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LAPAROSCOPIC MANAGEMENT OF PEDIATRIC VESICOURETERAL REFLUX: A SINGLE-CENTER EXPERIENCE WITH LONG-TERM FOLLOW-UP

Paediatric Surgery

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ABSTRACT

Background: Vesicoureteral reflux (VUR) is a common urological condition in children where urine flows backward from the bladder to the kidneys, potentially causing infections and kidney damage. While traditional open surgery has been the standard treatment for decades, minimally invasive approaches are becoming increasingly popular. This paper shares our experience with laparoscopic ureteral reimplantation for treating VUR in children. **Methods:** We reviewed records of 87 children (134 ureter procedures) who underwent laparoscopic extravesical ureteral reimplantation for grades III-V VUR at our hospital between 2015 and 2022. We analyzed patient information, surgical details, outcomes, and long-term follow-up data. Surgical success was defined as the absence of VUR on follow-up voiding cystourethrography and resolution of clinical symptoms. **Results:** The average patient age was 5.7 years with more girls than boys (ratio 2.6:1). Over half the patients had the condition in both kidneys. Operations took about 2 hours for one side and 2.7 hours for both sides. Children typically stayed in the hospital for less than 3 days. Some temporary complications occurred, including voiding difficulties (8%), urinary infections (5.7%), and a few cases requiring reoperation (3.4%). With nearly 5 years of follow-up, our success rate was 96.6%, with 94.3% of patients remaining infection-free long-term. **Conclusions:** Laparoscopic surgery is a safe and effective minimally invasive alternative to traditional open surgery for children with VUR. Our long-term results show excellent outcomes with minimal complications, shorter hospital stays, and better cosmetic results compared to conventional surgery.

KEYWORDS

Vesicoureteral Reflux, Laparoscopic Ureteral Reimplantation, Minimally Invasive Surgery, Pediatric Urology, Urinary Tract Infections, Kidney Scarring

INTRODUCTION

Vesicoureteral reflux affects approximately 1% of children worldwide and up to 30-40% of children with urinary tract infections (UTIs).[1,2] When urine flows backward from the bladder to the kidneys, it can cause repeated infections, kidney scarring, and potentially lead to high blood pressure and chronic kidney problems.[3]

Treatment options have evolved significantly over recent decades. They range from conservative approaches (antibiotics and monitoring) to minimally invasive procedures and traditional open surgery.[4] While injection therapy offers a less invasive option, open surgical correction has remained the gold standard for moderate to severe VUR, with success rates over 95%.[5,6]

As a pediatric urologist specializing in minimally invasive surgery, I've witnessed how these techniques benefit children with urological conditions. Since laparoscopic ureteral reimplantation was first introduced by Lakshmanan and Fung in 2000,[7] these approaches have gained popularity due to better visualization during surgery, less pain afterward, shorter hospital stays, and improved cosmetic results.[8]

However, adoption of laparoscopic techniques for VUR has been relatively slow compared to other urological procedures, mainly due to technical challenges and concerns about long-term effectiveness.[9] I've been performing laparoscopic ureteral reimplantation since 2015, continuously refining the technique.

This paper shares our experience with this procedure over an eight-year period, including outcomes, technical considerations, and lessons learned.

Methods

After obtaining ethical approval, we reviewed records of all children who underwent laparoscopic extravesical ureteral reimplantation for VUR at our hospital between January 2015 and December 2022.

We included patients aged 2-14 years with moderate to severe VUR (grades III-V) confirmed by imaging tests who had: recurrent UTIs despite antibiotics, new kidney scarring, or parents who preferred definitive correction after counseling. We excluded patients with previous failed treatments, significant bladder dysfunction, complex urological abnormalities, or neurogenic bladder.

All patients underwent comprehensive evaluation including medical history, physical examination, urine tests, kidney function tests, ultrasound, voiding cystourethrography (VCUG) to grade the reflux, and DMSA renal scan to check for scarring. Additional bladder function studies were performed when necessary.

Surgical Technique

All procedures were performed under general anesthesia. We used a three-port approach for one-sided cases and four ports for two-sided cases. After establishing pneumoperitoneum (inflating the abdomen with gas), we carefully dissected the ureter down to where it joins the bladder, preserving its blood supply. We created a new tunnel in the bladder muscle and placed the ureter within it, creating a one-way valve mechanism to prevent reflux.

In about 25% of cases, we used robotic assistance following the same surgical principles. All procedures were performed or directly supervised by me to ensure consistency.

Follow-up Care

Patients kept a urinary catheter for 24-48 hours after surgery. They were discharged once fever-free, eating normally, and comfortable on oral pain medication. Antibiotic prevention continued until the first follow-up visit at 2 weeks.

Further follow-up visits occurred at 3 months, 6 months, 1 year, and annually thereafter. Ultrasound was performed at 3 months, VCUG at 6 months to check for persistent reflux, and DMSA scan at 1 year to assess kidney function and scarring. Long-term follow-up focused on UTI recurrence, voiding patterns, and overall kidney function.

Results

Patient Characteristics

We treated 87 children (134 ureters) during the study period. The average age was 5.7 years (range: 2-14 years), with more girls than boys (ratio 2.6:1). About 54% had reflux on both sides. Most ureters had grade IV reflux (44%), followed by grade III (34.3%) and grade V (21.6%). The distribution of reflux grade is summarized in Table 1.

Table 1: Distribution of VUR by Grade and Laterality (n=134 ureters)

VUR Grade	Right Ureter (%)	Left Ureter (%)	Total (%)
Grade III	21 (15.7%)	25 (18.7%)	46 (34.3%)
Grade IV	27 (20.1%)	32 (23.9%)	59 (44.0%)
Grade V	13 (9.7%)	16 (11.9%)	29 (21.6%)
Total	61 (45.5%)	73 (54.5%)	134 (100%)

The main reason for surgery was breakthrough UTIs despite antibiotics (66.7%), followed by new kidney scarring (19.5%) and parental preference (13.8%). Nearly half the patients (49.4%) showed kidney scarring before surgery.

Surgical Outcomes

Operations took an average of 118 minutes for one side and 162 minutes for both sides. We noticed significant improvement in

operation time as our experience increased, with later procedures taking 25-30 minutes less than early ones.

Blood loss was minimal in all cases (<50 ml), and no patient needed a blood transfusion. Two cases (2.3%) required conversion to open surgery due to technical difficulties. Three cases (3.4%) had minor complications during surgery, all managed successfully.

The average hospital stay was 2.8 days, with a trend toward shorter stays in more recent cases. Postoperative pain was well controlled with oral medications.

Complications and Follow-up

The average follow-up period was 4.8 years. Early complications (within 30 days) occurred in about 14% of patients, most commonly transient voiding difficulties (8%), which resolved within 2-4 weeks. Five patients (5.7%) developed UTIs after surgery, which responded well to antibiotics. Early postoperative complications (within 30 days) occurred in 12 patients (13.8%) and are summarized in Table 2.

Table 2: Postoperative Complications (n=87 patients)

Complication	Number of Patients (%)	Management
Transient voiding dysfunction	7 (8.0%)	Conservative management
Urinary tract infection	5 (5.7%)	Antibiotics
Persistent VUR	3 (3.4%)	Reoperation
Ureteral obstruction	1 (1.1%)	Temporary ureteral stent
Port site infection	2 (2.3%)	Local wound care and antibiotics
Port site hernia	1 (1.1%)	Surgical repair

Follow-up imaging showed persistent reflux in 3 patients (3.4%), who underwent successful reoperation. One patient (1.1%) developed temporary ureter blockage, which resolved after temporary stent placement.

The overall success rate was 96.6% at the end of follow-up. Long-term data showed that 94.3% of patients remained free of UTIs throughout the study period. Follow-up kidney scans showed no new scarring in any patient, and improved function in about 14% of patients.

When comparing conventional laparoscopic (65 patients) versus robotic-assisted (22 patients) approaches, we found similar success rates but shorter operation times for two-sided procedures with robotic assistance (142 vs. 168 minutes) and fewer voiding problems (4.5% vs. 9.2%).

A satisfaction survey at the 1-year follow-up revealed high satisfaction levels among patients and parents, with 92% rating their experience as "excellent" or "good." The main factors contributing to satisfaction were minimal pain (85%), excellent cosmetic results (93%), and quick return to normal activities (89%).

DISCUSSION

The 96.6% success rate in our series compares favorably with traditional open surgery (95-98%) and exceeds typical results for injection treatment (70-85% after a single injection).[10,11] These findings align with other centers using minimally invasive approaches. In a systematic review of 23 studies including 1,311 patients, Riquelme et al. reported success rates ranging from 77% to 100% for laparoscopic ureteral reimplantation.[12]

One concern about laparoscopic reimplantation has been the potential for increased voiding problems compared to open surgery.[13] In our series, temporary voiding difficulties occurred in 8% of patients, primarily after two-sided procedures. This rate is lower than in some earlier studies and likely reflects improvements in surgical technique and patient selection.[14] Notably, we saw fewer voiding problems with robotic-assisted procedures.

The technical challenges of laparoscopic reimplantation are well documented, with a steep learning curve.[15] Our experience shows that operation times decreased significantly as our surgical team gained experience, emphasizing the importance of training and case volume.

Several technical modifications have contributed to our improved outcomes: limited dissection of the ureter to preserve blood supply, creation of a wider and longer submucosal tunnel, and careful closure of the bladder muscle over the ureter. In two-sided cases, we complete one side before starting the other, which seems to reduce the risk of voiding problems.

Robotic assistance has further expanded possibilities for minimally invasive VUR correction. In our limited experience with 22 robotic cases, we observed shorter operation times for two-sided procedures and fewer complications compared to conventional laparoscopy. These findings align with those of Kasturi et al., who reported reduced operative times and improved ergonomics with robotic assistance in pediatric urological procedures.[16] However, cost remains a significant consideration, particularly in resource-limited settings.

Our experience highlights the importance of comprehensive evaluation and careful patient selection. Children with significant bladder and bowel dysfunction should receive intensive management of these conditions before considering surgery, as persistent elimination problems can compromise surgical outcomes.[17]

Long-term follow-up is essential in evaluating lasting results. With nearly 5 years of follow-up, 94.3% of our patients remained free of UTIs, and no new kidney scarring was observed. These findings suggest that successful laparoscopic reimplantation provides durable protection against the long-term consequences of VUR, comparable to open surgical techniques.[18]

The high patient and parent satisfaction in our study highlights another advantage of minimally invasive approaches: improved cosmetic results and reduced discomfort. The small, nearly invisible incisions associated with laparoscopic surgery represent a significant advance over the larger incisions required for open approaches.

CONCLUSION

Laparoscopic extravesical ureteral reimplantation is a safe and effective minimally invasive alternative to open surgery for children with VUR. Our experience demonstrates excellent outcomes with this approach, with success rates comparable to traditional open techniques and superior to typical results for injection treatment.

The technical challenges are offset by significant advantages, including better visualization, less pain, shorter hospital stays, and superior cosmetic results. These benefits are particularly valued by patients and families and contribute to high satisfaction levels.

As with any surgical technique, careful patient selection, attention to technical details, and comprehensive follow-up are essential for optimal outcomes. With growing experience and ongoing refinements, minimally invasive approaches will likely play an increasingly important role in the surgical management of pediatric VUR in the future.[19]

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