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Хирургическая тактика при перфорациях желудка и тонкой кишки у детей (обзор литературы)

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АННОТАЦИЯ

Введение. В настоящее время остается высоким количество пациентов детского возраста, госпитализированных в экстренном порядке с различными вариантами перфораций желудочно-кишечного тракта, которые осложняются наличием перитонита. В данной работе представлены варианты оперативного лечения согласно локализации перфорационного дефекта (желудок, двенадцатиперстная кишка, тонкая кишка), а также описаны наиболее часто встречающиеся в клинике причины данных состояний (перфорация Меккелева дивертикула, спонтанные перфорации тонкой кишки и желудка у детей с экстремально-низкой массой тела, пациентов с синдромом Эллерса–Данлоса).

Цель. Определить наиболее актуальные варианты хирургической тактики у детей с перфорациями различных отделов желудочно-кишечного тракта (в частности, желудок, тонкая кишка) в условиях перитонита.

Материалы и методы. В ходе изучения литературы, были проанализированы 142 научные публикации на информационных ресурсах Google Академия, PubMed, eLIBRARY, опубликованных с 2002 по 2022 гг. Причем из исследования были исключены работы, описывающие перфорации кишечника на фоне некротического энтероколита, т. к. данная категория пациентов требует отдельного обсуждения и описания подходов к лечению.

Заключение. Согласно результатам анализа научной литературы, варианты хирургической тактики при перфорациях стенки желудка (перечислены от наиболее часто используемого к наименее встречающемуся): лапаротомия и ушивание с иссечением краев дефекта; ушивание в условиях лапароскопии; атипичная резекция с формированием желудочной «трубки» на зонде; резекция желудка. В случаях с перфорациями двенадцатиперстной кишки применяют ромбовидный дуодено-дуоденоанастомоз по Кимура, интракорпоральный шов с применением эндовидеохирургического доступа; лапаротомия и ушивание дефекта при обширном некрозе. При спонтанной перфорации кишечника с локализацией в тонком отделе кишечника целесообразна резекция участка кишки — анастомоз по Santulli в комбинации с концевой илеостомой, одномоментный анастомоз по типу «конец-в-конец» или же наложение кишечных стом.

Ключевые слова: *желудок; тонкая кишка; дети; перитонит; перфорация; лапаротомия; лапароскопия*

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Surgical Tactics in Perforations of Stomach and Small Intestine in Children (Literature Review)

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ABSTRACT

INTRODUCTION: Currently, the number of pediatric patients urgently hospitalized with different variants of gastrointestinal perforations complicated with peritonitis, remains high. In the given work, the variants of the surgical treatment depending on the location of the perforation defect (stomach, duodenum, small intestine) are presented, and the most common causes of such conditions encountered in clinical practice, are described (perforation of Meckel's diverticulum, spontaneous perforation of small intestine and stomach in children with extremely low body mass, patients with Ehlers–Danlos syndrome).

AIM: To determine the most relevant variants of surgical tactics in children with perforations of different parts of the gastrointestinal tract (in particular, stomach, small intestine) in conditions of peritonitis.

MATERIALS AND METHODS: In the process of studying the literature, 142 scientific publications were analyzed on Google Academy, PubMed, eLIBRARY information resources, published from 2002 to 2022. With this, works describing intestinal perforation with the underlying necrotic enterocolitis, were excluded from the study, since this category of patients requires a separate discussion and description of approaches to treatment.

CONCLUSION: According to the results of the analysis of scientific literature, variants of surgical tactics used in perforations of the gastric wall include (in the order from the most commonly used to the least common): laparotomy and suturing with excision of the edges of the defect; suturing in conditions of laparoscopy; atypical resection with the formation of a gastric 'tube' on the probe; resection of stomach. In duodenal perforations, the following methods are used: rhomboid duodeno-duodenoanastomosis according to Kimura, intracorporeal suture with endovideosurgical access; laparotomy and suturing of the defect in extensive necrosis. In spontaneous perforation in the small intestine, resection of the part of the intestine is advisable — anastomosis according to Santulli in combination with terminal ileostomy, simultaneous end-to-end anastomosis or application of intestinal stomas.

Keywords: *stomach; small intestine; children; peritonitis; perforation; laparotomy; laparoscopy*

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LIST OF ABBREVIATIONS

FGDS — fibrogastroduodenoscopy
GCSs — glucocorticosteroids
GIT — gastrointestinal tract
MD — Meckel’s diverticulum
NEC — necrotic enterocolitis

GP — gastric perforation
SI — small intestine
SIP— spontaneous intestinal perforation
US — ultrasound examination

INTRODUCTION

Annually in the world and in Russia in particular, a high number of patients are recorded among pediatric population that need surgical interventions for peritonitis associated with perforation of a part of the intestinal tube. The term ‘perforation’ initially meant ulcerative lesions, however, at present, this term includes other types of lesion such as isolated point perforations, necrosis of the wall and rupture of a hollow organ [1].

The main problem in the treatment of children with perforation of different parts of the gastrointestinal tract (GIT) is the presence of peritonitis (inflammatory alterations in the abdominal cavity) which prevents healing of the intestinal suture [2]. Today, one of the difficulties faced by pediatric surgeons, is the choice of the optimal surgical tactics in a particular clinical situation. The spectrum of pathological situations encountered by pediatric surgeons in routine clinical practice is rather wide: from inflammatory conditions, such as acute appendicitis, to ulcerative-necrotic enterocolitis and congenital anomalies of the intestinal tube complicated with perforation. Despite the established surgical schools, there remains a number of unsolved questions in urgent abdominal surgery requiring discussion and analysis [3].

In the modern pediatric surgery, a growing popularity is gained by surgical interventions with use of minimally invasive technologies (video endoscopic techniques, mini accesses) [4]. One of the main tasks of any surgical intervention especially in pediatric surgery,

is the minimal tissue injury, early recovery, and a good cosmetic effect. However, depending on such conditions as spread of peritonitis, age and general condition of the patient, the state of hemodynamics, laparotomy in history, the extent of alterations of the gastric or intestinal wall, surgical treatment may be different [5]. For the majority of such cases there is no developed algorithm of surgical tactics, which complicates the work of a pediatric surgeon.

The **aim** of this study to determine the most relevant variants of surgical tactics in children with perforations of different parts of the gastrointestinal tract (in particular, stomach, small intestine) in condition of peritonitis according to the data published in the open literature.

MATERIALS AND METHODS

In studying the literature, 142 scientific publications were analyzed in the information resources Google Academy, PubMed, eLibrary; search depth — 20 years, from 2002 to 2022 (Table 1). Works describing intestinal perforations with the underlying necrotic enterocolitis (NEC) were excluded from the study, since patients of this category require a separate discussion and description of treatment approaches. In total, 134 clinical cases of gastric perforation (GP), 50 — duodenal perforation (DP), 80 — perforation of the small intestine (SI) are described in these works.

Table 1. Characteristics of Literature Sources

Search Request	2017		2018		2019		2020		2021		2022		In Total
	E	R	E	R	E	R	E	R	E	R	E	R	
Gastric perforation	2	5	5	6	5	5	3	5	1	4	1	0	42
Duodenal perforations	2	4	3	10	2	6	4	5	4	5	2	0	48
Perforation of small intestine	4	5	5	9	3	9	4	5	6	2	0	0	52

Notes: E — publications in English, R — publications in Russian

Diagnosis of Perforations of Stomach and Small Intestine

Speaking about the instrumental examination methods on suspicion of perforation of a part of GIT, one should note the relevance of a traditional plain abdominal radiography, possessing the highest sensitivity, which records the presence of free gas in the form of a 'sickle' under the cupola of the diaphragm, or under the anterior abdominal wall in radiography in the lateroposition (this variant is most often used in the neonatal surgery). Ultrasound examination (US) may show enhanced pneumatization of the wall of the small intestine (characteristic of the 'pre-perforation' stage), free gas in the abdominal cavity as well as free fluid (as a rule, in the pelvic cavity) [6]. However, informational value of the transabdominal US depends on a number of factors, such as resolution of the device, sensitivity of sensor, the experience of a doctor. In this context, in our opinion, this method of examination plays a secondary role, and the preference should be given to classic plain radiography.

In case of a covered perforation, a number of examinations (radiography, fibrogastroduodenoscopy (FGDS), ultrasound) become less informative, complicating the diagnosis. In this case, an important role is played by the interpretation of the results of the examination, which directly depends on the experience of a doctor. For example, a pathognomonic US-symptom of a covered perforation is described that is characterized by breakage of the integrity of the outer contour of the organ in the area of the defect filled with highly echogenic contents and located in a thickened hypoechoic section of the wall [7]. In the work of S. N. Styazhkina, et al., a FGDS picture of a covered perforation is given: the duodenal bulb is roughly deformed along the back wall, bulging into 2/3 of its lumen diameter, the bulb does not unfold, the walls cannot be clearly seen, the distal border of the formation in this area is not visualized [8].

Foreign and Russian authors concur that the computed tomography has highest accuracy in this pathology is [9], but this method cannot be widely introduced everywhere because of limitations of many hospitals in equipment.

Gastric Perforation

Analysis of the literature data showed that gastric perforations (GPs) occur in 1:2900 to 1:5000 live births and account for 7% - 10% of all gastrointestinal perforations in newborns. From 1986 to 2018, 438 cases of GPs have been described in the medical literature. In MEDLINE and SCOPUS electronic databases, 328 cases

of GPs are presented with most common perforation site (up to 77%) at the curvature major represented by linear defects from 0.5 cm to 10 cm, and less often (about 23%) at the curvature minor [10, 11].

According to S. A. Karavaeva, et al., 87% of GP were detected in pre-term infants, and the remaining 13% — in children with critically low body weight [12].

The main causes of GP include perforation with the underlying tissue ischemia induced by asphyxia; activation of hypothalamic-pituitary-adrenal system induced by perinatal stress leading to gastromalacia with further rupture of the stomach; congenital defects of GIT leading to increase in the pressures inside the stomach; high acidity of gastric juice; type 4 (vascular) Ehlers-Danlos syndrome; defects due to peptic ulcer disease (1.6% of cases) [13].

So, in the study of A. A. Skopets, et al., based on the analysis of cases from their own clinical practice, variants of surgical tactics are described depending on the extent of spread of gastric wall defect: atypical gastric resection within healthy tissues with the formation of a gastric "tube" on a draining probe (in case of extensive necrosis and GP) — resection with a necessary reduction of volume of the organ, suturing of the perforation after excision of the edges of the defect (in case of local lesion) without changing the volume of the organ [14]. Patients with extensive defects of the gastric wall, who underwent atypical resections, may probably develop such a threatening complication of the postoperative period as cicatricial deformation of the organ with the result of impairment of patency and necessity for complex reconstructive surgery.

In the work of Yu. A. Kozlov, et al., a variant of laparoscopic suturing of the gastric wall defect is presented, which is a rather rare variant of treatment of this pathology, but, according to the author, it has certain advantages (minimal tissue injury and duration of surgical treatment). Nevertheless, it is worth noting that this treatment and access method is far not suitable for every patient in view of severity of their condition. Laparoscopy can be used in hemodynamically stable patients with no preceding laparotomy [15]. Nevertheless, this method undoubtedly possesses an important advantage — minimal trauma of the anterior abdominal wall, which permits the patient to recover in a shorter time, as well as to start the early enteral loading due to reduction of the paresis phenomena in the absence of a wide laparotomy.

The issues of minimally invasive treatment of GP and subsequent comparative characteristics were also studied by Kh. A. Akilov, et al., who described 68 cases of GP. Here, the spectrum of surgical interventions was rather wide: suturing of the perforation using laparotomy in 36 children, conversion from the

laparoscopy to laparotomy — 4 cases, laparoscopic suturing — 23 cases, gastric resection — 3 cases, suturing of the defect with excision of the ulcer according to Judd — 2 [16].

According to the results of the analysis of summarized data (Figure 1), the most widespread treatment method (56%) in modern clinical practice is transverse right-sided laparotomy and suturing of the

defect of the stomach wall. Besides, there is a frequent use of such methods as atypical resection (20.15%) and laparoscopic suturing of perforation (17,9%). A small number of laparoscopic manipulations, in our opinion, may be associated with traditional views of the colleges toward this problem and approaches to its salvation (adherence to ‘open’ interventions), poor provision of the clinic with equipment, absence of the required skill.

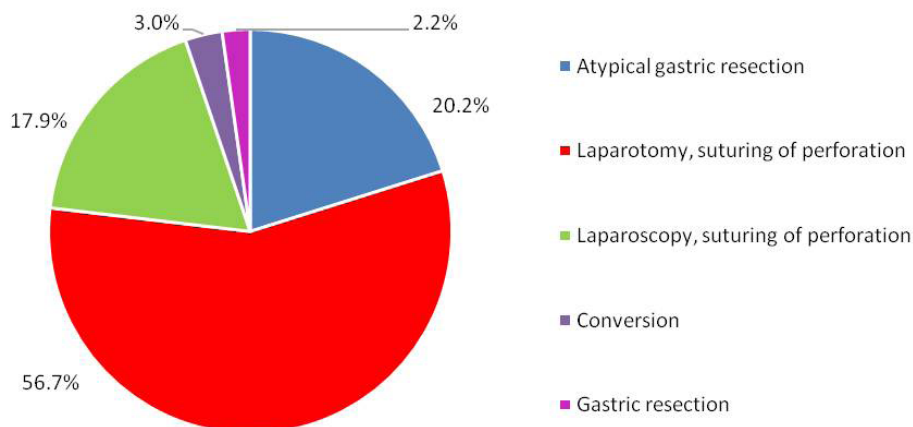


Fig. 1. Variants of surgical tactics in gastric perforations in children.

Duodenal Perforation

Duodenal perforation is a rare disease in children, characterized by a high mortality rate (above 50%). The etiology of the mucosal defect of the intestine consists in loss of the dynamic balance between aggressive acidic-peptic effects and resistance of mucosa. Here, activation of aggression often occurs in parallel with weakening of protection factors [17].

The most common surgical intervention in this pathology is laparotomy with suturing of a perforated hole with a ‘coaptation suture’. Speaking about ulcerative perforation, which can be combined with stenosis or ulcerative bleeding, in ‘adult’ practice, rhomboid-shaped transverse excision of the ulcer according to Judd or longitudinal incision with crossing the pylorus according to Heineke-Mikulicz is more often used, followed by suturing in the transverse direction. In recent years, in the surgical treatment of duodenal perforation in children with opening into the abdominal cavity, the preference is given to laparoscopic intervention with intracorporeal suturing of the defect. However, this method can be used, as in cases with GP, in stable patients [18].

In the work of Yu. Yu. Sokolov, et al., 2 clinical cases threatening with perforation with the underlying diverticulum of the duodenum are reported. In both cases, surgery was performed by laparoscopic method: mobilization of the gut by Kocher method, isolation and excision of diverticulum with subsequent suturing of the duodenal wound with separate interrupted stitches. The authors also described a successful use of laparoscopy in treatment of duodenal perforation [19].

S. A. Karavaeva, et al. report the results of treatment of 5 children with duodenal perforation. In 3 children with local lesion of the gut wall, the defect was sutured using a laparoscopic method, and in 2 children with extensive necrosis of the gut wall, laparoscopy was performed with resection of unviable tissues and suturing of the defect. In both cases, the postoperative period was complicated with development of duodenal stenosis. In the first case, stenosis levelled out spontaneously. In the second case, it was decided to perform gastrojejunal bypass due to impossibility of reconstructive operation on the duodenum because of severe condition of the patient [20].

A special mention should be made of a significant number of congenital malformations of the duodenum

(atresia, annular duodenum), running with threat of perforation. Treatment of these conditions is performed with increasing use of laparotomy (duodenotomy and excision of the membrane, duodenoduodenoanastomosis, longitudinal duodenotomy through the zone of stenosis) because of wide prevalence of this nosology and insufficient number of specialized neonatal surgery centers equipped and staffed with high-quality specialists, which could permit to increase the number of surgical interventions performed by laparoscopy [21].

M. A. Amanova, et al. report 2 clinical cases of spontaneous perforation of the duodenum with the underlying Ehlers–Danlos syndrome. In both cases, laparotomy was performed with suturing of the duodenal defect [22]. With many-hour generalized purulent

peritonitis with the underlying duodenal perforation, the operation of choice was laparotomy, suturing of the perforation. It was considered reasonable to complete the operation by applying a laparostomy (in recent years it has practically lost relevance in pediatric practice and is more often used in children with NEC) with two or three programmed sanations after 24–48 hours [23].

Based on the above, it can be said that the most common variant of surgical intervention in the duodenal perforation is laparotomy, the application of duodeno-duodenal anastomosis (48% of all reported cases); here, the percentage of surgical interventions performed by laparoscopic method (18%) prevails over the suturing of the perforation in the conditions of traditional laparotomy (8%, Figure 2).

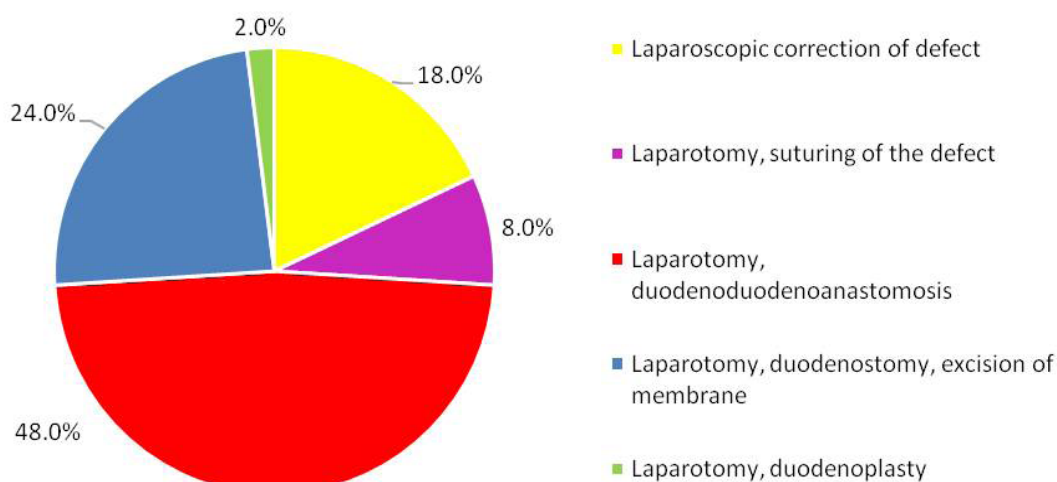


Fig. 2. Variants of surgical tactics in duodenal perforation in children.

Perforation of Different Parts of Small Intestine

Spontaneous intestinal perforation (SIP) is a life-threatening condition, multifactorial disease in premature newborns with the body mass at birth ≤ 1000 g, which most often develops within 1–7 days of the extrauterine life [24]. SIP is a much less common cause of the abdominal catastrophe in premature infants (19.4%) than NEC and intestinal obstructions, but it remains one of the most severe diseases of the neonatal period. Perforated lesion of different parts of the small intestine occurs in 68.9% of cases, in 47.6% of them in the ileum, perforations of the jejunum are twice less common

(21.4%). The mortality of patients with SIP considerably differs depending on the methods of surgical treatment used: thus, in patients who underwent abdominal drainage, mortality reaches 49%, while mortality with laparotomy declines to 19%. Mortality varies depending on the severity of the disease and the degree of maturity. Thus, in newborns with body weight less than 1,500 g, the mortality rate can reach 50%, with weight of more than 2,500 g, it decreases and ranges from 0% to 20% [25, 26].

Provoking factors of this pathology are the use of glucocorticosteroids (GCSs), for example, dexamethasone, cyclooxygenase inhibitors (ibuprofen, indomethacin), and

also hypo- and aplasia of the muscular layer of the gut wall, which superimpose on the main pathogenetic factor of the disease — disorders of regional mesenteric blood flow; pathology of the respiratory organs, in particular, respiratory express-syndrome [27]. Derangement of the structure of the muscular layer of the gut also leads to secondary ischemia resulting from focal dilatation of a segment of the intestinal tube. In mechanisms of the intestinal obstruction and neuromuscular diseases (or dysplasia) of the intestine, a role is played by immaturity of the intestinal wall structures, enzymatic insufficiency in the gut lumen, reduction of mesenteric circulation. Mesenteric ischemia and similar vascular disorders may also be induced by medical effects of vasopressor agents used in premature children in the critical state [28].

There are the following forms of SIP distinguished depending on the time of occurrence: early — the first 72 hours of life; late — after 72 hours from the moment of birth. By the clinical course, SIP is similar to NEC, but nevertheless, it has distinctive clinical features: lower weight of patients than in NEC; lower propensity for manifestation of severe complications in the form of multi-organ failure; only free air on X-ray examination [31].

In the treatment of SIP, two surgical options are classically considered: drainage of the abdominal cavity and laparotomy. L. D. Belotserkovtseva, et al., in their study give the spectrum of surgical aids for SIP including laparocentesis, laparotomy with resection of the affected areas of the intestine and with double end enterostomy. The authors also point out the need to perform programmed relaparotomies (of second look type) in cases of questionable viability of the extended part of the intestine [32]. O. M. Gorbatyuk, et al. enriched

a range of surgical aids with the addition of the formation of enteroenteroanastomoses, excision of edges and suturing of perforations, and the application of intestinal stomas [33].

Drainage of the abdominal cavity entails a higher mortality compared to laparotomy (49% vs. 19%). However, drainage of the abdominal cavity is included in the first-line treatment of more severe patients who have a high risk of death during laparotomy, and is the main part of wait-and-see therapy [34, 35]. In addition to the SIP, there is a state of pre-perforation or a threat of SIP. In such patients, the authors performed resection within healthy tissues in conditions of laparotomy, and completed the intervention by creating a single-row T-shaped anastomosis with a proximal ileostomy according to Santulli [36].

Another dangerous complication of a fairly common malformation of the intestinal tube (Meckel’s diverticulum, MD), is its perforation [37]. R. S. Shilo, et al. report the conduction of laparotomy in such cases with excision of the diverticulum with suturing of its basis with machine stitches and interrupted seromuscular sutures above the second row; another variant of surgical treatment is mobilization of the small intestine with resection of a perforated part with subsequent enteroenteral side-to-side anastomosis [38]. On the contrary A. Yu. Kozlov describes the possibilities for using minimally invasive interventions in MD perforations (video-assisted or laparoscopic resection with intracorporeal hand ties or machine stitches) [39, 40]. Thus, in perforations of the small intestine (SIP, MD), the prevailing surgical interventions are operations with a traditional open method (Figure 3).

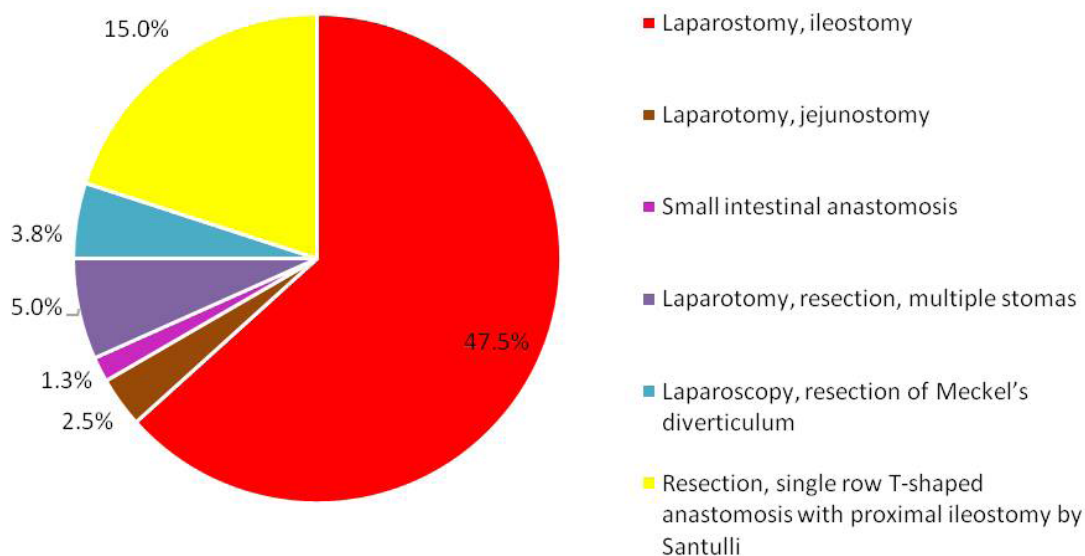


Fig. 3. Variants of surgical tactics in perforations of different parts of small intestine in children.

DISCUSSION

Currently, there is a high number of pediatric patients requiring emergency surgical treatment for perforation of different parts of the gastrointestinal tract with rapidly developing peritonitis; surgical interventions using endoscopic technologies (laparoscopy) are becoming a wide practice for such patients. However, the limitations of laparoscopy are primarily associated with the severity of the patient's condition and the timing of hospitalization after perforation of a part of the gastrointestinal tract. So, in our opinion, a reasonable variant for hemodynamically unstable patients is laparotomy, because laparoscopy, accompanied by carboxyperitoneum, will aggravate the patient's condition in this situation due to increase in pressure in the abdominal cavity, which can lead to spasm of mesenteric vessels and will enhance damage to the intestinal wall (due to hypoperfusion), provoked by the primary pathological process. Based on our own observations, we note that in case of perforation of unclear genesis and location, especially in low-weight newborns, we consider it reasonable to perform a right-sided transverse laparotomy for adequate sanitation of the abdominal cavity after its thorough revision.

A special point is laparocentesis in patients with SIP as the first stage of treatment. This category of patients, as a rule, includes low-birth-weight newborns requiring special attention of neonatal specialists and urgent surgical intervention. Very often, such intervention consists in draining the abdominal cavity directly in the humidicrib in an intensive care unit, because of extremely severe condition of the patient. Undoubtedly, laparocentesis in this situation is an operation of choice and is only preparation to the main stage of surgical treatment, laparotomy with subsequent application of the intestinal stoma (since formation of enteroenteroanastomosis will increase the length of surgical treatment, which is unacceptable in this situation). In severe cases, many authors resort to programmed sanitation relaparotomy (e.g., in generalized purulent peritonitis in perforations of the duodenum and small intestine) and application of laparostoma. Use of different approaches reasonable in every particular case, permits to achieve positive results of treatment in each individual patient. In pediatric practice, use of laparostomas is strictly limited, they are reported with decreasing frequency and are used in single cases. However, this method should not be rejected in case of necessary sanitation and control of the condition of the intestinal loops in patients with multiple perforations of different parts of GIT and generalized purulent peritonitis.

The landmarks for the choice of a variant of surgical tactics should be such parameters as timing and spread of peritonitis, the general condition of the patient,

hemodynamic condition (stable/unstable), the extent of coverage of the wall of intestinal tube with alterations in the affected area, local or multiple lesions, location of the defect (remoteness from the ileocecal angle and ligament of Treitz), and a possibility of performing surgical intervention with minimal tissue injury. Speaking about the choice of a variant of surgical intervention, it was determined in the analysis of the scientific literature that in GP, the main criterion of choice for most authors is the size of defect (in case of extensive lesion of the intestinal wall, laparotomy and suturing of the perforated defect are performed, and if suturing is impossible — gastric resection); in the duodenal perforation — the presence or absence of the GIT defect (which will permit to choose a variant of access to the abdominal cavity — laparoscopy or laparotomy) and the size of defect; and in perforation of the small intestine the criteria are causes and location of the defect. According to the above specified criteria, it is possible to start the surgical intervention with laparoscopic revision of the abdominal cavity in hemodynamically stable patients. This will permit to minimize tissue injury, determine the further amount of the operation and, with the availability of technical possibilities and sufficient experience of the personnel — to complete the operation without conversion of access. An indication for transition to laparotomy may be the absence of differentiation of tissues, existence of a dense fusion of intestinal loops due to a pronounced adhesion process in the abdominal cavity with the underlying peritonitis, as well as multiple perforations requiring extensive resections.

CONCLUSIONS

Thus, variants of surgical tactics in gastric wall perforation (given in the order from the most commonly used to the least common) are: laparotomy and suturing of the edges of defect (in extensive lesions and unstable patient's status); suturing in laparoscopic conditions (a small defect up to 2 cm, stable patient); atypical resection with the formation of a gastric 'tube' on the probe (a defect more than 2 cm or several defects); resection of stomach (in case the above methods prove ineffective and in high risk of stenosis in the postoperative period).

In duodenal perforations, the following methods are used: rhomboid duodenoduodenoanastomosis according to Kimura, intracorporeal suture with endovideosurgical access; laparotomy and suturing of the defect in case of extensive necrosis of the duodenal wall. The criteria of choice in duodenal perforation are similar to those in gastric perforation.

In multiple spontaneous perforations in the small intestine, resection of the part of the intestine is advisable — anastomosis according to Santulli in

combination with end ileostomy or application of intestinal stomas. In case of a single spontaneous intestinal perforation, single-stage application of end-to-end anastomosis is possible. Suturing of perforated holes of the intestinal tubes and application of enteroenteroanastomoses in conditions of peritonitis (using different suturing materials, proprietary methods and novel medical products) is the topic of numerous modern research works, and one of promising areas of development of modern abdominal surgery. Studies in the given field will permit to revise the existing approaches and develop new solutions to 'old' problems.

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for integrity of all parts of article; D. A. Severinov — collecting and processing of material, writing the text, editing; A. M. Ovcharenko — writing the text, editing. The authors confirm the correspondence of their authorship to the ICMJE International Criteria. All authors made a substantial contribution to the conception of the work, acquisition, analysis, interpretation of data for the work, drafting and revising the work, final approval of the version to be published and agree to be accountable for all aspects of the work.

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Вклад авторов: Гаврилюк В. П. — концепция и дизайн исследования, написание текста, редактирование, утверждение окончательного варианта статьи, ответственность за целостность всех частей статьи; Северинов Д. А. — сбор и обработка материала, написание текста, редактирование; Овчаренко А. М. — написание текста, редактирование. Авторы подтверждают соответствие своего авторства международным критериям ICMJE (все авторы внесли существенный вклад в разработку концепции, подготовку статьи, прочли и одобрили финальную версию перед публикацией).

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