ORIGINAL ARTICLE

CONTENTS

Practical experience in the surgical treatment of newborns with isolated gastrointestinal perforations based on scientific evidence

Olga M. Gorbatyuk[1], Taras V. Martyniuk[2], Andrey A. Momotov[1]
[1]SHUPYK NATIONAL HEALTHCARE UNIVERSITY OF UKRAINE, KYIV, UKRAINE
[2]LESYA UKRAINKA VOLYN NATIONAL UNIVERSITY, LUTSK, UKRAINE

ABSTRACT

Aim: To share first-hand experience in the surgical treatment of newborns with isolated gastrointestinal perforations.

Materials and Methods: This study examines 71 newborns with perforated peritonitis: 53 (74.65%) had necrotizing enterocolitis, 14 (19.72%) had isolated gastrointestinal perforations, and 4 (5.63%) had other intestinal perforations. Diagnosis involved clinical, laboratory, radiographic, ultrasound, and histological examinations of surgical and autopsy samples.

Results: The most significant risk factors for isolated perforations of the gastrointestinal tract in newborns were acute birth asphyxia and pathology of the respiratory system, which required tracheal intubation in 100% of children. Isolated perforations were localized in the stomach (n=6), jejunum (n=3), ileum (n=2), duodenum (n=1), colon (n=2). Morphological features of isolated perforations are as follows: a rapid muscle layer wasting of the wall, sometimes with the absence of muscle fragments; vascular malformations in the submucosal layer of the wall; ulcerous defect without necrotic changes; absence of pneumatosis of the intestinal wall. In isolated perforations, the operation of choice was closure of perforation in 11 children. In 2 patients direct interintestinal anastomoses were performed. Case mortality rate was 21.43% (3 newborns died).

Conclusions: 1. Clinical and pathomorphological features of gastrointestinal perforations in newborns indicate that isolated perforations are a separate nosological entity. 2. Isolated perforations of the gastrointestinal tract in newborns are characterized by such clinical differences as distress syndrome, prematurity, early onset, local lesions of a hollow organ, moderate peritonitis, favorable course and prognosis. 3. Isolated perforations are secondary to fibromuscular dysplasia of the wall of a hollow organ, indicating congenital pathology. 4. The operation of choice for isolated perforations is the excision of the edges of the perforation and closure of the perforation. 5. The prognosis for the gastrointestinal isolated perforations is favorable. Mortality was 21,43%.

KEY WORDS: newborns, perforative peritonitis, surgical treatment

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INTRODUCTION

Cases of isolated intestinal perforations (IP) account for 1-2% in newborns with very low birth weight (less than 1500 g) and 5-8% in newborns with extremely low birth weight (less than 1000 g) [1-3]. IPs are more common in infant boys but can also occur in full-term newborns. The average age of perforation occurrence is 7 days (ranging from 0 to 15 days) [4-6].

The clinical and pathomorphological characteristics of gastrointestinal perforations in newborns indicate that IP is a distinct nosological entity. It is characterized by specific clinical features such as prematurity, early onset, localized damage to a hollow organ, moderate peritoneal inflammation, and distress syndrome. IPs arise against the background of muscular and vascular dysplasia of the hollow organ wall, supporting the hypothesis of congenital pathology [7-10]. According to the literature, factors contributing to the development of IPs include various antenatal and postnatal factors (fetal hypoxia, medication effects, chorioamnionitis, etc.) [11, 12].

There is currently no unified approach to the surgical treatment of isolated (also referred to as spontaneous or localized) perforations in newborns. The literature describes a wide range of interventions, from primary peritoneal drainage to suturing of the perforation site and resection procedures [13-15].

It is estimated that 7% of newborns in intensive care units have gastrointestinal perforations. Among them, 53% are perforations associated with NEC, while 27% are intestinal perforations [16-18].

However, the issue of IP in newborns remains controversial and insufficiently studied. The relevance of this problem is due to the increasing prevalence of the

Table 1. Clinical Differences in Gastrointestinal Perforations in Newborns

No.	Clinical Features	NEC (n=53;100%)	IP (n=14;100%)
1.	Age of the child at the time of perforation (days)	7.2 ±0.6	2.5±0.3
2.	Respiratory distress syndrome and other respiratory pathologies	3 (5.66%)	11 (78.57%)
3.	Endotracheal intubation	46 (86.79%)	14 (100%)
4.	Perinatal encephalopathy	53 (100%)	5 (35.71%)
5.	Congenital cardiopathy	19 (35.85%)	5 (35.71%)
6.	Location of perforations in the lower GI tract and multiple perforations	51 (96.23%)	4 (28.57%)
7.	Location of perforations in the upper GI tract	2 (3.77%)	10 (71.43%)

pathology [19, 20], the risk of severe pre- and postoperative complications [21, 22], high mortality rates [23-26], and the lack of effective treatment strategies.

AIM

to share first-hand experience in the surgical treatment of newborns with isolated gastrointestinal perforations.

MATERIALS AND METHODS

The study is based on the examination and treatment results of 71 newborns with perforative peritonitis. Among them, 53 (74.65%) patients had necrotizing enterocolitis (NEC), 14 (19.72%) had spontaneous gastrointestinal perforations, and 4 (5.63%) had other types of perforations. Male newborns were twice as prevalent as females. There were 14 (19.72%) full-term newborns and 57 (80.28%) preterm newborns. Among 14 newborns with IP, 2 were full-term, and 12 were preterm. The average gestational age was 30 weeks for NEC patients and 31 weeks for those with IP. The average birth weight of newborns with NEC was 1850 g, while for those with IP, it was 1710 g.

Comprehensive diagnostics of perforative peritonitis in newborns included clinical and laboratory examinations, instrumental studies (radiography, ultrasound), and histological examination of biopsy samples from surgical and autopsy materials. All patients underwent general blood and urine tests, biochemical blood analysis, bacteriological tests, and monitoring of lactate levels, C-reactive protein, and procalcitonin tests.

The somatic and obstetric status of the mothers of these newborns was also analyzed.

The study utilized widely accepted statistical methods for analyzing medical and biological research data. Nonparametric statistical methods were applied due to the small sample size and the predominance of qualitative rather than quantitative characteristics. Numerical data are presented in absolute values (n) and percentages (%).

This research was approved by the Ethics and Bioethics Committees of Shupyk National Healthcare University of Ukraine and Lesya Ukrainka Volyn National University.

RESULTS

The study showed that all 14 newborns (100%) with IPs presented with a high-risk perinatal history:

- 10 (71.43%) were born from complicated pregnancies
- 11 (78.57%) were preterm
- 4 (28.57%) had extremely low birth weight.

Significant risk factors for IP development were as follows:

- chronic fetoplacental insufficiency (n=10; 71.43%)
- intrauterine fetal hypoxia (n= 8; 57.14%)
- low gestational age (n= 11; 78.57%)
- severe respiratory distress syndrome requiring prolonged mechanical ventilation (n=11; 78.57%)
- congenital cardiopathy (n=5; 35.71%)
- inadequate early postnatal nutrition (12 newborns, 85.71%, were formula-fed with a higher osmolarity than breast milk).

All newborns with gastrointestinal IP developed severe or critical conditions in the first days of life (see Table 1).

The typical clinical presentation of perforative peritonitis did not pose diagnostic challenges. However, identifying the type of perforation responsible for peritonitis was crucial. Laboratory tests revealed the following:

- anemia (n=9; 64.29%)
- thrombocytopenia (n=11; 78.57%)
- metabolic acidosis and electrolyte imbalances (n=12; 85.71%)
- elevated lactate and C-reactive protein levels (n=12; 85.71%).

Based on the clinical examination of patients, key differences between gastrointestinal IP and perforations associated with NEC were identified (Table 1).

The most reliable risk factors for IP of the gastrointestinal tract in newborns were acute asphyxia during

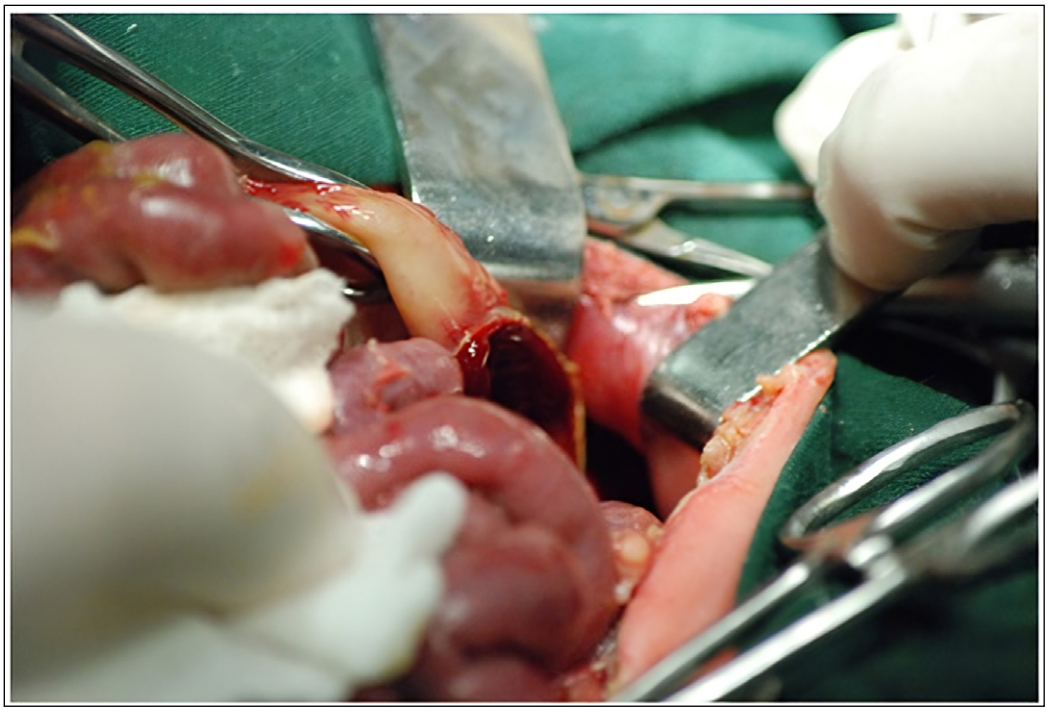

Fig. 1. Intraoperative Appearance of Isolated Gastrointestinal Perforation.

childbirth and respiratory pathology requiring endotracheal intubation in 100% of cases. In IP, respiratory distress syndrome served as the leading risk factor.

Intestinal perforations in NEC were predominantly located in the ileum (n=16), the large intestine (n=18), and only in 2 patients in the jejunum. Multiple perforative lesions of the gastrointestinal tract in NEC were observed in 17 newborns, accounting for 32.07%.

IPs, in most clinical cases, were localized in the jejunum (n=3), stomach (n=6), duodenum (n=1), and ileum (n=2). In the large intestine, 2 cases of IP were detected. Extensive damage to the gastrointestinal tract was not observed in newborns with IPs.

For diagnostic purposes, newborns with perforative peritonitis underwent radiological examinations, including plain radiography and contrast radiography when indicated, as well as abdominal ultrasound. To confirm the diagnosis, a morphological examination of biopsy material (both surgical and autopsy specimens) was performed.

The effectiveness of radiological methods in our observations was high, with false results obtained in only 3 cases. These occurred when the perforation sites were covered by an adjacent intestinal wall loop or a band of the greater omentum. A large amount of free gas in the abdominal cavity (pneumoperitoneum) led to severe respiratory and cardiac disturbances.

Abdominal ultrasound revealed free fluid between intestinal loops, decreased pneumatosis intestinalis, and static bowel loops with pendulum-like movement of the contents.

The morphological characteristics of IPs in newborns included: severe thinning of the muscular layer of the hollow organ wall, sometimes with the absence of individual muscle fragments; vascular aneurysms or vascular malformations in the submucosal layer of the hollow organ wall; an ulcerative defect with extensive hemorrhages in the perifocal tissues without necrotic changes; and the absence of intestinal wall pneumatosis.

All newborns with IP of the gastrointestinal tract underwent surgery. In five infants with extremely low birth weight (950–973 g), primary peritoneal drainage was used as preoperative preparation. Two infants with extremely low birth weight and concomitant congenital cardiopathies died. The other nine infants with IP underwent surgery. The surgical approach was determined based on the location of the perforation site, the extent of the pathological process in the wall of the hollow organ, and the overall condition of the infant. Macroscopically, the intestines and stomach appeared normal, with moderate peritoneal inflammation. Intraoperatively, IP presented as a localized perforation in the hollow organ wall with a localized pathological process, without extensive spread (Fig. 1).

All infants required preoperative preparation aimed at stabilizing hemodynamics, infusion and antibacterial therapy, correction of electrolyte imbalances and acidosis, and maintaining normal body temperature. Upon admission to the intensive care unit with a diagnosis of perforative peritonitis, the newborn was placed on enteral rest, a nasogastric tube was inserted for continuous aspiration of gastric contents, and intestinal

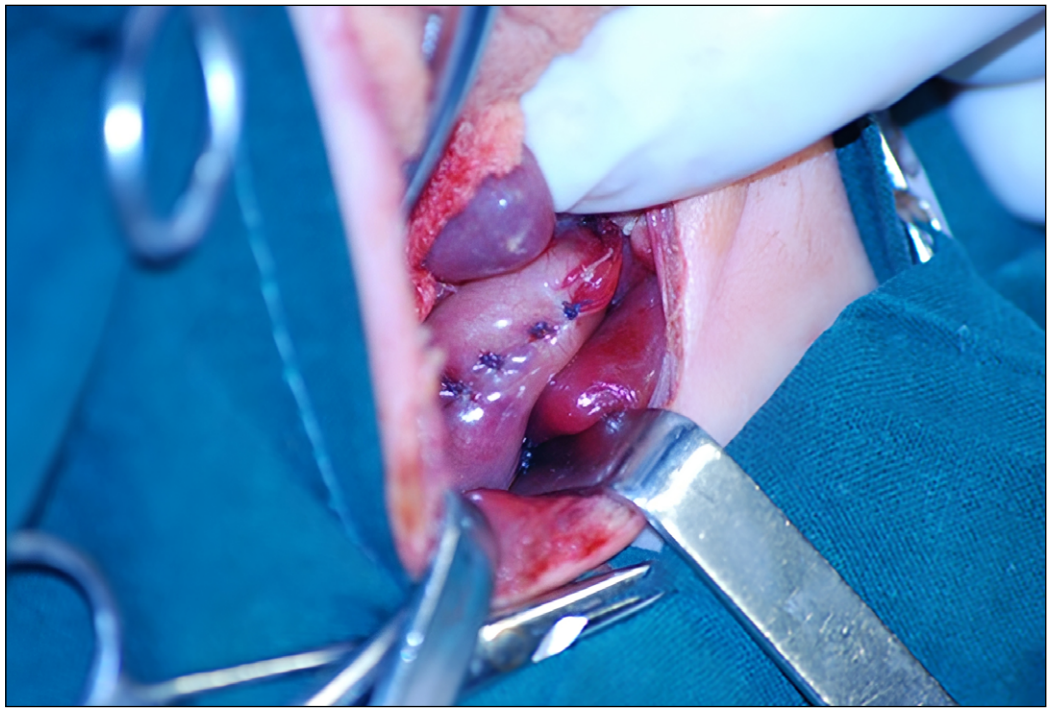

Fig. 2. Suturing of Gastrointestinal Perforation.

decompression was performed using a rectal tube. Additionally, bladder catheterization was carried out to monitor hourly urine output, and central venous catheterization was performed.

During NEC, the procedure of choice was suturing the perforation in 8 newborns. Surgical treatment involved excision of the defect edges and closure of the opening using Vicryl 5/0-6/0 sutures. In 4 patients who were in a stable condition, with large intestinal wall defects in the presence of a localized inflammatory process and absence of widespread peritonitis, resection procedures were performed with the creation of direct intestinal anastomoses. (Fig. 2).

In the postoperative period, prolonged infusion therapy, parenteral nutrition, as well as antibacterial and antifungal treatment were administered.

Enteral feeding was successfully initiated in 3 children starting from the 7th postoperative day. The initial formula used for enteral nutrition was Alfare, followed by a gradual transition to breast milk.

Three children with IP died, resulting in a postoperative mortality rate of 21.43%. All deceased patients were preterm infants with extremely low birth weight and congenital cardiopathies or heart defects, which led to severe hemodynamic disturbances and low systemic blood flow.

DISCUSSION

IPs of the gastrointestinal tract are among the most severe pathological conditions in the neonatal period. Cases of intestinal isolated perforations account for 1-2% in newborns with very low birth weight and 5-8% in those with extremely low birth weight. According to numerous literature sources and our own observations, significant factors contributing to IP include prematurity, low birth weight, respiratory distress syndrome on the background of an unfavorable premorbid condition, and inadequate nutrition in the early postnatal period [4].

The pathophysiology of neonatal IP remains a subject of discussion. Recently, IP of the gastrointestinal tract in newborns has been recognized as a distinct nosological entity, supported by clinical and scientific research. Pathomorphological examination of biopsy samples in IP cases reveals dysplasia or even the absence of the muscular layer of the hollow organ wall, indicating a congenital origin of the pathology.

IP is associated with a high mortality rate. Timely diagnosis and urgent surgical consultation are crucial, as they facilitate early diagnosis and prompt surgical intervention. The diagnosis of neonatal IP is based on premorbid background assessment, clinical, laboratory, and instrumental examination data, as well as mandatory morphological verification. Our observations indicate that the preferred surgical approach for IP of the gastrointestinal tract is perforation site suturing, which aligns with literature data. In stable patients with large intestinal wall defects, in the presence of a localized inflammatory process and the absence of widespread peritonitis, resection procedures with direct intestinal anastomoses are reasonable [6].

Future research on neonatal IP of the gastrointestinal tract should focus on developing preventive measures aimed at eliminating the etiopathogenetic factors that lead to intestinal blood circulation disorders and impaired barrier functions of the intestinal wall.

CONCLUSIONS

1. Clinical and pathomorphological features of gastrointestinal perforations in newborns indicate that IP is a distinct nosological entity.
2. IPs of the gastrointestinal tract in newborns are characterized by clinical features such as prematurity, early onset, localized damage to the hollow organ wall, moderate peritoneal inflammation, and distress syndrome, which is considered a leading risk factor for IP development.
3. IPs occur in the context of muscular-vascular dysplasia of the hollow organ wall, supporting its congenital origin.
4. The operation of choice for IPs in newborns is excision of the perforation edges and suturing of the perforation site.
5. The postoperative mortality rate among the studied group of neonates with IP of the gastrointestinal tract was 21.43%.

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CONFLICT OF INTEREST

The Authors declare no conflict of interest

CORRESPONDING AUTHOR

Olga M. Gorbatyuk
Shupyk National Healthcare University of Ukraine
9 Dorohozhytska St., 04112 Kyiv, Ukraine
e – mail: ol.gorbatyuk@gmail.com

ORCID AND CONTRIBUTIONSHIP

Olga M. Gorbatyuk: 0000-0003-3970-8797 A D E F
Taras V. Martyniuk: 0000-0002-0488-9148 B D E F
Andrey A. Momotov: 0000-0001-8759-3563 C D F

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