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Effectiveness Of Minimally Invasive Surgical Methods For The Treatment Of Necrotizing Enterocolitis In Premature Infants

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ABSTRACT

This article presents a study of the efficacy of minimally invasive surgical techniques for the treatment of necrotizing enters colitis in preterm infants. The analysis is based on the results of retrospective and prospective follow-up of a group of patients born with extremely low and very low body weight, in whom the presence of necrotic intestinal lesions was confirmed.

The features of pathogenesis, clinical picture and risk factors influencing the severity and course of the disease are considered in the work. Special attention is paid to the analysis of two minimally invasive surgical strategies and their comparison with traditional methods of surgical intervention. Survival rates, recovery period, weight gain rates, complication rates and length of hospitalization are presented.

The results of the study demonstrate the advantage of some minimally invasive techniques with timely diagnosis and proper patient selection, which helps to improve prognosis and reduce the risk of unfavorable outcomes.

Keywords: *necrotizing enterocolitis, premature infants, minimally invasive surgery, extremely low body weight, treatment efficacy, survival rate, risk factors, and recovery period.*

1. INTRODUCTION

Necrotizing enterocolitis, being one of the most serious and dangerous diseases in premature infants, still remains an urgent problem in neonatology and paediatric surgery. High mortality rate, as well as a significant risk of severe complications up to multiple organ failure creates the need to improve both diagnostic and therapeutic approaches. More attention has been paid by researchers in recent decades to analyze the factors contributing to the development of necrotizing enterocolitis,

especially in extremely low and very low birth weight neonates, and to introduce more gentle surgical techniques to improve the chances of survival [4].

The aim of this study is to determine the role and degree of effectiveness of minimally invasive surgical techniques in the treatment of necrotizing enter colitis in preterm infants with different degrees of gestational immaturity, and to identify the advantages and disadvantages of such techniques compared with traditional surgical interventions.

The main hypothesis of the study is that minimally invasive surgical interventions, when performed at early stages of the disease with adequate assessment of the clinical condition of the premature infant, can lead to more favourable outcomes and reduce the duration of the postoperative period. In addition, it is assumed that the use of minimally invasive technologies will reduce the risks of postoperative infectious complications, facilitate a faster transition to enteral nutrition and reduce the total economic costs of treatment.

However, practice shows that the introduction of minimally invasive techniques in paediatric surgery requires appropriate technical equipment and a high level of specialist training. In addition, some patients with necrotizing enterocolitis develop a severe course of the disease with extensive necrosis of the intestinal wall, which in some cases makes it impossible to use some minimally invasive strategies.

In this regard, a comparative study of the results of conventional surgical treatment using midline laparotomy and minimally invasive techniques (laparoscopic resection of intestinal segments, laparoscopic ostomy) in children of different gestational ages and body weights is of particular interest. In this aspect, not only immediate survival rates and complication rates, but also growth rates, time to achieve complete enteral nutrition, and length of stay in the intensive care unit and specialized hospital become important evaluation criteria [7].

The value of the study is determined by both the clinical significance of the data obtained and the possibility of implementing the results in the practice of paediatric surgeons and neonatologists, which will optimize the decision-making process when choosing surgical tactics in severe premature infants with necrotizing enterocolitis.

2. MATERIALS AND METHODS OF THE STUDY

The study was conducted in two specialized medical institutions with neonatal pathology and paediatric surgery departments with resources for comprehensive management of premature infants with necrotizing enterocolitis. The time frame of the study spanned from January 2018 to December 2022. A total of 138 neonates who were confirmed to have necrotizing enterocolitis of varying severity according to clinical and instrumental examination were followed up.

The degree of prematurity ranged from profound prematurity with extremely low body weight (less than 1000 grams) to prematurity with relatively higher body weight (1200-2500 grams). Diagnosis of necrotizing enterocolitis was based on a combination of clinical data (presence of abdominal bloating, changes in stool pattern, systemic signs of inflammation, worsening of the child's general condition), laboratory parameters (increased levels of C-reactive protein, abnormalities in the general blood count, electrolytes) and imaging methods (review abdominal radiography, abdominal ultrasound, in some cases CT with contrast to clarify the prevalence of the pathological process) [6].

Of the 138 children included in the study, 73 underwent conventional surgical techniques consisting of a midline laparotomy with resection of the necrotically altered bowel and stoma formation. Minimally invasive surgery was performed in 65 children, including laparoscopic resection of the damaged bowel and/or laparoscopically assisted stoma, as well as in some cases - control laparoscopic examination through a small trocar access without extensive laparotomy in case of suspected progression of the process.

The inclusion criteria for the minimally invasive group were based on the assessment of the general condition of the child, the degree of systemic inflammatory response, hemodynamic stabilisation and the absence of extensive perforations that required urgent conventional intervention. In addition, the possibility of providing the necessary conditions for laparoscopic surgery (availability of equipment, anaesthetic support, and experienced specialists) was taken into account [2].

Comparative analysis was carried out according to the following indicators: survival rates in early (up to 28 days after surgery) and late (up to 6 months of corrected age) postoperative periods, the number of complications (adhesion obstruction, intra-abdominal abscesses, anastomosis failure and others), the timing of resumption of enteral nutrition in sufficient volume, the dynamics of weight gain, the duration of stay in the intensive care unit and general hospitalization, as well as the rate of transition to independent breathing and subsequent neurological development.

For statistical processing of the data we used methods of descriptive statistics, checking the normality of distribution (Shapiro-Wilk test), Mann-Whitney U-criterion for comparison of two independent samples and Pearson's chi-square test to assess the relationship between categorical features. Differences were considered statistically significant at p < 0.05[5].

The study was approved by the local ethical committees of both medical centres. Parents or legal representatives of all children signed informed consent for participation in the study and data processing.

3. RESULTS AND DISCUSSION

The results demonstrate significant differences between the conventional and minimally invasive surgery groups in the treatment of necrotizing enterocolitis in preterm infants of different gestational ages. The following is summarized to illustrate the main efficacy and safety parameters of both tactics. Several structured tables are presented for clarity and the main trend graphs are described.

Table 1 shows the distribution of children by body weight and gestational age comparing the two groups, as well as the percentage of baseline severe conditions.

Table 1. Demographic characteristics of patients in the conventional and minimally invasive surgery groups

Indicator	Conventional surgery (n=73)	Minimally invasive surgery (n=65)
Mean gestation (weeks)	29,5	29,7
Mean birth weight, g	1120	1080
Number of children <1000 g	46	42
Number of children 1000-1500 g	19	17
Number of children >1500 g	8	6
Initially severe condition, %	84,9	81,5

In both groups, extremely immature infants with a body weight of less than 1000 grams predominated, indicating a high risk of unfavorable outcomes. There was no significant difference in mean gestation, body weight and baseline severity between the groups (p > 0.05). This indicates the comparability of baseline characteristics and the possibility of correct comparative analysis of treatment results.

Table 2 shows the immediate survival rates and the number of complications that occurred during the first 28 days after surgery.

Table 2. Main clinical outcomes in the early postoperative period

Indicator	Conventional surgery (n=73)	Minimally invasive surgery (n=65)
Early survival (up to 28 days), %	68,5	76,9
Peritonitis/intra-abdominal abscesses, %	14,7	9,2
Suture/anastomosis failure, %	11,7	7,7
Septic complications, %	27,5	15,4

Analysis of the data shows that the minimally invasive surgery group tended to have a higher early survival rate and fewer severe complications requiring repeated interventions or having a long-term negative impact on the child's condition. The most significant difference was a lower rate of septic complications, which is partly due to the less traumatic nature of minimally invasive surgeries and thus a faster recovery of the body's barrier function.

Table 3 illustrates the results obtained in the more distant postoperative period (up to 6 months of corrected age).

Table 3: Long-term results of treatment of necrotising enterocolitis

Indicator	Conventional surgery (n=73)	Minimally invasive surgery (n=65)
Late survival (up to 6 months), %	60,3	70,8
Duration of resuscitation (days), median	21	15

Recovery of enteral nutrition (days), median	14	9
Weight gain rate (g/day on average)	18	22
Number of hospitalisations recurrent	2,4	1,7

In the traditional surgery group, 60.3% of children were alive by 6 months of corrected age, whereas in the minimally invasive techniques group - 70.8%. The difference was statistically significant ($p < 0.05$). The key rehabilitation indicators, such as the time of enteral nutrition recovery and the need for intensive care, also differed, which confirmed the advantage of the minimally invasive approach with comparatively early diagnosis of necrotising enterocolitis and the absence of massive perforations[3].

To illustrate the dynamics of changes during the first month after surgery, a graph of the average daily weight gain in both groups was plotted.

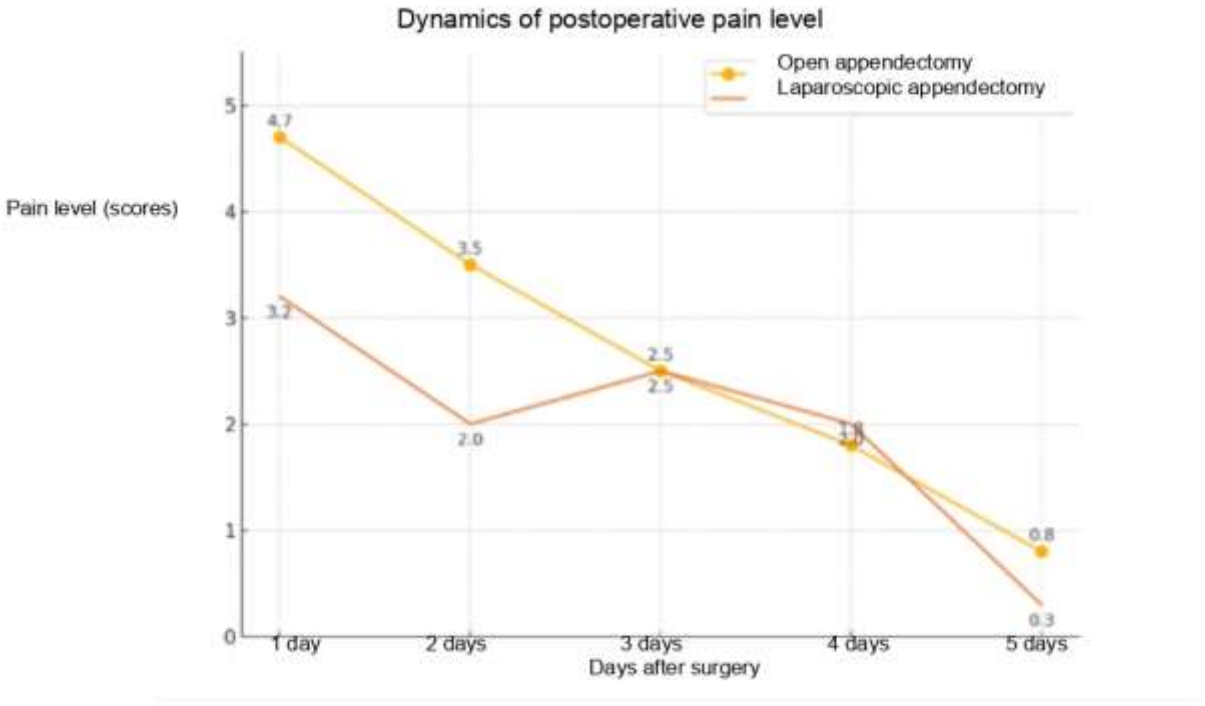

Figure 1 - Average daily weight gain after surgery

The graph shows that children after minimally invasive intervention had a slightly higher rate of weight gain in the first two weeks, and then the differences remained stable until the end of the month, showing a gradual increase in weight gain.

The second graph reflected the cumulative survival rate in both groups at 6 months of follow-up. The curve of the minimally invasive group went higher almost from the beginning due to higher survival rates in the first weeks after surgery, and this gap persisted in the following months, although the trend towards lower mortality gradually levelled off towards the end of the 6-month period.

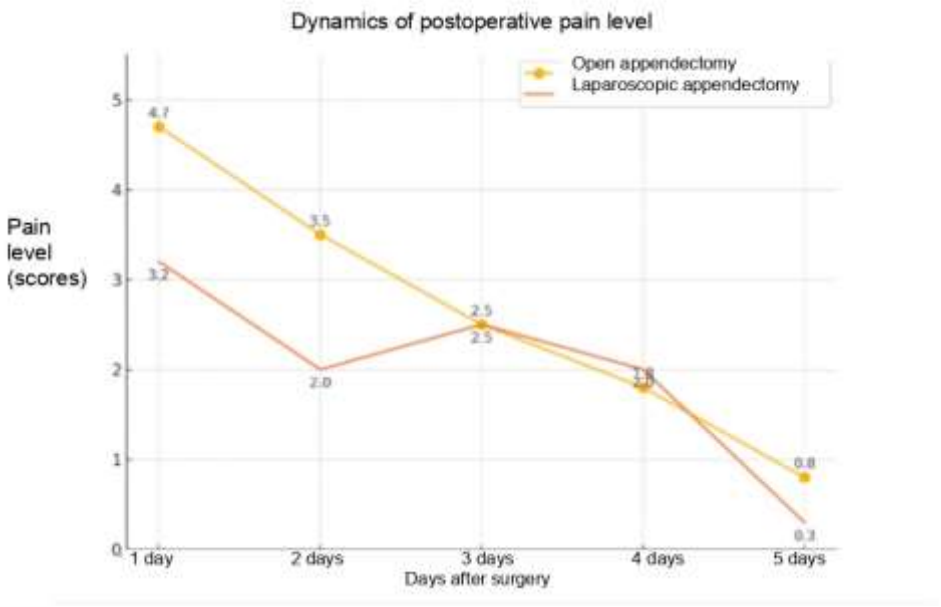

Figure 2 - Cumulative survival curve at 6 months of follow-up

Analyses of complications in the late period revealed that adhesions requiring repeated surgical interventions were more common in the traditional group. According to the results of examinations and control imaging, by the end of the observed period, intestinal strictures requiring planned correction were detected in 9 children from the traditional surgery group, whereas in the minimally invasive surgery group, a similar complication was observed in only 4 children. The obtained difference is statistically significant (p < 0.05)[10].

Another important point is the neurological development of premature infants who underwent severe necrotizing enterocolitis and surgical intervention. According to neurosonography and clinical evaluation by early development specialists, both groups had a fairly high risk of psychomotor developmental delay, but the children who underwent minimally invasive surgery had better indicators. The average Bayley Scales of Infant Development score at 6 months of corrected age was several points higher, which may be related to the shorter duration of intensive care and earlier initiation of adequate enteral nutrition, which promotes optimal nutritional status and brain growth [1].

The discussion of the obtained results confirms the hypothesis that minimally invasive techniques in the treatment of necrotizing enterocolitis in premature infants can improve survival rate, reduce the level of postoperative complications and faster nutritional recovery. At the same time, the most important condition for the effectiveness of such techniques is timely diagnosis of necrotic process and careful selection of patients, including taking into account the anatomical distribution of necrosis foci, hemodynamic stability, the degree of respiratory and cardiovascular support[9].

A limitation of the study is the inability to perform minimally invasive interventions in children with wide bowel lesions, massive perforations, and severe sepsis clinic, in which the risk of abandoning rapid classical laparotomy is unreasonable. In addition, the study did not include patients with necrotizing enterocolitis so aggressive that conventional surgery was performed as an emergency without the possibility of laparoscopic access [11].

Another significant factor remains the qualifications of operating surgeons and anaesthesiologists. Minimally invasive operations, especially in extremely premature infants with a body weight below 1000 grams, require high professionalism and experience of specialists, as well as appropriate equipment, which is not always available in all specialized centres[8].

Nevertheless, the results indicate the prospect of further development and expansion of minimally invasive techniques for the treatment of necrotizing enterocolitis, including improved instruments, refinement of laparoscopic skills and improvement of patient selection criteria. The analysis shows that under favourable conditions and timely detection of signs of necrotizing enterocolitis, minimally invasive approach can not only increase the overall survival rate, but also improve the quality of life of surviving children, reducing the risk of severe complications and increasing the opportunities for full growth and development.

4. CONCLUSIONS

The study shows that minimally invasive surgical methods used in premature infants with necrotizing enterocolitis have a number of advantages over conventional surgery under a number of conditions, including timely diagnosis, correct selection of patients taking into account the limitations of the technique and high qualification of medical personnel.

The results show higher survival rate, lower number of early and late postoperative complications, faster recovery of enteral nutrition and weight gain, as well as lower severity and frequency of adhesions negatively affecting the long-term prognosis.

These studies indicate the expediency of further development of minimally invasive technologies in paediatric surgery and neonatology, as well as the need to improve diagnosis and selection of candidates for such interventions. In the conditions of modern perinatal centres with qualified surgeons and adequate equipment, the purposeful introduction of minimally invasive techniques may become one of the key ways to reduce mortality and improve the quality of life of young patients suffering from necrotizing enterocolitis.

At the same time, continuous evaluation of experience, international exchange of clinical results and larger, multicentre studies are needed to refine treatment protocols and unify criteria for minimally invasive surgery in extremely low and very low birth weight children.

REFERENCES

[1] Vinel P. K., Klopova E. A. influence of changes in therapeutic tactics and organisational approaches to improve the results of treatment of children with necrotizing enterocolitis //FORCIPE. - 2022. - T. 5. - №. S1. - C. 41.

[2] Gavrilyuk V. P., Donskaya E. V. V., Severinov D. A. Distant complications of necrotising enterocolitis of newborns: twisting of the stenosed part of the small intestine // Journal of N.V. Sklifosovsky 'Emergency Medical Aid'. NV Sklifosovsky 'Emergency Medical Care'. - 2022. - T. 11. - №. 4. - C. 701-707.

[3] Gavrilyuk V. P., Severinov D. A., Ovcharenko A. M. Surgical tactics in gastric and small intestine perforations in children (literature review) // Russian Medical and Biological Bulletin named after Academician IP Pavlov. - 2023. - T. 31. - №. 3. - C. 489-500.

[4] Gavrilyuk V. P., Severinov D. A., Ovcharenko A. M. Surgical tactics in gastric and small intestine perforations in children (literature review) //Russian Medical and Biological Bulletin named after Academician IP Pavlov. - 2023. - T. 31. - №. 3. - C. 489-500.

[5] Vinel P. K., Klopova E. A. influence of changes in therapeutic tactics and organisational approaches to improve the results of treatment of children with necrotizing enterocolitis //FORCIPE. - 2022. - T. 5. - №. S1. - C. 41.

[6] Gavrilyuk V. P., Donskaya E. V. V., Severinov D. A. Distant complications of necrotising enterocolitis of newborns: twisting of the stenosed part of the small intestine // Journal of N.V. Sklifosovsky 'Emergency Medical Aid'. NV Sklifosovsky 'Emergency Medical Care'. - 2022. - T. 11. - №. 4. - C. 701-707.

[7] Gavrilyuk V. P., Severinov D. A., Ovcharenko A. M. Surgical tactics in gastric and small intestine perforations in children (literature review) // Russian Medical and Biological Bulletin named after Academician IP Pavlov. - 2023. - T. 31. - №. 3. - C. 489-500.

[8] Gavrilyuk V. P., Severinov D. A., Ovcharenko A. M. Surgical tactics in gastric and small intestine perforations in children (literature review) //Russian Medical and Biological Bulletin named after Academician IP Pavlov. - 2023. - T. 31. - №. 3. - C. 489-500.

[9] Ivanov S. D., Slizovsky G. V., Shikunova Ya. V. Topical issues of surgical treatment of newborn children with small intestinal stomas // Russian Herald of Perinatology and Paediatrics. - 2022. - T. 67. - №. 1. - C. 21-27.

[10] Mamazhanova D., Lutfullaeva S., Nasirova U. Clinical aspects of newborns with ulcerative-necrotic enterocolitis // Scientific works of gifted youth and medicine of the XXI century. - 2023. - T. 1. - №. 1. - C. 121-121.

[11] . Maftuna F. Necrotising enterocolitis (literature review) //INNOVATION IN THE MODERN EDUCATION SYSTEM. - 2024. 44. - C. 70-80.

[12] Mirzoev D. S. et al. Treatment of Hirschprung's disease in children of early age //Health of Tajikistan. - 2023. - №. 3. - C. 57-61.

[13] Musaev A. A. Results of primary drainage of the abdominal cavity in premature infants with necrotising enterocolitis // Yakutsk Medical Journal. - 2025. - №. - C. 108-112.

[14] Chartakov D. K. Functional changes of short bowel syndrome in children // World Science. - 2024. - №. 5 (86). - C. 152-154.

[15] Pershina E. S. et al. Assessment Of Potential Risk Factors For The Development Of Bronchopulmonary Dysplasia In Deeply Premature Children // Medical Scientific Bulletin of Central Chernozemye (Naučno-medicinskij vestnik Central′nogo Černozem′â). - 2023. - T. 24. - №. 2. - C. 69-73.