Ureteral Replacement and Onlay Repair with Reconfigured Intestinal Segments

Raul Ordorica,* Lucas R. Wiegand, J. Christopher Webster and Jorge L. Lockhart

From the University of South Florida, Tampa, Florida

Accepted for publication November 11, 2013.

* Correspondence: Department of Urology, University of South Florida, 2 TGH Cir., 6th Floor, Tampa, Florida 33606 (telephone: 813-259-8645; FAX: 813-259-0852; e-mail: rordoric@health.usf.edu).

Purpose: Ureteral loss represents a surgical challenge to provide low pressure drainage while avoiding urinary stasis and reflux. The ideal replacement should optimize drainage while minimizing absorption, allowing for ureteral repair of varied lengths and locations with maximal preservation of the urinary tract. We reviewed our experience with ureteral repair, focusing on the use of reconfigured intestine. We report what is to our knowledge the novel use of reconfigured intestine as an onlay flap on the preserved ureteral segment and as a circumferential interpositioned segment.

Materials and Methods: A total of 16 ureters were repaired in 4 men and 9 women using reconfigured ileum, colon or appendix. Mean patient age was 45 years (range 26 to 66). The etiology of the ureteral defect was iatrogenic in 8 patients, retroperitoneal fibrosis in 3, trauma in 3 and ureteritis cystica in 1. Mean defect length was 10 cm (range 5 to 20) in the 10 right and 6 left ureters, and the defect was proximal in 3, mid in 4, distal in 7 and panureteral in 2. Ureteral replacement was performed using a segment of ileum in 13 cases or colon in 1. The segment was detubularized and reconfigured according to the Yang-Monti principle and used as a complete retubularized interposed segment in 7 cases or as an onlay flap on the opened ureter without resection in 7. Also, 2 ureters were reconstructed with an incised appendiceal flap onlayed over the preserved ureteral plate. At a mean followup of 44 months (range 12 to 78) all patients underwent antegrade nephrostogram, followed by renal scan and upper tract imaging.

Results: All patients tolerated the procedure without initial bowel or urinary tract complications. In 1 patient who had received radiation a ureteral fistula developed to a blind Hartmann pouch at 9 months, requiring repair. Ultimately, cystectomy was done for irradiation cystitis (onlay group). Another patient with bilateral obstruction at presentation lost unilateral renal function during 5 years. Urinary drainage was achieved in all 14 remaining renal units with preservation of function, as shown on renal scan. Patients reported minor mucous production without renal colic or stone formation.

Conclusions: Long ureteral defects require tissue replacement when bladder flaps do not suffice. Ureteral replacement can be achieved by reconfigured intestinal segments, which are readily mobilized and secured as interposed segments or as an onlay flap on the preserved ureter. A relatively short segment can be used to repair a lengthy defect along any segment of ureter, also allowing for nonrefluxing reimplantation.

Key Words: ureter; wounds and injuries; intestines; transplantation, autologous; surgical flaps

0022-5347/14/1915-1301/0
THE JOURNAL OF UROLOGY®

http://dx.doi.org/10.1016/j.juro.2013.11.027
Vol. 191, 1301-1306, May 2014
Printed in U.S.A.

URETERAL reconstruction for ureteral injury and stricture may require replacement with nonureteral tissue depending on the length and location of the affected ureter along with the availability of alternative tissues. While short defects may be amenable to primary anastomosis and longer distal segments can be reconstructed using bladder flaps or by transureteroureterostomy, such reconstruction methods have inherent limitations that are dictated by the available ureter and bladder. More extensive defects may require replacing the ureter with bowel or bypassing the defect with renal autotransplantation.[1,2] Typical bowel interposition results in a relatively large caliber urinary column placed in an isoperistaltic direction, which is continued to the bladder by the creation of an open refluxing hiatus or less commonly by a nonrefluxing nipple valve.[3,4] While ileal interposition may be suitable for the aggressive stone former, it is a rather broad solution for patients who do not otherwise require large caliber drainage with potential metabolic implications.

Methods of small caliber bowel interposition include appendix for limited right mid ureteral defects.[5] Although reconfigured intestine is more commonly used to form catheterizable segments, it was also described for ureteral replacement.[6–8] Obliterated or cancerous segments may require complete replacement with end-to-end anastomosis but ureteral segments in the absence of malignancy can be preserved and used as a "ureteral plate" on which the bowel segment is onlayed. This ureteral preservation may provide urinary drainage that maximizes urinary tract integrity and most closely mimics normal anatomy. We present our experience with intestinal segments used for ureteral reconstruction as an onlay flap preserving the ureteral plate, and with circumferential interposition of the reconfigured bowel segment.

METHODS

Four men and 9 women had significant ureteral stricture or loss not amenable to repair using primary ureteral anastomosis or a bladder flap (table 1). Malignancy was involved in 5 patients (6 ureters), of whom 4 had received radiation (5 ureters), while the remainder had a benign condition. Seven ureters showed complete loss of the involved segment (4) or the opened ureteral segment was deemed not suitable to form a plate for onlay of the reconfigured bowel (3). The remaining 9 ureters were considered adequate to remain in situ as a ureteral plate after they were opened along the length of the stricture. All patients had experienced ureteral stenting with varying attempts at endoscopic management. One patient with a history of retroperitoneal fibrosis was treated with prior ureterolysis and omental wrapping for bilateral ureters.

Table 1. *Patient demographics*

No. Pt—Age	Side	Stricture Site	Length (cm)	Etiology
1—40	Rt	Proximal*	8	Trauma (motor vehicle accident)
2—50	Lt	Proximal*	5	Stone
3—57	Rt/lt	Proximal*/mid†	5/8	Retroperitoneal fibrosis
4—26	Rt	Mid†	5	Stone
5—55	Lt	Mid†	6	Retroperitoneal fibrosis
6—30	Rt	Mid†	6	Trauma (motor vehicle accident)
8—43	Rt/lt	Distal/distal‡	10/10	Cervical Ca, radiation
9—66	Rt	Distal‡	10	Rectal Ca, radiation
10—44	Lt	Distal‡	11	Baseloid Ca, radiation
11—27	Rt	Distal‡	14	Trauma (gunshot wound)
12—47	Rt	Distal‡	10	Cervical Ca, radiation
13—54	Rt	Distal‡	10	Vaginal Ca, radiation
14—45	Rt/lt	Panureteral/ panureteral	20/20	Ureteritis cystica/cystitis cystica

* Extending from renal pelvis.
† At or above pelvic brim.
‡ Extending proximally from bladder.

All patients underwent preoperative nuclear scan renography with low pressure drainage along with serum creatinine measurement to assess renal function and ensure adequacy to substantiate repair. Renal units were considered for repair when relative function on nuclear renography was a minimum of 20%. Involved renal units underwent ureteral stent removal with provision for nephrostomy tube drainage for at least 1 month before repair to minimize ureteral inflammation. Antegrade and retrograde contrast studies were repeated at repair to assess the length and location of the narrowed or obliterated ureter.

In patients with intact distal ureteral segments retrograde ureteral catheters were placed, approaching the affected segment performed at the time of repair, to assist in localizing the defect. Ureteral exposure was provided by a midline incision with access to the entire ureter and bowel, as required. The involved ureteral segment was left in situ and incised along the length of the stricture to determine the optimal repair method (fig. 1, *A*). Patients were considered for ureteral replacement when extensive ureteral segments were involved that could not be bridged due to location, length, lack of contralateral ureteral tissue for transureteroureterostomy, or an inadequate or compromised bladder (table 2). If the involved ureteral segments were considered adequate to remain as a ureteral plate, onlay was performed but otherwise ureteral segments deemed insufficient were excised for replacement.

Ureteral repair was performed using reconfigured detubularized segments of small bowel in 13 cases, colon in 1 and appendix in 2. Ureteral onlay repair required an intestinal strip 1 cm wide in 9 ureters (fig. 1, *B*). In contrast, complete tubularized replacement required a segment 2.0 cm wide in 7 ureters. A simple detubularized ileal segment provided for a ureteral repair of up to 6 cm long and a spiral segment allowed for replacement of up to 11 cm (fig. 1, *C*).

Ureteral replacement or repair was completed with 4-zero running, single layer absorbable suture. Four of the 9 ureters that underwent distal repair had tunneled