

Original Article

Augmentation cystoplasty and simultaneous ureteral reimplantation reduce high-grade vesicoureteral reflux in children with neurogenic bladder

Jen-Bin Wang^a, Chin-Su Liu^a, Shin-Lin Tsai^a, Chou-Fu Wei^b, Tai-Wai Chin^{a,*}

^aDivision of Pediatric Surgery, Department of Surgery, Taipei Veterans General Hospital and National Yang-Ming University School of Medicine, Taipei, Taiwan, ROC

^bDepartment of Surgery, Taipei Medical University Hospital, Taipei, Taiwan, ROC

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Abstract

Background: To compare the incidence of residual high-grade vesicoureteral reflux (HVUR) (\geq Grade III) in neurogenic bladder patients receiving augmentation cystoplasty alone or with simultaneous ureteral reimplantation. Furthermore, we also tried to find the risk factors of residual VUR and febrile urinary tract infection.

Methods: Between 1999 and 2009, urinary bladder augmentation was performed in 21 children with neurogenic bladder. Seventeen of these patients had VUR on preoperative voiding cystourethrography, of whom 11 patients (14 ureters) received augmentation alone (Group A) and 6 patients (8 ureters) received simultaneously ureteral reimplantation (Group B). Univariate logistic regression analysis and Fisher exact test were used for statistical analysis.

Results: Six patients (8 ureters) had residual HVURs in Group A, but none in Group B. The incidences of residual HVUR were 57.14% and 0%, respectively. Seven patients had febrile UTIs after operation, 6 of them had residual HVURs. In risk factor analysis, postoperative follow-up duration less than 12 months and lack of anti-reflux operation were significant risk factors for residual HVUR; the residual HVUR was the significant risk factor for febrile urinary tract infection.

Conclusion: Simultaneous ureteral reimplantation reduces postop HVUR significantly. We recommend augmentation and simultaneous ureteral reimplantation in children with HVUR and neurogenic bladder if technically feasible.

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Keywords: Augmentation cystoplasty; Neurogenic bladder; Ureteral reimplantation; Vesicoureteral reflux

1. Introduction

Vesicoureteral reflux (VUR) is a common problem associated with neurogenic bladder. High-grade VUR (HVUR) (Grade III–V) may increase the risks of febrile urinary tract infection (UTI) and renal damage.¹ Augmentation cystoplasty (AC) increases bladder volume, decreases intravesical pressure, and improves bladder compliance in patients with neurogenic

bladder. In the literature, many authors believe that AC alone is enough to resolve VUR in neurogenic bladder and that it is not necessary to perform simultaneous ureteral reimplantation.^{2,3} Previously at our institute (from 1999 to 2003), most patients who received AC also had simultaneous reimplantation if they were complicated with VUR. However, simultaneous reimplantation was not performed after August 2003 because of a change in our policy. Since then, we have noticed a high rate of failure to eliminate VUR in those patients who had AC only, similar to other reports.⁴ To decide whether simultaneous ureteral reimplantation should be performed during AC, we assessed the outcomes of residual HVUR in our patients. Furthermore, we also investigated the risk factors of febrile UTI and residual VUR.

* Corresponding author. Dr. Tai-Wai Chin, Division of Pediatric Surgery, Department of Surgery, Taipei Veterans General Hospital, 201, Section 2, Shih-Pai Road, Taipei 112, Taiwan, ROC.

E-mail address: twchin@vghtpe.gov.tw (T.-W. Chin).

Table 1
Characteristics of the Group A receiving bladder augmentation only

Case	Age (yr)/sex	Underlying disease	Op age (yr)	Material used	Preop VUR (grade)		Postop VUR (grade)		Postop febrile UTI
					Right	Left	Right	Left	
1	22/F	MMC	16	Ileum	5	0	0	0	No
2	25/M	LMC	21	Ileum	4	5	0	5	Yes
3	20/F	MMC	12	Ileum	5	4	0	5	Yes
4	5/F	LMC	3	Ileum	0	5	0	0	No
5	16/M	MMC	15	Ileum	0	5	0	0	No
6	10/M	MMC	9	Sigmoid	1	5	0	0	No
7	8/M	LMC	7	Ileum	0	3	0	0	No
8	10/F	Cauda equina syndrome	10	Ileum	5	5	5	5	Yes
9	15/F	SBO	14	Ileum	5	0	5	0	Yes
10	3/F	MMC	3	Ileum	5	3	3	4	Yes
11	6/F	Transverse myelitis	6	Ileum	3	2	3	3	Yes

F = female; LMC = lipomeningocele; M = male; MMC = myelomeningocele; Op = operation; Postop = postoperative; Preop = preoperative; SBO = spinal bifida occulta; UTI = urinary tract infection; VUR = vesicoureteral reflux.

2. Methods

We retrospectively reviewed 28 patients with neurogenic bladder who underwent AC during 1999–2009 in our hospital. The characteristics of the patients are listed in Table 1. The indications for AC were either deterioration of renal function or urine incontinence. Of these patients, one died from an unrelated cause and six were lost to follow-up (6 patients had augmentation only and one had concomitant left reimplantation), leaving a total of 21 patients (14 girls and 7 boys) for analysis. Preoperative evaluation included renal function, voiding cystourethrography (VCUG), urodynamic study (including maximal detrusor pressure, leaking point pressure) and renal ultrasonography. Urodynamic findings were typical, with small bladder volume and high intravesical pressure in all patients. The VUR was graded according to the International Reflux Study Group classification.⁵

Of the 21 patients, 17 patients showed initial HVUR on preoperative VCUG, composed of 22 ureters with Grade III–V VUR. Patients received AC plus reimplantation from 1999–2003, and AC only after August 2003 because of a departmental policy change. The patients were thus divided into two groups according to whether or not simultaneous ureteral reimplantation was performed while the patients were receiving AC.

The ureteral reimplantations were conducted using the Cohen cross-trigonal technique. A fine ureteral stent was placed or not according to the friability of the mucosa and condition of the ureteral orifice. If placed, it was removed on Day 3 after AC. These patients were followed with VCUG, renal function, and renal sonography 3–6 months after the operation in the initial period, and yearly thereafter when stable. No patients had urodynamic study after the operation.

In the search for the risk factors for residual VURs and febrile UTIs, several factors were assessed and defined. The risk factors included age at operation (>10 years), duration of follow-up (≤12 months), poor catheterization compliance [clean intermittent catheterization (CIC) ≤3 times/day], small bladder volume {maximum catheterization volume < expected bladder volume, [age (yrs)+2] × 30 mL}, presence of vesicle

stones, and presence of bladder trabeculation. Univariate logistic regression analysis and Fisher's exact test were used for statistical analysis. A *p* value <0.05 was considered statistically significant.

3. Results

The patients' characteristics are shown in Tables 1 and 2. Overall, 17 patients of the 21 patients had initial HVUR on preoperative VCUG. Of these patients, 11 patients (14 ureters) received AC alone and were assigned to Group A. Six patients (8 ureters) received simultaneous ureteral reimplantation during AC and were assigned to Group B. Residual HVUR was assessed by VCUG periodically until resolution. At the end of the study, 6 patients (8 ureters) in Group A and none in Group B had residual HVUR. The incidence of residual HVUR was 57.14% (8 of 14 ureters) in Group A versus 0% (0 of 8 ureters) in Group B. The characteristics of patient and grades of initial and residual HVUR are listed in Tables 1 and 2, respectively. Comparing the grades of VUR before and after operation, 7 ureters showed improvement, 5 remained unchanged, 2 worsened in Group A, and all 8 ureters in Group B showed improvement.

Table 2
Characteristics of the Group B receiving bladder augmentation and ureteral reimplantation

Case	Age (yr)/sex	Underlying disease	Op age (yr)	Material used	Preop VUR (grade)		Postop VUR (grade)		Postop febrile UTI
					Right	Left	Right	Left	
1	12/F	Sarcral agenesis	2	Ileum	4	0	0	0	No
2	12/F	SBO	3	Ileum	4	4	0	0	No
3	11/F	MMC	3	Ileum	4	4	0	0	No
4	15/F	SBO	8	Ileum	0	5	0	0	No
5	15/F	SBO	8	Sigmoid	0	3	0	1	Yes
6	10/M	SBO	4	Ileum	0	4	0	0	No

F = female; M = male; MMC = myelomeningocele; Op = operation; Postop = postoperative; Preop = preoperative; SBO = spinal bifida occulta; UTI = urinary tract infection; VUR = vesicoureteral reflux.

Table 3
Univariate logistic regression analysis of risk factors for residual HVUR

Risk factor	Patients with HVUR (n = 16)	Patient without HVUR (n = 11)	Odds ratio 95% CI (lower–upper)	<i>p</i> ^a
Age at op >10 yr	4	2	9.000 (0.914–88.575)	0.109
Postop duration less than 12 mo	3	0	–	0.029
Small bladder volume	0	3	–	0.515
Poor CIC compliance	5	3	13.333 (1.069–166.374)	0.050
Bladder trabeculation	4	8	0.075 (0.087–6.468)	1.000
Without anti-reflux surgery	0 (n = 8 ureters)	8 (n = 14 ureters)	–	0.018

^a Fisher exact test.

CIC = clean intermittent catheterization; CI = confidence interval; HVUR = high-grade vesicoureteral reflux; Op = operation; Postop = postoperative.

The maximal bladder volume measured by self-catheterization increased from an average of 257 mL to 418 mL following AC. The change of catheterized bladder volume was from 255 ± 166 mL to 412 ± 186 mL in Group A and from 275 ± 103 mL to 433 ± 112 mL in Group B (*p* = 0.755). The volume percentage increases in Groups A and B were 62% and 58%, respectively. Seven patients experienced episodes of febrile UTIs during the postoperative follow-up period, and 6 of them had residual VURs.

The risks factors for residual VURs and febrile UTIs were analyzed and are listed in Tables 3 and 4. We found that the postoperative duration (*p* = 0.029) and whether or not anti-reflux operations were performed (*p* = 0.018) were significant risk factors for residual HVURs. Poor catheterization compliance was a borderline risk factor (*p* = 0.05). For risk factors related to febrile UTI, residual HVUR was a significant risk factor (*p* < 0.01).

4. Discussion

In the management of patients with neurogenic bladder, the aim is to increase bladder compliance, lower intravesical pressure, achieve satisfactory continence, and avoid renal damage. AC is an effective way to improve urodynamics.⁶ However, a significant amount of residual VUR presents after the augmentation, especially if patients are high Grade (III–V) preoperatively.³ In the literature, the incidence of residual VUR after AC alone ranges from 0% to 47.3%.^{2,3,7–9} When concomitant anti-reflux operations are applied, the incidence reduces to about 4%.⁴ In our study, simultaneous ureteral reimplantation also achieved a low rate of residual HVUR when

compared with AC alone (0% vs. 57.14%). The high residual rate in AC alone may be attributed to the shorter follow-up duration of the patients with persistent reflux in Group A.

Many authors suggest performing bladder augmentation alone in the management of neurogenic bladder, commonly stating that VURs are secondary to noncompliant, high-pressure bladders. By improving the dynamics of neurogenic bladder with AC, the refluxes may resolve by themselves. However, a recent study reported VURs persisting despite a low-pressure bladder after bladder augmentation.⁹ It is assumed a primary ureterotrigoal insufficiency (short submucosal tunnel) exists and causes the persistent VUR after augmentation. Furthermore, some authors discourage ureteral reimplantation in a hypertrophied, trabeculated bladder with fragile mucosa because of technical difficulties, which increase the risk of postoperative ureteral obstruction.¹⁰ One patient in our series had bilateral ureteral obstruction after Cohen operation, and she needed reoperation for placement of the ureteral stent.

VUR is an important factor for upper UTIs and renal damage.¹ In our series, 7 patients experienced febrile UTIs during follow-up, and 6 of them had residual VURs. This finding implies a relationship between reflux and febrile UTIs.

We further assessed the risk factors contributing to febrile UTIs and residual VURs. The analysis revealed that a short postoperative duration, defined as less than 12 months, and a lack of anti-reflux surgery were significant risk factors for residual VURs. We hypothesize that this may be because the bladder compliance was low immediately after the operation. It takes time for the augmented bowel to expand and become more compliant. Residual VUR is a significant risk factor for

Table 4
Univariate logistic regression analysis of risk factors for febrile UTI

Risk factor	Patients with UTI (n = 7)	Patient without UTI (n = 14)	Odds ratio 95% CI (lower–upper)	<i>p</i> ^a
Age at op >10 yr	5	4	6.875 (0.931–50.782)	0.074
Postop duration less than 12 mo	3	2	4.875 (0.590–40.258)	0.274
Bladder stones	1	2	1.083 (0.081–14.412)	1.000
Poor CIC compliance	5	3	10.000 (1.260–79.333)	0.052
Small bladder volume	3	8	1.524 (0.250–9.295)	1.000
Residual VUR	6	0	–	<0.001
Bladder trabeculation	5	11	0.909 (0.123–6.715)	1.000

^a Fisher exact test.

CIC = clean intermittent catheterization; CI = confidence interval; Op = operation; Postop = postoperative; UTI = urinary tract infection; VUR = vesicoureteral reflux.

febrile UTIs. This strengthens our belief that we should do our best to avoid residual HVURs.

Poor compliance with CIC can be a confounding factor of postoperative UTI and residual VUR. All the 5 patients with poor compliance with CIC had residual high-grade VUR. The *p* values of risk factors for residual HVUR and UTI were 0.05 and 0.052 respectively. The results show the importance of compliance in catheterization. Without good compliance for CIC, residual HVUR and UTI may occur.

In our series, a high rate of residual reflux was noted as compared to most of the previous investigations. We do not know if this is related to a shorter postoperative follow-up duration or a higher percentage of primary reflux in these patients. But the data show that simultaneous anti-reflux surgery may reduce the incidence of residual reflux. This study is limited by small sample size. A larger randomized study may further clarify the issue.

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