



COMPARATIVE ANALYSIS OF THE RESULTS OF SURGICAL TREATMENT OF CHILDREN WITH MECKEL'S DIVERTICULUM BY LAPAROSCOPIC AND OPEN TECHNIQUE

Akilov Kh. A.
Primov F. Sh.,
Tilovov B. N.

Center for the Development of Professional Qualifications of Medical Workers¹
Republican Scientific Center for Emergency Medical Care²

Abstract

From 2006 to 2021, totally 98 of children with Meckel's diverticulum were treated in the Pediatric Surgery Department of the Republican Scientific Center for Emergency Medical Care. The introduction of endosurgical technologies into DM surgery in children made it possible to level the proportion of “useless” laparotomies due to the possibility of performing laparoscopic diverticulectomy and to limit the frequency of unreasonable laparotomies. Based on the diagnostic process and the choice of the method of surgical treatment, it allows to increase the possibilities and effectiveness of endosurgical technologies, reduce the frequency of unsatisfactory results in the immediate and long-term postoperative period, and reduce bed days.

Key words: Meckel's diverticulum (DM), laparoscopy, endosurgery, ectopic tissues, laparoscopic diverticulectomy.

Relevance

In urgent pediatric abdominal surgery, it remains to improve the algorithms for diagnostic and therapeutic measures for Meckel's diverticulum, which is one of the most difficult to diagnose and frequent congenital anomalies of the gastrointestinal tract.[1.2] Along with the widespread belief that Meckel's diverticulum is characterized by an asymptomatic course throughout life and, as a rule, it is accidentally detected at autopsy, a number of generalizing works present data on a fairly high frequency - 19-25% of clinical manifestations and complications of Meckel's diverticulum in children. [2.5]

In the clinical picture of Meckel's diverticulum, a triad of symptoms is distinguished: abdominal pain, gastrointestinal bleeding, and intestinal obstruction. The predominance and severity of each of them depend on the anatomical features, the presence of ectopic tissues in the wall of the diverticulum with different morphological and functional characteristics, and the age of the patient.[3.4]





Meckel's diverticulum is responsible for more than 50% of small bowel bleeding in children under 2 years of age. The possibilities of preoperative diagnosis of DM are minimal, do not exceed 12-25% [2.6]. At the same time, a complex of special research methods (ultrasonography of the abdominal organs, radionuclide method, etc.) acquires a certain significance and diagnostic capabilities, which are different.

Materials and Methods

The direction of the dissertation work is based on the results of examination and treatment of 98 children admitted to the Department of Pediatric Surgery of the Republican Scientific Center for Emergency Medical Care, who underwent surgical interventions for Meckel's diverticulum and its complications for the period from 2006 to 2021.

Table 1 Consolidated distribution of patients by type of surgical treatment in the group of laparoscopic diverticulectomy

Type of intervention	Laparoscopy in DM (n=98)	
	n	%
Laparoscopic diverticulectomy with interrupted Reder sutures	32	32,7%
Laparoscopic diverticulectomy with interrupted Reder sutures + appendectomy	11	11,2%
Laparoscopic diverticulectomy with extracorporeal sutures	16	16,3%
Laparoscopic diverticulectomy with single row sutures	3	3,1%
Laparoscopy. Minilaparotomy with video assistance. Wedge-shaped resection	17	17,3%
Laparoscopy, video-assisted minilaparotomy resection of the ileum with DM with "side-to-side" anastomosis	6	6,1%
Laparoscopy with resection of the small intestine with the imposition of "thin-thin" intestinal anastomosis	8	8,2%
Conversion to laparotomy	5	5,1%
Total	98	100,0%

The imposition of extracorporeal sutures was performed in 16 (16.3%) patients, single-row sutures - in 3 (3.1%). Laparoscopic resection of the ileum together with a diverticulum and the imposition of a "side-to-side" anastomosis (6.1%; 6 out of 98) were performed in destructive forms of DM with the involvement of the ileum wall in the process - due to a discrepancy between the diameter of the proximal and distal parts of the small intestine after resection.

In 8.2% (8 out of 98) cases, it was possible to perform a resection of the small intestine with the imposition of a small-intestinal anastomosis. Conversions to mid-median



laparotomy were performed in 5 (5.1%) patients, and video-assisted minilaparotomy was performed in 17 (17.3%) children (Table 1).

Laparoscopic diverticulectomy with interrupted Reder sutures was performed in 32 patients (32.7%), i.e. in a third of patients. This intervention was supplemented by appendectomy with concomitant inflammation of the appendix in 11.2% (11 of 98) cases.

The conversion rate to open was reduced from 9.7% (3 of 31) to 3.0% (2 of 67), and the conversion rate to video-assisted mini-laparotomy access was reduced from 35.5% (11 of 31) to 8.9% (6 out of 67) with a statistically significant difference ($\chi^2=11.59$, $p=0.0005$) as the indications expand and the laparoscopic diverticulectomy technique is introduced (Fig. 1).

Fig. 1 Conversion rates for laparoscopic diverticulectomy at different study periods

From **fig.2** shows that the reasons for conversions in 5 cases and transition to mini-laparotomy access in 17 cases were the presence of pronounced inflammatory and ischemic disorders in the diverticulum itself, as well as in the intestine (9.1%), a wide base of the diverticulum (45.5%) and gigantic dimensions of about 200 cm (13.6%), destruction involving the wall of the ileum (22.7%) and concomitant acute gangrenous appendicitis with local peritonitis (9.1%).

Fig. 2 Immediate reasons for switching to open surgery (n=5) (conversion) and mini-laparotomy approach (n=17) for DM in children

The results of treatment of Meckel's diverticulum using a minimally invasive technique (laparoscopy) were analyzed by comparison with a group of open operations. The criteria were intra- and postoperative parameters, such as the duration of the surgical intervention, the frequency of intraoperative complications, the length of the patient's stay in the hospital, and the frequency of postoperative complications.

The conventional surgery group (n=76) was matched by statistical comparability to the laparoscopy group (n=98). Open surgeries were also performed for various types of changes in Meckel's diverticulum. Among them, 39.4% (30 of 76) cases of catarrhal diverticulum, 43.4% (33 of 76) of patients with gangrenous changes in the diverticulum, 9.2% (7 of 76) of phlegmonous forms and 7.9% (6 of 76) - gangrenous-perforative changes in Meckel's diverticulum. (Table 2).



Table 2. Comparative characteristics of study groups

Parameters	Laparotomy for DM (n=76)		Laparoscopy in DM (n=98)		p
	n	%	n	%	
gender signs					
boys	46	60,5%	63	64,3%	>0.05
girls	30	39,5%	35	35,7%)	
Severity of the condition					
satisfactory	30	39,4%	20	35,3%	>0.05
average	28	36,8%	32	39,7%	
heavy	18	23,8%	46	25,0%	
Symptoms of Meckel's diverticulum					
acute abdomen	47	61,84%	60	61,22%	>0.05
jcc	21	27,63%	26	26,53%	
acute intestinal disorders	8	10,53%	12	12,25%	
Length DM, cm					
2-8 cm	70	92,1%	64	95,9%	>0.05
more than 10 cm	6	7,9%	4	4,1%	
Form of the DM					
tapered shape	42	55,3%	54	55,1%	>0.05
cylindrical shape	30	39,4%	38	38,8%	
peary shape	4	5,3%	6	6,1%	
Base of the DM, cm					
up to 2 cm	34	44,7%	46	46,9%	>0.05
more than 2 cm	42	55,3%	52	53,1%	
Distance of DM from the ileocecal angle, cm					
less than 20cm	2	2,6%	3	3,1%	>0.05
20-100 cm	72	94,8%	93	94,9%	
over 100 cm	2	2,6%	2	2,0%	
localization of DM					
against the mesenteric edge	37	48,7%	51	52,1%	>0.05
lateral surface	33	43,4%	41	41,8%	
mesenteric border of the intestine	6	7,9%	6	6,1%	
Pathological changes in DM					
catarrhal changes	30	39,4%	40	40,8%	>0.05
phlegmonous changes	7	9,2%	18	18,4%	
gangrenous	33	43,4%	35	35,7%	
gangrenous-perforative	6	7,9%	5	5,1%	



There were no intraoperative complications in patients of both the laparoscopy group and the laparotomy group with DM. The duration of laparoscopy was significantly less than in open surgery through laparotomy - 38.4 ± 7.2 (from 45 to 60 min) versus 62.6 ± 8.4 minutes (from 57 to 74 min). The average volumes of intraoperative blood loss were 140 ± 8.2 and 12 ± 1.2 ml in the laparotomy and laparoscopy groups, respectively.

Most of the children tolerated surgery for Meckel's diverticulum well. At the same time, the early postoperative period in traditional open surgeries was characterized by the development of complications in 10.6% (8 out of 76) of cases. The formation of an infiltrate in the abdominal cavity was detected in 4 (5.3%) patients, which required additional measures of conservative treatment and longer hospitalization. Wound infection and suppuration of the postoperative wound was noted in 2 (2.6%) patients, which required a second course of antibiotic therapy, with the addition of physiotherapy and local therapy for a week. In the postoperative period, 2 (2.0%) patients after laparotomy developed acute adhesive intestinal obstruction, of which in 1 case this complication was stopped by conservative measures, and in the other 1 case it was necessary to perform a second surgical intervention - to separate the adhesions laparoscopically. As a result, repeated interventions in the laparotomy group were required in 1 case, which was not noted in the laparoscopy group.

But it is also necessary to note the fact of a more pronounced pain syndrome after laparotomy, while after laparoscopy the pain was easily stopped by non-narcotic drugs. The mean duration of persistent pain was 1.8 ± 0.2 days after laparoscopy and 5.2 ± 0.8 days after laparotomy ($p < 0.05$).

In the laparoscopy group, children had an earlier normalization of body temperature, both in complicated and uncomplicated Meckel's diverticulum.

Table 3 Comparative characteristics of the intra- and postoperative period

Complication	Laparotomy group, n=76		Laparoscopy group, n=98		χ^2	P
Duration of operation, min	62,6±8,4		38,4±7,2		-	< 0.05
Volume of blood loss, ml	140±8,2		12±1,2		-	< 0.01
Infiltrate in the abdominal cavity, n, %	4	5,3%	0	0,0%	5.279	0.022
Wound infection, n, %	2	2,6%	0	0,0%	2.6	0.107
Postoperative complications intestinal obstruction syndrome	2	2,6%	0	0,0%	2.6	0.107
Re-interventions, n, %	1	1,3%	0	0,0%	1.1	0.513
Relief of pain syndrome, days	5,2±0,8		1,8±0,2		-	< 0,05
Normalization of body temperature, days	2,8±0,4		1,4±0,2		-	< 0,05
Recovery of disease, days	2,8±0,2		1,9±0,2		-	< 0,05
Activation of patients, days	2,7±0,4		1,4±0,2		-	< 0,05
Hospital stay, days	8,2±1,1		4,4±0,8		-	< 0,05
Died, n, %	0	0,0%	0	0,0%	-	-



After traditional operations for Meckel's diverticulum, a longer recovery of disease (2.4 days) was registered than after laparoscopic interventions (1.2 days) due to a significant decrease in the severity of intestinal paresis.

The patients were activated 1.4 ± 0.2 days after laparoscopy and 2.7 ± 0.4 days after laparotomy.

There were no deaths in any group.

The duration of hospitalization was also reduced with a significant statistical difference ($p < 0.05$) when using the laparoscopic technique, averaging 4.4 ± 0.8 days, while in the laparotomy group this indicator had a value of 8.2 ± 1.1 days.

Fig. 2. Results of surgical treatment of Meckel's diverticulum.

$\chi^2 = 4,505$; $p = 0,034$

Fig. 3. Summary results after all operations

Thus, optimization of the tactical aspects of minimally invasive surgery for Meckel's diverticulum in children made it possible to reduce the incidence of postoperative complications from 10.6% (8 out of 76 laparotomies) to 0.0% with a statistically significant difference ($\chi^2 = 8.546$, $p = 0.004$), in including the proportion of specific complications was reduced from 7.9% to 0.0%, general complications - from 2.6% to 0.0% (Fig. 2).

An analysis of the pooled results showed that the proportion of good results of surgical treatment of Meckel's diverticulum in children was higher after laparoscopic surgery, amounting to 94.9% (93 of 98) versus 85.5% (65 of 76) with open interventions (Fig. 3).

Conclusion

The results of surgical treatment of Meckel's diverticulum in children were studied by comparing the results of 98 laparoscopic operations with 76 open interventions from 2006 to 2021. The age of the children ranged from 1 month to 17 years. The frequency of using laparoscopy and reducing the proportion of unjustified open operations for Meckel's diverticulum in children varied with a statistically significant difference in different periods of research and implementation of minimally invasive surgery in pediatric practice. Так, если в период с 2006 по 2013 годы доля лапароскопий составляла всего 36,9%, то к настоящему периоду данный показатель был повышен до 74,4% ($p < 0.001$). Внедрение в хирургию дивертикула Меккеля у детей эндохирургических технологий позволило нивелировать долю «напрасных» лапаротомий за счет возможности выполнения лапароскопической дивертикулэктомии и ограничить частоту необоснованных лапаротомий с 21,5% до 6,2% ($p < 0.001$).



Literature

1. Vecherkin V.A., Vysotskaya V.P., Gisak S.N., Korablev V.A., Koryashkin P.V., Kuznetsova V.O., Baranov D.A. Differentiated approach to laparoscopic treatment of peritonitis in children. Youth innovation bulletin. 2016; 5(1): 5-17.
2. 1. Dronov A. F., Poddubny I. V., Kotlobovsky V. I. Endoscopic surgery in children / Ed. Yu. F. Isakova, A. F. Dronova. - M.: GEOTAR-MED, 2002. - 440 p.
3. Kushch N.L., Timchenko A.D. Laparoscopy in children. Vestnik khirurgii im. I.I. Grekov. - 1969. - T.102. - No. 5 - S. 92–94.
4. Courtney M. Townsend, Jr., R. Daniel Beauchamp, B. Mark Evers, Kenneth L. Mattox. Sabiston Textbook of Surgery, 19th Edition. 2012.
5. Di Saverio S, Vennix S, Birindelli A, Weber D, Lombardi R, Mandrioli M, Tarasconi A, Bemelman WA. Pushing the envelope: laparoscopy and primary anastomosis are technically feasible in stable patients with Hinchey IV perforated acute diverticulitis and gross faeculent peritonitis. Surg Endosc. 2016 Dec;30(12):5656-64. doi:10.1007/s00464-016-4869-y
6. Zitsman JL. Pediatric minimal-access surgery: update 2006. Pediatrics. 2006;118(1):304–308. doi: 10.1542/peds.2005-2736.

