Ureterocystoplasty

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Augmentation cystoplasty is the treatment of choice for the hyperreflexic, poorly compliant bladder unresponsive to medical treatment.[1] While the etiology for such bladders is multiple, the clinical manifestations are few and include urinary incontinence, urinary tract infections, and upper tract deterioration. When such bladders are accompanied by hydroureteronephrosis with or without reflux, the dilated ureter and pelvis may be used to augment the bladder.

Ureterocystoplasty is rapidly gaining acceptance among pediatric urologic surgeons.[2-5] Dilated ureter is clearly the best tissue available for augmentation. It is lined with transitional cell epithelium, and the muscular backing provides the necessary properties for a compliant reservoir. The lack of mucous production and absorptive or secretory properties of urothelium prevents some of the most common problems encountered with other forms of augmentation cystoplasty (e.g., metabolic abnormalities, mucous production, lithiasis, and recurrent infections).[6,7] The use of urothelium also eliminates the long-term concern of malignant degeneration of bowel used in augmentation.

The indications for this novel approach are still evolving. It was initially suggested that the entire ureter and pelvis were needed for a successful augmentation, limiting this procedure to patients with a dilated nonfunctioning renal unit.[2,4] New reports show, however, that it may be possible in certain cases to preserve the ipsilateral functioning renal unit while using the mid and distal ureter for augmentation.[5] In such cases, a transureteroureterostomy (TUU) or other creative alternatives become necessary. In addition, in selected cases of bilateral moderate ureterohydronephrosis where the use of one ureter would be inadequate to augment the bladder sufficiently, both ureters can be utilized.

In our institution, 7 cases of ureterocystoplasty were performed with preservation of the ipsilateral functioning renal unit in 5 patients, including 2 patients in whom bilateral ureterocystoplasty was performed. Representative case histories with a description of the surgical technique of unilateral and bilateral ureteral bladder augmentation are presented.

CASE HISTORIES

Case No. 1

NR is a 5-year-old female myelomeningocele patient with a history of

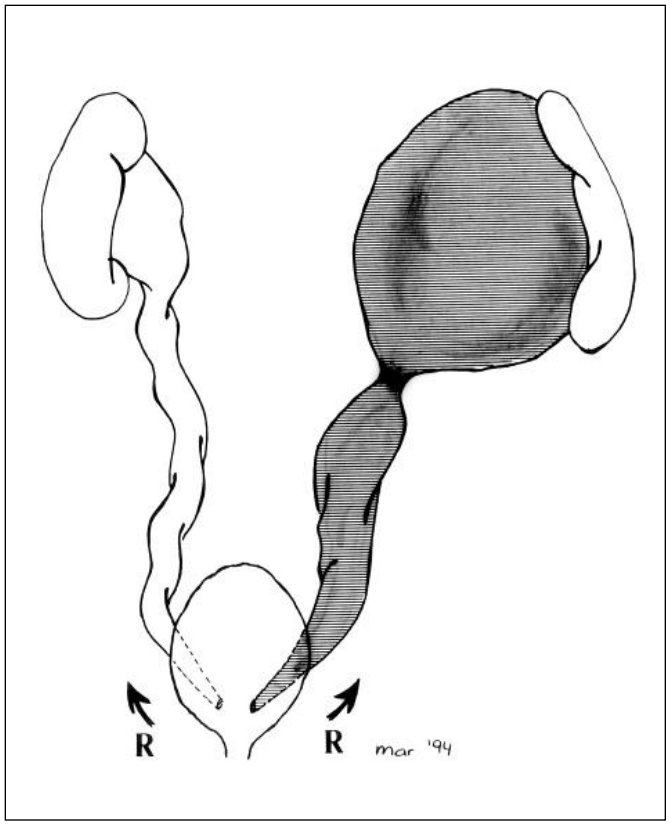

Figure 1. Patient NR: preoperative findings included low-capacity, noncompliant bladder with bilateral high-grade vesicoureteral reflux, left ureteropelvic junction obstruction, and left nonfunctioning kidney.

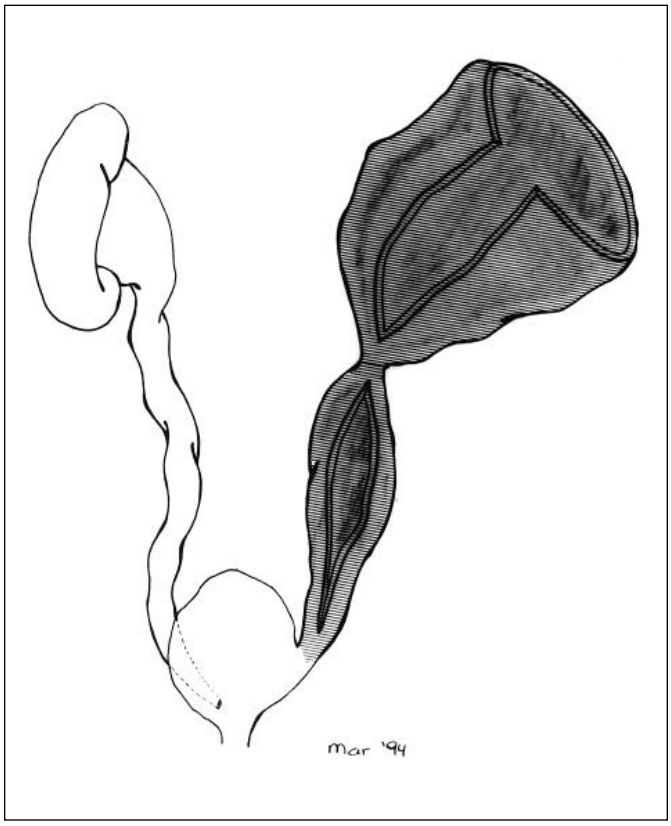

Figure 2. Patient NR: left nephrectomy was performed, and the left renal pelvis and ureter were detubularized.

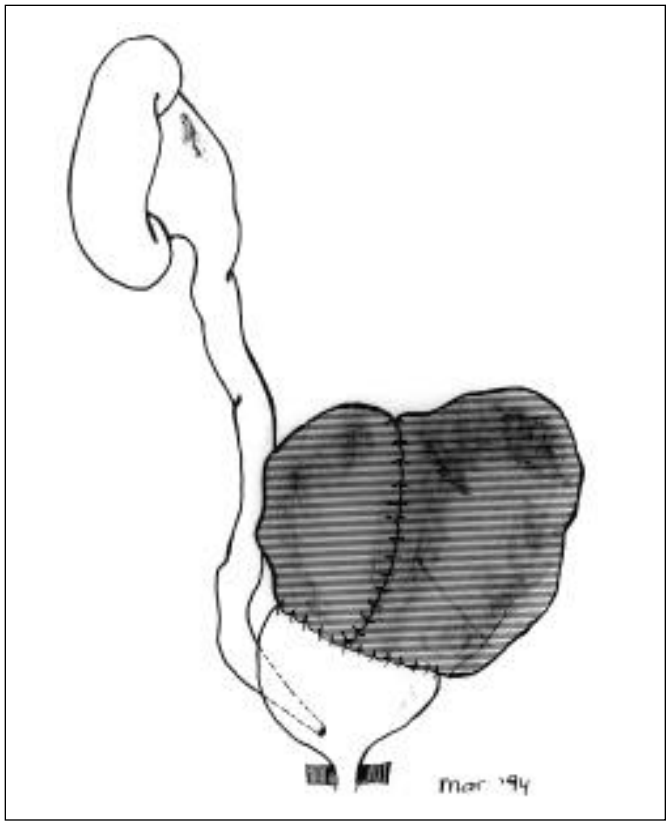

Figure 3. Patient NR: completed reconstruction after ureterocystoplasty, right ureteral reimplantation and bladder neck sling.

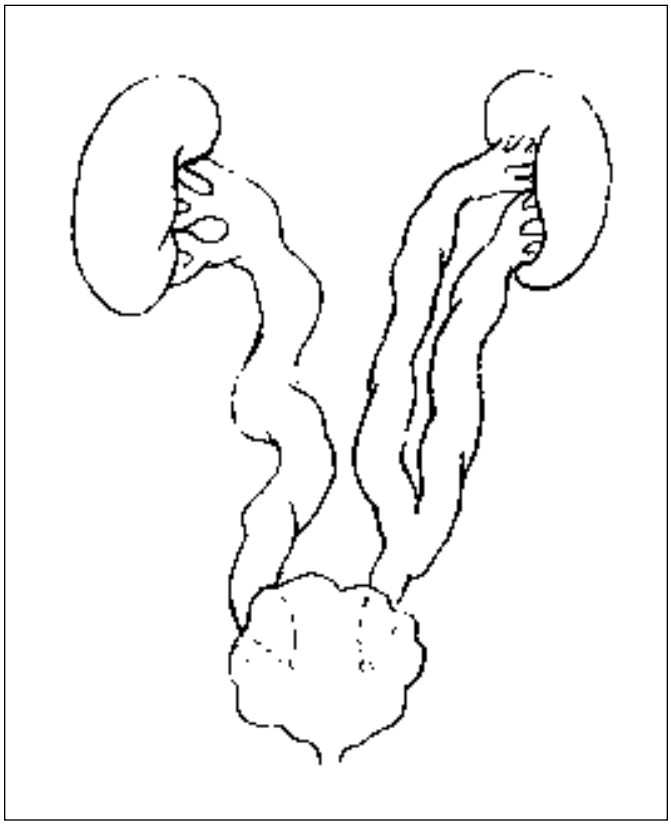

Figure 4. Patient CI: operative findings included low-capacity, noncompliant bladder, moderate bilateral hydroureteronephrosis, and incomplete duplication of the left collecting system.

bilateral grade 5/5 vesicoureteral reflux (VUR) and a left ureteropelvic junction obstruction who was referred for reconstruction. She had a vesicostomy and a hydronephrotic nonfunctioning left kidney. Videourodynamics revealed a very small-capacity and noncompliant bladder, incompetent bladder neck, grade 4/5 right VUR, and severe left VUR up to the obstructed ureteropelvic junction. We decided to perform a bladder augmentation utilizing the left ureter and renal pelvis with excision of the nonfunctioning renal parenchyma. Other adjunctive procedures included a right ureteral reimplantation, appendiceal Mitrofanoff, and bladder neck sling.

Case No. 2

CI is a 34-year-old man who presented with a small trabeculated, thick-walled bladder secondary to longstanding obstruction from posterior urethral valves. He had severe bilateral hydroureteronephrosis, grade-5 right VUR, and renal insufficiency. 99m technetium mercaptoacetyltriglycine (MAG-3) renal scan revealed poor function of the right kidney and moderate function of the left kidney. On videourodynamics, the bladder had a capacity of 100 cc, poor com-

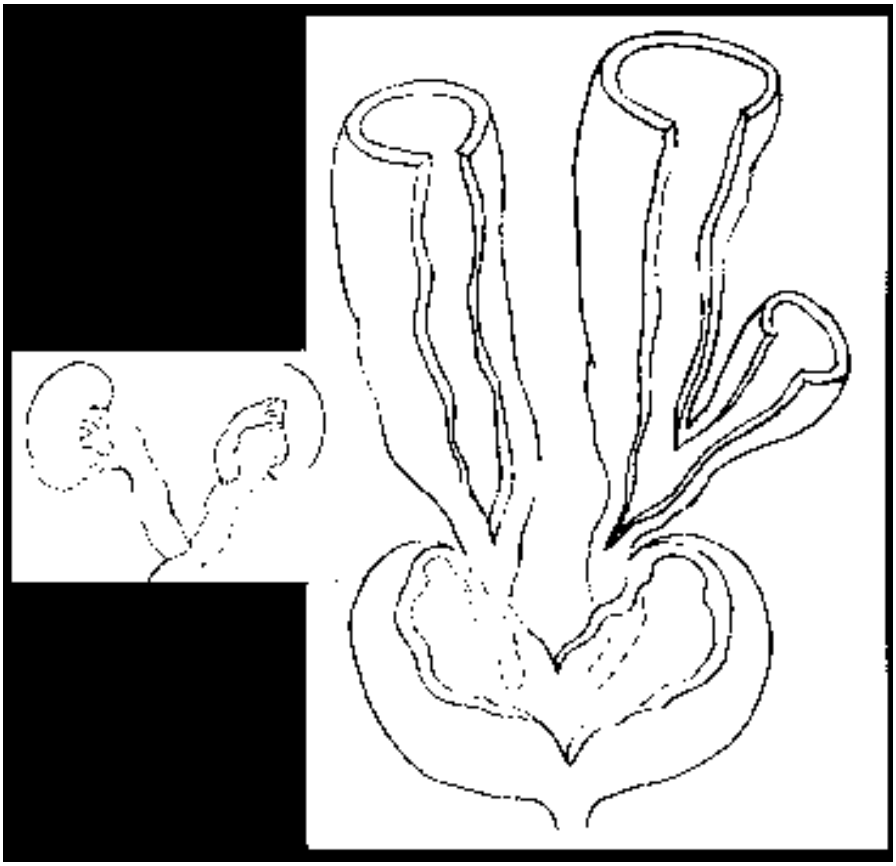

Figure 5. Patient CI: both ureters are transected as indicated. Left upper to lower ureteropyelostomy and right to lower left transureteroureterostomy is performed. The right and the remaining duplicated left ureters are detubularized and used to augment the bladder.

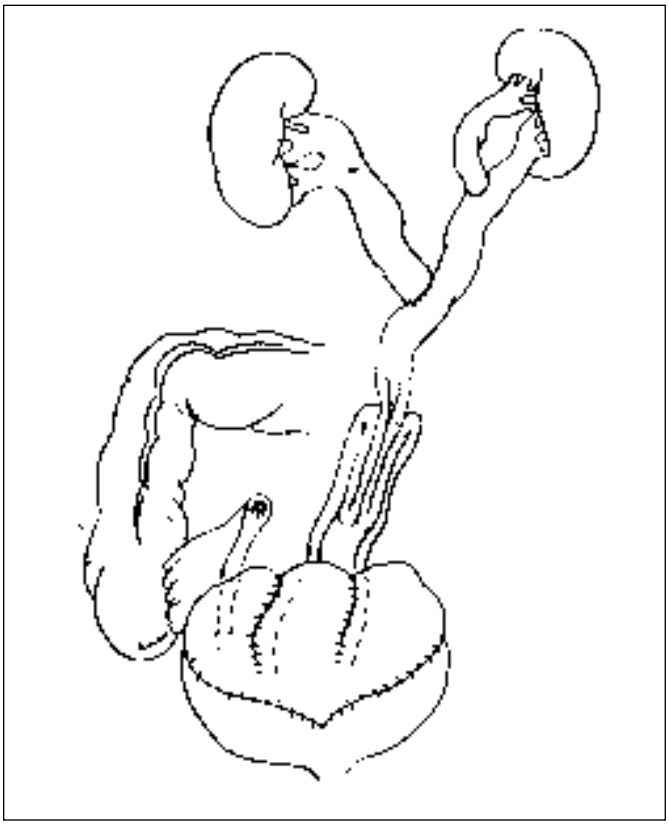

Figure 6. Patient CI: the reconstructed upper tracts are reimplanted into the bladder using an interposition of ileum with ileal antireflux nipple.

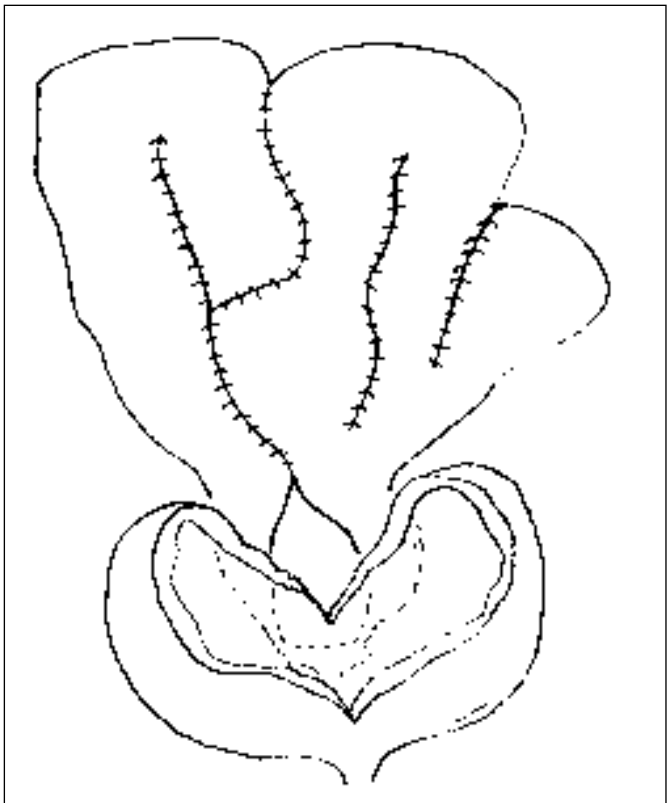

Figure 7. Patient CI: the detubularized ureters are reconfigured into a patch. The distal ureteral segments are not detubularized, giving the appearance of a "handle" coming off the posterior bladder wall.

Table 1. Urodynamics data before and after augmentation

	PREOPERATIVE					POSTOPERATIVE				
	CONT	CIC	CAPAC	EFDP	COMP	CONT	CIC	CAPAC	EFDP	COMP
1. AH	y	y	200	50	4	y	y	280	2	140
2. AG	y	n	400	45	8.8	y	n	500	38	13
3. CI***	*	-	100	100	1	y	y	900	10	90
4. EM	y	y	230	40	5.8	y	n	900	10	90
5. NR	**	-	30	30	1	y	y	250	15	17
6. LR	n	y	160	80	2	y	y	400	38	10.5
7. JD***	n	y	100	100	1	y	y	400	30	13
total (mean)			174	63	3.4			518	20	54

* Indwelling foley
** Vesicostomy
*** Bilateral ureterocystoplasty

pliance, and massive right VUR. We decided to perform an augmentation cystoplasty utilizing the dilated ureter. Because of the deterioration of his renal function, preservation of both kidneys was indicated. Upon exploration, an unexpected incomplete duplication of the left collecting system was found. A left upper to lower ureteropyelostomy and right to lower left TUU was performed which allowed for a bilateral ureterocystoplasty. In addition, an ileal antireflux nipple was interposed between the bladder and ureter and an appendiceal Mitrofanoff was performed.

SURGICAL TECHNIQUE

Unilateral Ureterocystoplasty

A standard abdominal midline supra- and infraumbilical incision is used. Exposure of the retroperitoneal space is obtained extraperitoneally when the ipsilateral kidney is nonfunctioning and we plan to perform a concomitant nephrectomy. A second subcostal or flank incision is usually necessary for the nephrectomy. When the ipsilateral kidney is functioning the approach is transperitoneal since a TUU becomes necessary. The tortuous dilated ipsilateral ureter is mobilized, preserving the collateral vascular supply from all sources and avoiding its dissection from the gonadal vessels (Fig. 1). Ipsilateral nephrectomy is performed at this time, preserving the renal pelvis and proximal ureter. In cases of good ipsilateral renal function, preservation of kidney is indicated. This is usually accomplished with a TUU or, in rare cases, by reimplantation of the proximal ipsilateral ureter directly into the bladder. In most cases, a TUU is preferable since it allows for a much larger segment of distal ureter to be used for augmentation. The TUU is performed as high as possible to preserve the maximum amount of ureter for the cystoplasty. A contralateral ureteral reimplantation is performed if there is VUR. The remaining ipsilateral ureter is then detubularized along its anterolateral aspect avoiding spiraling the incision. The bladder is opened in an eccentric fashion from the ipsilateral ureteral orifice, extending horizontally over the dome of the bladder (Fig. 2). The ureter is then reconfigured into a patch and anastomosed to the bladder, completing the ureterocystoplasty (Fig. 3). Other adjunctive procedures are performed as needed.

Bilateral Ureterocystoplasty

Bilateral ureterocystoplasty should be considered in selected cases where both ureters are dilated and tortuous but the bladder is too small to be successfully augmented with just one ureter (Fig. 4). Both ureters are carefully dissected free preserving their blood supply. They are then transected as high as possible to allow for maximum tissue for augmentation but with enough proximal length to allow a tensionless upper tract reconstruction and bladder anastomosis. In this case, the left collecting system had an incomplete duplication, and an upper to lower ureteropyelostomy was performed. This allowed the distal duplicated ureter to be used for augmentation. A TUU and a single ureteral reimplantation into the posterior bladder flap are performed (Fig. 5). Because of the severe hydroureter, reimplantation was performed using an ileal antireflux nipple (Fig. 6). Variations of the surgical technique utilized for bilateral cases hinge on the type of bladder incision performed. When the bladder is incised in an anteroposterior fashion, the ureters must be detubularized to a distance of about 4 or 5 cm from the ureteral orifices, joined in the midline, and reconfigured into a patch which is then anastomosed to the bladder. This leaves the distal ureter tubularized giving the appearance of a "handle" coming off the posterior bladder wall (Fig. 7). The main disadvantage of this technique is that it does not maximize the amount of ureter reconfigured into a patch. The alternative is to perform the bladder incision from one ureteral orifice, across the bladder dome, to the contralateral ureteral orifice. The ureter may then be detubularized all the way down to the ureterovesical junction on both sides. It is important

to avoid dissecting the peritoneum off the bladder dome and posterior bladder wall to prevent vascular compromise to the large posterior bladder flap.

OVERALL RESULTS

Patients ranged from 4 to 34 years of age (mean: l3 years) and included four females and three males. The diagnoses were various, including myelodysplasia (2), posterior urethral valves (2), non-neurogenic neurogenic bladder (1), and two patients with high-pressure bladders and upper tract deterioration of uncertain etiology (both with previous history of anoxic brain injury). Two patients had chronic renal insufficiency, including one with end-stage renal failure on hemodialysis. Five patients had bilateral functioning kidneys.

Patient follow-up ranged from 6 to 24 months. The only surgical complication was a temporary ureterovesical anastomotic obstruction due to edema that required placement of a double J ureteral stent (patient JD). The stent was removed eight weeks later without sequelae. All patients are continent postoperatively. Two patients empty their bladder by voluntary voiding, four patients require CIC, and one patient uses a combination of both.

Renal function as assessed by serum creatinine remained stable in all patients. In the five patients in which the ipsilateral functioning kidney was preserved, renal nuclear studies revealed no loss of relative function.

Cystograms were performed on all patients as part of the postoperative videourodynamic study and revealed no vesicoureteral reflux in any patient. Renal ultrasound revealed resolution or improvement of hydronephrosis in all patients. There was no progression in renal parenchymal loss.

Preoperative bladder capacity ranged from 30 to 400 cc with an average of 174 cc (Table 1). Compliance was universally poor, ranging from 1.0 to 8.8 cc/cm H_20 with an average of 3.4 cc/c H_20. Bladder capacity increased threefold to an average of 518 cc. Compliance increased almost sixteenfold to 54 cc/cm H_20. No patients had uninhibited bladder contractions after augmentation. Pre- and postoperative urodynamic data obtained in all seven patients is outlined in Table 1.

DISCUSSION

In selected patients with dilated upper tract collecting systems, the use of ureter for bladder augmentation is a good choice. Our short-term results have been excellent, providing good bladder capacity and compliance without encountering the common problems of metabolic disturbance and mucous production seen when one uses bowel or stomach for augmentation. The malignant degeneration potential should not be a factor when one uses ureter. In addition, the gastrointestinal tract is not disrupted, resulting in quicker return of normal bowel function and decreasing the risk of bowel obstruction postoperatively.

The indications for the use of ureter are still evolving and controversy remains over patient selection. Initial reports suggested the need to use the entire ureter and pelvis of a nonfunctioning kidney for the procedure to be successful.[2,4] However, in patients with bilateral renal function, it is possible to preserve both kidneys, as confirmed by our series and others.[5] There are two alternatives when dealing with the proximal ureter of a functional kidney after unilateral ureterocystoplasty. The ureter may be directly reimplanted into the bladder or a TUU may be performed.[2] We prefer the latter since it allows for a much longer segment of distal ureter to be used for augmentation. The TUU must be performed as proximal as possible, and it often helps to partially mobilize the contralateral ureter, which is often dilated and tortuous, and bring it medially to minimize the distance between them.

In instances of bilateral moderate ureterohydronephrosis in which one ureter is inadequate to augment the bladder sufficiently, both ureters may be utilized. Preservation of the kidneys in bilateral ureterocystoplasty entails either direct reimplantation of both proximal ureters or, alternatively, reimplantation of one ureter in combination with TUU.

Depending on the upper tract anatomy, creative reconstructions can be used for augmentation. In two of our cases, a partial ureteral duplication was present, allowing us to use a larger ureteral surface for augmentation by performing an upper to lower ureteropyelostomy in combination with a TUU.

In addition, because contamination from bowel is avoided when ureter instead of bowel is used for augmentation, simultaneous renal transplant and cystoplasty are possible. We have successfully combined the two procedures in one of our patients with ESRD and a neurogenic bladder, preventing the necessity of two major operations.

CONCLUSIONS

Ureterocystoplasty has proven to be successful in select patients who need bladder augmentation. Ureter provides certain advantages over the conventional bladder augmentations but requires an adequately dilated upper collecting system. Initial reports emphasized the use of ureter from a nonfunctioning kidney but patient selection is evolving. In selected patients with bilateral renal function, we have shown that ureterocystoplasty can be safely performed with preservation of both kidneys. STI

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