Original Article

Access this article online

Website: www.afrjpaedsurg.org

DOI: 10.4103/0189-6725.194671

Quick Response Code:

Meckel's diverticulum in children: Our 12-year experience

Kamal Nain Rattan, Jasbir Singh[1], Poonam Dalal[1], Ananta Rattan

ABSTRACT

Background: Meckel's diverticulum (MD) is the one of the most common congenital malformation of gastrointestinal tract and has varied clinical presentations. We are presenting here our 12-year experiences with MD in children at tertiary care hospital in North India. It highlights the fact that isolated gangrene of MD can occur, and it is associated with increased morbidity. **Materials and Methods:** This retrospective study is conducted by analysing the medical records of the patients who were operated for MD in the last 12 years in paediatric surgery department at our hospital. **Results:** Sixty-five patients were operated for MD in study period; in this 52 were males and 13 were females with mean age of presentation 3.2 years. The most common presentation was intestinal obstruction seen in 86.1% (56 cases). Intestinal haemorrhage was seen in 4.6% (3 cases) and diverticulitis in 3% (2 cases). Perforation of the gut with peritonitis was present in 6.1% (four cases). Cause of obstruction was intussusception in 21.4% (12 cases), fibrous band connected to umbilicus in 17.8% (10 cases), volvulus in 17.8% (10 cases), kinking in 16.0% (9 cases), knotting in 14.2% (8 cases) and herniation of gut below in 12.5% (7 cases). Isolated gangrene of MD was present in ten cases with intestinal obstruction. The ectopic gastric mucosa was seen in three and pancreatic mucosa in two cases. Mortality and morbidity during the study were one and three cases, respectively. **Conclusion:** MD may remain clinically silent for lifetime, or it may have life-threatening complications. In our series, intestinal obstruction and not the haemorrhage was the most common presentation. Isolated gangrene of MD with obstruction was present in significant numbers, which we failed to find in literature.

Key words: Diverticulitis, intestinal haemorrhage, intestinal obstruction, Meckel's diverticulum and omphalomesenteric duct

Departments of Pediatric Surgery and [1]Pediatrics, PGIMS, Rohtak, Haryana, India

Address for correspondence:
Dr. Jasbir Singh, Department of Pediatrics, PGIMS, Rohtak - 124 001, Haryana, India.
E-mail: jasbir2001@gmail.com

INTRODUCTION

Meckel's diverticulum (MD) was first reported by Meckel in 1809, by describing its embryological origin as remnant of omphalomesenteric duct. Although Fabricus Hildamus pictured ileal diverticulum much earlier in 1650 but he fails to describe its embryological origin. It was named after Meckel, who was first to publish the detailed description.[1]

During fetal period yolk sac and primitive gut are connected by the omphalomesenteric duct.[2] The failure of this duct to disappear completely gives rise to various malformations such as omphalomesenteric fistula, enterocyst, umbilical sinus, fibrous cord and MD.[3] Of these, MD is the most common anomaly in which proximal part of omphalomesenteric remains patent[4] with equal incidence in male and female.[5]

MD is located typically on anti-mesenteric border at terminal ileum and very rarely on the mesenteric side. It is a true diverticulum containing all layers of the bowel wall.[6] It derives its blood supply through two vitelline arteries which are the remnants of embryologic omphalomesenteric blood vessels. MD commonly follow 'rule of 2s' as it occurs in 2% of population, usually discovered before 2 years of age, situated within 2 feet of ileocecal valve, 2 inches in length and 2 cm in diameter.

Vitelline duct contain pluripotent cells so MD may contain heterotopic tissue.[7] Gastric mucosa is the most common type ectopic tissue followed by

Cite this article as: Rattan KN, Singh J, Dalal P, Rattan A. Meckel's diverticulum in children: Our 12-year experience. Afr J Paediatr Surg 2016;13:170-4.

pancreatic and rarely colonic and biliary mucosa. This heterotopic mucosa is main underlying pathological reason behind complications such as haemorrhage and perforation.[5] MD can occur alone or along with other developmental anomalies such as CNS malformations, exomphalos, anorectal malformations and esophageal atresia.[8,9]

As described by Mayo that 'Meckel's diverticulum is frequently suspected, often overlooked for, and seldom found'.[10] MD may remain asymptomatic, usually present with the complications associated with it. MD can present at any age, but complications occur more frequently in children. The risk of showing clinical manifestations is reported 25–33%.[11-13] Various complications can arise in the form of intestinal obstruction, haemorrhage, diverticulitis, perforation and very rarely vesicodiverticular fistulae and tumours.

Segmental resection is the treatment of choice in case of symptomatic MD because adjoining normal ileum is also resected because it may contain ectopic mucosa.[14]

The purpose of this study was to analyse the incidence of clinical manifestation of MD in children and their outcome while comparing to other studies conducted so for.

MATERIALS AND METHODS

It was a retrospective observational study, conducted at a tertiary level teaching hospital. All the available medical records of patients who were operated for MD at paediatric surgery department from 2002 to 2015 were reviewed. All operated cases were confirmed for diagnosis by histopathological examination (HPE). We categorised the patients according to age, gender, clinical presentation, peroperative, HPE findings and outcome of the patient.

RESULTS

A total of 65 patients were operated for MD in period of 12 years starting from 2002 to 2015. Out of 65 patients, 52 were males and 13 were females with male to female ratio of 4:1. The average age of presentation was 3.2 years [Table 1]. Youngest case observed was 20 days old neonate.

The most common presenting feature was intestinal obstruction [Table 2] seen in 86.1% (56 cases). All of the patients presented with abdominal pain and bilious vomiting, abdominal distension and constipation. These patients were put on intravenous fluids and nasogastric decompression. Routine investigations complete blood counts, blood urea, serum electrolytes, X-ray and ultrasonography (USG) (abdomen) were done. After stabilisation, patients were taken up for exploratory laparotomy.

Table 1: Distribution of patients according to age and gender

Age (in years)	Number of cases (%)	Male	Female
<1	14 (21.5)	9	5
1-5	30 (40.0)	24	2
6-10	11 (18.4)	10	3
>10	10 (20.0)	9	3
Total	65	52	13

Table 2: Distribution of patients according to clinical presentation

Clinical features	Number of cases (*n*=65) (%)	Male	Female
Intestinal obstruction	56 (86.1)	48	8
Intestinal haemorrhage	3 (4.6)	2	1
Diverticulitis	2 (3.0)	1	1
Perforation of MD with peritonitis	4 (6.1)	1	3

MD: Meckel's diverticulum

During laparotomy underlying cause of intestinal obstruction was detected and treated accordingly as in case of (1) intussusception in 21.4% (12 cases) was manually reduced followed by diverticulectomy and anastomosis, (2) when there was fibrous band causing obstruction 17.8% (10 cases) and kinking in 16.0% (9 cases), it was divided, and obstruction was relieved; in cases of vovulus in 17.8% (10 cases), it was corrected by derotation with division of band; (3) knotting of gut was present in 14.2% (8 cases); (4) where there was internal hernia in 12.5% (7 cases), it was reduced and vitelline artery was divided. In case of volvulus in three patients and in herniation two patients were having gangrene of gut. In a significant finding, isolated gangrene of MD was seen in ten cases of the intestinal obstruction cases with adjoining ileum was normal on both sides of diverticulum. After correcting the underlying cause of obstruction, resection of MD along with normal ileum on both side of diverticulum and ileoileal anastomosis was done.

In peroperative findings, the length of MD was ranging from 4 to 12 cm [Figure 1]. A congenital band connecting MD with umbilicus was present in ten cases, which was the remnant of vitelline duct.

Intestinal haemorrhage was seen in 4.6% (three cases). It was painless and massive lower gastrointestinal haemorrhage in all patients. The mean age of patients

having haemorrhage was 2.2 years (1.5–6 years). All patients needed transfused blood to stabilise them. Tc-99m scan was done after resuscitation of the patient which came out to be positive in all cases. Routine haematological investigations and USG abdomen were done to rule out other causes of bleeding. Thereafter patients were operated, segmental resection of intestine and anastomosis were done. HPE confirmed the diagnosis of MD in all three patients. They all were found to have ectopic gastric mucosa [Figure 2].

Inflammation of MD [Figure 2] was seen in 3.0% (two cases). Both cases were older than 5 years of age (7.5 and 8 years). These patients presented with clinical features such as appendicitis in having nausea, vomiting and tenderness on palpation. USG abdomen showed no features of appendicitis. After preliminary investigations and resuscitation, these patients were taken for exploratory laparotomy. Appendix was found normal in each patient. If treatment is delayed, inflamed diverticulum can perforate and can lead to peritonitis. Perforation of MD was seen in two cases which was associated with diverticulitis. They were managed by urgent surgery, in which perforation was located at the base of MD. Peritoneal irrigation and resection anastomosis were done.

HPE was done in every patient, which confirmed the diagnosis of MD. Five patients were found to be having ectopic mucosa, in which gastric mucosa was seen in three and pancreatic mucosa was seen in two cases.

In post-operative period, the patient was managed in the paediatric surgery ward. The average duration of post-operative stay in the ward was 6 days. Sixty patients were discharged from the ward after uneventful hospital stay, with regular follow-up.

The incidence of morbidity was 6.1% (four cases), which involve three cases of post-operative wound infections. They were managed on intravenous antibiotics and wound dressing. One case presented with post-operative adhesions with intestinal obstruction, which was managed conservatively. There was 1.5% (one case) mortality in our series. It occurred in patient who presented late with perforation of MD with septic shock and diffuse peritonitis.

DISCUSSION

The incidence of MD is reported as 0.3–1.2% in general population.[15,16] It incidence is found to be equal in male and females, but complications occur more frequently in males.[17] The lifetime risk of developing complications is reported to be 4–6%.[10,18] MD can clinically present with a wide range of complications as intestinal obstruction, intestinal haemorrhage and diverticulitis with or without perforation.

In our series, total 65 patients were operated during the study period for various symptom of MD. The median age of presentation was 3.2 years (20 days to 14 years). In other series, median age of presentation was ranging from 3.1 to 5.2 years.[19-21] We observed highest incidence (44.6%) in age group of 1–5 years. Sixty percent of patients in our study were below 5 years of age. Youngest patient in our study was 20 days old neonate. In this case, MD was associated with fibrous band connected to umbilical polyp. As we go on with increase in age, the incidence of complications decreases.

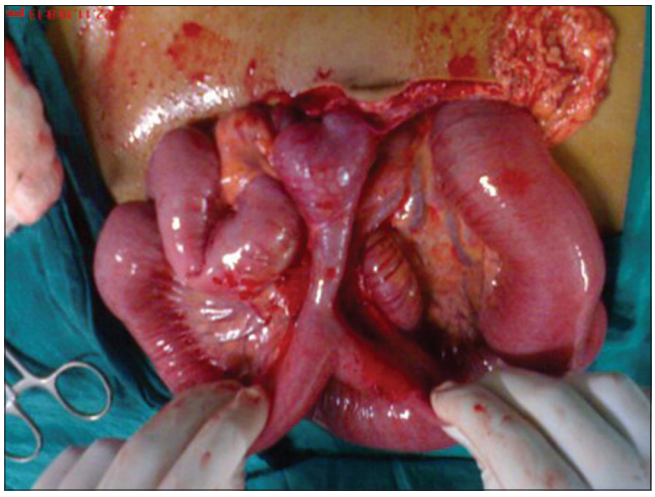

Figure 1: Peroperative picture showing large Meckel's diverticulum attached to umbilicus

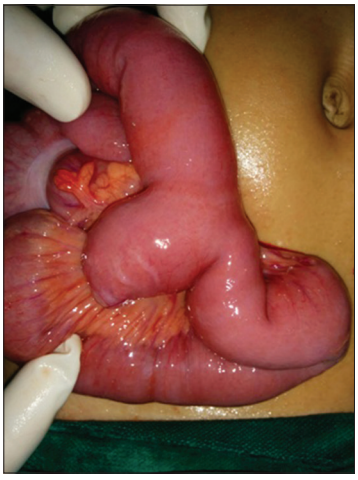

Figure 2: Peroperative picture showing inflamed and wide base Meckel's diverticulum

Regarding distribution according to gender, male to female ratio of 4:1 was observed, in our study. Here, our results are in consistence with other studies which had reported male:female ratio ranging from 1.5:1 to 5.5:1.[22] Higher incidence in male was also maintained in different age groups also.

Intestinal obstruction was the most common complication in our study group. It was observed in 86.1% (56 cases) of the cases. We had considerably higher occurrence of intestinal obstruction although it is reported second most common presentation in children. The Mayo clinical experience also reports intestinal obstruction as the most common complication in paediatric age group, but the incidence was 40%.[23] Rutherford *et al*. while studying 148 paediatric patients with MD found only 26 patients with intestinal obstruction.[24] ur Rehman *et al*. had observed high incidence of 82% for intestinal obstruction,[25] which was very high like our results. In an Indian study Ghritlaharey *et al*. found the incidence of obstruction as 60%.[26] In most of the other series, this incidence was observed almost half from ours, ranging from 40% to 48%.[19-21] Some authors such as Blevarakis and Menezes *et al*. had reported even a very low incidence (8.9% and 14.2%, respectively)[25,26] of intestinal obstruction in paediatric age group. The most common secondary cause of obstruction was intussusception in 46.1% (thirty cases), where MD was acting as the lead point followed by volvulus. During surgery, we also found six patients with gangrenous changes in gut associated with volvulus and herniation which was segmentally resected. Significantly isolated gangrene of MD was also found in 10.5% cases of obstruction in our series [Figure 3]. The cause of isolated gangrene was most probably thrombosis of vitelline artery supplying MD. It was associated with increased incidence of morbidity and mortality. Although gangrene of bowel along with MD was reported in many studies but we failed to found the incidence of isolated gangrene.

Figure 3: Peroperative picture showing isolated gangrene of Meckel's diverticulum

Intestinal haemorrhage had incidence of 4.6% (three cases) in our study. The average age of the patients with intestinal haemorrhage was 2.1 years. Although haemorrhage is the most common complication in paediatric age with reported incidence as high as 50%,[28] but we observed a very low incidence. Menezes and Chen *et al*. had reported the incidence of haemorrhage as 55.5 and 39%, respectively.[28,29] An Indian series by Mittal *et al*. had observed intestinal haemorrhage in 71.42% cases.[30] In other studies, the incidence of bleeding was of range 27–56% in paediatric age.[19-21] Intestinal haemorrhage can occur as a result of ulceration due to acid/alkali production by ectopic mucosa. We found ectopic gastric/pancreatic mucosa in all of the three cases. Intestinal haemorrhage can occur in many conditions such as polyps, clotting disorder and arteriovenous malformations, so we needed a group of investigation to detect the underlying cause. Tc-99 sodium pertechnetate is very useful in defining the presence of ectopic gastric mucosa due to high affinity for parietal cells with sensitivity of 81–90% and specificity of more than 95%. It is preferred investigation in children with unexplained gastrointestinal haemorrhage due to its non-invasiveness.

We found the incidence of MD inflammation as 3.0% (two cases). They were of age of 6.5 and 8 years. Diverticulitis is seen more commonly in older children. Clinically, patients presented like appendicitis but peroperatively, in all cases, appendices were found normal. On exploratory laparotomy, after locating inflamed MD diverticulectomy along with surgical resection and anastomosis was done. If treatment is delayed in diverticulitis, it can perforate. We had found four cases of perforation with peritonitis associated with inflammed MD. There are more chances of peritonitis in perforated MD than appendicitis because diverticulum lies free in the peritoneal cavity. In series by Park, diverticulitis is reported as 29% with 13% cases of perforation.[23] Blevarakis observed the incidence of diverticulitis as 13.3% with 6.6% cases of perforation.[31] In other studies, incidence was ranging from 2.7% to 19.5%.[19-21] Hence, the incidence of diverticulitis is also significantly low in our study. Due to very low incidence, MD remains undetected in most of the circumstances.

After surgery, morbidity observed in our study was 6.1% (four cases) and mortality was one case (1.5%), which is less when compared to other series. In Mayo clinical experience, it was 13% and 0% with the symptomatic patients.[23] In another study, post-operative morbidity and mortality is reported as 12% and 2%.[32] In morbidity, three cases were having post-operative wound infections which responded to conservative treatment and discharged from hospital. One case was detected with post-operative adhesions, which was managed conservatively. One patient was expired during, which was associated with septic shock and perforation of gut with diffuse peritonitis.

CONCLUSION

MD has a varied clinical presentation ranging from asymptomatic course to life-threatening complications. Intestinal obstruction not the haemorrhage was most common complication observed in our study with the paediatric age group. Significantly obstruction was associated with isolated gangrene of MD in many patients; probably due to thrombosis of vitelline artery. As it can mimic other abdominal diseases, we should keep high suspicion for timely diagnosis and surgical intervention.

Financial support and sponsorship
Nil.

Conflicts of interest
There are no conflicts of interest.

REFERENCES

1. Meckel JF. Uber die divertikel am darmkanal. Arch Physiol 1809;9:421-53.
2. Mackey WC, Dineen P. A fifty year experience with Meckel's diverticulum. Surg Gynecol Obstet 1983;156:56-64.
3. Turgeon DK, Barnett JL. Meckel's diverticulum. Am J Gastroenterol 1990;85:777-81.
4. Artigas V, Calabuig R, Badia F, Rius X, Allende L, Jover J. Meckel's diverticulum: Value of ectopic tissue. Am J Surg 1986;151:631-4.
5. Mckenzie S, Krantz SB. Small intestine. In: Sabiston Textbook of Surgery. 20th ed. Philadelphia: Elsevier; 2012. p. 1268-70.
6. Moore KL, Persaud TV. The Developing Human: Clinically Oriented Embryology. 8th ed. Philadelphia: Saunders; 2007. p. 255-86.
7. Whang EE, Ashely SW, Zinner MJ. Small intestine. In: Schwartz's Principles of Surgery. 8th ed. New York: McGraw-Hill; 2005. p. 1043-4.
8. Townsend CM. Diverticular diseases. In: Sabiston Textbook of Surgery. 16th ed. Philadelphia: W. B. Saunders Company; 2001.
9. Sugiura Y, Suzuki Y, Kobayashi M. The Meckel syndrome: Report of two Japanese sibs and a review of literature. Am J Med Genet 1996;67:312-4.
10. Mayo CW. Meckel's diverticulum. Proc Mayo Clin 1933;8:230.
11. Prall RT, Bannon MP, Bharucha AE. Meckel's diverticulum causing intestinal obstruction. Am J Gastroenterol 2001;96:3426-7.
12. Heldans F, Neff G. Das maxkelsche divertikel erbgeb. Chir Orthop 1937;30:227-315.
13. Ho JE, Konieczny KM. The sodium pertechnetate Tc 99m scan: An aid in the evaluation of gastrointestinal bleeding. Pediatrics 1975;56:34-40.
14. Jewett TC Jr., Duszynski DO, Allen JE. The visualization of Meckel's diverticulum with 99mTc-pertechnetate. Surgery 1970;68:567-70.
15. Williams RS. Management of Meckel's diverticulum. Br J Surg 1981;68:477-80.
16. Yahchouchy EK, Marano AF, Etienne JC, Fingerhut AL. Meckel's diverticulum. J Am Coll Surg 2001;192:658-62.
17. Quarrie R, Lindsey D, Bahner DP. Review of the incidence and management of Meckel's diverticulum. Austin J Surg 2014;1:1015.
18. Schwartz MZ. Meckel's diverticulum and other omphalomesenteric duct remnants. In: Wyllie R, Hyams JS, editors. Pediatric Gastrointestinal Disease: Pathophysiology, Diagnosis, Management. Philadelphia: Saunders; 1999. p. 483-8.
19. Pollak R. Adjunctive procedure in intestinal surgery. Mastery of surgery. 5th ed. Philadelphia: Lippincott Williams & Wilkins; 2007. p. 1392-3.
20. Bazrafshan A, Heydarian F, Rahmani S. Meckel's diverticulum: Prevalence in 1000 laparatomies. Patient Saf Qual Improv 2013;1:10-2.
21. Oguzkurt P, Talim B, Tanyel FC, Caglar M, Senocak ME, Büyükpamukçu N. The role of heterotopic gastric mucosa with or without colonization of *Helicobacter pylori* upon the diverse symptomatology of Meckel's diverticulum in children. Turk J Pediatr 2001;43:312-6.
22. St-Vil D, Brandt ML, Panic S, Bensoussan AL, Blanchard H. Meckel's diverticulum in children: A 20-year review. J Pediatr Surg 1991;26:1289-92.
23. Ruscher KA, Fisher JN, Hughes CD, Neff S, Lerer TJ, Hight DW, *et al*. National trends in the surgical management of Meckel's diverticulum. J Pediatr Surg 2011;46:893-6.
24. Park JJ, Wolff BG, Tollefson MK, Walsh EE, Larson DR. Meckel diverticulum: The Mayo Clinic experience with 1476 patients (1950-2002). Ann Surg 2005;241:529-33.
25. Rutherford RB, Akers DR. Meckel's diverticulum: A review of 148 pediatric patients, with special reference to the pattern of bleeding and to mesodiverticular vascular bands. Surgery 1966;59:618-26.
26. ur Rehman I, Burki T, Alam S, e Rahman F. Presentations of Meckel's diverticulum at Khyber Teaching Hospital Peshawar. J Ayub Med Coll Abbottabad 2003;15:30-2.
27. Ghritlaharey RK, Budhwani KS, Shrivastava DK, Srivastava J. Meckel's diverticulum and patent vitello-intestinal duct in children: A review of 11 years of experience with 46 Cases. J Clin Diag Res 2001;5:683-9.
28. Blevrakis E, Partalis N, Seremeti C, Sakellaris G. Meckel's diverticulum in paediatric practice on Crete (Greece): A 10-year review. Afr J Paediatr Surg 2011;8:279-82.
29. Menezes M, Tareen F, Saeed A, Khan N, Puri P. Symptomatic Meckel's diverticulum in children: A 16-year review. Pediatr Surg Int 2008;24:575-7.
30. Chen JJ, Lee HC, Yeung CY, Chan WT, Jiang CB, Sheu JC, *et al*. Meckel's diverticulum: Factors associated with clinical manifestations. ISRN Gastroenterol 2014;2014:390869.
31. Mittal BR, Kashyap B, Bhattacharya A, Singh B, Radotra BD, Lakshmi K, *et al*. Meckel's diverticulum in infants and children; technetium-99m pertechnate scintigraphy and clinical findings. Hell J Nucl Med 2011;11:26-9.
32. Mohiuddin SS, Gonzalez A, Corpron C. Meckel's diverticulum with small bowel obstruction presenting as appendicitis in a pediatric patient. JSLS 2011;15:558-61.