

EXTRAVESICAL URETERAL RE-IMPLANTATION VERSUS INTRAVESICAL TECHNIQUES FOR VESICoureTERAL REFLUX IN CHILDREN

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Objectives: To analyze the efficacy and outcome of extravascular (EUR) and intravesical ureteral re-implantation (IR) techniques in primary and secondary vesicoureteral reflux (VUR) in children.

Patients and Methods: Between 1997 and 2000, 218 patients (339 ureters) admitted to the Hospital For Sick Children, Toronto, Canada, underwent ureteral re-implantation. The patients were stratified into four groups: primary or secondary VUR and EUR or IR. We analyzed the success rates, contralateral VUR, postoperative retention, de-novo hydronephrosis and surgical complications.

Results: The mean age at presentation and surgery was 2.5 (birth-12 years) and 5.5 (1-19 years) years, respectively. Mean follow-up was 15 months. Hospital stay was 2.3 and 4.2 days for EUR and IR, respectively. In primary VUR, 147 patients (235 ureters) underwent EUR and 6 (12 ureters) IR. Success rates were 94.5% and 91.7% at 3 months, and 97.3% and 91.7% at 15 months, respectively. In secondary VUR, 41

(56 ureters) and 24 patients (36 ureters) had EUR and IR, respectively; the success rates were 93% and 88.9% at 3 months and, 98.2% and 91.7% at 15 months, respectively ($p=ns$). Contralateral VUR was detected in 11.8% after EUR and de-novo hydronephrosis in 14.2% and 28.6% in both groups, respectively. Six patients had retention after bilateral EUR and one after bilateral IR.

Conclusion: Both the extravascular and intravesical re-implantation methods yield excellent results in the treatment of vesicoureteral reflux. However, the easy application of the extravascular approach, its high success rate in primary as well as secondary reflux, the brief hospital stay and the decrease in the urinary retention rate after bilateral surgery with technical improvements make it our preferred approach for open surgical repair in primary and secondary VUR.

Key Words: vesicoureteral reflux, extravascular re-implantation, intravesical re-implantation

INTRODUCTION

Primary vesicoureteral reflux (VUR) is common and most often resolves spontaneously.^{1,2} The main objective of the treatment of VUR is the prevention of urinary tract infection and renal scars to avoid progressive renal damage. Open surgical repair of VUR, when indicated, remains the gold standard against which other surgical interventions are compared. Most series report surgical success in 95% to 98% of patients.³ The Politano-Leadbetter technique described in 1958⁴ has

been widely used with excellent success rates⁵. Other intravesical techniques, such as the Cohen, Glenn-Anderson and Gil-Vernet techniques have achieved success rates between 90 to 100%.⁶⁻⁸

The morbidity of intravesical techniques is well recognized.⁹ Intravesical ureteral re-implantation might cause bladder spasms and pain, requiring additional analgesics and anticholinergic medication. A prolonged hospital stay with urethral catheterization and postoperative gross hematuria is well documented^{3,9}.

Table 1: Symptoms and Signs at Presentation of 218 Patients with Primary and Secondary Vesicoureteral Reflux

Symptom / Sign	Primary VUR	%	Secondary VUR	%	Total
Urinary tract infection	136	88.9%	36	46.0%	172
Antenatal hydronephrosis	11	7.2%	14	18.0%	25
Incidental*	4	2.6%	2	2.6%	6
Associated anomalies	-	-	8	10.4%	8
Total	153		65		218

* incidental = patients who presented with different complaints to other departments and were found to have reflux

Table 2: Causes of Secondary VUR

Anomalies	EUR	IR	Total
Duplex systems	34	10	44
Meningomyelocele	2	3	5
Posterior urethral valves	2	3	5
VACTERL*	2	1	3
Bladder exstrophy	-	5	5
Prune belly syndrome	-	2	2
Anterior urethral valves	1	-	1
Total	41	24	65

* VACTERL = V (vertebral), A (anal), C (cardiac), TE (tracheoesophageal), R (renal), L (limb)

For these reasons, there has been renewed interest in the use of the extravesical technique. Various authors report extravesical reflux correction to be comparable with the traditional intravesical techniques^{10,11}.

In this study, we analyzed and compared the efficacy and outcomes of extravesical (EUR) and intravesical techniques (IR) in patients with primary and secondary VUR.

PATIENTS AND METHODS

Between January 1997 and December 2000, 218 patients (339 ureters) admitted to the Hospital for Sick Children, Toronto, Canada, underwent ureteral re-implantation. The patient group included 141 females and 77 males with a ratio of 1.8/1. The mean age at presentation and at surgery was 2.5 (birth-12)

and 5.5 (1-19) years, respectively. The mean follow-up after surgery was 15 months. The symptoms and signs at presentation, congenital anomalies associated with secondary VUR, grade of reflux and indications for surgery in both groups are summarized in Tables 1 through 4.

The charts were reviewed and the patients were divided into four groups according to the type of VUR (primary or secondary) and the surgical technique used (EUR or intravesical). The International Reflux Study grading system was used¹², and we classified hydronephrosis as mild, moderate and severe. Surgery was performed based on specific indications including non-resolution of VUR after a period of 4 to 6 years of follow-up, breakthrough urinary tract infection, deterioration in the grade of VUR or renal function, and noncompliance with medical treatment. Re-implantation was combined

Table 3: Grades of VUR and Surgical Technique Used

Grade	Extravesical		Intravesical		Total
	Primary	Secondary	Primary	Secondary	
G1	18	4	1	8	31
G2	67	10	1	3	81
G3	98	26	4	14	142
G4	46	15	1	7	69
G5	6	1	5	4	16
Total	235	56	12	36	339

Table 4: Indications for Surgery

Indication	Extravesical	%	Intravesical	%	Total	%
Persistent VUR	96	51.0%	9	30.0%	105	48.2%
Urinary tract infection	75	40.0%	10	33.3%	85	39.0%
Upper tract deterioration	16	8.5%	5	16.7%	21	9.6%
Non compliance with medical treatment	1	0.5%	1	3.3%	2	1.0%
Small bladder capacity with voiding dysfunction and indication of augmentation	0	0%	5	16.7%	5	2.2%

with bladder augmentation or surgical repair of bladder anomalies in five patients.

Non-dismembered extravesical ureteral reimplantation was performed as described by Zaontz et al.^{13,14}. The technique is briefly described as follows: the bladder is exposed through a Pfannenstiel incision and rotated to expose the involved ureter and detrusor hiatus. The ureter is gently mobilized to preserve the blood supply. The detrusor muscle is incised to expose the bladder mucosa, creating a muscular trough that forms the tunnel, which should be in a ratio of 5:1 based on the diameter of the ureter. The edges of the detrusor muscle are dissected to expose the bladder mucosa and to form detrusor flaps. The ureter is then advanced and anchored distally to the trigone using two 4-0 polyglycolic sutures. Then the detrusor trough is closed over the ureters to

form the submucosal tunnel. The wound is closed in layers without a drain.

In the IR group, the Leadbetter, Cohen and Glenn-Anderson techniques were used for primary and secondary VUR. The technique utilized was dependent on the surgeon's preference.

Postoperative evaluation included renal and bladder ultrasound and voiding cystourethrogram (VCUG) at 3 months. When reflux persisted, the VCUG was repeated one year later. All patients were maintained on prophylactic antibiotics until resolution of the reflux was documented by a negative VCUG.

We analyzed and compared the efficacy and outcome of the extravesical and intravesical techniques in primary and secondary VUR

in terms of success rate, rate of new contralateral VUR, postoperative urinary retention, de-novo hydronephrosis, length of hospital stay and surgical complications. The statistical analysis was performed using Fisher's exact test.

RESULTS

Extravesical surgery was performed in 188 patients. Bilateral re-implantation was done in 88/147 patients with primary VUR and in 15/41 patients with secondary VUR. Intravesical techniques were applied in 30 patients, bilateral in all 6 patients who had primary VUR and in 12/24 patients with secondary VUR. Grade I VUR was re-implanted only as a part of the bilateral procedure. The mean hospital stay was 2.3 (2-6) days in the EUR group and 4.2 (3-7) for the intravesical group, when excluding the patients who had concomitant bladder augmentation.

For the 153 patients with primary VUR (247 ureters), the success rates were 94.5% and 91.7% at 3 months and 97.3% and 91.7% at 15 months for the extravesical and intravesical reimplantation groups, respectively (p =not significant). For secondary VUR (65 patients, 92 ureters), the success rate was 93% and 88.9% at 3 months and improved to 98.2% and 91.7% at 15 months for EUR and IR, respectively (p =not significant). Persistence of VUR was noted in 17 units after EUR and resolved spontaneously in 10 units (58.8%) with primary and secondary VUR. Most of these units (12/1, 70.6%) were affected by low-grade reflux.

Contralateral VUR was detected after unilateral EUR in 10/85 ureters (11.8%) at three months, 10% and 15% for primary and secondary VUR. The grade of ipsilateral VUR was III and V preoperatively, and postoperative contralateral VUR was grade I-II. In four of these 10 patients, the contralateral VUR had been diagnosed at presentation, had resolved preoperatively and was subsequently re-identified postoperatively. Overall, 7 units (4 primary and 3 secondary VUR) resolved within one year. No contralateral reflux was detected in the intravesical group.

De-novo hydronephrosis was detected in 14% of the patients (30/212, 25 primary and 5 secondary) after EUR and in 28.6% (6/21 secondary VUR) after the intravesical techniques ($p=0.10$). It had resolved in 50% of them by the

last follow-up visit. Of the patients with persistent hydronephrosis, 77% had mild and 23% had moderate hydronephrosis. None of the patients required any intervention other than ultrasound follow-up for this hydronephrosis and none of them had persistence of reflux.

Six patients out of 103 (5.8%, 5 females, 1 male) subjected to bilateral EUR at a mean age of 4 years had postoperative transient urinary retention. Three had a history of voiding dysfunction. All underwent urethral re-catheterization for less than one week. In the intravesical group, one out of 18 patients (5.6%) subjected to bilateral re-implantation had transient urinary retention. In the extravesical group, two patients (1.4%) had suprapubic collections managed conservatively, one (0.7%) had a wound seroma and one had anuria after re-implantation of a solitary kidney requiring exploration and redo surgery. None in the extravesical group suffered from postoperative gross hematuria or bladder spasms.

DISCUSSION

The goal of antireflux surgery is to restore the flap-valve mechanism of the ureterovesical junction by creating an adequate submucosal tunnel for the intramural portion of the ureter. A general principle reported by the experimental works by Paquin states that the tunnel length must be five times that of the ureteral diameter³. In order to achieve a successful outcome after antireflux surgery, one must use meticulous surgical techniques in order to preserve the ureteral blood supply and a smooth course of the ureter through the ureterovesical hiatus, as well as to provide a secure back wall to the ureter.

All clinical trials in antireflux surgery aim at decreasing the hospital stay without compromising the outcome. Avoidance of perivesical drainage is considered an advantage. Minimally invasive techniques with less morbidity have been encouraged. Most of these criteria coincide with the use of the extravesical approach but there are concerns regarding postoperative urinary retention after bilateral surgery⁹.

In our study, the success rates after EUR for primary and secondary VUR are encouraging. EUR achieved excellent results with grade I-III VUR. In high grade VUR, EUR was effective in more than 90% in grade IV and 80% in

grade V. EUR achieved comparable results to the intravesical techniques. The hospital stay was short in the EUR patients and urethral catheterization was used for 24-48 hours compared to 3-7 days for the intravesical group. None of the EUR patients experienced gross hematuria or bladder spasms

EUR was effective in almost all cases of duplex systems (43/44, 98%). This near-perfect success rate with extravesical common sheath re-implantation encourages us to recommend this approach for patients with duplex systems when open surgery is indicated, even with high-grade VUR. In our series, the intravesical technique was also successful in all patients with duplex systems, but the longer hospital stay with urethral catheter as well as the occurrence of complications such as postoperative hematuria and bladder spasms are a major drawback of this approach. Extravesical re-implantation had comparable success rates in the treatment of VUR in uncomplicated cases, with less morbidity. We, therefore, reserve the intravesical approach for cases requiring associated major bladder reconstruction (i.e. augmentation cystoplasty).

The rate of spontaneous resolution of postoperative persistent VUR is 24% to 100% as reported in the literature.^{15,16} In our present study, the high success rates in the EUR and intravesical groups advocate the conservative management of persistent VUR. For patients with persistent VUR and recurrent breakthrough infections, we recommend endoscopic injection as a minimally invasive, simple and effective technique to correct VUR.¹⁷

Contralateral reflux has been reported to develop in 10% to 27% of cases after successful unilateral antireflux surgery^{18,19}. The mechanism of contralateral reflux is still unknown. Two main hypotheses explain the pathogenesis of contralateral reflux. Kumar and Puri described iatrogenic distortion of the contralateral trigone as a result of ipsilateral surgical correction, which was avoided when they used the endoscopic approach²⁰. Diamond et al. suggested that an elimination of the pop-off mechanism may be responsible for contralateral VUR¹⁹. In our study, only patients who were re-implanted by the EUR techniques had contralateral VUR which was of low grade and resolved spontaneously.

Early postoperative detrusor edema causing transient obstruction is often detected clinically

by ultrasound as de-novo hydronephrosis. A higher incidence of de-novo hydronephrosis was noted in the intravesical group, which may be due to mucosal trauma caused during the creation of the new tunnel and the prolonged postoperative catheterization resulting in edema. Overall, all these patients had asymptomatic mild hydronephrosis and required no further intervention. Observation of our patients by ultrasound was sufficient, and no clinically significant obstruction was encountered.

Transient urinary retention after bilateral EUR has been reported in the literature.²¹⁻²³ In earlier studies carried out at our institution, urinary retention after extravesical reimplantation was noted predominantly in males less than 3 years of age. In our present study, the predominance of transient urinary retention was found in females older than 3 years who underwent bilateral re-implantation. It resolved within a week and all patients voided normally except one that had voiding disturbances and continued on behavioral modification. Any preoperative history of voiding dysfunction should be considered, especially before bilateral EUR. The decreased incidence of retention in the present series may be explained by our decreased usage of electrocautery during the dissection of the detrusor flaps. There are concerns that in patients with voiding dysfunction and high-grade VUR ureteral and detrusor dissection might be more extensive. Therefore, in this situation, we seriously consider adopting an intravesical technique to perform bilateral re-implantation.

In conclusion, EUR has proved to be very successful in correcting reflux (over 97%) in primary and secondary VUR with results comparable to the intravesical techniques. The easy application of the technique, the short hospital stay and the decrease of urinary retention after technical improvement in bilateral surgery makes it our preferred modality for the correction of VUR in children when open surgical repair is indicated and for the correction of reflux in refluxing duplex systems. The intravesical approach is reserved for patients with associated pathology necessitating concomitant reconstructive surgery.

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RESUME

Les Techniques de réimplantation urétérale pour reflux vésico-urétéral chez l'enfant: La voie extravésicale versus la voie intravésicale

Objectifs: Analyser l'efficacité et les résultats de la réimplantation urétérale par voie extravésicale (EVR) et par voie intravésicale (IVR) dans le traitement du reflux vésico-urétéral primitif et secondaire (VUR) chez les enfants. **Patients et Méthodes:** De 1997 à 2000, 218 patients (339 uretères) ont subi une réimplantation urétérale. Les patients ont été répartis en quatre groupes: VUR primitif ou secondaire et EVR ou IVR. Nous avons analysé le taux de succès, le VUR controlatéral, la rétention postopératoire, l'hydronephrose de novo et les complications chirurgicales. **Résultats:** L'âge moyen à la découverte et à la chirurgie était de 2,5 ans (naissance-12) et 5,5 ans (1-19), respectivement. Le suivi était en moyenne de 15 mois. Le séjour à l'hôpital était respectivement de 2,3 et 4,2 jours pour

l'EVR et l'IVR. Dans le VUR primitif, 147 patients (235 uretères) ont subi une EVR et 6 (12 uretères) une IVR. Les taux du succès étaient respectivement de 94,5% et 91,7% à 3 mois, et 97,3% et 91,7% à 15 mois. Dans le VUR secondaire, 41 (56 uretères) et 24 patients (36 uretères) ont eu, respectivement, une EVR et une IVR; les taux du succès étaient 93% et 88,9% à 3 mois et 98,2% et 91,7% à 15 mois, respectivement ($p=ns$). Un VUR controlatéral a été détecté dans 11,8% des cas après EVR et une hydronéphrose de novo dans 14,2% et 28,6% dans les deux groupes, respectivement. Six patients ont présenté une rétention après une EVR bilatérale et un après une IVR bilatérale. **Conclusions:** Les deux méthodes de réimplantation pour reflux vésico-urétéral présentent des résultats excellents. Cependant, la réalisation facile de l'approche extravésicale, son haut taux de succès dans le traitement du reflux primitif aussi bien que le reflux secondaire, le bref séjour à l'hôpital et le faible taux de rétention urinaire après chirurgie bilatérale en font notre approche préférée pour la chirurgie à ciel ouvert du VUR primitif et secondaire.

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