright red in color. Complications in the form of gangrene, peri-diverticular abscess, perforation peritonitis, intestinal obstruction, and pseudomyxoma peritonei were noted in twelve children (66.6%). Among these, intestinal obstruction was the most common complication noted (33.3%) followed by gangrene and intestinal perforation (22.2%) (Table 1). Three out of six cases of intestinal obstruction were discovered to be caused

TABLE 1. Demographic and clinical profile of the study population (n=18)

	Number (n)	Percentage (%)
AGE		
0-4 years	14	77.7 %
5-9 years	04	22.3 %
SEX		
Male	16	88.8 %
Female	02	11.2 %
CLINICAL MANIFESTATIONS		
Lower GI bleeding	10	55.5 %
Abdominal distension	04	22.2%
Abdominal pain	06	33.3%
Vomiting (bilious or nonbilious)	08	44.4%
Severe anemia (requiring BT)	05	27.7%
Irritability / excessive cry	04	22.2%
Incidental Finding	01	5.5 %
COMPLICATIONS	(n=12)	66.6%
Intestinal Obstruction	06	33.3 %
Perforation Peritonitis	04	22.2%
Peridiverticular abscess	02	11.2 %
Pseudomyxoma peritonei	02	11.2 %
TYPE OF PRESENTATION*		
1. Acute	13	76.4%
2. Chronic	04	23.6%
2a. Abdominal Pain	02	50%
2b. Lower GI bleeding	02	50%
*Incidental detection in 01		
TYPE OF SURGERY		
Open	12	67%
Laparoscopic	06	33%

BT: Blood transfusion

by intussusception, one by an incarcerated hernia, one by a volvulus, and the remaining one by a fibrous band. All the cases were subjected to surgical resection. Resection of the MD was done either through laparotomy (12/18,67%) or laparoscopic (06/18,33%) means (Table 1). While laparotomy was performed in cases of bleeding Meckel's diverticula and diverticulitis, laparoscopy was preferred in cases of intestinal obstruction, perforation, and undiagnosed GI bleeds. Diverticulectomy was done in 8 cases (72%) and adjacent bowel resection & end-to-end anastomosis was required in the rest 10 cases (28%). In all the cases, MD was found to be located in the terminal ileum, within fifty cm from the ileocecal junction. In two patients (11%), the diverticulum was found on the mesenteric surface of the distal ileum instead of the conventional anti-mesenteric side (Table 2). The entire rest of the heterotopic mucosae were removed & frozen sections were sent for pathological confirmation. Histopathology revealed ectopic gastric mucosa in the majority of patients (38.8%), followed by duodenal (16.6%), pancreatic

(11.1%), and both gastric and pancreatic ectopic tissue (11.1%) (Table 2).

TABLE 2. Intraoperative findings & HP study

	Number (n)	Percentage (%)
HP STUDY		
Gastric	07	38.8 %
Duodenal	03	16.6 %
Pancreatic	02	11.1%
Gastric & Pancreatic	02	11.1 %
LOCATION OF MD		
Mesenteric	02	11%
Anti-mesenteric	16	89%

Because most of our cases presented in a hemodynamically unstable state, emergency open or laparoscopic exploration was the favored diagnostic technique in our setup. Due to the non-specific and abrupt signs of this illness, the USG abdomen was done in all patients. It picked up Meckel's diverticulitis in only two patients. It also revealed findings such as edematous terminal ileum and ileocecal junction, intestinal obstruction, and free fluid in the abdomen suggestive of intestinal perforation. CT scan was performed on eight patients but was not useful in diagnosing Meckel's diverticulum. Meckel's scan was done in six hemodynamically stable patients and was diagnostic in all. The majority of the patients (16/18, 88.88%) had an uneventful postoperative course with an average hospital stay of ten days. Two children had anastomotic leak postoperatively requiring a re-laparotomy with a proximal ileostomy. Stoma closure was done after two months. Few patients had hypokalemia and hypoalbuminemia requiring correction and prolonged PICU stay (Table 3).

TABLE 3. Laboratory profile of the study population at the initial presentation

Parameter	Mean	SD
Hb (g/dl)	9.8	2.3
TLC (Thousands/cumm)	14,522	3885
TPC (Lakhs/cumm)	3.6	1.3
Serum sodium (meq/L)	135	1
Serum potassium (meq/L)	3.9	0.4
Serum albumin (g/dl)	3.6	0.8

TLC: Total leucocyte count; TPC: Total platelet count; Hb: Haemoglobin; SD: standard deviation

The mean follow-up period was 6 months. In the last follow-up, all the patients are doing fine with no symptoms.

DISCUSSION

Meckel's diverticulum is a congenital abnormality with an incidence of 0.14 to 4.5 percent [4-6]. The

male-to-female ratio in the present study was larger than the previously documented ratio of 2:1 to 4:1 [7-9], which could be due to the small sample size. Children below two years of age are mostly affected [10], which was reflected in the present study as well with more than 50% of the patients reporting under the age of five years. MD has a diverse range of clinical presentations. Having Meckel's diverticulum increases a person's lifetime chance of complications by 4-6% [9]. It is probably the most common cause of painless, lower GI bleeding in children leading to hemodynamic instability, accounting for 46.7-59.3% of all symptomatic MD patients [11]. The primary pathophysiology behind this is the presence of heterotopic pancreatic and gastric mucosa within the MD, which secretes acid and extremely alkaline pancreatic secretion, respectively, leading to ulceration of adjacent ileal mucosa. Intestinal obstruction was found to be the most frequent symptom in children under ten years of age, while gastrointestinal hemorrhage was mostly seen in children under the age of twenty years according to Bemelman et al., in their experience of 136 patients with MD [12]. Few studies have reported the reverse [13] Intestinal obstruction can result from either intussusception or volvulus by twisting of the small intestine around a fibrous cord or mesodiverticular band or from adhesion of the tip of the diverticulum with adjacent mesentery causing an internal hernia. In the present study, acute lower gastrointestinal bleeding was the most frequently reported symptom of MD. Blevrakis et al demonstrated peritonitis to be one of the commonest clinical presentations of Meckel's diverticulum in the pediatric age group [14]; in our study four patients presented to the emergency with peritonitis. MD in children is mostly a disease presented in an acute emergency, as is shown in our experience (13/18, 76.4%). Plain radiographs, abdominal ultrasound, and CT (computed tomography) scans have been rarely helpful in establishing the preoperative diagnosis of MD [15,16]. USG abdomen is often the screening modality of choice in cases of acute abdomen despite the limited sensitivity. The diagnostic efficacy of high-frequency USG abdomen in diagnosing MD in cases presenting with lower GI bleed is fast emerging, though available at few centers in India. In a study of 784 children by Hu Y et al, the USG abdomen helped detect bleeding MD by using higher-frequency probes with a sensitivity of 93.6% & specificity of 98.1% [17]. MD was located by identifying a thick-walled intestinal malformation with one blind end & other end connected to the normal ileum. It also helped to differentiate from other causes of acute abdomen like diverticulitis, and appendicitis. A simple abdominal X-ray may show numerous air-fluid levels and dilated bowel loops in cases of intestinal obstruction or gas under the diaphragm in perforation [10]. On

CT scans, MD typically shows up as a blind-ending tubular/cystic structure attached to the ileal loop, and it may or may not have the typical “gut signature sign” [18]. However, Meckel’s scan (Technetium Tc 99m pertechnetate imaging) has a proven role in detecting a bleeding MD (isotope taken up by ectopic gastric mucosa). It has a sensitivity of 80 to 90%, a specificity of 95%, and a positive predictive value of 95% [19]. In the present study, MD was detected by Meckel’s scan in six cases presenting with lower gastrointestinal hemorrhage. The issue with Meckel’s scan is that it can only be performed in a hemodynamically stable child. There is no scope for using Meckel’s scan in patients who do not have lower gastrointestinal hemorrhage or are in an emergency. Surgical resection is the treatment of choice for symptomatic MD. Diverticulectomy with or without segmental resection of the adjacent ileal loop followed by ileo-ileal anastomosis or ileal repair is the most common procedure being performed depending on the length and location of the diverticulum. Resection of a larger segment of the bowel might be required in cases of gangrene. Resection can be done by laparotomy, laparoscopy, or laparoscopic-assisted approach. Laparoscopic surgery has recently gained recognition as a safe and minimally invasive surgical procedure that can be used for both diagnosis and intervention [20-22]. It is a diagnostic modality of choice for undetected intraabdominal pathologies as it helps to visualize the whole abdomen. It has a proven role in managing a Meckel’s diverticulum complicated by perforation & intestinal obstruction. However, several schools of thought exist for laparoscopic management of a bleeding MD considering the inability to palpate the base of the diverticulum & the ileum and the chances of leaving behind the ectopic mucosa increasing the risk of future recurrence [10]. Several factors like the length and height-to-diameter ratio (HDR) of the diverticulum have aided in deciding the surgical intervention to be taken. While simple transverse resection with stapling device can be done for long diverticula, the shorter ones can be dealt with by wedge resection or ileal resection with end-to-end anastomosis. Endostapling technology has improved the safety, effectiveness, and speed of resections.

In the current study, concurrent upper GI endoscopy and colonoscopy (endo colon) was performed in two patients (revealing normal findings) who had a chronic presentation in the form of lower GI bleeding and an inconclusive Meckel’s scan, followed by diagnostic laparoscopy and subsequently diverticulectomy in the same sitting suspecting MD. This type of multimodality approach to treating MD saves the patient from repeated hospital visits. Heterotopic rests of the gastric mucosa are seen in 50-60% of casein histopathology. These ectopic gastric mucosae may cause abdominal pain, ulceration,

and bleeding. The pancreatic, colonic, duodenum and biliary tissues are some of the less prevalent mucosae seen in approximately 5-6% of cases and are mostly associated with intestinal obstruction [23-25]. Similar findings were noted in our study. There was a correlation between gastric mucosa and the patients who presented with complications, as all seven patients with ectopic gastric mucosa presented with some form of complications. Differential diagnoses of a bleeding MD can be polyps, arteriovenous malformations, inflammatory bowel disease, and clotting disorders which need to be excluded by appropriate investigations. The optimum treatment for an asymptomatic or incidental MD is still uncertain, and controversial [26]. In their review, Soltero and Bill and Zani, et al. came to the conclusion that prophylactic removal of incidentally discovered Meckel’s diverticulum is not justified [27,28]. Letting an incidentally discovered MD in situ lowers the risk of postoperative complications without raising late complications, as MD is one of the rarest causes of mortality and primarily affects the younger population. However, some authors have recommended the removal of incidental MD considering the risk-benefit ratio [9]. Some specific indications for removal as per previous studies are narrow neck, thickened base, presence of palpable heterotopic mucosa within the diverticula, associated diverticulitis, or any other persistent remnants of vitelline duct, though controversy remains about managing incidental MD. In our series, a neonate on day one of life was taken up for surgery for an imperforate anus and diverticulectomy was performed due to the narrow base of the MD. Several studies [7,29] have previously documented complications following MD resection in the early and late postoperative periods which include burst abdomen, anastomotic leakage, intra-abdominal abscess, wound dehiscence, peritonitis, and intestinal obstruction. 2 cases in our study had anastomotic leakage in the immediate post-operative period who required re-exploratory surgery. Mortality can be due to multiple factors [30] like delayed presentation, complicated MD, post-operative burst abdomen, and poor general condition of the patient. Our study did not report any mortality.

CONCLUSION

Painless, intermittent, brisk bleeding PR should raise the index for clinical suspicion for MD, especially necessitating blood transfusion. MD can present with complications & chronic symptoms. It may be found on the mesenteric border of the distal ileum. The role of high-frequency ultrasound abdomen in the preoperative diagnosis of MD is gradually emerging. Simultaneous endocolon followed by surgery may help in diagnosis & saving time thereby,

avoiding serious complications like gangrene and intestine perforation. Surgical removal of incidentally detected MD is still debatable depending on the surgeon's discretion; however, its removal was not associated with adverse events.

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