Split-cuff Nipple Technique of Ureteral Reimplantation in Children With Thick-walled Bladders Due to Posterior Urethral Valves

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OBJECTIVE To describe a novel technique of ureteral reimplantation in patients with thick-walled bladders, which addresses the technical challenges and high failure rates seen in this population.

METHODS From 1997 to 2012, 45 megaureters were reimplanted in 26 children aged 2-11 years. Key surgical modifications included ureteral trough creation within the detrusor, formation of a distal ureteral split-cuff nipple, reliance on transureteroureterostomy (TUU) when the bladder would not support the reimplantation of 2 ureters, performance of psoas vesicopexy, and judicious utilization of ureteral stump augmentation in patients undergoing TUU. Follow-up ranged from 1 to 12 years.

RESULTS Seven patients underwent unilateral and 4 underwent bilateral ureteral reimplantation; TUU was performed in 15. Psoas vesicopexy was performed in 22 patients. Voiding cystourethrography showed no reflux in all children who underwent vesicopexy. Reflux resolved in 6 of 8 bilaterally reimplanted ureters; 2 of 8 had improved reflux that later resolved with Deflux injection. No ureters obstructed. Hydronephrosis improved in 32 of 45 renal units and remained stable in 13. Seven patients continue to develop bacteriuria. Five have developed renal failure.

CONCLUSION In our experience, a long ureteral trough combined with a split-cuff nipple technique for reimplanting megaureters into thick-walled bladders yields improved results over conventional submucosal tunneling, effectively eliminating or improving reflux and preventing obstruction. TUU and psoas vesicopexy proved useful adjuncts in creating adequate intravesical trough length. The risk for continued bacteriuria and renal failure due to limited renal reserve, however, remain notable in this group. UROLOGY 85: 199–204, 2015. © 2015 Elsevier Inc.

Vesicoureteral reflux (VUR) may be categorized as primary VUR, relating to a primary abnormality of ureteral insertion into the bladder, and secondary etiologies, that is, VUR as a consequence of more distal obstruction and/or elevated detrusor pressures. The management of primary VUR is well described and includes in its armamentarium options for expectant management, endoscopic subureteric injection of bulking substances, and ureteral reimplantation. Outcomes of surgical management are both well described and excellent for patients with primary VUR, with success rates for subureteric injection and reimplantation cited as high as >75%[1] and 98%, respectively.

In contrast to the well-described and generally successful outcomes reported in the management of primary VUR, similar outcomes are both less frequently attained and described in children with VUR secondary to posterior urethral valves (PUV). Roughly two-thirds of patients with PUV have associated VUR,[2-4] which may be a poor prognostic indicator for long-term renal function[3,5,6] (especially in cases of bilateral VUR),[7] as well as for lower urinary tract function.[8] Although reflux resolves in most patients after valve ablation,[2,9] refractory or symptomatic reflux may require intervention. Endoscopic management with subureteric injection is generally less successful in patients with neurogenic bladder, correcting VUR 62% of the time.[1] In PUV specifically, subureteric injection for VUR has met with modest success in European studies, ranging from 58% to 71%[10,11]; however, these studies used polytetrafluoroethylene (Teflon; Ethicon, Inc, Johnson & Johnson, New Brunswick, NJ) for some or all of their patients, which is not presently approved by Food and Drug Administration in the United States for injection in VUR owing to concerns over particle migration.

Ureteral reimplantation has met with lower rates of success as well, primarily because of reimplantation into a bladder with underlying functional and anatomic abnormality. This scenario poses a challenge to pediatric urologists, not only with respect to successful surgical technique but also with respect to counseling families for

Financial Disclosure: *The authors declare that they have no relevant financial interests.*

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Submitted: May 25, 2014, accepted (with revisions): September 16, 2014

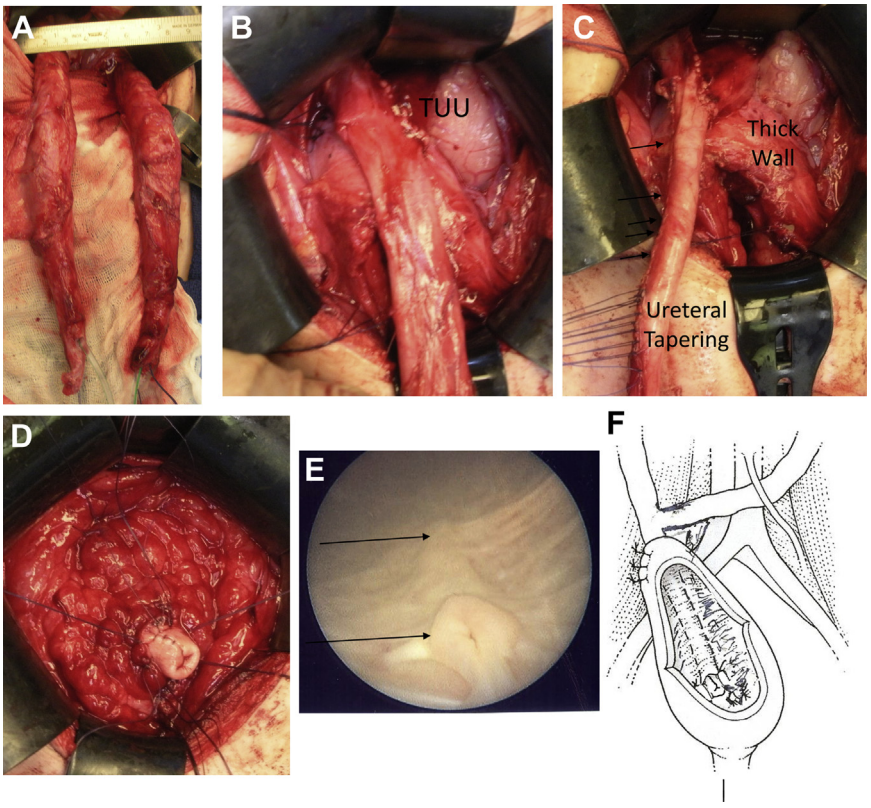

Figure 1. Transureteroureterostomy (TUU), psoas vesicopexy, and split-cuff nipple technique in a patient with bilateral reflux. **(A)** Bilateral dilated ureters which will require tapering. **(B)** TUU and psoas vesicopexy are performed. **(C)** Tapering of the distal TUU segment. Note the thick-walled small bladder, which would have made bilateral reimplantation prohibitive. **(D)** Creation of the split-cuff nipple. **(E)** Postoperative endoscopic view of the ureteral trough and split-cuff nipple. **(F)** Schematic demonstrating the final result: TUU, psoas vesicopexy, long ureteral trough, and a split-cuff nipple.

whom traditional postsurgical rates of VUR resolution, when inappropriately applied to this population and quoted to parents, become an overestimate.

We describe a novel surgical approach aimed at reimplantation of the refluxing ureter into the "hostile" bladder and present the outcomes of this procedure.

METHODS

Patient Selection and Data Collection

Retrospective chart review of 171 patients with a history of PUV identified 26 patients, who had undergone ureteral reimplantation by a single surgeon between 1997 and 2012. All patients had prior valve ablation and failed medical management, which included prophylactic antibiotics, anticholinergic therapy, and/or alpha-blocker medications. Indications for reimplantation included recurrent breakthrough pyelonephritis (16), persistent grade V reflux in children aged >5 years (6), and worsening hydronephrosis (4). Patients with primary VUR were not included in this analysis. Charts were reviewed for data regarding age at surgery, urodynamic evaluation, surgical procedure performed, duration of follow-up, postoperative resolution of VUR, subsequent urinary tract infections, and progression to renal failure.

Surgical Technique

Cystoscopy. Cystoscopy was performed initially in all patients to evaluate the bladder and ureters to facilitate surgical decision making.

Ureteral Dissection and Bladder Inspection. All refluxing and obstructed ureters underwent surgical correction with reimplantation. The bladder was entered using a midline vertical incision. The ureteral orifice of the affected ureter(s) was circumferentially separated from the surrounding bladder mucosa, and the ureter was dissected proximally to free it of the surrounding bladder attachments and to release any proximal tortuosity. The bladder was evaluated for size; if the bladder appeared as though it would successfully accommodate only 1 ureteral trough, a transureteroureterostomy (TUU) was performed based on the surgeon's discretion at the time of surgery (Fig. 1). TUU was universally performed in a left-to-right fashion for technical ease of the procedure. If the bladder appeared large enough to accommodate 2 ureteral troughs, bilateral ureteral reimplantation was performed (Fig. 2). Ureteral excisional tapering or plication were performed over a 10F catheter on the reimplanted ureters in cases of unilateral or bilateral ureteroneocystostomy and the ureteral segment distal to the TUU anastomosis when TUU was performed. Stents were left in all tapered ureters and across the anastomosis of all TUUs.

Psoas Vesicopexy. Psoas vesicopexy was performed in all of the unilateral reimplant and TUU patients (22 patients in total) to create a longer trough or submucosal tunnel.

Ureteral Trough Creation and Split-cuff Nipple Technique. A distally directed ureteral trough was created along a 5-6 cm detrusor segment. In highly trabeculated bladders, the mucosa was split and the ureter laid in this trough; in mildly