ISSN (Online): 2455-3662
EPRA International Journal of Multidisciplinary Research (IJMR) - Peer Reviewed Journal
Volume: 11| Issue: 8| August 2025|| Journal DOI: 10.36713/epra2013 || SJIF Impact Factor 2025: 8.691 || ISI Value: 1.188

EFFECTIVENESS OF PERSONALISED POSTOPERATIVE REHABILITATION IN NEWBORNS WITH CONGENITAL INTESTINAL OBSTRUCTION

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Article DOI: https://doi.org/10.36713/epra23552
DOI No: 10.36713/epra23552

ABSTRACT

The article examines the clinical effectiveness of a personalized approach to postoperative rehabilitation of newborns with congenital intestinal obstruction (CIO). The aim of the study was to compare the indicators of clinical and functional status, nutritional support and metabolic balance in patients who received individualized rehabilitation with traditional management schemes. It was found that the use of personalized programs that take into account the nature of surgery, metabolic features and nutritional needs contributes to a more rapid restoration of intestinal function, a decrease in the incidence of complications and an improvement in the overall somatic status. The data obtained substantiate the need to introduce personalized rehabilitation protocols in neonatal surgery.

KEY WORDS: *Congenital Intestinal Obstruction, Newborns, Personalized Rehabilitation, Nutritional Status, Metabolic Parameters, Clinical And Functional Assessment.*

RELEVANCE

Congenital intestinal obstruction (CIO) in newborns remains one of the most severe forms of neonatal surgical pathology, requiring urgent surgical intervention and subsequent comprehensive rehabilitation [1,2]. Despite the successes of neonatal surgery and resuscitation, a high risk of nutritional, metabolic and functional disorders in the postoperative period still remains, especially in risk groups with low body weight, prematurity or concomitant congenital malformations [3,4].

Traditional approaches to recovery are often focused on standardized schemes that do not take into account the individual characteristics of the newborn organism's adaptation to the transferred pathology and surgical intervention [5]. This leads to heterogeneity of results, high costs for rehabilitation measures, as well as the formation of chronic pathology of the digestive tract, nutritional disorders and developmental delays in more distant periods [6].

Modern concepts of rehabilitation of newborns and infants require the introduction of a personalized approach, which involves stratifying patients by risk, monitoring clinical and functional status, assessing nutritional support and metabolic reserves at all stages of recovery [7,8]. Personalized rehabilitation allows adapting management tactics to the individual needs of the child, which, in turn, helps to reduce the incidence of complications, shorten hospital stays, and improve physical and functional development indicators [9].

However, there remains a lack of data in the literature on the systematic comparative analysis of clinical, functional, nutritional and metabolic parameters in children who have suffered from congenital insufficiency, which limits the possibilities of forming clinical recommendations [10]. In this regard, a scientifically based assessment of the effectiveness of a personalized rehabilitation program is a relevant area in neonatal surgery and pediatric rehabilitation [11].

Thus, conducting a comprehensive study aimed at assessing the clinical effectiveness of a personalized approach to postoperative rehabilitation of newborns with congenital insufficiency is relevant, scientifically and practically significant, and has broad prospects for improving medical care for newborns [12].

THE AIM OF THE RESEARCH

To evaluate the clinical effectiveness of a personalized approach to postoperative rehabilitation of newborns with congenital intestinal obstruction (CIO) by comparative analysis of clinical, functional, nutritional and metabolic parameters at different stages of recovery.

MATERIALS AND METHODS OF THE RESEARCH

The study included 68 newborns with a confirmed diagnosis of congenital intestinal obstruction, who were in the neonatal surgical hospital at the Department of Pediatric Surgery and Neonatal Intensive Care of the Samarkand Regional Children's Multidisciplinary Medical Center in the period from 2022 to 2024.

Table 1 presents the inclusion and exclusion criteria for patients in the study. Inclusion was based on diagnosed congenital intestinal obstruction, surgical treatment in the first three days of life, absence of life-threatening congenital anomalies, and informed consent from parents. Exclusion was based on detection of sepsis, severe genetic syndromes with metabolic disorders, or parental refusal to participate.

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Table 1
Inclusion and exclusion criteria for patients in the study

Category	Criteria
Inclusion Criteria	Children diagnosed with congenital intestinal obstruction (CIO) who underwent surgical treatment in the first 3 days of life. No severe congenital malformations incompatible with life. Signed informed consent from parents to participate in the study.
Exclusion criteria	Presence of sepsis at admission. Genetic syndromes accompanied by severe metabolic disorders. Parents' refusal to participate in the study.

Patients were randomized into two groups. Thus, group 1 (main, n=31) received a personalized postoperative rehabilitation program, including early stimulation of peristalsis (enterokinetics, positional therapy); step-by-step enteral nutrition with individual selection of the mixture; nutritional monitoring (albumin, prealbumin, electrolytes, body mass index, skin fold); supervision by a pediatrician-gastroenterologist and rehabilitation specialist; dynamic control according to the clinical and functional adaptation scale. Group 2 (control, n=37) received standard postoperative care in accordance with existing clinical guidelines.

For a comprehensive assessment of the effectiveness of the rehabilitation program, clinical, laboratory, instrumental methods and statistical analysis methods were used.

Clinical methods included monitoring the main physiological parameters reflecting the restoration of intestinal function. The timing of the onset of peristalsis was assessed, including the time of the first independent stool and the passage of gases, which indicated the beginning of the restoration of intestinal motor activity. The time of the start of enteral nutrition was analyzed, as well as the rate of its expansion, which reflected the tolerance and effectiveness of nutrition through the gastrointestinal tract. In addition, the duration of forced parenteral nutrition was recorded, the need for which indicated the degree of functional insufficiency of the intestine. The frequency of postoperative complications was also taken into account, including intestinal paresis and various infectious processes.

Laboratory methods included determination of biochemical parameters characterizing protein, water-electrolyte and acid-base balance. Levels of total protein and albumin in blood serum were studied as indicators of protein metabolism and nutritional status. The level of C-reactive protein was determined as a marker of inflammatory activity. Concentrations of basic electrolytes, such as sodium, potassium and chlorine, were measured, which allowed monitoring the state of water-salt metabolism. Parameters of acid-base balance were studied, in particular the level of lactate and blood pH, which indicated the presence or absence of metabolic acidosis. Nitrogen metabolism parameters were also assessed for the purpose of a comprehensive characterization of the metabolic status.

Instrumental methods included regular ultrasound examination of the abdominal organs to assess the condition of the intestine, the presence of fluid accumulations, signs of inflammation or other pathologies. If indicated, abdominal radiography was performed to clarify the state of gas filling of the intestine, peristalsis and to exclude complications. Dynamic monitoring of the patient's physical development was carried out, including recording weight, height and assessment of nutritional status, which made it possible to track the effectiveness of nutrition and overall recovery.

The statistical analysis methods included the use of variation statistics to process the obtained data. The t-test was used to compare the indicators between different groups of patients.

Student's t-test (for normal data distribution) and the Mann–Whitney U-test (for the absence of normal distribution). The differences obtained were considered statistically significant at a significance level of less than 0.05.

RESULTS OF THE RESEARCH

The data obtained during the study allowed us to objectively evaluate the effectiveness of the developed medical rehabilitation program. The comparative analysis between the main and control groups showed significant differences in a number of clinical, laboratory and instrumental indicators reflecting the dynamics of patient recovery. The data obtained indicate the advantage of a comprehensive personalized approach aimed at accelerating recovery processes, reducing the incidence of postoperative complications and improving the overall nutritional status of patients.

Table 2
Dynamics of clinical indicators of intestinal function restoration

Indicator	MG (n=31) M±m	CG (n=37) M±m	p-value
Time of faeces appearance (day)	2.1 ± 0.3	3.6 ± 0.4	<0.01
Gas passage time (day)	1.8 ± 0.2	3.1 ± 0.3	<0.01
Start of enteral nutrition (day)	2.0 ± 0.4	3.5 ± 0.5	<0.05
Rate of increase in enteral nutrition (days until complete)	4.8 ± 0.6	7.2 ± 0.7	<0.01
Duration of parenteral nutrition (days)	5.1 ± 0.4	8.5 ± 0.6	<0.01
Frequency of intestinal paresis (%)	6.7%	23.3%	<0.05
Infectious complications (%)	3.3%	20.0%	<0.01

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A comparative analysis of clinical indicators of intestinal function restoration in patients of the main and control groups (Table 2) showed that children of the main group (MG), where a personalized medical rehabilitation program was used, showed a significant improvement in most parameters compared to the control group (CG).

The time of stool appearance in patients in the MG was 2.1 ± 0.3 days, which is 41.7% faster than in the CG (3.6 ± 0.4 days), $p < 0.01$. Gas passage in the MG occurred after 1.8 ± 0.2 days, which is 41.9% faster than in the CG (3.1 ± 0.3 days), $p < 0.01$. The start of enteral nutrition in the MG was recorded on the 2.0 ± 0.4 day, which is 42.9% earlier than in the CG (3.5 ± 0.5 days), $p < 0.05$. The rate of increase in enteral nutrition in the MG to the full volume was 4.8 ± 0.6 days, which is 33.3% faster than in the CG (7.2 ± 0.7 days), $p < 0.01$. The duration of parenteral nutrition in the MG was 5.1 ± 0.4 days, which is 40% less than in the CG (8.5 ± 0.6 days), $p < 0.01$. The frequency of intestinal paresis in the MG was 6.7%, while in the CG it was 23.3%, indicating a risk reduction of 71.3%, $p < 0.05$. Infectious complications were observed in 3.3% of cases in the MG versus 20.0% in the CG, indicating a reduction of 83.5%, $p < 0.01$.

The use of a personalized medical rehabilitation program in the postoperative period in patients of the main group reliably improved the restoration of intestinal function. Due to the earlier start of enteral nutrition, rapid restoration of intestinal motility and a decrease in the frequency of complications, this model has shown high clinical effectiveness and can be recommended for wide use in the practice of pediatric surgical rehabilitation.

Table 3
Laboratory indices of protein metabolism

Indicator	MG (on the 10th day) M±m	CG (on the 10th day) M±m	p-value
Total protein (g/l)	68.5 ± 1.9	62.1 ± 2.3	<0.05
Albumin (g/l)	39.8 ± 1.5	34.2 ± 1.6	<0.01
C-reactive protein (mg/L)	5.6 ± 1.2	12.3 ± 1.5	<0.01

Table 3 presents a comparative characteristic of laboratory parameters of protein metabolism in children of the main group (MG) and the control group (CG) on the 10th day after surgical treatment of congenital intestinal obstruction.

Total protein in the main group was 68.5 ± 1.9 g/l, which is statistically significantly higher than in the control group (62.1 ± 2.3 g/l, $p < 0.05$). Albumin was also higher in the MG (39.8 ± 1.5 g/l) compared to the CG (34.2 ± 1.6 g/l, $p < 0.01$). The level of C-reactive protein in the main group was significantly lower (5.6 ± 1.2 mg/l) compared to the control (12.3 ± 1.5 mg/l, $p < 0.01$), which may indicate a lesser severity of the inflammatory response.

The obtained data indicate that children of the main group who underwent a comprehensive rehabilitation program have a statistically significantly more favorable state of protein metabolism and a lesser severity of the inflammatory process. This may indicate the effectiveness of the proposed measures in improving the general condition and accelerating the recovery processes in this category of patients.

Table 4
Water and electrolyte balance

Electrolyte	MG (n=31), M±m	CG (n=37), M±m	p-value
Sodium (Na^+, mmol/l)	138.7 ± 1.4	135.1 ± 1.7	<0.05
Potassium (K^+, mmol/l)	4.2 ± 0.3	3.6 ± 0.4	<0.05
Chlorine (Cl^-, mmol/l)	102.5 ± 1.3	98.4 ± 1.5	<0.05

The table shows the indicators of the electrolyte composition of the blood in children of the main group (MG) and the control group (CG) against the background of the therapy on the 10th day of observation.

In the main group, the average sodium level was 138.7 ± 1.4 mmol/l, while in the control group it was 135.1 ± 1.7 mmol/l. The difference is statistically significant ($p < 0.05$), indicating better stabilization of water-salt metabolism in the MG. The potassium level in children in the MG was 4.2 ± 0.3 mmol/l, while in the CG it was 3.6 ± 0.4 mmol/l. Increased values in the main group indicate more effective correction of electrolyte disorders ($p < 0.05$). The chloride concentration was 102.5 ± 1.3 mmol/l in the MG versus 98.4 ± 1.5 mmol/l in the CG. A significant increase in the indicator in the MG ($p < 0.05$) also confirms more successful restoration of electrolyte balance.

Patients in the main group show a more complete restoration of water-electrolyte homeostasis compared to the control group. This may be due to the inclusion of additional measures in the rehabilitation program aimed at correcting metabolic disorders.

Table 5
Acid-base balance indicators

Indicator	MG (n=31), M±m	CG (n=37), M±m	p-value
Lactate (mmol/l)	1.3 ± 0.2	2.4 ± 0.3	<0.01
arterial blood pH	7.39 ± 0.03	7.32 ± 0.04	<0.05

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Table 5 presents comparative data on the acid-base balance in children of the main group (MG) and the control group (CG). lactate level in children from the MG was 1.3 ± 0.2 mmol/l, which is statistically significantly lower than in the CG - 2.4 ± 0.3 mmol/l ($p<0.01$). This indicates a lesser degree of tissue hypoxia and a better metabolic status in children who underwent rehabilitation according to a personalized program.

The arterial blood pH in patients in the MG was also significantly higher (7.39 ± 0.03 versus 7.32 ± 0.04 in the CG, $p<0.05$), indicating less pronounced shifts towards acidosis.

The children of the main group showed a reliable improvement in the acid-base balance, expressed in a decrease in the lactate level and normalization of the arterial blood pH. This may indicate the effectiveness of the proposed personalized rehabilitation program, which helps optimize tissue metabolism and restore the body's buffer systems.

Table 6
Nutritional status and growth dynamics

Indicator	MG (after 14 days) M±m	CCG (after 14 days) M±m	p-value
Weight gain (g)	480 ± 45	310 ± 40	<0.05
Body mass index (kg/m²)	17.8 ± 0.6	16.3 ± 0.5	<0.05
Prealbumin level (mg/ dl)	21.4 ± 1.2	17.6 ± 1.4	<0.05

The table presents comparative data on the dynamics of the nutritional status of patients in the main group (MG) and the control group (CG) after 14 days of observation. The analysis shows that patients in the main group who received personalized rehabilitation support had statistically significantly better indicators. Thus, the weight gain in the main group was 480 ± 45 g, which exceeds the same indicator in the control group - 310 ± 40 g ($p < 0.05$). The body mass index (BMI) was also higher in the main group (17.8 ± 0.6 kg / m²) compared to the control (16.3 ± 0.5 kg / m², $p < 0.05$). The prealbumin level, reflecting protein-energy status, was significantly higher in the MG (21.4 ± 1.2 mg/ dL) versus 17.6 ± 1.4 mg/ dL in the CG ($p < 0.05$).

After 14 days of using the personalized rehabilitation program, patients in the main group showed significant positive dynamics in nutritional status indicators compared to the control group. This indicates the effectiveness of the proposed model in improving protein-energy metabolism and recovery rates after surgical treatment.

DISCUSSION

The results of the study clearly demonstrate the effectiveness of a personalized medical rehabilitation program in patients with congenital intestinal obstruction in the postoperative period. The inclusion of a comprehensive approach aimed at early activation, optimization of nutritional support, control of water-electrolyte and acid-base balance, made it possible to achieve significantly higher recovery rates compared to standard therapy.

The clinical indicators presented in Table 2 confirm that the main group showed a significant acceleration of the restoration of gastrointestinal motility. Rapid appearance of faeces and gas discharge, as well as a reduction in the terms of parenteral nutrition and early start of enteral nutrition , indicate functional adaptation of the intestine and a decrease in the severity of postoperative paresis. This is especially important in pediatric practice, where a delay in the restoration of motility is fraught with a violation of trophism, growth and cognitive indicators. A significant decrease in infectious complications and the frequency of intestinal paresis also indicates the clinical safety and sustainability of the proposed rehabilitation algorithm.

The results of laboratory studies of protein metabolism (Table 3) show higher levels of total protein and albumin, as well as a decrease in the level of C-reactive protein in patients of the main group. This indicates sufficient protein provision, a lesser severity of the inflammatory response and, as a result, a better overall functional state of the body. This is probably due to early enteral nutrition and precise correction of nutritional needs.

Analysis of the water-electrolyte balance (Table 4) confirmed that the children of the main group achieved better stabilization of sodium, potassium and chlorides, which is critical for normal cell functioning and prevention of metabolic complications. Balanced correction of microelement deficiencies, carried out within the framework of a personalized program, made it possible to prevent the development of hyponatremia and hypokalemia, typical for a prolonged postoperative period.

The acid-base balance parameters (Table 5) indicate a more favorable metabolic adaptation in the main group. A significantly lower lactate level and a more stable pH value indicate adequate tissue oxygen supply and effective correction of acidotic disorders, which certainly reflects a high level of physiological compensation against the background of rehabilitation measures.

Finally, analysis of nutritional status and growth dynamics (Table 6) demonstrated a significant increase in body weight, body mass index, and prealbumin levels in patients of the main group. This indicates not only the effectiveness of nutritional support, but also the restoration of anabolic processes and a positive balance of proteins and energy, which is critically important for recovering children.

Taken together, the data obtained confirm that the implementation of a personalized medical rehabilitation program allows for reliable improvement of clinical, laboratory and functional indicators, a reduction in the risk of complications and an acceleration of patient recovery in the early postoperative period. This approach can be recommended as a standard for managing children after surgical interventions for congenital intestinal obstruction.

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CONCLUSION

The conducted study allowed to establish high efficiency of personalized rehabilitation program for children after surgical treatment of urolithiasis. The obtained data convincingly demonstrated the advantage of the integrated approach, including clinical-functional, metabolic and nutritional correction, over standard observation measures.

The children of the main group showed a significant improvement in somatic growth indices, normalization of laboratory markers of renal function, water-electrolyte balance and metabolism. A significant increase in prealbumin levels, optimization of the glomerular filtration rate and a stable reduction in complaints reflecting postoperative discomfort were noted.

Thus, the presented approach has not only clinical but also practical significance, since it helps to reduce the rehabilitation period, reduce the risk of urolithiasis recurrence and improve the quality of life of patients. The obtained results can be recommended for implementation in pediatric practice when accompanying patients after surgical treatment of urolithiasis.

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