Extravesical Common Sheath Ureteral Reimplantation Versus Intravesical Techniques for Refluxing Duplex Systems in Children

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Purpose: Retrospective comparative study of the efficacy of extravesical non-dismembered common sheath ureteral reimplantation (ECSR) versus intravesical common sheath ureteral reimplantation (ICSR) techniques for the correction of vesicoureteral reflux (VUR) in complete duplex systems.

Material and Methods: Between 2010 and 2019, ECSR was performed in 38 children (8 bilaterally), and the mean ages at presentation and at surgery were 31 and 57 months, respectively. The ICSR technique was performed in 25 units (25 patients). Voiding cystography and ultrasound of the kidney and bladder were performed 3 and 12 months postoperatively. We analyzed the surgical outcomes for both groups.

Results: The mean follow-up times for the ECSR and ICSR groups were 15 and 18 months, respectively. The success rate of the ECSR group was 93.5% at 3 months, improving to 95.7% at an average of one year; the rate of the ICSR group was 96% at 3 months and was the same after one year, with no significant difference between the two groups (p = .66). Postoperative complications were compared in the ECSR and ICSR groups: transient contralateral VUR was seen in 5 renal units versus 4, de novo hydronephrosis was seen in 3 units versus 2, and UTIs were observed in 3 patients versus 4.

Conclusion: Both (ECSR) and (ICSR) surgeries are highly successful for the correction of VUR in uncomplicated complete duplex systems. The results of the extravesical approach are comparable with those of the intravesical technique with less morbidity and a shorter hospital stay. Thus, ECSR is our preferred technique when open surgical repair is indicated. ICSR should be reserved for complicated duplex systems necessitating concomitant reconstructive surgery.

Keywords: vesicoureteral reflux; duplex systems; ureteral reimplantation.

INTRODUCTION

Despite their rarity, with an incidence of 0.75% in the general population, renal duplex system anomalies are associated with vesicoureteral reflux (VUR) in 95% of cases.[1-3] Duplicated collecting systems are more common in females. Spontaneous resolution of VUR in duplex systems is assumed to be lower than that in single systems because of the anatomical configuration that prevents the development of an adequate submucosal tunnel.[2] Some early studies suggested a high success rate of up to 58% for the nonsurgical management of refluxing duplicated systems, including high-grade VUR. [4] On the other hand, Lee et al.[2] reported higher resolution rates for grade I and II reflux in duplex systems (85%), which decreased to 36% in grade III and then decreased to nil (0%) in grade IV and V reflux. Again, due to the nature of the anomaly, endoscopic sub-ureteral injections have shown poor results for the correction of reflux in complete duplex systems. [5-7] To date, the presence of VUR in duplex systems, especially high-grade VUR, has been considered an indication for open surgical correction.[8] In most studies in the published literature, laparoscopic and robotic ureteral reimplantation techniques have been reported to have equivalent success rates to open surgery.[9,10] However, because of the lack of randomized controlled trials and the insufficient long-term outcome data, open ureteral reimplantation is still accepted as the gold standard.[11] Our objective is to compare retrospectively; (ECSR) versus (ICSR) techniques for the correction of vesicoureteral reflux (VUR) in complete duplex systems.

MATERIAL AND METHODS

In this retrospective comparative study, we reviewed all patients who underwent surgery for VUR in complete duplex systems between 2010 and 2019. The criteria for selection for the type of technique either ICSR or ECSR were based on the degree of reflux, surgeon preference and experience with technique as it is retrospective study. Data were collected for all patients who underwent ECSR and ICSR. The persistence of VUR for more than 48 months, two breakthrough Urinary Tract Infections (UTIs), upper tract deterioration (grade of reflux, renal functions) and noncompliance with medical management were considered indications for surgery. Patients with incomplete ureteral duplications and other

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Table 1. Demographics and success rates for duplex systems in all anti-reflux procedures.

	ECSR group	ICSR group	Statistics
No of patients (% of total)	38 (60.3%)	25(39.7%)	NA
No. of units	46 (60.5%)	25 (50%)	.289
Grade of reflux			
II	8 (17.4%)	6 (24%)	.601
III	22 (47.8%)	8 (32%)	
IV	10 (21.7%)	6 (24%)	
V	6 (13.1%)	5 (20%)	
Success rates at 3 months	43/46 (93.5%)	24/25 (96%)	.659
Last follow up	44/46 (95.7%)	24/25 (96%)	.943

pathological conditions (for example, ureterocele) were excluded from our study.

ECSR technique: If an extravesical procedure (Lich-Gregoir technique) is planned, cystoscopy should be performed preoperatively to assess the bladder mucosa and the position and configuration of the ureteral orifices. The ECSR technique was performed as described by Zaontz et al.,[12] Briefly, through a Pfannenstiel incision, the bladder was exposed and rotated to expose the involved ureters. ureters were gently mobilized together with attention to blood supply. The detrusor muscle was incised to expose the bladder mucosa to create the muscular defect that will form the tunnel, which should have a 5:1 ratio, based on the side-to side combined diameters of the two ureters. The edges of the detrusor muscle were dissected from the mucosa to form two detrusor flaps and trough sufficient to accommodate the common sheath. Two advancing sutures were made, and the detrusor defect was closed over the ureters to form the submucosal tunnel (**Figures 1-3**).

ICSR technique: The Cohen cross-trigonal technique and modified Leadbetter technique were performed in patients who underwent ICSR. All patients were assessed postoperatively by kidney-bladder ultrasound (U/S KUB) and voiding cystourethrography (VCUG) at three months and at one year. All children were maintained on prophylactic antibiotics until the resolution of reflux was documented by VCUG. We analyzed the outcomes in these two surgical groups in terms of success rates, contralateral reflux, de novo hydronephrosis, (UTIs) and the incidence of complications. Data were collected, tabulated, and entered the Statistical Package for Social Science (IBM SPSS) version 20 for statistical analysis.

RESULTS

ECSR was performed in 38 children (8 males and 30 females), of whom 8 underwent bilateral reimplantation. Their mean ages at presentation and at surgery were 31 months (range from birth-100) and 57 (11 –120) months, respectively. Urinary tract infections represented the mode of presentation in 24 patients, antenatal hydronephrosis in 12 patients and incidental discovered reflux during investigations in 2 patients. One child had family history of reflux with past history of febrile UTI. The second had voiding dysfunction and did not respond to anticholinergic medications. We found no statistically significant difference between the degree of reflux in either groups ($p = .6$). ICSR was performed in 25 patients (20 females & 5 males) who underwent surgery. The mean ages at presentation and at surgery were 21 months (range from birth - 90) and 40 (range from 13-122) months, respectively. The mode of presentation was UTI in 22 patients and antenatal hydronephrosis in 3 patients. Overall, the indications for surgery were breakthrough UTIs in 25 patients, persistence of reflux (follow-up > 48 months) in 31 patients, and deterioration in the grade of reflux in 7 patients. The

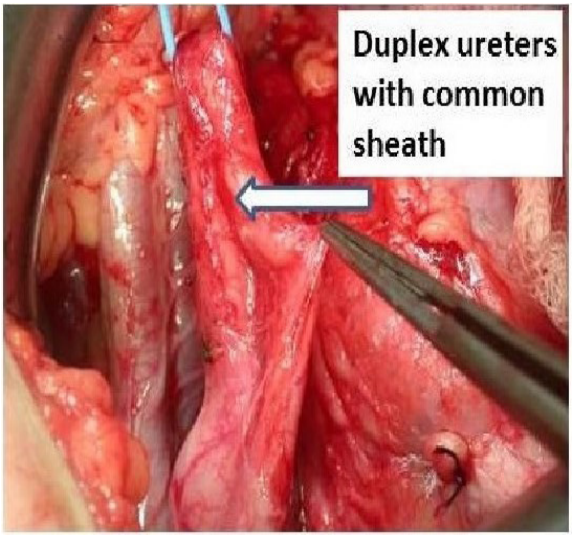

Figure 1. Dissection of the lower part of the duplex ureter.

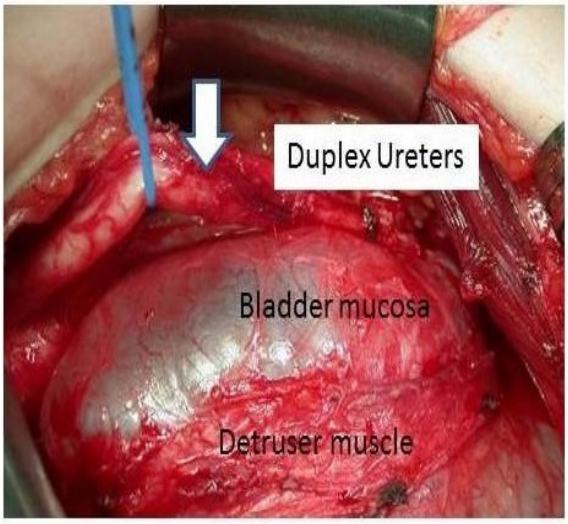

Figure 2. Creation of a tunnel with undermining the edges to create flaps for duplex ureters.

Table 2. Operative data.

Operative data	ECSR group	ICSR group	Statistics
No of patients (% of total)	38 (60.3%)	25 (39.7%)	NA
Hospital stays	Range (2-7) days (mean 3.8 + 2.2 days)	Range (3-10) days (mean 6.7 + 2.9 days)	$p < .05$
Period of urethral catheterization	Range (2-7) days (mean 3 3.5+ 1.7 days)	Range (3-10) days (mean 5.9 + 2.7 days)	$p < .05$
Operative time	Range (105-140 minutes) mean 123 + 21 minutes	Range (115-220 minutes) mean 151 + 17 minutes	$p < .05$

distribution of reflux grade is described in (**Table1**). Mean operative time was 125 minutes (Range 105-140) for ECSR group compared to 160 minutes (Range 115-220) in ICSR group (**Table 2**). The mean postoperative follow-up in the ECSR and ICSR groups were 15 (range 3-28) and 18 (range 3–32) months, respectively. The success rate of ECSR was 93.5% at 3 months, which improved to 95.7% at an average of 15 months (range 6-28). There was no statistically significant difference in the success rate of the ECSR group and that of the ICSR group ($p = .66$). Mean hospital stay was 3.8 days in ECSR group compared to 6.7 days in ICSR group. Urethral catheterization postoperatively was 3 days for ECSR versus 5 for ICSR. All postoperative complications are described in the (**Table 3**). Persistent low-grade reflux was noted after ECSR in 2 units (5%), one of which was resolved after 6 months with continuous prophylactic antibiotic. New contralateral reflux was detected in five renal units (13%) after ECSR. Reflux was mild and resolved spontaneously with follow-up. De novo hydronephrosis was noted after ECSR in three units (8%), and it was mild and resolved after one year of follow-up. Two patients (5%) had postoperative urinary retention after bilateral ECSR. For these two patients, they are managed conservatively with re-catheterization for more few days and removed safely with good urine flow. No patients had hematuria or bladder spasms postoperatively for ECSR group. Three patients (8%) had postoperative UTIs. These post-ECSR complications were not correlated with the grade of VUR. All the patients who underwent ICSR were cured from reflux without significant complications, except two (8%) patients who had de novo hydronephrosis as an impact of the surgery, which is resolved spontaneously with conservative management, four (6%) who had UTIs and six (24%) who had postoperative hematuria. Bladder spasms was reported in the form of leakage of urine around the catheter, pulling the catheter, crying and pain in 4 patients (16%) required anticholinergic medications. All the patients who underwent ICSR had urethral catheterization for 5 days (range 3 – 10), while the patients who underwent ECSR had a catheter for 3 days (range 2-7). No statistically significant difference was found between the two groups regarding the postoperative persistence of reflux, contralateral reflux, or de novo hydronephrosis or the incidence of UTIs.

DISCUSSION

A duplex collecting system is one of the most reported urinary tract anomalies in the pediatric population. [13] The management of vesicoureteral reflux in duplicated collecting systems has evolved with time. In duplicated ureters with VUR, without obstruction, and with preserved function of both renal moieties, the gold-standard surgical intervention is ureteral reimplantation. Therefore, surgery remains the primary mode of management.[14,15] Controversies regarding the management of reflux in duplex systems are still present because of the complexity of these anomalies and the availability of many non- and/or minimally invasive alternative treatments. Some have advised medical management[16], but the low-resolution rate with long-term follow-up has prompted some surgeons to recommend early surgical intervention, especially for higher grades of VUR.[17-19] The Toronto team tried to inject low-grade refluxing duplex systems with Macroplastique between 1997 and 2000 in 22 reflux moieties. They selected patients with low-grade reflux only. They had a success rate of 68% at the three-month follow-up, which improved to 81.8% at one year. They considered high-grade reflux in duplex systems to be an indication for early ureteral reimplantation. They compared these results with the results of ECSR performed in 34 children (10 bilaterally). The results showed that the success rate of ECSR was 95.5% at 3 months, which improved to 97.7% at an average of 15 months ($p = .04$).[20] Our patients required surgical intervention due to the persistence of reflux after 48 months of follow-up or due to recurrent breakthrough infections during follow-up. Various surgical interventions are available for repairing refluxing duplicated systems, including common sheath ureteral reimplantation techniques, such as ICSR and ECSR. Various ECSR and ICSR techniques have been described for the surgical correction of VUR. Among these techniques, the Cohen (intravesical) and Lich-Gregoir (extravesical) techniques are most used. However, there are a limited number of studies in the literature that have compared these two surgical techniques. In our study, common sheath reimplantation was performed via an extravesical approach in 38 patients and an intravesical approach in 25 patients. Various techniques were used as dictated by surgeon preferences. Our success rate with the extravesical technique was similar to that reported for reimplantation in single systems (92% to

Postoperative complications	ECSR group	ICSR group	Statistics
No of patients (% of total)	38 (60.3%)	25 (39.7%)	NA
Persistence of reflux	2 (5.3%)	1 (4%)	.817
Contralateral reflux	5 (13.2%)	4 (16%)	.753
De Novo hydronephrosis	3 (7.9%)	2 (8%)	1.0
Postoperative urine retention	2 (5.3%)	0	NA
Postoperative hematuria	0	6 (24%)	NA
UTIs	3 (7.9%)	4 (16%)	.316
Bladder spasms	0	4 (16%)	NA

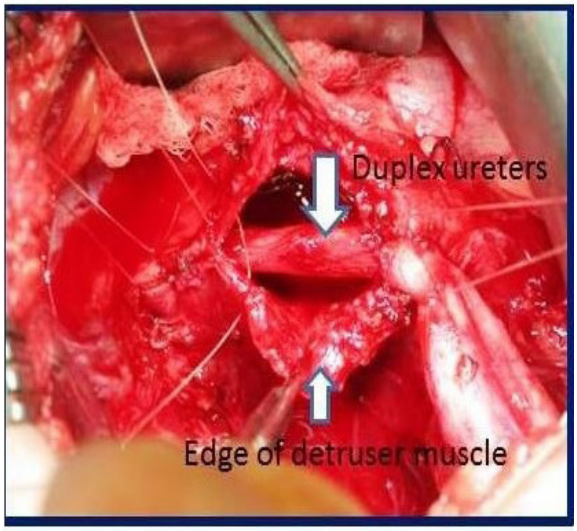

Figure 3. Closure of the tunnel over the duplex ureters without tension.

100%).[21-22] Mesrur et al.[21] reported that both the intravesical and extravesical techniques had advantages and disadvantages, with high success rates reaching more than 90%. On the other hand, the evidence comparing these techniques is not yet sufficient, and there is a need for optimization of open surgical techniques. Their results confirmed that both the Cohen and the Lich-Gregoir procedures had equivalent success and complication rates in the treatment of unilateral primary VUR. In addition, the Lich-Gregoir technique was superior to the Cohen technique in terms of the hospital stay and operative time. Moreover, it avoided the need for urethral and ureteral stenting, which may increase the comfort of patients postoperatively. Ellsworth et al.[23] reported on common sheath ureteral reimplantation in refluxing systems. They reimplanted 48 units intravesically, and only 6 units were reimplanted extravesically. The overall success rate was 96%. They concluded that even though the presence of a duplicated collecting system increased the risk for surgical treatment, it did not adversely affect the surgical outcome. Modifications of procedures commonly performed in the surgical treatment of single system reflux to accommodate common sheath reimplantation have excellent surgical results with minimal morbidity.[23] Minevich et al.[24] reported a success rate of 98% without complications in 62 units (43 children). The follow-up time was 86 months. These results are supportive of our results in considering ECSR as the initial approach for the correction of VUR in complete duplex systems.[24] Further supporting the efficacy of ECSR, minimal short-term complications were noted in our patients except for one patient who had transient contralateral reflux. Despite the higher success rate of ICSR surgery, the morbidity was higher in terms of de novo hydronephrosis and contralateral VUR. After ICSR surgery, patients required a longer hospital stay with urethral catheterization and pain management. In contrast, the ECSR procedure offered a shorter hospital stay with less morbidity.[23,24] Although excellent results with ICSR have been reported in refluxing duplex systems, ECSR has comparable success rates for the treatment of uncomplicated cases of VUR with less morbidity.[24] However, the disadvantage of unnecessary reimplantation of the normal ureter with the refluxing ureter cannot be avoided in the common sheath reimplantation procedure. Conversely, reimplantation of the refluxing ureter alone may compromise the blood supply of the normal ureter.

CONCLUSIONS

Both (ECSR) and (ICSR) surgeries are highly successful for the correction of VUR in uncomplicated complete duplex systems. The results of the extravesical approach are comparable with those of the intravesical technique with less morbidity and a shorter hospital stay. Thus, ECSR is our preferred technique when open surgical repair is indicated. ICSR should be reserved for complicated duplex systems necessitating concomitant reconstructive surgery.

CONFLICTING INTERESTS

The authors declared no potential conflicts of interest with respect to the research, authorship and/or publication of this article.

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