

## Laparoscopic Ureteroneocystostomy and Psoas Hitch for Post-Hysterectomy Ureterovaginal Fistula

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**Purpose:** We assessed the results of laparoscopic ureteroneocystostomy with a psoas hitch for iatrogenic lower ureteral injuries leading to a ureterovaginal fistula.

**Materials and Methods:** Between July 2003 and November 2007, 18 patients with iatrogenic lower ureteral injuries during hysterectomy leading to ureterovaginal fistula underwent laparoscopic ureteroneocystostomy with a psoas hitch. Of the patients 17 underwent abdominal or vaginal hysterectomy, while in 1 with a ruptured gravid uterus emergency hysterectomy was done for uncontrolled bleeding. Mean patient age was 35.5 years (range 23 to 45) and mean time to surgery since the injury was 2.2 months (range 1.5 to 3.5). Transperitoneal 3 or 4 port laparoscopic ureteroneocystostomy with a psoas hitch was performed.

**Results:** Of the procedures 17 were completed successfully. Intraoperative cardiac arrhythmia occurred in 1 patient due to pneumoperitoneum and hypercarbia, requiring open conversion. Mean operative time was 2.5 hours (range 1.9 to 2.8) hours, mean blood loss was 90 ml (range 45 to 150) and total hospital stay was 5.3 days (range 2.9 to 8). The nephrostomy tube was blocked on the table in all patients and it was removed on day 7. At an average followup of 26.4 months (range 3 to 52) postoperative excretory urography did not reveal obstruction in any patient. One patient had vesicoureteral reflux on voiding cystogram.

**Conclusions:** Laparoscopic ureteroneocystostomy with a psoas hitch for ureterovaginal fistula secondary to hysterectomy is safe and effective, and associated with a low incidence of postoperative reflux and obstruction.

*Key Words: ureter, postoperative complications, laparoscopy, fistula, tendons*

Ureteral injury is a recognized complication of pelvic surgery with a 0.3% to 2% incidence after gynecological surgery.<sup>1-3</sup> About 70% of ureteral injuries during gynecological procedures are identified in the postoperative period and instruments involved in electrocoagulation are associated with the most injuries incurred during laparoscopic surgery.<sup>1</sup>

Traditionally open surgery has been used to treat ureteral injury. When an injury is recognized in the postoperative period, the treatment is endoscopic management or laparotomy for ureteral injury repair. When endoscopic surgery fails or thermal injury to the ureter is suspected, percutaneous nephrostomy is placed to salvage the renal unit and ureteroneocystostomy is performed at a later date. We present our experience with laparoscopic ureteroneocystostomy in patients presenting or referred a few weeks after ureteral injury who had a ureterovaginal fistula.

### MATERIALS AND METHODS

A total of 18 patients underwent laparoscopic ureteroneocystostomy from July 2003 to October 2007 for a ureterovaginal fistula following hysterectomy. All patients were re-

ferred from elsewhere 1 to 6 weeks after surgery. Of the patients 11 underwent laparoscopic assisted vaginal hysterectomy, 4 underwent open hysterectomy and 2 underwent vaginal hysterectomy for benign disease of the uterus unrelated to pregnancy. One patient with a ruptured gravid uterus underwent emergency laparotomy and hysterectomy for uncontrolled bleeding. All patients had undergone prior endourological procedures, which were unsuccessful.

All patients had an ipsilateral percutaneous nephrostomy to preserve renal function and subsequently a radiological study was done to access stricture length. Preoperative evaluation also involved voiding cystography, cystoscopy and retrograde ureterography. Table 1 shows patient demographics and preoperative attempts to perform various endourological procedures.

All fistulas were pelvic fistulas associated with stricture or complete obliteration of the ureteral lumen. A guidewire could be passed across the injured area of the ureter in only 2 cases, although passing a Double-J® stent was not possible. A combined retrograde and antegrade study was performed in all patients and mean stricture length was 1.45 cm (range 1.1 to 2.4). The segment of ureter distal to the fistula that was left behind was 3 to 4 cm, as determined by RGC at retrograde pyelography. Sterile urine was confirmed, after which patients underwent laparoscopic ureteroneocystostomy.

The procedure was done as described previously.<sup>4,5</sup> Briefly, the patient was placed under general anesthesia in the Trendelenburg position. Pneumoperitoneum was achieved

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TABLE 1. Patient demographics and prior attempted endoscopy procedures

Mean age (range)	35.5	(23–45)
Mean kg/m <sup>2</sup> BMI (range)	22.3	(20.2–25.3)
Mean wks to referral after injury (range)	2.4	(1.1–6.4)
No. prior endoscopic procedures:		
RGC + attempted guidewire passage only	26	
RGC + stent	2	
RGC + ureteroscopy	16	

through a Veress needle. The initial 10 mm trocar was placed at the lower edge of the umbilicus. An additional 2 or 3, 5 or 10 mm working ports were placed under direct vision. On the ipsilateral side the posterior peritoneum over the iliac vessels was incised and the ureter was dissected lower down, up to the stricture segment with care taken to preserve the periureteral tissue. The distal ureter was clipped and the normal healthy proximal part was spatulated at the 6 o'clock position. The bladder was filled with sterile saline and adequately mobilized. The bladder wall was hitched to the ipsilateral psoas tendon with interrupted 3-zero polypropylene sutures. The detrusor was incised using electrocautery, followed by opening of the bladder mucosa by scissors. The ureter was anastomosed to the bladder mucosa using interrupted 4-zero polyglactin sutures. The nonrefluxing Lich-Gregoir onlay technique was used.

No stent was placed but a drain was placed in all patients. The urethral catheter was removed on day 7 postoperatively after a nephrostogram was done using the existing nephrostomy tube under antibiotic coverage.

Followup was performed with voiding cystography at 3 months, followed by IVP. Subsequently at visits at 3-month intervals patients were followed by ultrasonography and urine examination for 2 years. IVP was performed at 12 months and yearly thereafter. Data collected for analysis included BMI in kg/m<sup>2</sup>, operative time in minutes, blood loss in ml, hospitalization in days and average followup.

## RESULTS

Mean patient age was 35.5 years (range 23 to 45) and an average BMI was 22.3 kg/m<sup>2</sup>. The procedure was completed successfully in 17 of 18 patients. In a 23-year-old female bradycardia developed with atrioventricular dissociation due to pneumoperitoneum and hypercarbia, which was a grade IVa complication according to the Clavien classification system.<sup>6</sup> The procedure was terminated, normal sinus rhythm was established, and after 48 hours of cardiac monitoring and evaluation open ureteroneocystostomy was performed.

Table 2 shows intraoperative and postoperative parameters. Mean operative time was 2.5 hours (range 1.9 to 2.8), estimated blood loss was 90 ml (range 60 to 150), average hospital stay was 5.3 days (range 5 to 7) and mean followup was 26.4 months (range 3 to 52). Followup voiding cystogram revealed reflux in 1 of the 18 patients. Postoperative IVP at 3 and then at 12 months did not reveal obstruction in any patient. No major or minor procedure related complications were observed in our patients.

## DISCUSSION

Ureteral reimplantation is most often performed in the adult population for disease or trauma of the lower ureter that

results in ureteral obstruction or fistula. When the ureter is not long enough for implantation into the bladder, psoas hitch or Boari flap reconstruction is performed. Endourological procedures should be considered for ureteral injury as the initial treatment.<sup>7</sup> However, open surgery for reconstruction of the lower ureter is considered the gold standard. Ureteroureterostomy should be restricted for a short segment of stricture or when the fistula is diagnosed early in the postoperative course. However, any degree of thermal injury requires wide débridement because the degree of microvascular damage can extend for 2 cm beyond the evidence of gross injury.<sup>8</sup> Our patients with a ureterovaginal fistula had delayed presentation of the fistula, suggestive of a high probability of thermal injury. Hence, they were not candidates for ureteroureterostomy.

Laparoscopic surgery has the advantages of less pain, early ambulation and rapid convalescence compared to open surgery, while the disadvantage is longer operative time.<sup>9,10</sup> Laparoscopic reconstructive surgery in the pelvis and lower abdomen is technically demanding and it requires surgeon experience. There are sparse data on laparoscopic repair of vesicoureteral reimplantation for ureteral injury.

Laparoscopic ureteroneocystostomy was first described by Ehrlich et al for high grade vesicoureteral reflux<sup>11</sup> and the first such procedure in an adult was reported in 1994 by Reddy and Evans.<sup>12</sup> Subsequently it was described for various conditions, including endometriosis, stricture due to an impacted calculus, and ureteral injury during laparoscopic hysterectomy and due to lower ureteral malignancy.

The important aspects of ureteroneocystostomy are an antireflux anastomosis without immediate or delayed obstruction. The Lich-Gregoir extravesical approach is the most commonly performed laparoscopic procedure for ureteroneocystostomy.<sup>13,14</sup> The results of this procedure have been reported to be 90% to 100% effective without any additional morbidity but with a slightly longer operative time.<sup>13,15</sup> When an adequate length of lower ureter is not available, the vesico-psoas hitch is an option. The psoas hitch is a reliable adjunctive procedure that promotes tension-free repair.<sup>16</sup> The site of injury and the length of stricture in the lower ureter usually determine the type of surgery to be offered to patients.

We prefer to mobilize the bladder for a psoas hitch rather than perform extensive ureteral mobilization to preserve ureteral vascularity. Regular use of the psoas hitch ensures a tension-free anastomosis between the ureter and the bladder mucosa. This gives a gentle curve to the course of the ureter and the position of the ureter does not change with a full or empty bladder.

We believe that the low reflux rate and no ureteral obstruction are due to maintaining a 1:4 ratio of ureter width to tunnel length and regular use of the psoas hitch as a part of uretero-

TABLE 2. Intraoperative and postoperative data for 17 patients

	Mean (range)
Operative time (hrs)*	2.5 (1.9–2.8)
Blood loss (ml)	90 (60–150)
Time to oral intake (hrs)	8.2 (6.7–10.1)
Time to ambulation (hrs)	14 (9.2–18)
Hospital stay (days)	5.3 (5–7)
Time to nephrostomy removal (days)	7
Time to catheter removal (days)	7

neocystostomy. Most of our patients were in the middle third to fifth decades of life, and they were sexually active. Our intent was to avoid upper tract infection in the event of cystitis. Furthermore, with regular use of the psoas hitch we did not find any shortage of ureteral length for antireflux reimplantation. Since most ureters were not dilated due to proximal nephrostomy, tapering or a long tunnel was not necessary.

A Double-J stent is used during laparoscopic ureteral reimplantation for a ureterovaginal fistula.<sup>17,18</sup> We do not use a Double-J stent routinely in most extravesical ureteroneocystostomies performed at the time of living donor related kidney transplantation. Based on experience with transplantation we have avoided using a Double-J stent in any of our patients undergoing laparoscopic ureteroneocystostomy for a ureterovaginal fistula. Spatulation of the ureteral end and precise suturing of the ureter wall to the bladder mucosa, advancement of the ureter into the bladder and good detrusorrrhaphy provide a leak-proof anastomosis. None of the patients required an ancillary procedure in the immediate or late postoperative period. However, a blocked nephrostomy tube was maintained to diagnose and treat urinary leakage in all cases.

Rassweiler et al compared laparoscopic and open ureteroneocystostomy procedures.<sup>19</sup> In their laparoscopic group all patient had a vesico-psoas hitch or Boari flap and none had urinary leakage, while 2 in the open group with ureteroneocystostomy had urinary leakage. The laparoscopic group had a lesser analgesic drug requirement, shorter hospitalization and more rapid recovery.

Recurrent stricture typically develops within 1 year after treatment. In their 20-year experience with managing ureteral strictures Selzman and Spirnak observed only a 11% stricture rate after 1 year at an average followup of 8.5 years.<sup>20</sup> At an average followup of 26.4 months (range 3 to 52) none of our patients had a stricture. Because 14 patients (77.7%) had a followup of greater than 1 year, our outcome rate is likely to remain the same as observation continues. Only 1 patient had grade 2 vesicoureteral reflux on voiding cystogram. In other words, antireflux status was achieved in 94.7% of our patients.

## CONCLUSIONS

To our knowledge this is the largest series of laparoscopic ureteroneocystostomy for ureterovaginal fistula. The extravesical modified Lich-Gregoir technique combined with a psoas hitch is associated with a low incidence of postoperative vesicoureteral reflux. None of our patients had obstruction or urinary leakage despite no Double-J stent use.

### Abbreviations and Acronyms

BMI	=	body mass index
IVP	=	excretory urogram
RGC	=	retrograde ureteral catheterization

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