Ureterocystoplasty: Videourodynamic Assessment

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Purpose: We evaluated bladder function outcome in children who underwent ureterocystoplasty based on preoperative and postoperative videourodynamic studies.

Materials and Methods: Between 1977 and 2003, 8 patients with a median age of 6 years who had severe bladder dysfunction underwent ureterocystoplasty as a single surgical procedure. Augmentation was performed in 1 refluxing ureter in 7 patients and with a nonrefluxing megaureter in 1. All patients were evaluated urodynamically before and after augmentation using videourodynamic studies. Preoperative bladder capacity was estimated subtracting the volume trapped inside the refluxing ureter from the total amount of contrast fluid infused into the bladder. Controls included 8 patients matched in age (median 7.8 years) and diagnosis who had undergone ileocystoplasty and were studied with the same urodynamic methodology. Median age in patients with ureterocystoplasty and controls at postoperative urodynamic testing was 7.3 and 11.2 years, respectively.

Results: Median cystometric bladder capacity for age before and after ureterocystoplasty was 75% (range 10% to 92%) and 94% (range 49% to 100%), respectively. In the ileocystoplasty group cystometric bladder capacity increased significantly after augmentation (median 44% vs 118, $p < 0.0005$). Comparison of postoperative cystometric bladder capacity between the 2 treatment groups showed significantly higher bladder volumes in the ileocystoplasty group (median 217 vs 290 ml, $p < 0.02$). When we analyzed compliance before and after ureterocystoplasty, no statistically significant difference was found (4.09 vs 10.5 ml/cm water). The same parameter in the ileocystoplasty group was statistically significant (1.6 vs 22.5 ml/cm water, $p < 0.016$).

Conclusions: Our retrospective study suggests that, although ureterocystoplasty is a useful method for improving bladder storage abnormalities in properly selected patients, enterocystoplasty is associated with a better storage function outcome.

Key Words: bladder, ureter, urodynamics, urinary diversion

Augmentation cystoplasty is recommended in patients with a poorly compliant bladder and high intravesical storage pressure refractory to medical treatment, and associated with progressive upper tract dilatation, renal function deterioration and/or urinary incontinence. Various materials are currently in use for bladder enlargement, including gastrointestinal segmentsm,[1,2] auto-augmentation,[3] ureteral tissue[4,5] and engineered tissue.[6] Of these options the most commonly used material for bladder reconstruction has been isolated segments of ileum or sigmoid by the addition of a simple patch of bowel into the bladder or by removing a portion of the vesical wall, followed by anastomosis of a reconfigured intestinal segment to the lower urinary tract. However, when bowel is incorporated into the urinary tract, many patients experience complications, including bowel obstruction, spontaneous perforation, mucous production, metabolic disturbances, stone formation and an increased risk of malignancy.

Thus, because of the problems inherent in contact between the intestinal epithelium and lower urinary tract, when a patient considered for bladder enlargement has a severely unilateral dilated ureter associated with a nonfunctioning kidney, some urologists developed an augmentation technique using the tortuous ureter.[4,5] This type of augmentation procedure avoids a substantial number of complications related to gastrointestinal cystoplasty.

To determine bladder function behavior in children treated with ureterocystoplasty as a single surgical procedure we retrospectively analyzed VUD findings before and after augmentation at our institution. We also compared VUD results and the overall continence outcome in the ureterocystoplasty group to those in a similar cohort of patients treated with ileocystoplasty who were assessed using the same urodynamic conditions.

MATERIALS AND METHODS

Between July 1977 and June 2003, 12 patients with severe bladder dysfunction underwent augmentation ureterocystoplasty (group 1) at our hospital. Four of these 12 patients were excluded from study because they were not evaluated preoperatively or postoperatively with VUD studies. The remaining 4 boys and 4 girls who had undergone at least 1 preoperative and postoperative VUD test were included in the study. Table 1 shows patient age at ureterocystoplasty and when they were tested urodynamically before and after surgery.

The underlying etiology of bladder dysfunction was myelomeningocele in 5 cases, posterior urethral valves in 1,

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bilateral ectopic ureteroceles in 1 and neuropathic bladder dysfunction secondary to imperforate anus in 1. Before surgery all except 1 patient had 1 dilated refluxing ureter (VUR) associated with a poorly or nonfunctioning kidney. The remaining patient had a unilateral nonrefluxing megaureter with a damaged ipsilateral kidney.

^{99m}Technetium dimercapto-succinic acid was used to measure relative renal function. Severe renal damage was defined as functional uptake lower than 10% on 1 side of total bilateral kidney function. Dilatation of the upper urinary tract was estimated by ultrasonography and categorized as present or absent. Table 2 shows surgical procedures done before ureterocystoplasty. The indications for ureterocystoplasty was a small capacity, noncompliant bladder unresponsive to medical treatment with progressive upper tract deterioration and/or urinary incontinence.

In all patients ureterocystoplasty was done through an extraperitoneal approach, beginning with standard flank nephrectomy of the nonfunctioning kidney, followed by ureteral division at the level of the ureteropelvic junction. Through an extended Pfannenstiel incision the bladder was opened and the ureter was mobilized into the pelvis based on the vascular supply provided by the gonadal arteries, the superior and inferior bladder vessels, and the internal iliac artery. Vascularization of the proximal ureter was ensured by arterial inflow via the rich adventitial collateral plexus. At this point the entire ureter was incised longitudinally, avoiding damage to its main blood supply, folded into a U-shaped flap and sutured to the opened bladder. A suprapubic cystostomy tube was placed for 2 weeks postoperatively.

VUD studies were performed on an outpatient basis, including simultaneous measurements of intravesical, intraabdominal and subtracted detrusor pressure with synchronous fluoroscopic monitoring of the lower urinary tract.[7] The bladder was filled through a transurethral catheter in 4 to 5 minutes with radiographic contrast material (iothalamate meglumine 17% solution) at room temperature.

Bladder capacity refers to CBC for age, expressed as a percent of expected bladder capacity according to the formula, 24.8 × age in years + 31.6 in boys and 22 × age in years + 37 in girls.[8] In neurologically normal children CBC was estimated as the volume in ml at which the child felt a strong desire to void or when spontaneous micturition occurred. In children without bladder sensation CBC was estimated as the bladder volume at which leakage occurred around the filling urethral catheter or when resting detrusor pressure increased to 30 cm water. If sphincteric function was inadequate, CBC was measured using a Foley catheter with the balloon occluding the bladder neck.

End filling detrusor pressure was correlated with normal CBC for age or in patients with a small capacity bladder to maximum bladder capacity. Compliance was calculated by the formula, bladder capacity in ml divided by end filling detrusor pressure in cm water. In our study simultaneously recorded video/pressure flow cystography permitted an approximate preoperative bladder volume calculation despite gross VUR.

After the bladder was filled with radiographic contrast material the fluoroscopic image of the lower urinary tract and refluxing ureter was displayed on the monitor with simultaneous display of urodynamic tracings. If spontaneous voiding was absent, the volume infused to the bladder was emptied during fluoroscopic screening through the transurethral catheter used for bladder filling. As soon as the radiographic contrast fluid trapped inside the refluxing ureter had drained to the bladder, it was measured by catheterization. The interval between these 2 steps was never longer than 5 minutes. Consequently estimated preoperative CBC was calculated from the total volume infused to the lower urinary tract minus the volume of fluid sequestered inside the refluxing ureter.

To analyze our results more accurately we compared preoperative and postoperative urodynamic data, and the continence outcome in patients with ureterocystoplasty (group 1) with those in 8 age matched patients, including 4 boys and 4 girls, who underwent ileocystoplasty (group 2) and were studied with the same urodynamic methodology. The underlying etiology of bladder dysfunction in the latter group was posterior urethral valves in 1 patient and myelomeningocele in 7. Indications for ileocystoplasty were progressive upper urinary tract deterioration and urinary incontinence in 4 patients, and urinary incontinence with a nondilated upper urinary tract in 4. Before enterocystoplasty all patients failed to respond to anticholinergic therapy and clean intermittent catheterization. Table 1 lists control group characteristics.

Median postoperative followup in groups 1 and 2 was 1.7 and 3.3 years, respectively. Data are reported as the mean and median ± SD or SE, when indicated, and range. The unpaired Student t test was used to analyze data with $p < 0.05$ considered significant.

TABLE 1. *Age at surgery and VUD testing before and after augmentation*

Pt Age	Median Yrs ± SE (range)	
	Ureterocystoplasty	Ileocystoplasty
At augmentation	6.0 ± 1.1 (2.9–13.2)	7.8 ± 1.0 (5.5–13.5)
At VUD study:		
Preop	5.5 ± 0.9 (2.0–11.5)	7.6 ± 0.9 (4.8–12.9)
Postop	7.3 ± 1.0 (5.7–13.6)	11.2 ± 1.0 (6.9–15.5)

TABLE 2. *Operations before augmentation*

	No. Ureterocystoplasty
Bilat ureterostomy	1
Vesicostomy*	2
Ureteroneocystostomy + ureterostomy closure	1
Ureteroneocystostomy + ureterocele resection	1
Transurethral resection of posterior urethral valves	1

* One patient with vesicostomy underwent ileocystoplasty.

RESULTS

Seven of the 8 group 1 patients underwent ureteral augmentation of an entirely dilated refluxing ureter and 1 underwent ureteral augmentation of a nonrefluxing megaureter. At presentation 3 group 1 patients had a bilateral dilated upper urinary tract and 5 had unilateral ureterohydronephrosis. After ureterocystoplasty upper tract dilatation was resolved in all except 1 patient by the end of followup.

In the ureterocystoplasty group median CBC for age before and after augmentation was 75% (range 10% to 92%)