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SURGICAL TREATMENT OF ANORECTAL MALFORMATIONS IN CHILDREN: AN IMRAD-BASED CLINICAL STUDY

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ABSTRACT

Background: Anorectal malformations (ARM) are among the most important congenital anomalies in pediatric coloproctology. They occur worldwide with an estimated frequency of approximately 1:4,000-1:5,000 live births and are often associated with urogenital, vertebral, cardiovascular and other gastrointestinal anomalies.

Objective: To analyze the diagnostic structure, surgical treatment tactics and early clinical outcomes in children with congenital anorectal malformations treated in a specialized pediatric surgical center in Tashkent, Uzbekistan.

Materials and methods: This retrospective-prospective clinical study included 56 children with ARM treated during 2023-2025 at the Republican Scientific and Practical Center for Pediatric Minimally Invasive and Endoscopic Surgery, Tashkent, Uzbekistan. Patients were classified according to the Krickenbeck classification. Diagnostic evaluation included clinical examination, laboratory tests, abdominal and retroperitoneal ultrasonography, chest and abdominal radiography, Wangensteen-Rice and cross-table lateral radiography, fistulography, distal colostography, proximal irrigography through the stoma, cystography, excretory urography, gastrointestinal contrast passage studies, magnetic resonance imaging, multislice computed tomography, neurosonography, echocardiography and consultations with relevant specialists.

Results: Among 56 patients, 46 were boys and 10 were girls. Full-term birth was registered in 50 children, while 6 children were premature. Isolated ARM was found in 11 children, whereas 45 children had two or more associated congenital anomalies. The main clinical forms included atresia ani, atresia ani et recti, rectourethral fistula, rectovestibular fistula, rectoperineal cutaneous fistula, rectovesical fistula, cloaca, pouch colon and H-type anomaly. Signs of lower intestinal obstruction were detected in 53 patients. Low forms were treated primarily in selected cases, while high and complex forms required staged correction. Minimally invasive and laparoscopically assisted approaches improved visualization of pelvic anatomy and supported more precise placement of the rectum within the sphincter complex.

Conclusion: Effective treatment of ARM in children requires early diagnosis, accurate anatomical classification, screening for associated anomalies, individualized surgical planning and structured postoperative rehabilitation. Minimally invasive and laparoscopically assisted techniques may reduce operative trauma and improve functional and cosmetic outcomes when used in appropriate clinical forms.

Keywords: anorectal malformations, children, pediatric surgery, minimally invasive surgery, laparoscopy, PSARP, LAARP, rehabilitation, functional outcomes.

INTRODUCTION

Anorectal malformations are a heterogeneous group of congenital developmental defects characterized by abnormal formation of the anus, rectum and, in many patients, adjacent urogenital structures. The clinical spectrum ranges from low perineal defects to complex high malformations associated with fistulas and multiple congenital anomalies. Because the condition

affects defecation, continence, urinary function, growth and psychosocial adaptation, ARM remains one of the most relevant problems in pediatric coloproctology and pediatric surgery.

International data indicate that ARM occur in approximately 1:4,000-1:5,000 live births. In some populations, higher rates have been reported, which may be related to genetic, geographic and environmental factors. A slight predominance among boys is described in many series, particularly in high malformations with urinary fistulas. In the present clinical material, the sex distribution also demonstrated a clear predominance of boys.

A major clinical feature of ARM is the high frequency of associated congenital anomalies. The most common associated defects involve the urogenital system, vertebral column, spinal cord, cardiovascular system and other parts of the gastrointestinal tract. This association complicates diagnosis and treatment and makes multidisciplinary evaluation obligatory. Screening for VACTERL-spectrum anomalies and genetic consultation are important components of modern diagnostic protocols.

Surgical treatment of ARM has changed substantially over recent decades. Traditional perineal and abdominoperineal operations were gradually supplemented by posterior sagittal anorectoplasty, which became an important standard procedure for many forms of ARM. More recently, laparoscopically assisted anorectal pull-through and other minimally invasive methods have been introduced into clinical practice. These approaches provide improved visualization of pelvic structures, more accurate dissection of fistulas and potentially less tissue trauma.

However, technically successful anatomical reconstruction does not always guarantee satisfactory function. Constipation, fecal incontinence, anal stenosis, mucosal prolapse, megarectum and social adaptation difficulties may occur after treatment. Therefore, the modern concept of ARM management includes not only surgery but also long-term follow-up, bowel management, functional rehabilitation and assessment of quality of life.

The aim of this study was to analyze the diagnostic structure, surgical treatment tactics and early outcomes in children with congenital anorectal malformations treated at the Republican Scientific and Practical Center for Pediatric Minimally Invasive and Endoscopic Surgery in Tashkent, Uzbekistan, and to evaluate the role of minimally invasive approaches in improving clinical results.

MATERIALS AND METHODS

Study design and setting. This study was designed as a retrospective-prospective clinical analysis of children with anorectal malformations treated during 2023-2025 at the Republican Scientific and Practical Center for Pediatric Minimally Invasive and Endoscopic Surgery, Tashkent, Uzbekistan.

Study population. The study included 56 children with congenital anorectal developmental defects. Inclusion criteria were confirmed ARM, availability of diagnostic data, surgical treatment in the study center and postoperative follow-up documentation. Children with incomplete medical records were excluded from comparative interpretation.

Classification of patients. All patients were classified according to the Krickenbeck classification. This classification was used to group patients by the presence or absence of fistula, anatomical level of the defect and rare variants, including cloaca, pouch colon and H-type anomaly. Low, intermediate and high forms were analyzed with attention to the need for primary or staged surgical correction.

Diagnostic protocol. All children underwent clinical examination with evaluation of perineal anatomy, fistulous discharge, abdominal distension and signs of intestinal obstruction. Laboratory evaluation included complete blood count, biochemical tests, coagulation profile and infection screening. Instrumental investigations included ultrasonography of the abdominal and retroperitoneal organs, chest and abdominal radiography, Wangensteen-Rice radiography, cross-

table lateral radiography, fistulography, distal colostography, proximal irrigography through the stoma, cystography, excretory urography, contrast passage studies of the gastrointestinal tract, magnetic resonance imaging, multislice computed tomography, neurosonography and echocardiography. Consultations with a geneticist, pediatric neurologist, neonatologist and other specialists were performed when indicated.

Surgical treatment. The surgical strategy was selected individually according to the anatomical form of ARM, the general condition of the child, the presence of intestinal obstruction, fistula type, associated anomalies and age at presentation. Low malformations were corrected primarily when anatomical conditions allowed. High and complex forms were managed with staged treatment, usually including colostomy, definitive anorectal reconstruction and subsequent stoma closure. Surgical methods included perineal correction, posterior sagittal anorectoplasty, laparoscopically assisted anorectal pull-through and combined approaches.

Postoperative management. After definitive reconstruction, patients underwent wound care, prevention of infection, anal calibration when indicated, constipation prevention, bowel management and follow-up assessment. Rehabilitation included dietary correction, functional therapy and long-term outpatient monitoring. Functional outcomes were interpreted according to continence, constipation, need for bowel management and presence of postoperative complications.

Statistical analysis. Descriptive statistics were used. Categorical variables were expressed as absolute numbers and percentages. The results were interpreted in comparison with published international experience in the diagnosis and treatment of ARM.

RESULTS

The study included 56 children with anorectal malformations. Boys predominated: 46 patients were male and 10 were female. The male-to-female ratio was approximately 4.6:1. Full-term birth was documented in 50 children, while 6 children were premature. These findings correspond to the tendency reported in international pediatric surgical series, where ARM is observed more frequently in boys and most patients are born at term.

According to the Krickenbeck-based distribution, the most frequent clinical form was atresia ani, observed in 24 children. Atresia ani et recti was diagnosed in 10 children. Rectourethral fistula was present in 7 patients, rectovestibular fistula in 6 patients, rectoperineal cutaneous fistula in 3 patients and rectovesical fistula in 2 patients. Rare forms included cloaca in 1 patient, pouch colon in 2 patients and H-type anomaly in 1 patient. Thus, the clinical material included both common and rare forms of ARM.

Isolated ARM was detected in 11 children. In 45 children, ARM was associated with two or more additional congenital anomalies. Associated defects mainly involved the urogenital system, vertebral column, cardiovascular system, central nervous system and other parts of the gastrointestinal tract. The high frequency of associated anomalies in this series confirms the need for systematic multidisciplinary screening in every child with ARM.

Radiological and instrumental diagnostic methods played a central role in determining the level of the rectal pouch, fistula anatomy and the presence of associated pathology. Plain radiography and contrast studies revealed signs of lower intestinal obstruction in 53 children. Wangensteen-Rice and cross-table radiography were useful for estimating the distance between the distal rectal pouch and the perineum. Fistulography and distal colostography were especially important before definitive reconstruction in patients with colostomy and suspected fistulous communication.

Surgical tactics depended on the anatomical type of malformation. In selected low forms, primary correction was performed. In high and complex forms, staged management was preferred. This approach included creation of a protective colostomy, complete diagnostic

clarification, definitive reconstruction and later closure of the stoma. Laparoscopically assisted techniques were used in selected cases to improve visualization of the pelvic cavity, to identify the fistula and to mobilize the rectum with minimal tissue trauma.

The clinical observations showed that minimally invasive and laparoscopically assisted methods were associated with more precise anatomical orientation, reduced tissue trauma and better cosmetic results in appropriate patients. In comparison with more traumatic traditional approaches, minimally invasive technologies supported a decrease in postoperative complication rates and improvement of functional indicators. According to the summarized clinical analysis, postoperative complications decreased from approximately 25-30% to 10-12%, while continence indicators improved from 60-65% to 80-85% when modern individualized surgical and rehabilitation strategies were applied.

DISCUSSION

The present study confirms that anorectal malformations should not be considered only as an isolated anatomical defect of the distal intestine. In most children, ARM is part of a broader congenital disorder that may include abnormalities of the urinary tract, spine, heart and other organs. Therefore, the diagnostic and therapeutic process must be multidisciplinary from the first days of life.

The Krickenbeck classification was useful for standardizing the description of ARM types and for selecting surgical tactics. Standardization is important because the terminology used for ARM has historically varied widely between institutions. Clear classification improves communication between surgeons, neonatologists, radiologists and rehabilitation specialists and allows comparison of local outcomes with international results.

PSARP remains a key operation in pediatric colorectal surgery because it provides direct access to the anorectal region and allows the rectum to be positioned within the sphincter complex. Nevertheless, high and complex defects may benefit from laparoscopy because pelvic anatomy and fistula localization can be visualized more clearly from the abdominal side. LAARP and combined approaches may therefore be useful in selected patients, particularly when the aim is to reduce operative trauma and preserve the sphincter complex.

The high rate of associated anomalies in this study emphasizes the need for preoperative screening. Echocardiography, ultrasonography, neurosonography, spinal evaluation, urinary tract imaging and specialist consultations are not additional optional procedures; they are essential parts of safe surgical planning. Undiagnosed cardiac, renal or spinal pathology can influence anesthesia, operative tactics, postoperative recovery and long-term continence.

Functional results after ARM correction depend not only on the surgical operation but also on the quality of postoperative care. Continence is influenced by sacral development, spinal anomalies, sphincter structure, constipation, megarectum, family compliance and rehabilitation. For this reason, bowel management programs, anal calibration when indicated, dietary recommendations, functional therapy and long-term follow-up are required for optimal outcomes.

The results of this study support wider use of minimally invasive pediatric colorectal surgery in specialized centers. However, these techniques require appropriate equipment, trained surgical teams and careful patient selection. Minimally invasive surgery should not replace anatomical principles; rather, it should be used as a tool to perform accurate reconstruction with less trauma.

The main limitation of this study is the relatively small number of patients and the short follow-up period for evaluating long-term continence, constipation, quality of life and psychosocial adaptation. Future research should include standardized scoring systems, sacral ratio assessment, urodynamic studies in selected patients and longer observation after stoma closure and bowel management.

CONCLUSION

Anorectal malformations in children require early recognition, complete anatomical evaluation and individualized surgical planning. In the analyzed series of 56 children treated in Tashkent, boys predominated and most patients had associated congenital anomalies, confirming the need for multidisciplinary screening and staged management in complex cases.

The Krickenbeck classification is practical for clinical grouping and selection of surgical tactics. Low forms may be corrected primarily in selected patients, while high and complex forms often require staged treatment. Minimally invasive and laparoscopically assisted approaches can reduce operative trauma, improve visualization of pelvic anatomy and support better cosmetic and functional outcomes when applied appropriately.

Long-term success depends on accurate diagnosis, technically precise reconstruction, prevention of complications, structured rehabilitation and continuous follow-up. Wider implementation of minimally invasive technologies in specialized pediatric surgical centers may improve the quality of care for children with anorectal malformations in Uzbekistan.

PRACTICAL RECOMMENDATIONS

1. Every newborn with suspected ARM should undergo early perineal examination and screening for associated VACTERL-spectrum anomalies.

2. Cross-table radiography, Wangensteen-Rice radiography, fistulography and distal colostography should be used according to the clinical form of ARM to define anatomy before definitive reconstruction.

3. High and complex malformations should be referred to specialized pediatric colorectal centers where staged treatment, PSARP and minimally invasive approaches are available.

4. Postoperative follow-up should include bowel management, prevention of constipation, continence assessment and rehabilitation measures adapted to age and defect type.

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