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Comparative Evaluation of Early and Long-Term Clinical Outcomes of Surgical Treatment for Abdominal Masses in Neonates and Young Children

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Abstract

The early and long-term outcomes of surgical treatment for abdominal masses were comparatively evaluated in 122 neonates and young children. Following implementation of the optimized treatment algorithm, the proportion of organ-preserving procedures increased from 82.8% to 98.3%, while the nephrectomy rate decreased from 17.2% to 1.7% and the incidence of postoperative complications declined from 21.9% to 6.9%. Health-related quality of life assessed using the PedsQL™ Infant Scales improved from 78.74% to 92.36%. These findings confirmed the high clinical effectiveness of the optimized surgical management strategy.

Keywords: Children; abdominal masses; surgical treatment; laparoscopic surgery; early outcomes; long-term outcomes; clinical effectiveness.

Introduction

Abdominal masses (AMs) in neonates and young children represent one of the most clinically significant conditions encountered in pediatric surgery. Owing to their

diverse morphological characteristics, anatomical locations, and clinical manifestations, these lesions pose substantial challenges in establishing an accurate diagnosis and selecting the optimal surgical strategy [1,9].

Advances in ultrasonography, computed tomography (CT), and magnetic resonance imaging (MRI) have significantly improved the accuracy of preoperative diagnosis in recent years. Nevertheless, comprehensive studies evaluating both the early and long-term outcomes of surgical treatment remain limited [3,5,12].

From a topographic perspective, lesions originating in the retroperitoneal space constitute the predominant group of abdominal masses in neonates and young children. According to previous studies, pathological conditions of the urinary system, including hydronephrosis and multicystic dysplastic kidney, account for approximately 55–75% of all palpable abdominal masses in neonates [2,7,10]. The second most common group comprises masses arising from the pelvic organs and hepatobiliary system. Specifically, choledochal cysts, mesenteric lymphangiomas, and hepatic lesions collectively account for approximately 5–15% of cases [4,6,8,11].

Contemporary pediatric surgery increasingly emphasizes organ-preserving and minimally invasive surgical techniques to reduce postoperative complications, preserve organ function, and improve patients' quality of life. However, comparative evaluation of the early and long-term clinical outcomes of different surgical approaches, identification of their advantages and limitations, and determination of the optimal surgical strategy remain important scientific challenges [7,9,10].

Therefore, a comparative analysis of the early and long-term clinical outcomes of surgical treatment for abdominal masses in neonates and young children, together with an assessment of the effectiveness of organ-preserving and minimally invasive approaches, is essential for developing evidence-based recommendations for clinical practice.

Objective. The aim of this study was to comparatively evaluate the early and long-term clinical outcomes of surgical treatment for abdominal masses in neonates and young children.

Methods

A total of 122 neonates and young children (up to 3 years of age) with morphologically and clinically confirmed abdominal masses were included in this study. The study was conducted between 2015 and 2025 and involved a comparative analysis of diagnostic approaches and surgical treatment outcomes.

The study was performed in two phases. During the first phase (2015–2019), a retrospective analysis was conducted using the medical records of 64 patients who had received conventional diagnostic evaluation and standard surgical management. These patients constituted the comparison group (CG). During the second phase (2020–2025), a prospective cohort study was performed, including 58 patients who underwent evaluation according to an optimized diagnostic algorithm and were treated using an improved surgical strategy. These patients comprised the main group (MG).

All patients underwent a comprehensive diagnostic evaluation that included clinical examination, laboratory investigations, and sequential instrumental imaging studies. The diagnostic work-up was individualized according to the patient's age, general clinical condition, the suspected anatomical location of the lesion, and its presumed morphological characteristics.

Results and Discussion

The selection of the surgical approach for abdominal masses in neonates and young children should be based on objective criteria derived from a comprehensive evaluation of clinical, morphological, and instrumental findings (Table 1).

Table 1. Comparative Analysis of the Selection Criteria for Open and Laparoscopic Surgical Approaches

Criterion	Laparoscopic Surgery	Open Surgery
Indications	Localized and well-defined abdominal masses	Any lesion, including extensive or diffuse disease
Patient selection	Hemodynamically stable patients only	Can also be performed in patients with severe general condition
Lesion size	Small to medium-sized lesions	Lesions of any size, including giant masses

Suspected malignancy	Limited indication	Preferred surgical approach
Complicated lesions (peritonitis, necrosis, etc.)	Contraindicated or of limited applicability	Primary treatment of choice
Visualization	Depends on the quality of ultrasonography and CT imaging	Independent of imaging because of direct intraoperative exploration
Extent of abdominal exploration	Limited	Complete exploration of the abdominal cavity
Hemostatic control	Limited	Complete hemostatic control
Surgical trauma	Minimal	Greater surgical trauma
Risk of postoperative adhesions	Low	High
Length of hospital stay	Shorter	Longer
Recovery period	Faster	Slower
Technical complexity	High; highly dependent on the surgeon's experience	Standardized surgical technique
Limitations	Large lesion size, extensive adhesions, and intraoperative bleeding	Few or virtually no technical limitations

The effectiveness of preoperative preparation was evaluated based on the stabilization of central and peripheral hemodynamics, normalization of arterial blood pressure and body temperature, resolution of tachycardia, acrocyanosis, and skin mottling, as well as restoration of adequate urine output and acid–base balance. In several patients, inadequate fluid resuscitation during the prehospital stage resulted in worsening hypovolemic shock and the development of acute kidney injury. This complication was observed in three neonates from the study cohort.

According to the surgical strategy employed, patients were divided into two groups. The main group (MG) consisted of 58 patients (47.5%) who underwent treatment according to the optimized management protocol, whereas the comparison group (CG) included 64 patients (52.5%) who received conventional surgical management. Since the end of 2019, videolaparoscopic surgery has been introduced into our institution. Consequently, 17 of the 58 surgical procedures (29.3%) performed in the MG were completed using a laparoscopic approach.

Among the 122 patients, the postoperative course was uneventful in 104 cases (85.2%). Postoperative complications of varying severity occurred in 15 patients (12.3%), predominantly among neonates. Three postoperative deaths (2.5%) were recorded in the CG. The unfavorable postoperative course in neonates was mainly associated with the severity of the underlying disease, concomitant congenital abnormalities, and prenatal developmental disorders, which were further aggravated by the limited physiological adaptive capacity of this age group.

Over the past decade, survival rates among neonates with abdominal masses have improved considerably. Notably, among the 64 patients treated between 2015 and 2019, three deaths (4.7%) occurred in the CG. In contrast, all 58 patients treated between 2020 and 2025 in the MG recovered successfully, and no mortality was recorded in this group.

Early treatment outcomes were assessed 6–12 months after hospital discharge in 108 of the 119 surviving patients (90.8%). Follow-up evaluation was completed in 55 patients (94.8%) from the MG and 53 patients (82.8%) from the CG. Follow-up could not be performed in 11 patients (9.2%) because of changes in their place of residence or contact information.

Quality of life was assessed 6–12 months after surgery using the PedsQL™ Infant Scales, a standardized and validated instrument designed to evaluate health-related quality of life in infants. The assessment was performed according to the child's age and enabled a comprehensive evaluation of the impact of the disease and surgical treatment on physical, emotional, social, and cognitive development.

The PedsQL™ Infant Scales, developed for children aged 1–24 months, were used to assess postoperative quality of life. The instrument provides a multidimensional evaluation of

physical functioning, physical symptoms, emotional well-being, social functioning, and cognitive development.

The questionnaire was completed by the patients' parents or legal guardians. Each item was scored using a 5-point Likert scale, and the raw scores were transformed into a 0–100 scale according to the standard scoring algorithm. Higher scores indicated better health-related quality of life and superior functional status. The use of the PedsQL™ Infant Scales enabled an objective assessment of the functional outcomes of surgical treatment, the level of social adaptation, and the psychophysical development of the children (Table 2).

Table 2. Health-Related Quality of Life Assessed by the PedsQL™ Infant Scales at 6 and 12 Months After Surgery in the Main Group and Comparison Group (n = 108)

PedsQL™ Infant Scales Domain	Comparison Group (CG), n = 53		Main Group (MG), n = 55	
	6 Months After Surgery	12 Months After Surgery	6 Months After Surgery	12 Months After Surgery
Physical Functioning (PF)	69.49 ± 8.72	77.5 ± 10.5^Δ^	80.49 ± 9.84*	91.51 ± 5.11*^Δ^
Physical Symptoms (PS)	64.91 ± 7.65	76.9 ± 9.85^Δ^	83.89 ± 8.90*	94.90 ± 2.39*^Δ^
Emotional Functioning (EF)	61.50 ± 7.31	65.2 ± 8.53^ΔΔΔ^	71.50 ± 8.23*	89.19 ± 5.00*^Δ^
Social Functioning (SF)	71.20 ± 10.97	75.6 ± 12.10	78.20 ± 11.87**	93.61 ± 3.36*^Δ^
Cognitive Functioning (CF)	59.60 ± 6.19	68.6 ± 6.84^Δ^	79,6±7,62*	92,6±4,18*$^{\Delta}$

Data are presented as mean ± standard deviation (SD).*P < 0.05, P < 0.01, and P < 0.001 compared with the Comparison Group (CG).

ΔΔΔ P < 0.05, ΔΔ P < 0.01, and Δ P < 0.001 compared with the corresponding 6-month postoperative values within the same group.

Thus, the study findings demonstrated that health-related quality of life in the main group (MG) improved significantly across all major domains of the PedsQL™ Infant Scales compared with the comparison group (CG). In the MG, the mean overall quality-of-life score increased to 78.74% at 6 months after treatment and to 92.36% at the 12-month follow-up. In the CG, the corresponding score increased from 65.34% to 72.76%.

Long-term treatment outcomes were evaluated 1–3 years after treatment in 108 of the 119 patients discharged from the hospital (90.8%).

The outcomes of the 55 patients in the MG were assessed through inpatient follow-up examinations in 41 patients and outpatient follow-up in 14 patients. In the CG, the outcomes of 53 patients were evaluated through outpatient examinations in 31 patients and telephone-based surveys in 22 patients.

The follow-up assessment included a review of medical history, clinical examination, laboratory and biochemical investigations, and ultrasonography. Contrast-enhanced radiographic examination of the gastrointestinal tract, irrigography, excretory urography, and multislice computed tomography were performed when clinically indicated.

The outcomes of surgical treatment were classified as good, satisfactory, or unsatisfactory according to the criteria described below.

Good treatment outcomes were recorded in 89 of the 108 evaluated patients (82.4%) (Table 3). In the MG, good outcomes were observed in 51 of 55 patients (92.7%), compared with 38 of 53 patients (71.7%) in the CG. A good outcome was defined as the absence of clinical complaints and the absence of pathological changes in the abdominal organs on laboratory and instrumental examinations. No late complications or adverse consequences related to surgery were observed, and the children's physical development was fully consistent with age-specific norms.

Satisfactory outcomes were recorded in nine patients (8.3%), including three patients in the MG (5.5%) and six patients

in the CG (11.3%). In these cases, although the patients' general condition improved after surgery, certain functional disorders persisted. These included recurrent abdominal pain, chronic constipation, intestinal microbiota disturbances, gastroduodenal abnormalities, and body weight deficits of 5–12% relative to age-specific reference values.

Table 3. Long-Term Surgical Outcomes in the Main and Comparison Groups According to the Location and Type of Abdominal Masses (n = 108)

Location and Type of Lesion	Comparison Group (CG), n = 53						Main Group (MG), n = 55					
	Good		Satisfactory		Unsatisfactory		Good		Satisfactory		Unsatisfactory	
	abs	%	abs	%	abs	%	abs	%	abs	%	abs	%
1. Hepatobiliary system	2	3.77	0	0.00	1	1.89	9	16.36	1	1.82	1	1.82
2. Gastrointestinal tract	6	11.32	0	0.00	1	1.89	10	18.18	0	0.00	0	0.00
3. Mesentery, omentum, and lymphatic system	4	7.55	0	0.00	0	0.00	6	10.91	0	0.00	0	0.00
4. Urinary system	16	30.19	3	5.66	5	9.43	7	12.73	0	0.00	0	0.00
5. Female reproductive system	5	9.43	1	1.89	0	0.00	15	27.27	0	0.00	0	0.00
6. Spleen	1	1.89	0	0.00	0	0.00	1	1.82	0	0.00	0	0.00
7. Pancreas	2	3.77	0	0.00	0	0.00	1	1.82	0	0.00	0	0.00
8. Teratomas	2	3.77	2	3.77	2	3.77	2	3.64	2	3.64	0	0.00
P	χ^2= 10.952; p = 0,690						χ^2= 22,157; p = 0,075					
P	χ^2 = 19.384; p = 0,007											
Total	38	71,70	6	11,32	9	16,98	51	92,73	3	5,45	1	1,82
P	χ^2 = 9,265; p = 0,010											

Note: Data are presented as absolute numbers (n) and percentages (%). CG, comparison group; MG, main group. A p-value of <0.05 was considered statistically significant.

However, none of these patients required repeat surgery, and the remaining abnormalities were successfully managed using conservative and symptomatic treatment.

Unsatisfactory outcomes were recorded in 10 patients (9.3%). Of these, only one patient (1.8%) belonged to the main group (MG), whereas nine patients (17.0%) were from the comparison group (CG). Patients classified as having unsatisfactory outcomes demonstrated delayed physical development relative to age-specific norms, a body weight deficit exceeding 20% of the expected value, the development of long-term complications, and the need for repeat surgical interventions to manage these complications. Fatal outcomes resulting from severe surgery-related complications were also classified as unsatisfactory outcomes.

Altered motor activity was identified in five children who had undergone surgery at an early age and was considered a residual manifestation of perinatal injury to the central nervous system. These patients remained under the supervision of a pediatric neurologist.

The analysis demonstrated that favorable long-term outcomes were more frequently observed in the MG than in the CG. In particular, good long-term outcomes were recorded in 13 of 18 patients with ovarian cysts (72.2%), six of 12 patients with nephrogenic cysts (50.0%), three of eight patients with renal duplication anomalies (37.5%), and four of eight patients with choledochal cysts (50.0%).

The proportions of satisfactory and unsatisfactory outcomes were comparatively higher in the CG. Unsatisfactory long-term outcomes were identified in three of 12 patients with hydronephrosis (25.0%), two of seven patients with cystic duplication of the small intestine (28.6%), and two of six patients with sacrococcygeal teratomas (33.3%).

The frequency of unsatisfactory outcomes was substantially lower in the MG. Most patients in this group experienced a favorable postoperative course without disease recurrence or clinically significant functional impairment.

Overall, the higher proportion of good long-term outcomes and the lower frequency of unsatisfactory outcomes in the MG confirmed the high clinical effectiveness of the optimized diagnostic and surgical treatment algorithm.

Comparative analysis of the surgical outcomes demonstrated the greater effectiveness of the management strategy used in the MG. The rate of good outcomes was 92.7% in the MG, which was 21.0 percentage points higher than the corresponding rate of 71.7% in the CG.

The rate of satisfactory outcomes was 5.5% in the MG compared with 11.3% in the CG, representing a reduction of 5.8 percentage points.

The frequency of unsatisfactory outcomes was 1.8% in the MG and 17.0% in the CG, representing a reduction of 15.2 percentage points.

The findings demonstrated that the implementation of the developed algorithm increased the frequency of organ-preserving procedures and reduced the incidence of postoperative complications. Furthermore, the use of minimally invasive techniques shortened the length of hospital stay and accelerated postoperative recovery.

The developed differential diagnostic and treatment-planning algorithm enabled the selection of the surgical approach for children with abdominal masses on the basis of scientifically substantiated criteria. A comprehensive approach that considered organ function, the severity of anatomical abnormalities, and the presence of complications improved the effectiveness of surgical treatment and contributed to better early and long-term outcomes (Table 4).

Table 4. Advantages of the Developed Differential Diagnostic and Treatment-Decision Algorithm (n = 122)

Outcome Measures.	Study Groups				Pearson's χ^2		Total		Outcome
	Comparison Group (CG), n = 64		Main Group (MG), n = 58						
	abs	M±m, %	abs	M±m,%	χ^2	P	abs	M±m,%	
Individualized selection of surgical strategy, n (% ± SE)	0	0,0±0,0	17	29,31±5,98	21,796	0,000	17	13,93±3,14	Achieved
Organ-preserving procedures, n (% ± SE)	53	82,81±4,72	57	98,28±1,71	8,204	0,004	110	90,16±2,7	Increased by 15.5%
Nephrectomies, n (% ± SE)	11	17,19±4,72	1	1,72±1,71	8,204	0,004	12	9,84±2,7	Decreased by 15.5%
Mean operative time, min, mean ± SD	120±19,34		93±11,89*				107,16±21,09		Reduced by 22.5%
Postoperative complications, n (% ± SE)	14	21,88±5,17	4	6,9±3,33	5,427	0,020	18	14,75±3,21	Decreased by 15.0%
Length of hospital stay, days, mean ± SD	13,64±1,86		10,19±1,52*				12±2,43		Reduced by 20.2%
Postoperative rehabilitation assessed using the PedsQL™ Infant Scales, mean ± SD	72,76±4,9		92,36±1,79*				82,74±10,5		Improved by 26.9%

Note: The asterisk indicates that the difference in the arithmetic mean values compared with the comparison group (CG) was statistically significant (**p < 0.05; *p < 0.01; p < 0.001).

In the main group (MG), the surgical strategy was individualized in 29.3% of cases, allowing selection of the optimal operative approach according to the anatomical and functional characteristics of the lesion and the patient's age. This individualized approach contributed to improved treatment outcomes. The proportion of organ-preserving procedures was 98.3% in the MG, which was 15.5 percentage points higher than the 82.8% recorded in the comparison group (CG). At the same time, the nephrectomy rate decreased from 17.2% in the CG to 1.7% in the MG, which may be attributed to earlier diagnosis and the effective implementation of organ-preserving surgical techniques.

Conclusion

The study findings demonstrated that the postoperative complication rate decreased from 21.9% in the CG to 6.9% in the MG. Mortality was 4.7% in the CG, whereas no deaths were recorded in the MG.

Assessment using the PedsQL™ Infant Scales demonstrated that the mean quality-of-life score increased from 78.74% at 6 months to 92.36% at 12 months in the MG. In the CG, the corresponding score increased from 65.34% to 72.76%.

Comparative analysis of surgical outcomes confirmed the greater clinical effectiveness of the management strategy used in the MG. Good long-term outcomes were observed in 92.7% of patients in the MG, which was 21.0 percentage points higher than the corresponding rate of 71.7% in the CG.

Thus, implementation of the proposed diagnostic and treatment-decision algorithm increased the proportion of organ-preserving procedures from 82.8% to 98.3%, reduced the nephrectomy rate from 17.2% to 1.7%, decreased the incidence of postoperative complications, and shortened the operative time by 22.5%. The algorithm also contributed to improved early and long-term clinical outcomes, with good long-term results achieved in 92.7% of patients in the MG compared with 71.7% in the CG.

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