

Effectiveness Of Surgical Treatment of Appendicitis in Young Children Using Laparoscopy

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ABSTRACT

Annotation. In the scientific community there is a growing interest in minimally invasive methods of surgical intervention, in particular in laparoscopic appendectomy in young children. The aim of this study was to evaluate the efficacy and safety of the laparoscopic approach in the treatment of acute appendicitis in patients aged 3 to 7 years compared to traditional open appendectomy.

The analysis of clinical and epidemiological data, peculiarities of surgical intervention and postoperative period was carried out. The results of the study revealed a decrease in the incidence of wound complications and a reduction in the duration of hospitalisation in children operated laparoscopically. At the same time, the indices of operation time and conversion to open surgery remained at an acceptable level.

The study concludes that the laparoscopic method is highly effective in terms of reducing traumatic injuries, improving quality of life indicators and favourable economic effect..

Keywords: *acute appendicitis, laparoscopic appendectomy, young children, surgical intervention, postoperative complications, duration of hospitalisation, effectiveness of surgical treatment, minimally invasive surgery*

1. INTRODUCTION

The urgency of the problem of acute appendicitis in young children is determined not only by the high prevalence of this nosology, but also by the difficulties of early diagnosis. Anatomico-physiological features, including insufficient differentiation of the immune response, can lead to an atypical course of appendicitis, which often complicates timely detection of the disease. Early diagnosis and correct treatment tactics are extremely important, as delay increases the risk of complications, including perforation of the worm and spread of the infectious process in the abdominal cavity.

Surgical intervention is the main method of treatment of acute appendicitis. Until recently, open appendectomy was considered the standard, but in recent decades, laparoscopic surgery has been actively developed and is widely used in paediatrics. There are opinions about the superiority of the laparoscopic method over the traditional one due to its less traumatic nature, better visualisation of the abdominal cavity organs and lower incidence of postoperative complications [5]. This is especially important in young children, as they are more likely to have difficulties in diagnosing appendicitis and a high risk of atypical course, which may lead to complications during open intervention.

One of the key advantages of laparoscopy is considered to be shorter rehabilitation time, as patients are less likely to experience sequelae such as gross scarring or significant pain. However, the feasibility of the laparoscopic approach in routine practice in children, especially pre-school children, continues to be debated given the need for specialised equipment, staff qualifications, and the difficulty of performing laparoscopy when the peritoneal cavity is small in young patients [2].

There are data indicating a high level of safety and efficacy of this approach, but there are still discussions in the world practice concerning the economic justification, as well as the need to standardise the methods of anaesthesia and postop management.

The aim of this study is to evaluate the efficacy and safety of laparoscopic appendectomy compared with traditional open surgery in children aged 3 to 7 years in a paediatric surgical clinic. The analysis covers postoperative complications, recovery dynamics, length of hospitalisation and indirect economic indicators.

2. MATERIALS AND METHODS OF THE STUDY.

The study was conducted at the surgical department of a multidisciplinary children's hospital for the period from January 2022 to January 2024. Patients with acute appendicitis aged 3 to 7 years were included. Diagnosis was established on the basis of clinical symptoms (complaints of abdominal pain, vomiting, fever, local pain), laboratory parameters (leukocytosis, increased C-reactive protein), and abdominal ultrasound findings. In difficult cases computed tomography with contrast was used.

The total number of patients was 180. All patients underwent standard preoperative preparation including infusion therapy for correction of water-electrolyte balance, antibacterial prophylaxis before incision. Exclusion criteria were the presence of concomitant severe congenital malformations, oncological diseases or recent operations on abdominal cavity organs, which could distort the data on the efficacy and safety of treatment.

The patients were divided into two groups depending on the surgical treatment method used. The first group consisted of 92 children who underwent laparoscopic appendectomy. The second group consisted of 88 children who underwent traditional open appendectomy. In all patients, regardless of the method, the operations were performed by paediatric surgeons who had undergone appropriate training and had sufficient experience in performing the chosen intervention.

Laparoscopic appendectomy was performed using general endotracheal anaesthesia. Access was made through three trocar ports: the first (10 mm) in the region of the umbilicus for the laparoscope and two additional ports (5 mm each) in the right and left quadrants, depending on the expected location of the worm. Carbon dioxide insufflation was performed, maintaining intra-abdominal pressure within 6-8 mmHg, taking into account the peculiarities of the paediatric organism. After visualisation of the worm and its mesentery, we performed clipping and transection of the process with subsequent extraction or coagulation of the stump. If inflammatory fluid was present, it was aspirated and the abdominal cavity was thoroughly sanitised. The total operation time averaged 45-60 minutes, depending on the complexity of the inflammatory process and the surgeon's experience [3].

Open appendectomy in the comparison group was performed under general anaesthesia with a 3-5 cm incision in the right iliac region. The worm was removed using ligatures and ligatures, sanitation and drainage of the abdominal cavity were performed as indicated. The operation time ranged from 30 to 50 minutes.

The efficacy evaluation criteria included the duration of hospitalisation (from the moment of surgery to discharge from the hospital), the frequency of postoperative complications (purulent-inflammatory processes, intra-abdominal abscesses, bleeding), the severity of pain syndrome (according to the pain rating scale taking into account childhood age), as well as indirect economic indicators (the need for additional medication, reoperation, prolonged rehabilitation) [1]. [1]. Pain was assessed using a modified visual analogue scale. It was taken into account that young children participated in the study, so if the scale could not be used directly by the child, the data were obtained according to the parents' testimony and the medical staff's assessment (changes in behaviour, appetite, sleep) [4].

The follow-up period was 30 days after surgery. During this period of time, all cases of complications were recorded, which allowed us to objectively judge the safety of the technique.

3. RESULTS AND DISCUSSION.

The analysed data allowed us to form a general clinical picture. The mean age of patients in both groups was 5.1 years. The proportion of boys and girls was approximately the same (54% of boys, 46% of girls). Most children presented with classic symptoms (abdominal pain, fever up to 38°C, leukocytosis up to $12-14 \times 10^9/l$), but 28% had an atypical onset associated with more diffuse complaints and non-specific manifestations.

Preoperative diagnostic accuracy was slightly higher in the laparoscopic intervention group, as the possibility of examining the abdomen by laparoscopy and access to detailed images made it possible to exclude other pathologies (Meckel's diverticulum, acute salpingitis in girls, etc.). In open surgery, in case of doubt about the diagnosis, surgeons were more often faced with the need for a larger incision to revise the abdominal cavity [7].

Table 1 illustrates the operative time, conversion rates (conversion from laparoscopic to open surgery), and average pain levels in the first 24 hours after surgery.

Table 1. Indicators by study groups (n=180)

Indicator	Laparoscopic group (n = 92)	Open group (n = 88)
Average operative time, min.	52	42
Conversion rate, %	5,4	—
Average pain level on the first day, points (according to VAS/visual analysis of child's behaviour)	3,2	4,7

In patients in the laparoscopic group, the operative intervention time was slightly longer, which can be explained by the stage of trocar placement and the need to follow the endosurgical technique. Nevertheless, a lower level of postoperative pain syndrome was detected, especially pronounced in the first day. Conversion was required in 5.4% of cases where there were visualization difficulties with adhesions or unclear anatomy and the presence of a perforated process with widespread peritonitis. In these situations, surgeons preferentially chose open access for faster revision [5].

Table 2 shows the data on the complication rate, length of hospitalization and approximate cost of treatment (averages over the follow-up period), which allows us to judge not only the clinical but also the cost-effectiveness of laparoscopic appendectomy.

Table 2. Frequency of postoperative complications, length of hospitalization and cost of treatment

Indicator	Laparoscopic group (n = 92)	Open group (n = 88)
Purulent complications, %	3.3 (3 cases out of 92)	9.1 (8 cases out of 88)
Intra-abdominal abscesses, %	1.1 (1 case out of 92)	4.5 (4 cases out of 88)
Average length of hospitalisation, days	4.3	6,1
Approximate cost of treatment, RUB.	64,000 (including disposable laparoscopic instruments)	52,000 (with relatively lower cost of consumables)

The data obtained allow us to note a lower incidence of purulent complications (3.3%) and intra-abdominal abscesses (1.1%) after laparoscopic interventions compared to open surgery (9.1% and 4.5%, respectively). The mean duration of hospitalization was also shorter with the laparoscopic approach (4.3 days versus 6.1 days with open interventions). At the same time, the cost of treatment was higher in the laparoscopic group (64,000 rubles) due to the need to use expensive disposable instruments.

According to the presented results, the incidence of purulent complications and intra-abdominal abscesses in children operated on laparoscopically was lower, which is consistent with the data of a number of foreign studies. One of the decisive factors is better visualisation, which allows thorough removal of inflammatory exudate. Due to less traumatic and reduced pain syndrome, hospitalization in this category of patients is shorter by an average of 1.8 days [8].

Despite the higher immediate cost of the surgical intervention, including the costs of laparoscopic equipment and disposable instruments, the economic benefit in the long term is due to fewer complications and shorter hospital stay [9].

When intraoperative features were analyzed, it was observed that in children, laparoscopic appendectomy provides better access to the small and large intestine. In some patients with atypical location of the worm, this technique allowed operative orientation of the anatomy and preservation of a small scar length. The lower pain syndrome reduced the need for analgesics and facilitated rapid recovery of activity [11].

Figure 1 compares the frequency of analgesic and antibiotic prescription in the postoperative period in patients of both groups. In children who underwent laparoscopy, analgesic courses were generally shorter and required smaller doses of drugs.

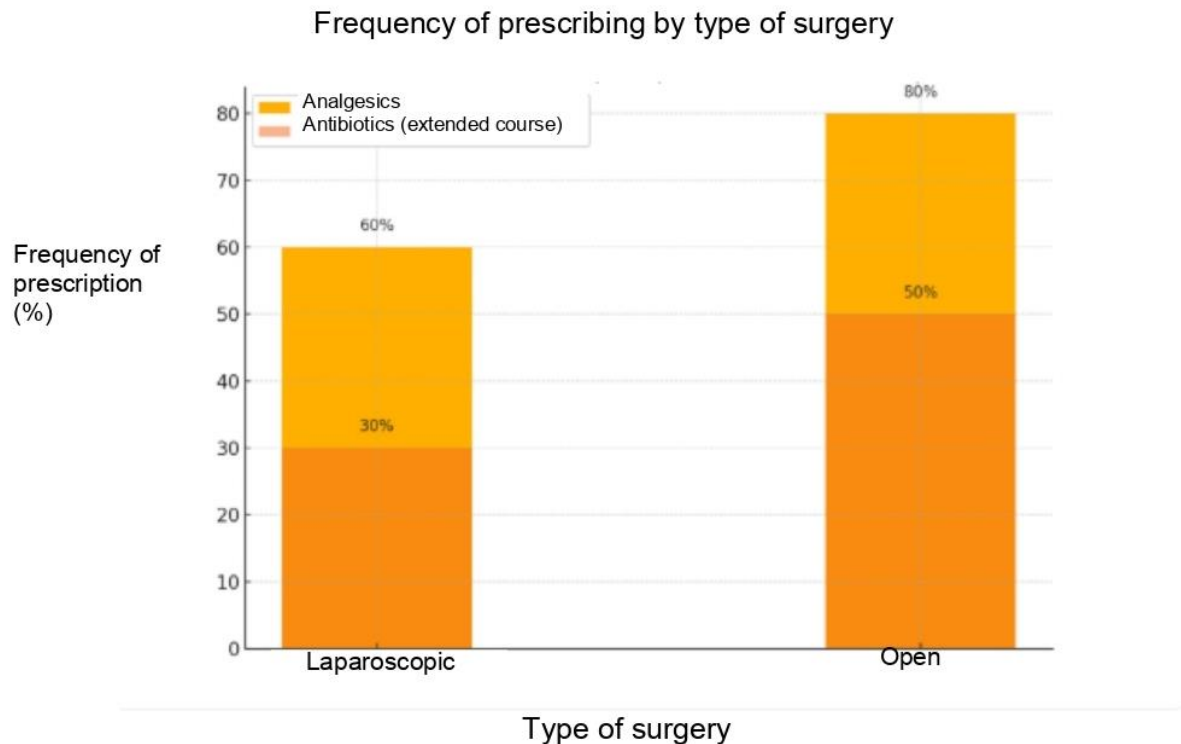


Figure 1: Comparison of the frequency of prescribing analgesics and antibiotics in the two groups

The reduction in antibiotic prophylaxis is due to the smaller exposed wound area and lower risk of contamination, which is particularly valuable in paediatric surgery. Although antibiotics continue to be the standard for any surgical procedure, results show that in the laparoscopic group the course of antibiotic therapy is shorter or limited to prophylactic regimens [3].

Figure 2 demonstrates the dynamics of pain syndrome level indicators by days of the postoperative period.

It can be seen that pain decreases significantly faster during laparoscopic intervention. According to the indicators on the 3-4 days after surgery, the patients returned to an almost normal level of activity, significantly ahead of the group after open intervention.

This graph shows that throughout the postoperative period (from the 1st to the 5th day), the pain level in the laparoscopic group decreased faster than in the open surgery group. This corresponds to the description in the text: children who underwent laparoscopy need less painkillers and recover more quickly, which is indirectly confirmed by the low pain values at the end of the first 3-5 days.

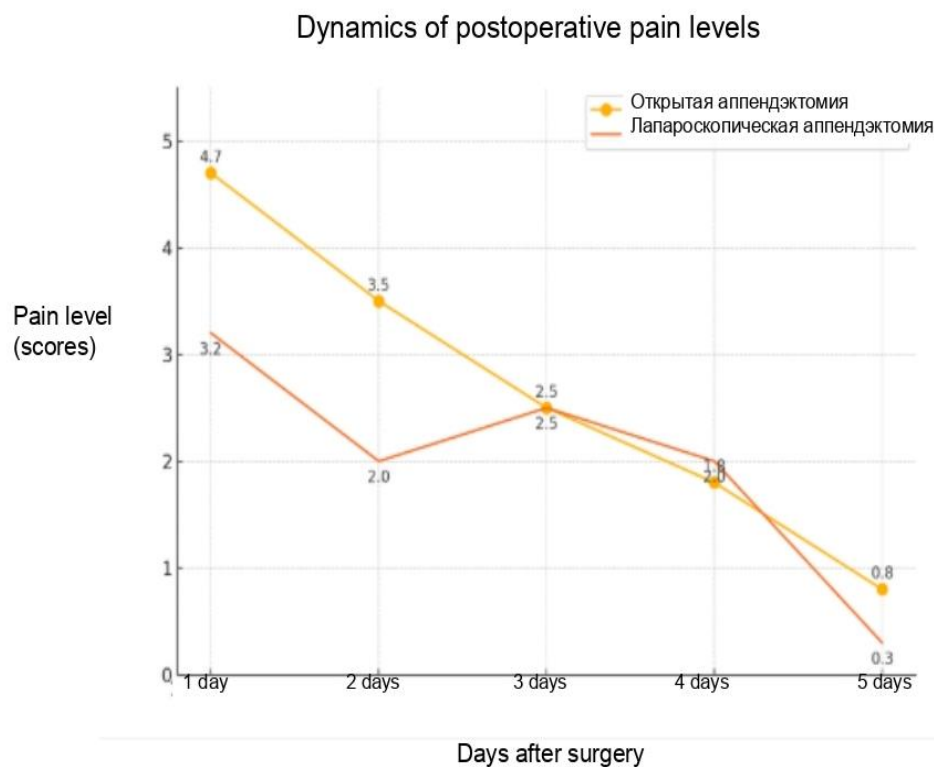


Figure 2: Pain level (on a 10-point scale or child behavioral assessment) during postoperative days

Good tolerance of minimally invasive manipulations is especially important for children 3-7 years old, who have psychological peculiarities of pain perception. Minimizing the stress associated with pain and mobility restrictions has a positive effect on the overall course of the postoperative period. For parents, an important aspect is the possibility of an earlier return of the child to the usual regime, attendance at a preschool institution, as well as saving on sick leave [7].

The results obtained in the study generally confirm the data given in foreign literature. Nevertheless, it should be noted that the sample was limited within one surgical centre and the follow-up period was relatively short - 30 days. Some postoperative complications may occur at a later stage. At the same time, the small conversion rate suggests the relative safety of laparoscopy in young children.

The disadvantage of the laparoscopic method may lie in the need for training and experience of specialists. The process of building skills when working with young patients requires diligence and constant practice. In conditions of limited funding, not all clinics can afford the introduction of modern laparoscopic equipment, which sometimes hinders the spread of the method [10].

From the perspective of evidence-based medicine, it is necessary to conduct further studies on larger samples, compare different modifications of the laparoscopic technique, and analyze costs in more detail. In some cases, the possibility of non-surgical treatment of uncomplicated appendicitis with antibiotics has been discussed, but this approach remains controversial in preschool children, and most paediatric surgeons stick to the operative approach.

4. CONCLUSIONS

Laparoscopic appendectomy in young children (3-7 years old) demonstrates high efficiency in terms of reducing the incidence of postoperative complications and the level of pain syndrome compared to open appendectomy. The method of minimally invasive intervention leads to a reduction in the duration of hospitalization, which positively affects the psychological state of the patient and the economic component of treatment.

Somewhat higher immediate cost of laparoscopic equipment is compensated by the reduced number of complications and accelerated return to normal activities of the child. The presence of a small but significant conversion rate indicates the need for careful patient selection and high qualification of surgical staff.

Such results confirm the validity of wider introduction of laparoscopy in paediatric surgical practice in the treatment of acute appendicitis, but require further large-scale analysis, including long-term follow-up of patients, evaluation of long-term outcomes and quality of life.

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