



# Ureterocystoplasty in pediatric patients with unilateral nonfunctioning kidney

## *Tek taraflı nonfonksiyone böbrekli çocuk hastalarda üreterosistoplasti*

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### ABSTRACT

**Objective:** Bladder augmentation with uroepithelium lined material yields an absence of mucus production, with reduced possibility of urinary infection and lithiasis. The utilization of the ureter in augmentation cystoplasty results in a uroepithelium-lined neobladder with all of the appropriate histologic layers. The purpose of this study was to assess the efficacy and safety of ureterocystoplasty in children with a small bladder capacity and low bladder compliance.

**Material and methods:** Between January 1992 and August 2011, six females and eight males who were 3 to 13 years old (median age 6 years) and had a low-capacity, poorly compliant bladder underwent augmentation cystoplasty using dilated ureters. Unilateral non-functioning renal moiety draining into a massively dilated ureter was present in every patient. The etiology of hydroureteronephrosis was a neurogenic bladder secondary to meningomyelocele in five patients, a posterior urethral valve in four patients, an obstructive megaureter in three patients and ectopic obstructive ureterocele in two patients.

**Results:** Mean age was 6 years (3-13 y). Clinical improvement regarding the resolution of reflux, a better bladder capacity and improved compliance was achieved in every patient. The increase in bladder capacity ranged from 84 cc (30 to 200) to 235 cc (150 to 420), with a mean increase of 318% (210 to 500). Marked improvement in compliance was also observed (from 1.2 to 5.1 mL/cm H<sub>2</sub>O, mean 2.4, to 22 to 50 mL/cm H<sub>2</sub>O, mean 41). No uninhibited bladder contractions were detected during a urodynamic study at 12 months postoperatively.

**Conclusion:** In patients with a low-capacity, poorly compliant bladder, augmentation cystoplasty using the ureter seems to be a viable alternative. Ureterocystoplasty results in a large-capacity, high-compliance bladder, without metabolic and infective complications, compared with other techniques of augmentation cystoplasty.

**Key words:** Nonfunctioning kidney; pediatric; ureterocystoplasty.

### ÖZET

**Amaç:** Mesane ogmentasyonunda augmentasyon materyalinin üroepitel kaplı olması, mukus üretiminin yokluğu, taş, enfeksiyon gibi komplikasyonların düşüklüğü gibi yararlar ortaya çıkartır. Üreter, mesane augmentasyonunda kullanıldığında üroepitelyumla kaplı üriner sisteme uygun histolojik tabakalar içeren bir yeni mesane ile sonuçlanır. Bu çalışmada düşük kapasiteli ve düşük kompliance mesanesi olan çocuklarda üreterosistoplastinin uygun bir seçim olup olmadığı değerlendirilmiştir.

**Gereç ve yöntemler:** Kliniğimizde Ocak 1992 ile Aralık 2008 tarihleri arasında düşük kapasiteli ve düşük kompliance mesanesi olduğu saptanan 6 kız 8 erkek (toplam 14) hastaya üreterin tümü kullanılarak üreterosistoplasti uygulanmıştır. Hastaların tümünde şiddetle dilate olmuş üretere dirençli olan tek taraflı fonksiyonunu tamamen kaybetmiş böbrek ünitesi mevcuttur. Hidroüreteronefroz etiyolojisi olarak 5 hastada meningomyelocele ikincil nörojenik mesane, 4 hastada posterior üretral valv, 3 hastada obstrüktif megaüreter ve 2 hastada da ektopik obstrüktif üreterosel saptanmıştır.

**Bulgular:** Ortalama yaşı 6'dır (3-13 y). Ameliyat sonrasında hastalarda klinik düzelme sağlanmış, karşı tarafa olan reflü kaybolmuş, mesane kapasitesi artmış ve kompliance iyileşme olmuştur. Mesane kapasitesinde ortalama artış 84'ten (30-200 mL) 235 mL'ye (150-420 mL) şeklindedir (Ortalama %318 [%210-500]). Compliance iyileşme 1,2-5,1 mL/cmH<sub>2</sub>O'dan (ortalama 2,4), 22-50 mL/cmH<sub>2</sub>O'ya (ortalama 41) olmuştur. Augmentasyon sonrası 12. ayda yapılan ürodinamik incelemede inhibe edilemeyen detrusor kontraksiyonu saptanmamıştır.

**Sonuç:** Düşük kapasiteli ve düşük kompliance mesanesi olan ve hastalarda üreterosistoplasti uygun bir seçenek olarak görülmektedir. Diğer materyaller ile yapılan augmentasyon tekniklerine göre metabolik ve cerrahi komplikasyonlar çok daha azdır ve ürodinamik olarak tatmin edici sonuçlara ulaşılmaktadır.

**Anahtar sözcükler:** Çocuk; nonfonksiyone böbrek; üreterosistoplasti.

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## Introduction

In patients with a small-capacity, low-compliance bladder, augmentation cystoplasty provides an acceptable increase in bladder capacity. In children, certain benign diseases, such as neuropathic bladder dysfunction caused by congenital events, including meningomyelocele, require augmentation cystoplasty.<sup>[1]</sup> During childhood, severe vesicoureteral reflux bladder exstrophy and pelvic tumors requiring extensive excision also necessitate augmentation cystoplasty.<sup>[1]</sup> An artificial urinary sphincter and clean intermittent catheterization maintain continence and improve a patient's quality of life after augmentation cystoplasty.<sup>[1]</sup> The principal purpose of urinary reconstruction is to achieve sufficient bladder capacity and adequate bladder compliance. Augmentation cystoplasty is frequently preferred for urinary reconstruction for this purpose.<sup>[1]</sup>

Because intestinal segments have metabolic and infective disadvantages, the ureter is an eligible material for augmenting the bladder because this tissue mimics the normal bladder wall. Ureterocystoplasty has gained wide acceptance due to a lower complication rate compared with the use of intestinal segments.<sup>[2]</sup> However, the amount of available tissue surface is greatly variable, depending on the length and width of the ureteral patch.

A refluxing and/or obstructive megaureter features a satisfactory amount of tissue for bladder augmentation. Because the

number of patients with a non-functioning kidney draining into a megaureter is limited, ureterocystoplasty has been applied only in selected cases.<sup>[3]</sup>

We aimed to analyze the indications, complications and results of our series of augmentation ureterocystoplasties. Other types of ureterocystoplasties are also discussed.

## Material and methods

From January 1992 to August 2011, 14 ureterocystoplasties were performed in 14 patients, (six females and eight males) who were 3 to 13 years old (median age 6 years), at our center (Table 1). Written informed consent was obtained from patients who participated in this study. A urinary tract infection (UTI) associated with massive hydroureteronephrosis in a small-capacity, noncompliant bladder was the most common related symptom, present in 100% of cases. All patients had a massively dilated ureter and a non-functioning unilateral renal moiety. The etiology of hydroureteronephrosis was neurogenic bladder secondary to meningomyelocele in five patients, a posterior urethral valve (PUV) in four patients, an obstructive megaureter in three patients and ectopic obstructive ureterocele in two patients. Preoperative evaluation included urinary ultrasound, voiding cystourethrography, urodynamic analysis and a nuclear renal scan with <sup>99m</sup>technetium dimercapto-succinic acid (DMSA). Of the 14 patients, none had ipsilateral vesicoureteral reflux (VUR), and eight had contralateral VUR.

**Table 1. Summary of the patients with ureterocystoplasty**

Patients	Age	Sex	Primary cause	Incision	Improvement in bladder capacity (%)	Improvement in compliance (cc/cm H <sub>2</sub> O)
1	4	M	Neurogenic bladder	Midline	200	1.2 to 22
2	4	M	Neurogenic bladder	Midline	250	2.4 to 37
3	5	F	Megaureter	Extraperitoneal	300	2.6 to 47
4	9	M	PUV	Midline	250	2.1 to 39
5	3	F	Ureterocele	Extraperitoneal	50	2.2 to 31
6	13	M	PUV	Midline	350	5.1 to 50
7	6	M	PUV	Midline	300	3.2 to 38
8	4	F	Ureterocele	Extraperitoneal	200	3.2 to 45
9	5	M	Megaureter	Extraperitoneal	250	1.9 to 44
10	3	F	Neurogenic bladder	Midline	200	2.8 to 38
11	8	M	PUV	Midline	250	1.7 to 45
12	5	M	Neurogenic bladder	Midline	200	2.9 to 38
13	6	F	Megaureter	Extraperitoneal	250	2.0 to 48
14	9	F	Neurogenic bladder	Midline	350	1.5 to 50

PUV: Posterior urethral valve  
Improvement: Percentage increase in bladder capacity and compliance

The primary approach consisted of UTI treatment. Infection was proven by urinary culture. All of the patients were followed up by regular urine microscopy and urine cultures. Suppressive antibiotics (ampicillin, tmp-smx) were used during the preoperative period. All operations were performed after obtaining sterile urine cultures.

The decision of ureterocystoplasty was performed according to the existence of a poorly compliant bladder with a low capacity associated with hydroureteronephrosis.

The operative technique included ureterocystoplasty using a complete ureter associated with simultaneous ipsilateral nephrectomy. A midline incision was used in nine patients who required the Mitrofanoff procedure. The other five patients' operations were performed through an extraperitoneal approach with two incisions. Great efforts were made to avoid damaging the distal ureteral circulation by not dividing the ureterovesical junction.

The length of the ureter for augmentation ranged from 8 to 16 cm in length (mean 12) and 1.0 to 3.2 cm in width (mean 1.8). The diameter of the ureter was determined during ultrasonographic evaluation, and the length was measured during the operation.

During the surgical procedure, the distal part of the ureter and hiatus were left intact to preserve the blood vessels. The ureter was mobilized and detubularized along the antimesenteric border. The detubularized ureter was folded and structured into a patch and anastomosed to the either sagittally or transversally opened bladder. The neobladder was drained via a suprapubic cystostomy tube for 10 days postoperatively. The contralateral ureter was catheterized regardless of whether re-implantation was performed. The ureteral catheters were removed on the fifth day after the operation.

Anticholinergic drugs were routinely given to all patients in the postoperative period. The dose of anticholinergics was gradually decreased to zero after all catheters were removed.

During follow-up, the patients were evaluated clinically and radiologically at the third postoperative month and twice per year. Ultrasonography, cystography, a urodynamic study and renal scans were performed during follow up.

### Statistical analysis

Significant differences between groups were evaluated with the Kruskal-Wallis test. Significance was defined as  $p < 0.01$ .

## Results

Bladder capacity increased and end-filling pressure decreased (improved compliance) significantly in all patients. Contralateral

reflux was resolved in six patients, and an increase in bladder capacity and improvement in compliance were observed in 14 patients. All patients experienced the sensation of reservoir fullness. Improvement in bladder capacity and compliance was significant in all patients (Table 1). The median capacity of the bladder increased from 80 cc (range: 30 to 200) to 310 cc (range: 150 to 420), with a mean increase of 250% (range: 50 to 350) ( $p < 0.01$ ). Compliance improved (from 1.2 to 5.1 cc/cm  $H_2O$ , mean 2.4, to 22 to 50 cc/cm  $H_2O$ , mean 41) ( $p < 0.01$ ), and no uninhibited bladder contractions were detected at 6 months postoperatively (Table 1).

Only three patients (21%) voided spontaneously using abdominal contraction, with insignificant residual urine (less than 10% bladder capacity) without any catheterization. Clean intermittent catheterization was performed through the patients' own urethras in six cases (43%) and through a Mitrofanoff stoma in five patients (36%).

There was no difference between neurogenic bladders, megaureters and PUVs regarding success (mean improvement of 240%, 266% and 287%, respectively). However, in patients with ureterocele, the mean improvement in bladder capacity was nearly half of that observed with other pathologies (mean 125%).

Minor complications were encountered in the early postoperative period. These complications were urine leakage via a Penrose drain in four patients, which ceased spontaneously; wound infection in three patients; and ileus in one patient. The wound infection was treated with antibiotics. Ileus was resolved without intervention.

The follow-up ranged from 12 to 60 months (mean 37 months). There was no mortality. During follow-up, three patients who had not required a contralateral antireflux procedure suffered from contralateral VUR. Two patients required open ureteroneocystostomy, and one patient required subureteric injection. Three patients had a catheterization problem via Mitrofanoff, and one of these patients underwent a revision operation. The other two patients continued catheterization via the urethra. None of these 14 patients required further augmentation surgery.

During long-term follow-up, the bladder capacities did not change. In five patients, compliance decreased slightly (10 to 20%). In the other nine patients, no difference was encountered in term of compliance. Voiding status (e.g., Crede, catheterization) did not change during that time.

## Discussion

A bladder with a low capacity and poor compliance decreases the quality of life of patients. Augmentation cystoplasty increas-

es the compliance and capacity of the bladder in adult and pediatric patients with a poorly compliant, low-capacity bladder.

In bladder augmentation, gastrointestinal segments, and particularly segments of the stomach, ileum, sigmoid or colon, have been the most commonly preferred materials since the late 1950s.<sup>[4]</sup> Intestinal segments are not completely appropriate for cystoplasty. The ileum is generally favored because of its lower incidence of mass peristaltic contractions compared with the colon. The use of stomach in children is controversial. In patients with gastrocystoplasty, hematuria-dysuria syndrome results in severe discomfort if the patients have urethral sensation and bladder neck incompetence. Gastric augmentation may be preferred, particularly to prevent acidosis. However, in patients with renal failure, this procedure may not be beneficial. Moreover, the gastric patch may be shrunk secondary to ulceration and fibrosis in certain patients. Although the colon seems to be an ideal cystoplasty material among gastrointestinal segments, excessive mucus production, urolithiasis and infection are the inevitable disadvantages of colocolocystoplasty. In summary, the most common long-term complications due to intestinal segments are repeat urinary infections, bladder stones, mucus production, intestinal absorption disorders, a perforated bladder, the appearance of second tumors and metabolic disorders.

Ureterocystoplasty is a reasonable choice for patients with a small-capacity, poorly compliant urinary bladder and a unilateral poorly functioning kidney and megaureter. The ureter's mucosal lining has the great advantage of being non-secretory and free from the metabolic complications of enterocystoplasty, such as acidosis. Ureterocystoplasty is primarily performed in children. Eckstein and Martin described the extraperitoneal removal of a poorly functioning left kidney from an infant who was 7 months old. The authors opened the bladder transversely to enable anastomosis of the longitudinally incised ureter.<sup>[5]</sup> However, ureterocystoplasty did not become popular until the procedure was described by other surgeons.<sup>[6-9]</sup> Certain investigators have used the dilated part of the ureter to perform ureterocystoplasty in patients with a hydronephrotic, nonfunctioning renal unit. These researchers excised the ipsilateral kidney or performed a transuretero-ureterostomy if the kidney was worth saving.<sup>[10,11]</sup> The blood supply to the megaureter should be preserved for a successful outcome.

The major drawback of using the ureter in augmentation cystoplasty is the paucity of patients who have both a megaureter and a nonfunctioning kidney. However, it has been shown in an animal model that it is possible to experimentally dilate a normal ureter and successfully use this tissue for bladder augmentation.<sup>[12]</sup>

The major advantages of bladder augmentation with uroepithelium are mainly related to the absence of mucus production,

with a decreased likelihood of urinary infection and lithiasis. Because the augmentation material contains no heterotopic tissue, the reported risk of late bladder neoplasia in enterocystoplasty must theoretically be decreased.<sup>[13,14]</sup> The most important concern regarding ureteral tissue is that a large enough ureter is not always available for proper bladder augmentation.

Taghizadeh et al.<sup>[15]</sup> observed that the median proportional increase in bladder capacity was 226% of the original capacity and that the median postoperative capacity was 312 cc and ranged from 110-450 cc following ureterocystoplasty in a multi-institutional study.

In the 14 patients on whom we performed ureterocystoplasty at our clinic, good bladder augmentation results (i.e., increased bladder capacity and maintained low bladder pressures) were achieved in all children who were followed up; no serious complications were encountered in any of the patients. After ureterocystoplasty, a notable increase in bladder capacity and decrease in end-filling pressure (improvement in compliance) were obtained. Nephrectomy is not always necessary for ureterocystoplasty.

Perovic et al.<sup>[10]</sup> performed ureterocystoplasty with preservation of the ipsilateral kidney by dividing the megaureter and using the distal part for ureterocystoplasty and the proximal part for re-implantation into the bladder. In patients with a functioning ipsilateral renal unit, distal ureterocystoplasty and transuretero-ureterostomy can be performed.<sup>[16]</sup> "Teapot" ureterocystoplasty is also suitable for patients with massively dilated ureters and functioning kidneys.<sup>[17]</sup> Ahmed et al.<sup>[18]</sup> also described the tandem use of bilateral megaureters for ureterocystoplasty.

Our study presents limitations, as it is a retrospective and descriptive study with a limited number of patients.

The described ureterocystoplasty using a detubularized, reconfigured megaureter allows the bladder to be desirably enlarged and the ultimate neobladder to be lined by uroepithelium and supported by urinary smooth muscle, both of which are served by a preserved blood supply. However, recently, ureterocystoplasty has been reserved for selected patients who have the unique appropriate anatomy, and most commonly, unilateral VUR and dysplasia (VURD) syndrome.

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#### Conflict of Interest

No conflict of interest was declared by the authors.

**Peer-review:** Externally peer-reviewed.

**Informed Consent:** Written informed consent was obtained from patients who participated in this study.

**Author Contributions**

Concept - T.Ö.; Design - T.Ö.; Supervision - A.A.; Funding - T.Ö.; Materials - T.Ö.; Data Collection and/or Processing - T.Ö.; Analysis and/or Interpretation - T.Ö.; Literature Review - T.Ö.; Writer - T.Ö.; Critical Review - A.A.

**Çıkar Çatışması**

Yazarlar herhangi bir çıkar çatışması bildirmemişlerdir.

**Hakem değerlendirmesi:** Dış bağımsız.

**Hasta Onamı:** Yazılı hasta onamı bu çalışmaya katılan hastalardan alınmıştır.

**Yazar Katkıları**

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