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Complications of Meckel's diverticulum in children: A 10-years experience

Berat Dilek Demirel*, Sertac Hancioglu, Unal Bicakci, Ferit Bernay, Ender Aritürk

Department of Pediatric Surgery and Division of Pediatric Urology, Faculty of Medicine, Ondokuz Mayıs University, Samsun, Turkey

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*** Correspondence to:**
Berat Dilek Demirel
Department of Pediatric Surgery and
Division of Pediatric Urology,
Faculty of Medicine,
Ondokuz Mayıs University,
Samsun, Turkey
e-mail: bdayhan@hotmail.com

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ABSTRACT

Meckel's diverticulum is the most common congenital anomaly of the gastrointestinal tract. We aimed to evaluate the risk factors which could be cause complications of Meckel's diverticulum. The patients who were operated in our clinic on for Meckel's diverticulum complications between 2008-2018 were evaluated retrospectively for age, gender, timing of surgery, scintigraphic detection of bleeding, histopathological evaluation, type of resection and surgical method. 62 patients (38 males, 24 females) (6 months-17.08 years), 35 underwent emergent and 27 elective surgery. Only 3 had preoperative diagnosis who underwent emergency surgery. In the emergency group, the number of invagination, internal herniation, diverticulitis and perforation were 14, 11, 6, 4 respectively. Twenty two patients were managed with laparatomy and the thirteen patients were managed with laparoscopy asisted. Ileal segment resection and wedge resection were performed in 16 and 19 patients retrospectively. In emergency surgery group 16 patients had both ectopic stomach and pancreas tissue and six patients had gastric tissue alone in histopathological evaluation. On the other hand 13 patients had no ectopic tissue. All the elective surgery group patients had rectal bleeding and scintigraphic imaging was performed to the all patients. Ectopic focal radionuclide substance accumulation was detected in the 22 patients. In this group, 21 patients were managed with laparoscopy asisted and only six patients underwent laparatomy. Ileal segment resection and wedge resection were performed in 11 and 16 patients, respectively. In the all cases, histopathological specimens had gastric mucosa in the elective surgery group. Meckel's diverticulum has serious complications in children. Existance of ectopic mucosa does not affect the development of complications rate requiring urgent surgery.

1. Introduction

Meckel's diverticulum (MD) is the most common congenital gastrointestinal system anomaly in children. The incidence is 2% in population (Sagar et al., 2006). MD develops as a result of omphalomesenteric canal not completely obliterated embriyologically. MD is a real diverticulum and it contains 45% to 80% heterotropic tissue (Sagar et al., 2006; Menezes et al., 2008). Gastric mucosa, pancreatic mucosa or colonic mucosa are the heterotrophic tissue in MD. The heterotopic mucosa is at the distal end of the diverticulum in most cases. Sometimes it extends to ileum (Menezes et al., 2008). The majority of patients with MD are clinically silent and are often identified incidentally in the operation which made for different intestinal pathologies other than MD. In the literature, it is controversial whether MD should be excised, which was encountered incidentaly in the operation.

Some authors recommend that it should be resected because of its own risk of complications, on the other hand some authors argue that it is unnecessary surgery for the patients until the complications occur (Zani et al., 2008; Gezer et al., 2016). The complications of MD which require surgery are bleeding, intestinal obstruction, diverticulitis, internal herniation due to fibrous band and perforation in childhood (Blevrakis et al., 2001). If risk factors can be determined about the development of complications, more clear decisions could be made about how the approaches should be made in cases diagnosed incidentally (Slivova et al., 2018). In current study, we aimed to determine the risk factors that affect the complication development rate by evaluating the patients who underwent excision of the MD because of complications.

2. Material and methods

We evaluated the patients who underwent operation for MD and its complications between 2008-2018 in Ondokuz Mayıs University Department of Pediatric Surgery, retrospectively. The parameters that were evaluated are age, gender, timing of surgery (elective or emergency), scintigraphic detection of ectopic tissue, ectopic tissue presence or not in histopathological examination, type of resection (wedge resection or ileal resection with anastomosis), type of surgery (laparoscopy asisted or laparatomy). The data were then entered into a database and analyzed. We used descriptive statistical methods for calculated means, medians and percentages.

3. Results

Sixty two patients had undergone surgery for MD complications in our center between 2008 and 2018. Of the patients, 38 (61.3%) were male and 24 (38.7%) were female. The male / female ratio was approximately 3/2. The mean age of the patients was 6.04 years and the median age was 4.45 years in the range from 6 months to 17.08 years. Emergency surgery was performed in 35 (56.45%) patients and elective surgery was performed in 27 (43.5%) patients.

In emergency surgery group, age ranges from 8 months to 17.08 years (median 7 years). In this group, only three (10.5%) patients were preoperatively diagnosed with ultrasound. All the other patients were diagnosed during the operation. MD was found to cause invagination in 14 patients, axial torsion fibrous band and internal herniation in 11 patients, diverticulitis in six and perforation in four of them (Table 1) (Fig. 1). Of the 14 patients who were operated for invagination, eight patients underwent an ultrasound-guided hydrostatic reduction. The first reduction was successful in two patients but the invagination recurred in seven days in these patients. A repeat hydrostatic reduction was performed but it was not successful. In these two patients, a diagnostic laparoscopy revealed that MD was the leading point. Laparoscopy-assisted surgery was performed in a total of 13 (37.2%) patients; in whom MD caused invagination in eight, diverticulitis in four and perforation in one patient. An open surgical intervention was performed in other 22 (62.8%) patients. Wedge resection was performed in 19 (54.3%) patients. Of these patients; nine had an internal herniation, six had diverticulitis, two had invaginations and two had perforation. Ileal resection was performed in 16 (45.7%) patients. Of these patients; 12 had invagination, two had perforations, and two had internal herniation. The resection strategy was determined by taking the margins of the ectopic tissue into consideration when palpable ectopic tissue was present. When no macroscopic ectopic tissue was suspected, the type of resection was selected on the basis of aiming to achieve sufficient intestinal passage. The histopathological evaluation of MDs in the patients undergoing emergency surgery revealed ectopic gastric tissue in 16 (45.7%) patients. In these patients, MD caused invagination in seven patients, perforation in two, diverticulitis in four, and axial torsion, fibrous bands, and internal herniation in three patients. Ectopic pancreatic and gastric tissue was present at the same time in six (17.1%) patients. In these patients; three had axial torsion, fibrous band, and internal herniation, two had diverticulitis, one had invagination. No heterotopic mucosa tissue was observed in 13 (37.1%) patients. Of these patients, six had invagination, five had axial torsion, fibrous band, and internal herniation, two had obstruction and two had perforation (Table 2). The youngest patient was an eight-month-old male, operated on for invagination. No heterotopic mucosa was identified in the histopathological examination made for thispatient. The oldest patient was 17.08 years old, diagnosed with axial torsion, fibrous band, and an internal herniation. The histopathological examination revealed the presence of ectopic pancreatic and gastric tissue in this patient.

Table 1. Distribution of complications in patients with Meckel's diverticulum.

Complications	Patient number (n)	Percentage (%)
Bleeding	27	43.5
Invagination	14	22.6
Axial torsion, fibrous band, and internal herniation	11	17.7
Diverticulitis	6	9.7
Perforation	4	6.5
Total	62	100

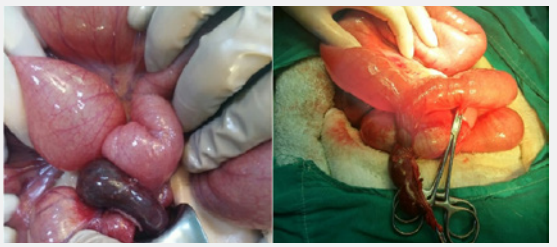

Fig. 1. Complications of Meckel.

Table 2. Distribution of complications in patients with Meckel's diverticulum.

Complications	Histopathological evaluation of ectopic tissue		
	Stomach	Stomach and pancreas	No heterotopic tissue
Bleeding	27	-	-
Invagination	7	1	6
Perforation	2	-	2
Diverticulitis	4	2	-
Internal herniation	3	3	5
Total			

Of the 27 patients, who underwent elective surgery, the age range was from six months to 14.25 years (median 4.73 years). The physical examination were completely normal in all patients, all of them had painless rectal bleeding and they were conservatively followed up with intravenous fluid therapy and ranitidine administration. The hemoglobin concentrations were in the range between 4.23 and 14.6 mg/dl and the median hemoglobin level was 10.6 mg/dl. During the follow-up period, eight patients (29.6%) required erythrocyte replacement. Hypovolemic shock was observed in one (3.7%) patient. Tc-99m pertechnetate imaging was performed in all patients who presented with rectal bleeding and had normal findings in colonoscopy. In twenty two patients (81.4%) MD was detected by scintigraphy. In five patients, there were not any finding in the scintigraphy and the diagnosis was made during the diagnostic laparoscopy. Of the patients, who underwent elective surgery, twenty one (77.7%) were operated on with laparoscopy-assisted and 6 underwent laparotomy. Resection of the ileac segment was performed in 11 patients (40.7%) and wedge resection was performed in 16 patients (59.3%). The histopathological examination of the diverticulum revealed the presence of ectopic gastric mucosa in all patients and all of those presented with rectal bleeding were subsequently diagnosed to have an MD.

Sixty two patients were operated for complications of MD; 34 (54.8%) underwent laparoscopy-assisted surgery and 28 (45.2%) underwent open surgery. Wedge resection was performed in 35 (56.4%) patients and ileal resection was performed in 27 (43.6%) patients (Table 3).

Table 3. Meckel's diverticulum complications and surgical method.

Complication	Laparoscopy-assisted		Open	
	Wedge resection	Ileal resection	Wedge resection	Ileal resection
Bleeding	11	10	1	5
Invagination	2	6	-	6
Perforation	1	-	1	2
Diverticulitis	1	3	2	-
Internal herniation	-	-	9	2

Only one patient underwent laparotomy because of postoperative intestinal obstruction after laparoscopy-assisted surgery. Long-term follow-up of all other patients was uneventful.

4. Discussion

Complications related to MD are 3-4 times more common in males than females (Celebi, 2017). Similarly in our series, MD complications were 1.5 times higher in males. The most common complication of MD is gastrointestinal bleeding due to ectopic mucosa in childhood (Lin et al., 2017a) In the study of Park et al., bleeding was reported in 38% of the patients with complicated MD in a series of 1476 patients with MD (Park et al., 2005). All of our patients had complicated MD and bleeding occurred in 43.5% of these patients. Hemorrhage may sometimes be severe enough to require transfusion and patients may even present with varying degrees of hypovolemic shock (Tseng and Yang, 2009). All of our patients received intravenous fluids and 29.6% of them required transfusion. The typical bleeding encountered in cases of MD is painless rectal bleeding (Tseng and Yang, 2009; Robinson et al., 2017). The cause of bleeding is ulcer development due to the ectopic stomach or pancreatic tissue on the diverticulum (Robinson et al., 2017). Scintigraphic imaging with Tc-99m pertechnetate is useful in the diagnosis of MD. The presence of gastric mucosa is in favor of MD with scintigraphic imaging (Irvine et al., 2017). In twenty two (81.4%) of our patients presented with rectal bleeding were diagnosed by scintigraphy. Although ectopic gastric tissue was encountered in the histopathological evaluation of all patients, it could not be demonstrated by scintigraphy.

Complications such as perforation, diverticulitis, invagination, peritoneal bands, Littre hernia, diverticular stricture, and bezoar in the diverticulum have been reported among the complications of MD (Huang et al., 2014; Chen et al., 2018). There is no specific test or visualization technique for MD diagnosis and most of the patients presenting with acute abdomen cause these patients to be diagnosed more frequently during surgery (Chen et al., 2018). We were able to diagnose MD in the preoperative period in only 3 patients out of 35 in emergency surgery group. All other patients were diagnosed intraoperatively.

MD may act as a leading point and may be cause invagination (Lin et al., 2017b). In most of the centers, ultrasound-guided hydrostatic reduction is applied primarily in the treatment of invagination (Talabi et al., 2018; Simon et al., 2019). In our patients, 14 MD excision was performed which caused invagination and hydrostatic reduction was tried in eight of these patients. The ultrasound-guided hydrostatic reduction neither did reduce the invagination nor could prevent it to be recurred. The success rate of hydrostatic reduction is very low in the presence of MD. At the same time, if reduction achievement occurred, recurrence is likely very high. Heterotopic tissue was not observed in six of 14 invagination cases related to Meckel's diverticulum. The cause of invagination of Meckel's diverticulum appears to be independent of the presence of ectopic tissue. Another complication of MD is internal herniation. Torsion of MD is a rare complication in childhood (Ahmed et al., 2016). The torsion reason is the fibrous band extending from the diverticulum to the abdominal wall or mesentery. The necrosis of the torsioned MD and internal herniation due to fibrous band are the causes of intestinal obstruction (Rattan et al., 2016). Six of 11 patients underwent surgery because of axial torsion fibrous band and internal herniation did not have ectopic tissue. Therefore we suggest that this complication was independent of ectopic tissue.

Clinically, diverticulitis and perforation of MD have similar symptoms and signs as appendicitis, laboratory results and radiological imaging even does not make difference among them. MD should be considered in the differential diagnosis in patients when the radiological evaluation of appendix be normal (Farah et al., 2015). Surgical treatment is inevitable in the treatment of MD complications. Laparoscopy or minimally invasive method laparoscopy assisted surgery can be performed. In a study comparing laparoscopic and open MD resections, outcomes were reported to be similar (Ezekian et al., 2019). We performed laparoscopy-assisted surgery in 54.8% of our series. Laparoscopy provides both diagnosis and treatment. Only one patient required laparotomy during long-term follow-up after laparoscopy among our patients. Lei et al. performed basal ligation of MD similar to appendectomy and verified that they did not have ectopic tissue with frozen biopsy (Lei et al., 2018). However, in our opinion, current method is not very accurate, because appendectomy-like basal ligation in the MD may lead to localized stenosis in the ileac segment. In MD surgery, not only the experience of the surgeon but also frozen biopsy are important in deciding wedge resection or ileac resection. Wedge resection is sufficient if all the ectopic tissue can be removed and intestinal stricture is not expected. However, when ectopic tissue cannot be excised totally or intestinal narrowing is considered, ileac resection must be performed (Glenn et al., 2018). Wedge resection was sufficient in 45% of our patients. Success rate of MD surgery was high and morbidity and mortality are very rare. Although the outcomes of the surgical treatment are successful, the lack of preoperative diagnosis cause delay in intervention and increase the mortality and morbidity. The complications of MD should be considered in pediatric patients, presenting with an acute abdomen (Choi et al., 2017).

In our study, we considered that ectopic tissue is a risk factor for MD complications. In addition, we found that the size of the diverticulum, regardless of the ectopic tissue, lead to intussusception via the mass effect. MD also may cause internal herniation in case of extension to the abdominal wall or mesentery with a fibrous band.

Surgical excision of an incidentally recognized MD should be recommended due to the risk of ectopic tissue, big enough to cause mass effect or has a narrow neck that predisposes to obstruction and diverticulitis.

REFERENCES

Ahmed, K., Hayet, Z., Hamdi, L., Mahdi, B.D., Mohamed, J., Riadh, M., 2016. Laparoscopic management of an axially torsed gangrenous Meckel's diverticulum in a child. Afr. J. Paediatr. Surg. 13, 150-151.

Blevrakis, E., Partalis, N., Seremeti, C., Sakellaris, G., 2011. Meckel's diverticulum in paediatric practice on crete (Greece). Afr. J. Paediatr. Surg. 8, 279-282.

Celebi, S., 2017. Male predominance in Meckel's diverticulum: A hyperacidity hypotheses. Med. Hypotheses. 104, 54-57.

Chen, Q., Gao, Z., Zhang, L., Zhang, Y., Pan, T., Caj, D., Xiong, Q., Shu, Q., Qian, Y., 2018. Multifaceted behavior of Meckel's diverticulum in children. J. Pediatr. Surg. 53, 676-681.

Choi, S.Y., Hong, S.S., Park, H.J., Lee, H.K., Shin, H.C., Choi, G.C., 2017. The many faces of Meckel's diverticulum and its complications. J. Med. Imaging Radiat. Oncol. 61, 225-231.

Ezekian, B., Leraas, H.J., Englum, B.R., Gilmore, B.F., Reed, C., Fitzgerald, T.N., Rice, H.E., Tracy, E.T., 2019. Outcomes of laparoscopic resection of Meckel's diverticulum are equivalent to open laparotomy. J. Pediatr. Surg. 54, 507-510.

Farah, R.H., Avala, P., Khaiz, D., Bensardi, F., Elhattabi, K., Lefriyekh, R., Berrada, S., Fadil, A., Zerouali, N.O., 2015. Spontaneous perforation of Meckel's diverticulum: A case report and review of literature. Pan. Afr. Med. J. 20, 319.

Gezer, H.O., Temiz, A., Ince, E., Ezer, S.S., Hasbay, B., Hicsönmez, A., 2016. Meckel diverticulum in children: Evaluation of macroscopic appearence for guidance in subsequent surgery. J. Pediatr. Surg. 51, 1177-1180.

Glenn, I.C., El-Shafy, I.A., Bruns, N., Muenks, E.P., Duran, Y.K., Hill, J.A., Peter, S.D.S., Prince, J.M., Lipskar, A.M., Ponsky, T.A., 2018. Simple diverticulectomy is adequate for management of bleeding Meckel diverticulum. Pediatr. Surg. Int. 34, 451-455.

Huang, C.C., Lai, M.W., Hwang, F.M., Yeh, Y.C., Chen, S.Y., Kong, M.S., Lai, J.Y., Chen, J.C., Ming, Y.C., 2014. Diverse presentations in pediatric Meckel's diverticulum: A review of 100 cases. Pediatr. Neonatol. 55, 369-375.

Irvine, I., Doherty, A., Hayes, R., 2017. Bleeding meckel's diverticulum: A study of the accuracy of pertechnetate scintigraphy as a diagnostic tool. Eur. J. Radiol. 96, 27-30.

Lei, J., Xu, W., Yang, W., Xiao, J., Huang, H., Deng, Q., Xu, H., Feng, L., Tao, Q., Zhang, S., 2018. A faster and simpler way of operation for Meckel's diverticulum: Basal ligation combined with intraoperative frozen section. Surg. Endosc. 32, 1464-1469.

Lin, X.K., Huang, X.Z., Bao, X.Z., Zheng, N., Xia, Q.Z., Chen, C.D., 2017a. Clinical characteristics of Meckel diverticulum in children: A retrospective review of a 15-year single-center experience. Medicine (Baltimore). 96, e7760.

Lin, X.K., Xia, Q.Z., Huang, X.Z., Han, Y.J., He, G.R., Zheng, N., 2017b. Clinical characteristics of intussusception secondary to pathologic lead points in children: A single- center experience. Pediatr. Surg. Int. 33, 793-797.

Menezes, M., Tareen, F., Saeed, A., Khan, N., Puri, P., 2008. Symptomatic Meckel's diverticulum in children: A 16-year review. Pediatr. Surg. Int. 24, 575-577.

Park, J. J., Wolff, B.G., Tollefson, M.K., Walsh, E.E., Larson, D.R., 2005. Meckel diverticulum: The Mayo Clinic experience with 1476 patients (1950-2002). Ann. Surg. 241, 529-533.

Rattan, K.N., Singh, J., Dalal, P., Rattan, A., 2016. Meckel's diverticulum in children: Our 12-year experience. Afr. J. Paediatr. Surg. 13, 170-174.

Robinson, J.R., Correa, H., Brinkman, A.S., Lovvorn, H.N., 2017. Optimizing surgical resection of the bleeding Meckel diverticulum in children. J. Pediatr. Surg. 52, 1610-1615.

Sagar, J., Kumar, V., Shah, D.K., 2006. Meckel's diverticulum: A systematic review. J. R. Soc. Med. 99, 501-505.

Simon, N.M., Joseph, J., Philip, R.R., Sukumaran, T.U., Philip, R., 2019. Intussusception: Single center experience of 10 years. Indian Pediatr. 56, 29-32.

Slivova, I., Vavrova, Z., Tomaskova, H., Okantey, O., Penka, I., Ihnat, P., 2018. Meckel's diverticulum in children-parameters predicting the presence of gastric heterotopia. World J. Surg. 42, 3779-3784.

Talabi, A.O., Famurewa, O.C., Bamigbola, K.T., Sowande, O.A., Afolabi, B.I., Adejuyigbe, O., 2018. Sonographic guided hydrostatic saline enema reduction of childhood intussusception: A prospective study. BMC Emerg. Med. 18, 46.

Tseng, Y.Y., Yang, Y.J., 2009. Clinical and diagnostic relevance of Meckel's diverticulum in children. Eur. J. Pediatr. 168, 1519-1523.

Zani, A., Eaton, S., Rees, C.M., Pierro, A., 2008. Incidentally detected Meckel diverticulum: To resect or not to resect? Ann. Surg. 247, 276-281.