



## Outcomes of a minimally invasive surgical approach to manage persistent high-grade vesicoureteric reflux post successful augmentation cystoplasty of patients with non-compliant bladder<sup>☆</sup>

Ossamah Alsowayan<sup>\*</sup>, Alaa Barham, Naif Alqarni, Mansour Alnazari, Mahmoud Alsakharni, Tamer Ewida, Mahmoud Trbay, Ahmad A. Elderwy<sup>1</sup>, Hamdan Alhazmi, Khalid Fouda Neel

Division of Urology, Department of Surgery, College of Medicine and King Khalid University Hospital, King Saud University, PO Box 2925, 11461 Riyadh, Saudi Arabia

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**Abstract Purpose:** To assess the outcome of a minimally invasive surgical approach in management of persistent high-grade vesicoureteric reflux (VUR) in patients with non-compliant bladders after augmentation cystoplasty.

**Materials and methods:** Between 2001 and 2011, 24 patients (13 male and 11 female, mean age 7.62 years) with non-compliant bladders and 44 high-grade refluxing units, (40 bilateral and 4 unilateral, grades 3–5), underwent augmentation cystoplasty without ureteric re-implantation. Of the 24 patients, 17 underwent augmentation ileocystoplasty and 7 underwent ureterocystoplasty. Of the 44 refluxing units, 7 were used for ureterocystoplasty, and 1 was excised. For those who did not show resolution of VUR and had recurrent breakthrough febrile urinary tract infections (UTI) despite antibiotic prophylaxis, interval endoscopic correction was initiated.

**Results:** Of the 36 remaining refluxing units, 21/36 (58.3%) showed complete resolution in the first follow-up cystogram, and 1 showed complete resolution after 1 year. Two patients, each with single refluxing unit, received repeat augmentation cystoplasty because of inadequate bladder capacity

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<sup>\*</sup> Corresponding author. Department of Urology, College of Medicine and King Fahad Hospital of the University, University of Dammam, PO Box 40086, Alkhobar 31952, Saudi Arabia. Tel.: +966 556855003; fax: +966 138966770.

E-mail address: [sowayan81@gmail.com](mailto:sowayan81@gmail.com) (O. Alsowayan).

<sup>1</sup> Present address: Pediatric Urology Unit, Urology Department, Assiut University Hospital, Assiut, Egypt.

post ureterocystoplasty and demonstrated complete resolution postoperatively. Of the remaining 12 refluxing units, 10 underwent interval endoscopic intervention. VUR resolved in 8 of the refluxing units after the first trial and in another 2 after the second trial. Parents of the patient with the remaining 2 refluxing units preferred to continue on conservative management.

**Conclusion:** Augmentation cystoplasty without ureteric re-implantation with interval endoscopic management if needed is an effective and adequate treatment for high-pressure, non-compliant bladders as well as high-grade persistent VUR when conservative management fails. In our study, a VUR resolution rate of 94% (34/36) was achieved by combining conservative and minimally invasive approaches without ureteric re-implantation at the time of augmentation cystoplasty.

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## Introduction

Secondary vesicoureteric reflux (VUR), caused by neuro-pathic bladder or valve-bladder syndrome, is a common problem associated with a non-compliant bladder. The management of this disorder is a topic of debate in the literature [1–7]. High-grade VUR (grades 3–5), significantly increases the risk of recurrent febrile urinary tract infections (UTI) that may lead to permanent renal damage and devastating long-term complications [2,3]. Many authors have reported a high resolution rate of VUR with augmentation cystoplasty alone [1,5–7]. Others have shown significant residual VUR after augmentation cystoplasty and recommend ureteric re-implantation at the time of augmentation [2,3,8].

Endoscopic correction of VUR (ECVUR) is a widely used minimally invasive approach that has gained popularity in managing VUR in a normal compliant bladder that failed conservative treatment. This approach has also been used to treat VUR in non-compliant bladders [9,10].

In our institute, we manage patients with non-compliant bladders and high-grade VUR with augmentation cystoplasty alone assuming that by correcting the primary bladder pathology and converting a high pressure bladder into low pressure, VUR will resolve. Those with persistent high-grade VUR (grades 3–5) and recurrent breakthrough febrile UTIs despite antibiotic prophylaxis were enrolled in our trial of endoscopic management of VUR. No previous studies to our knowledge have examined the efficacy of ECVUR in patients with persistent, symptomatic, high-grade VUR post augmentation cystoplasty.

## Materials and methods

Patients with non-compliant bladders and high-grade VUR (grades 3–5) are enrolled in the program at our institute, where they are initially managed conservatively with antibiotic prophylaxis, anticholinergics and clean intermittent catheterization (CIC). Those who are not responding to the conservative approach are managed endoscopically using intravesical botulinum toxin A, ECVUR, CIC and bowel management as needed [10]. Patients who are not candidates for this approach, valve bladder patients with very small bladder capacity, or who failed to gain normal compliance and/or continence with this approach, intravesical pressure >40 cmH<sub>2</sub>O at low volumes, <50% of

expected capacity, and/or incontinence in <3 h, undergo augmentation cystoplasty without ureteric re-implant.

A total of 82 patients with non-compliant bladder underwent augmentation cystoplasty in the period between 2001 and 2011 in our institute. Of those 24 patients, 13 boys and 11 girls, had high-grade VUR with 44 refluxing units, 20 bilateral and 4 unilateral, 23 grade 5, 13 grade 4 and 8 grade 3, who failed our conservative and/or minimally invasive approach and underwent augmentation cystoplasty. The mean age at intervention was 7.62 years with a mean follow-up of 5.6 years. The underlying pathology for non-compliant bladder was neuropathic bladder (meningomyelocele in 12 cases, anorectal malformation in 2 cases, sacral agenesis in 1 case and syringomyelia in 1 case) and non-neuropathic bladder (valve-bladder syndrome in 6 cases and Hinman syndrome in 2 cases).

All patients were fully examined using renal function tests, ultrasound, VCUG and urodynamic studies preoperatively as well as 3–6 months postoperatively, putting in mind that UDS might not be so accurate in the presence of high-grade VUR. Patients were then examined semiannually with an ultrasound and renal function test as well as an annual VCUG for patients with symptomatic persistent high-grade VUR. The international reflux study classification for the grading of VUR is used [11].

Patients with persistent high-grade VUR and recurrent breakthrough febrile UTI despite antibiotic prophylaxis following augmentation cystoplasty were identified and enrolled in our prospective trial of interval ECVUR, between 2001 and 2011, where dextranomer/hyaluronic acid copolymer injection using hydrodistension-implantation technique (HIT) was performed on a day surgery basis [12].

Statistical analyses was performed using inter-cooled STATA, version 9.2. A univariate analysis was performed to identify the predictors of high-grade VUR resolution after augmentation cystoplasty and ECVUR, including a chi-square test for comparison of the categorical data. A *p* value <0.05 was considered statistically significant (Table 1).

## Results

Of the 24 patients, 17 underwent ileocystoplasty and 7 underwent ureterocystoplasty; 17 required continent catheterizable stoma and none required bladder neck

**Table 1** Factors associated with VUR resolution after augmentation cystoplasty.

Variable	VUR resolution rate	P value
Age		0.47
<8 years	61.9%	
>8 years	73.3%	
Type of augmentation		0.51
Ileocystoplasty	70%	
Ureterocystoplasty	57.1%	
Underlying pathology		0.381
Neuropathic bladder	64.7%	
Non-neuropathic bladder	44.4%	
CIC compliance		0.235
Good compliance	75%	
Poor compliance	43.75%	

reconstruction as it looked competent by VCUG imaging and cystoscopic examination. Detrusotomy was not considered as all patients had non-compliant small capacity bladder.

Of those patients who underwent ureterocystoplasty, 4 underwent laparoscopic nephrectomy of a non-functioning kidney, and each kidney's dilated tortuous refluxing ureter was used for ureterocystoplasty. For the remaining 3 patients who underwent ureterocystoplasty, a transureteroureterostomy was performed while using the distal tortuous refluxing ureter on the same side for ureterocystoplasty.

Additionally, there was 1 patient with a blind ending refluxing ureter who underwent ureterectomy because the ureter was not suitable for ureterocystoplasty; the patient therefore underwent ileocystoplasty.

Of the 36 remaining refluxing units, 21/36 (58.3%) showed complete resolution in the first follow-up cystogram, and 1 showed complete resolution after 1 year. Two patients, each with a single refluxing unit, received a repeat augmentation ileocystoplasty because of poor compliance and/or inadequate bladder capacity post ureterocystoplasty as documented by VCUG and urodynamic study and showed complete resolution of reflux post-operatively, which increased the resolution rate post augmentation ileocystoplasty to 66.6% (24/36) (Table 2).

Of the remaining 12 refluxing units in 7 patients, grades 3-5, proved to have good bladder capacity and compliance using VCUG and urodynamic study, 10 underwent endoscopic intervention because of the patients' history of recurrent breakthrough febrile UTIs despite antibiotic prophylaxis. An average of 1.8 cc (range 1.2–2.5) was

**Table 3** Grade of VUR before and after ECVUR.

Grade of VUR	Number of RU before ECVUR	Number of RU after ECVUR	
		1st trial	2nd trial
5	2	0	0
4	0	2	0
3	8	0	2 <sup>a</sup>

<sup>a</sup> Family of patient with persistent 2 RU preferred to continue on conservative management.

injected per ureter using the HIT method [12]. The VUR resolved in 8 refluxing units after the first trial and in another 2 after the second trial (Table 3). The parents of 1 patient with the remaining 2 refluxing units preferred to continue with conservative management (Table 2).

An analysis for factors associated with VUR resolution was performed. Patient age, the augmentation type used, the underlying pathology and patients' compliance with CIC, defined as doing CIC every 3–4 h ensured by taking history from the family, were studied. A chi-square test was used for data analysis and revealed that none of these factors could predict VUR outcome (Table 1).

## Discussion

There are several pathologies that may lead to a small, non-compliant bladder, including neuropathic bladder and valve-bladder syndrome [1–7]. VUR in these patients is usually a secondary symptom to high detrusor pressure, low compliance and small capacity [1,5,6].

Although conservative management of this disorder in the form of antibiotic prophylaxis, anticholinergics and CIC is the standard of care in such cases, those patients who fail to improve are candidates for total endoscopic management with intravesical botulinum toxin A injection, ECVUR and CIC or bladder augmentation [1,7,10]. VUR management in these patients is a topic of great debate in the literature. Whereas some investigators have shown a high resolution rate of VUR post augmentation without ureteric re-implantation [1,5–7], others have shown a high incidence of persistent VUR and recommend ureteric re-implantation at the time of augmentation cystoplasty [2,3,8].

There is a wide range of VUR resolution post augmentation cystoplasty (42.86–100%) that could be related to different surgical techniques and follow-up times [2,3]. In our study, the incidence of spontaneous resolution was

**Table 2** Grade of VUR before and after augmentation.

Grade of VUR	Before augmentation	After augmentation			
		Used for ureterocystoplasty/excised	Resolved	Improved	Did not improve
5	23	5	10	6	2
4	13	2	9	2	0
3	8	1	5	0	2 <sup>a</sup>

<sup>a</sup> Family of patient with persistent 2 RU preferred to continue on conservative management.

66.6% (24/36) as we included only high-grade VUR cases. The authors who support augmentation cystoplasty without ureteric re-implantation claim that such VUR is secondary to high detrusor pressure and low compliance; by augmenting the bladder, they suggest, compliance will increase, detrusor pressure will decrease, and as a result, VUR will spontaneously resolve [1,5–7].

This incidence of high VUR resolution after augmentation cystoplasty convinces many urologists not to re-implant the ureters at the time of augmentation cystoplasty. This approach is also favored by many urologists because of the potential complications after ureteric re-implant in a severely trabeculated, small capacity bladder [4]. To minimize such complications, a serous lined extramural tunnel technique for ureteral re-implantation to create a non-refluxing anastomosis as described by Abol-Enen and Ghoneim can be used with a stricture and/or reflux rate of less than 4% [13].

This study sought to identify risk factors for residual VUR after augmentation cystoplasty, but none of the studied factors were statistically significant (Table 1). We believe that larger studies could be valuable in identifying risk factors for residual VUR.

An essential factor for the resolution of VUR is the adequate capacity of the augmented bladder post augmentation cystoplasty. We had 2 cases post ureterocystoplasty who still had inadequate bladder capacity. In both, residual VUR resolved spontaneously after a repeat ileocystoplasty. Soylet et al. reported 2 similar cases of VUR that resolved after a repeat ileocystoplasty [1].

Resolution of low-grade VUR is documented in many reports with bladder augmentation alone with success rate between 90% and 100% [5,6,8]. However, some authors support the need for ureteric re-implantation in patients with high-grade VUR at the time of augmentation cystoplasty [2,3,8]. They claim that residual VUR incidence (47–57%) is still high and could be a cause of recurrent UTIs and deterioration of renal function [2,8].

In our approach, we performed augmentation cystoplasty without re-implanting the ureters for patients with high-grade VUR. VCUG and UDS to document normal bladder compliance were done 3–6 months post-operatively. In cases where VUR is identified, ECVUR is performed. With this approach, the resolution of VUR increased to 94% (34/36) and none of the treated patients had a significant febrile UTI thereafter.

This preliminary study is conducted in a single center and is limited by the small number of patients, lack of randomization and lack of comparison group in which patients undergo augmentation cystoplasty with ureteric re-implantation. A larger, randomized, multi-center study may offer further information that can be used in the management of secondary VUR.

## Conclusion

Augmentation cystoplasty without ureteric re-implantation and with interval endoscopic management seems to be an effective and adequate treatment for high pressure, non-compliant bladder as well as high-grade VUR when conservative management fails.

In our examination of cases of high-grade reflux, a resolution rate of 94% was achieved by combining augmentation cystoplasty and interval ECVUR without ureteric re-implantation at the time of augmentation cystoplasty.

## Conflict of interest

None.

## Funding

None.

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