

Two-stage Laparoscopic Repair of Two-level Ureteral Strictures: Our Experience of 8 Patients

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Purpose: To evaluate the feasibility and effectiveness of two-stage laparoscopic repair for two-level ureteral strictures.

Materials and Methods: From October 2010 to January 2017, 8 patients with two-level ureteral strictures, which were located in upper and lower ureter, received two-stage laparoscopic repair in our institution. Laparoscopic ureteroureterostomy was conducted for the upper ureteral strictures in first stage and 8 weeks later laparoscopic ureterovesical reimplantation was performed for lower stricture after the patency of upper lesion was confirmed by antegrade ureteropyelography. The kidney was drained by a nephrostomy tube during the interval period of two operations.

Result: All the operations were performed successfully without intraoperative complications except one patient converted to open surgery during second-stage operation. For first-stage surgery, mean operating time was 120.88 ± 16.88 min, mean blood loss was 89.38 ± 13.74 mL, and mean duration of postoperative hospitalization was 3.63 ± 0.74 days. While in second-stage surgery, mean operating time took 125.25 ± 17.00 min, mean blood loss was 65.63 ± 10.16 mL, and mean duration of postoperative hospitalization was 3.62 ± 1.41 days. On ureteropyelography 10 weeks after second-stage surgery, the contrast medium flowed from kidney down into bladder unrestrictedly and the patency of entire ureter was restored in all patients. During the follow-up, one female was observed kidney atrophy with ureteral calculus formed on the lesion side, and was successfully treated by ureteroscopic lithotripsy. No sign of stricture recurrence was found on other patients.

Conclusion: Two-stage laparoscopic repair is a feasible and effective treatment for two-level ureteral strictures. But its indication is relatively narrow and confined to ureteral strictures located in two sites with sufficient interval distance and minor stricture length.

Keywords: laparoscopy; reconstruction; ureteral stricture; ureteroureterostomy; ureterovesical reimplantation

INTRODUCTION

During recent years, the widespread diffusion of minimally invasive procedure in ureteral treatments has led to an increasing incidence of ureteral strictures.⁽¹⁾ Among them, the two-level ureteral stricture, which is defined as two sites of strictures in unilateral ureter, is a relatively rare but definitely challenging issue for urology surgeons to deal with. Although numerous clinicians have tried various efforts to restore patency, few of them achieved the satisfied outcome, recurrence of strictures is the most common final results for these therapeutic attempts.^(1,2)

In our report, by describing operational and follow-up data of 8 patients with two-level ureteral strictures, we aim to evaluate the feasibility of our two-stage laparoscopic repair for this complicated disease, and explore the optimal indication of this procedure.

MATERIAL AND METHODS

Patients

From October 2010 to January 2017, 8 patients with two-level ureteral strictures were referred to our institutes and received the two-stage laparoscopic surgery. All of the patients signed the informed consent agreements and this study had been approved by ethic committee of the Xiangya Hospital of Central South University. Ranging from 28 to 63 years old, these 8 patients share the same chief complains of flank pain and discomfort. Among them, 5 patients' etiology were considered as Holmium laser injuries, their historical operational records offered by the local hospital showed that the laser was mainly operated in the upper and lower parts of ureter, and the patients developed hydronephrosis rapidly after surgery. 3 patients were diagnosed as two-level ureteral strictures which were caused by impacted calculus. According to their description, they had multiple times of hematuria followed by experience of urinating stones a few months before, and none of

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Received August 2017 & Accepted April 2018

Table 1. Preoperative data of patient

Case	Age (years)	Gender	Side	Etiology	Presentation US & UPJ(cm)	Distance between LS & UVJ(cm)	Distance between distance (cm)	Interval
1	44	M	L	Holmium laser	Left flank pain	9	2	15
2	38	F	L	Impacted calculus	Left flank pain	3	1	22
3	56	M	R	Holmium laser	Right flank pain	12	4	8
4	55	F	R	Holmium laser	Right flank pain	7	3	14
5	63	F	L	Impacted calculus	Left flank pain	10	1	12
6	33	F	R	Holmium laser	Right flank pain	7	2	15
7	28	M	R	Idiopathic causes	Right flank pain	9	3	14
8	40	M	L	Holmium laser	Left flank pain & fever	7	1	18

Abbreviations: US, Upper Stricture; UPJ, Ureteropelvic Junction; LS, Lower Stricture; UVJ, Ureterovesical Junction

them had received ureteral surgeries in the past. There is only one patient who had no operation in the past and denied any symptoms of urolithiasis, we concluded his etiology as idiopathic. Because of the fast development of hydronephrosis, all patients had received percutaneous nephrostomy and kept a nephrostomy tube for temporary drainage in local hospital prior to admission to our institution.

Operative technique

Facing this challenging disease, instead of repairing the two lesions in one single surgery, we adopted two-stage laparoscopic operation. In first stage we repaired the upper stricture of ureter by transperitoneal laparoscopic end-to-end anastomosis, while lower ureteral strictures were dealt with ureteral reimplantation in second-stage surgery.

Before operation, upper ureteral stricture was confirmed by antegrade ureteropyelography in all patients (Figure 1A). When the first-stage surgery began, under general endotracheal anesthesia, patients were placed in a supine position with lesion side elevated, then the three-port laparoscopic approach was established with a

12-mm port positioned infraumbilically and two 12-mm ports in the lateral border of rectus muscles. The ureter was mobilized in the first step, ureteral part above the stricture site is often dilated, thus the joint site of dilated ureter and non-dilated ureter indicates the position of lesion and stricture site of upper ureter could be located accordingly (Figure 2A). The ureteral stricture lesion was excised and its lumen turned out to be completely occluded, no urine flowed out from proximal end (Figure 2B). After trimming the lesion site until normal lumen was seen, an interrupted anastomosis with 4-0 monocryl was performed accordingly. When the upper ureteral anastomosis was finished, since the lower stricture still existed, we kept the nephrostomy tube in place to divert urine and had not placed the double J stent. Patients were discharged with nephrostomy tube and readmitted 8 weeks later to receive second-stage surgery. Before second surgery, all patients' upper ureter had been confirmed unobstructed by antegrade ureteropyelography, the contrast medium passed through original upper stricture lesion fluently (Figure 1B) but obstructed in lower stricture area, and no contrast medium

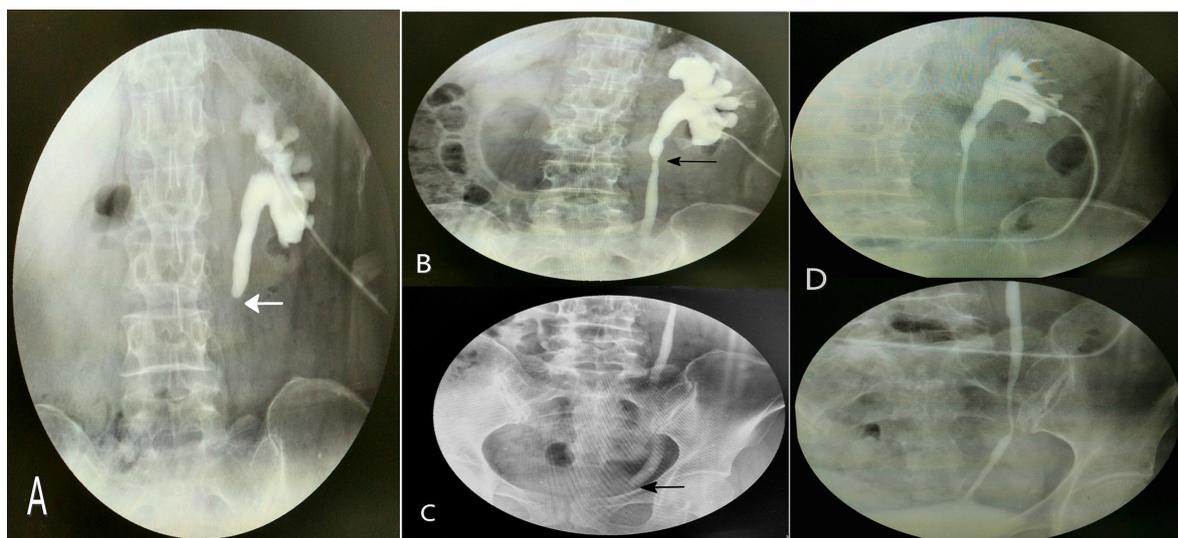


Fig.1 A. Preoperative antegrade ureteropyelography of patient showed the contrast medium was obstructed at stricture site of left upper ureter (arrow). **B.** Before the second surgery, an antegrade ureteropyelography was arranged, the contrast medium passed the anastomotic site of upper ureter smoothly without any sign of stricture or leakage (arrow). **C.** Although the patency of upper ureter was restored, the contrast medium was obstructed in lower strictured area, and no contrast medium had reached bladder. **D.** 10 weeks after second-stage surgery, an antegrade ureteropyelography via nephrostomy tube (arrow) was arranged, it showed patency of the entire length of ureter and contrast medium flowed from renal pelvis down into bladder unrestrictedly.

Table 2. Operative and follow-up data of patients

Case	Operating time		Operation data				Complications	Follow-up dataa	
	of FSS (min)	of SSS (min)	Blood loss of FSS (mL)	Blood loss of SSS (mL)	LHS after FSS (days)	LHS after SSS (days)		Duration of follow-up (months)	Radiography recheck
1	115	136	90	75	3	3	None	79	No recurrence of stricture
2	131	112	100	55	4	3	None	33	No recurrence of stricture
3	120	153	90	80	3	7	Converted to open surgery during SSS	30	No recurrence of stricture
4	105	130	80	70	3	3	Kidney atrophy & ureteral calculus formed	25	Kidney atrophy & ureteral calculus formed
5	139	95	100	65	3	3	None	22	No recurrence of stricture
6	90	122	60	70	4	3	None	15	No recurrence of stricture
7	132	125	100	50	5	4	None	11	No recurrence of stricture
8	135	129	95	60	4	3	Moderate stenosis of upper anastomotic site	3	Moderate stenosis of upper anastomotic site

Abbreviations: FSS, First-Stage Surgery; SSS, Second-Stage Surgery; LHS, Length of Hospital Stay.

^aThe data was documented since second-stage surgery, there was no complication or unexpected event occurred during and after the first operation.

had reached bladder (**Figure 1C**). In such situation, the second surgery of laparoscopic ureteral reimplantation was performed accordingly. The patient was put in supine position with pads under their hips, then three-port laparoscopic approach was established with one 12-mm trocar in the umbilicus, one 12-mm trocar above the symphysis pubis and one 12-mm trocar in the McBurney point or its symmetry point. After the isolation of the stricture lesion of lower ureter (**Figure 2C**), a cystotomy was made for the reimplantation of

the ureter. Prior to complete the ureteroneocystostomy with 4-0 interrupted stitches (**Figure 2D**), a double J stent was placed. Prevention of vesicoureteric reflux is routinely performed in our institution. Anastomotic part of ureter obliquely passed through the bladder muscular layer and was regularly wrapped by vesical membrane to form an artificial tunnel for ureter. The double J stent was kept for 8 weeks, and for safety reasons the nephrostomy tube was still kept in place when second-stage surgery was finished. Before removal of the nephrostomy tube, which was regularly arranged 10 weeks after the second-stage operation, antegrade ureteropyelography via nephrostomy tube was scheduled for all patients, and images showed patency of the entire length of ureter and contrast medium flowed from renal pelvis down into bladder unrestrictedly (**Figure 1D**).

RESULTS

For all the 8 patients, the diagnosis of two-level ureteral stricture was confirmed by antegrade ureteropyelography and retrograde pyelography, which respectively demonstrated upper and lower stricture lesion. According to imaging data, the measured distance from the upper ureteral stricture to ureteropelvic junction ranged from 3 cm to 12 cm, and distance between lower ureteral stricture and ureterovesical junction was no longer than 4 cm. Correspondingly, the approximated interval distance between upper and lower strictures was measured varying from 8 cm to 22 cm. Specific preoperative details of the patients are listed in **Table 1**.

All patients received the surgical treatments on schedule and no intraoperative complication was occurred except one patient was converted to open surgery during his second-stage operation, due to the extreme adhesion and difficulty of dissection under laparoscopy. For first-stage surgery, mean operating time was 120.88 ± 16.88 min, mean blood loss was 89.38 ± 13.74 mL, and mean duration of postoperative hospitalization was 3.63 ± 0.74 days. While in second-stage surgery, mean operating time took 125.25 ± 17.00 min, mean blood loss

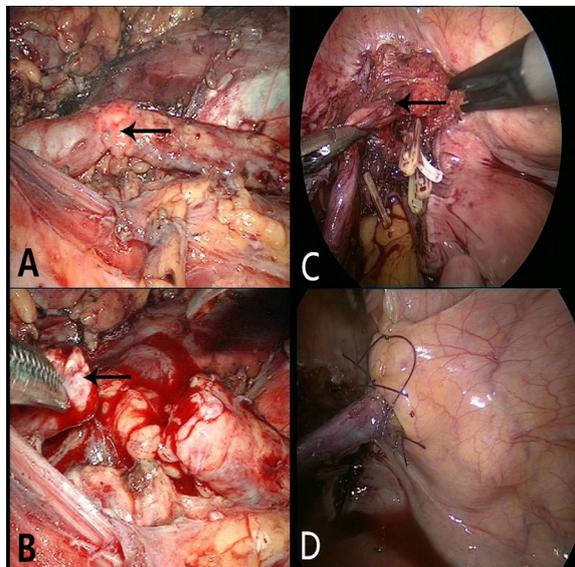


Fig. 2 **A.** The first stage surgery was performed through transperitoneal approach, after the ureter was mobilized, we located the stricture site of upper ureter (arrow). **B.** When the ureteral stricture lesion was excised, the lumen turned out to be completely occluded and no urine flowing out from proximal end of incision (arrow). **C.** The second surgery was laparoscopic ureteral reimplantation. The stricture lesion was located at lower end of ureter (arrow). **D.** The anastomotic site of ureteroneocystostomy was sutured with 4/0 interrupted stitches

was 65.63 ± 10.16 mL, and mean duration of postoperative hospitalization was 3.62 ± 1.41 days. Foley catheter was removed in the first day after first-stage surgery, while for second-stage surgery the catheter was normally kept for 7 days before removal to prevent early vesicoureteric reflux. In both stages of surgeries, all patients' abdominal cavity drainage tube was removed when the daily drained volume was less than 10 mL. These 8 patients were under persistent follow-up. One female was observed kidney atrophy and ureteral calculus formed on the lesion side. The ureteral calculus was treated successfully by ureteroscopic lithotripsy the day we found it, by far her serum creatinine and estimated glomerular filtration rate (GFR) are still normal and under regular recheck. No recurrence of strictures or aggravation of hydronephrosis was showed of all other patients. The feedback of telephone follow-up indicated all the patients are asymptomatic by far. Specific perioperative and follow-up data is provided in Table 2.

DISCUSSION

As a by-product of fast development of endoscopic therapy in urology, ureteral strictures occur much more frequently than the past, and patients with multiple sites of ureteral strictures are not rare to see in nowadays. For decades, urologists have been groping for solutions continuously, but except traditional open ureteral reconstruction surgery, which had been proved attached with severe complications and surgical trauma, current minimal invasive treatments for this disease have been fruitless and rarely reported.⁽²⁻⁵⁾

The surgical procedure adopted in our report is the two-stage laparoscopic ureteroplasty, which includes ureteroureterostomy and ureterovesical reimplantation. The main reason of conducting this surgery in two stages instead of in one is to simplify complexity of the operation and guarantee good healing of the anastomotic site. By dividing treating procedure into two stages, we focused on only one site of lesions in each surgery, and performing the second-stage treatment only after the success of first surgery was confirmed. Through this step-by-step operation, the curative effect is actually enhanced with minor surgical difficulty.

Both of the two stages of laparoscopic surgeries were conducted through transperitoneal approach. Although there are some surgeons preferring to perform upper ureteral anastomosis by retroperitoneal laparoscopy, we think a larger surgical space and greater clarity of vision offered by transperitoneal approach could much facilitate the operation. The laparoscopic ports placement in the first surgery was arranged by reference to the relevant surgical instructions⁽⁶⁾. To be noticed, the two ports on lateral border of rectus muscles should not be placed too far from midline of body, otherwise much difficult will be met during the process of turning the colon downward to expose retroperitoneal structures. The placement of ports in the second surgery, which aimed to facilitate the dissection of lower ureter and bladder, was regularly adopted in ureteral reimplantation. However, intense carefulness should be paid when inserting the first trocar in umbilicus, because first-stage surgery may have caused intestinal adhesion with visceral abdominal wall, and intestinal puncture injury could occur due to blinded actions. Thus fully pulling up of abdominal skin before puncture and a progressive piercing manoeuvre are necessary to prevent such com-

plication.

Another advantage of two-stage operation is that it can protect the blood supply of ureter and guarantee good healing of anastomotic site. Ureteral blood supply mainly comes from vascular network that embedded in the periureteral sheath (sheath of waldeyer).^(7,8) Performing resection and anastomosis of both sites in one-stage surgery will inevitably involve large-scale dissection of periureteral sheath, which will lead to damage of main blood supply of ureters.^(9,10) According to the study of 64 patients who received ureteral anastomosis from Wang,⁽¹¹⁾ overmuch dissection of periureteral sheath can easily cause ischemia necrosis of anastomosis site, while preserving periureteral sheath or covering pedicled omentum on it remarkably reduced this complication. In our report, during each stage we only operated on one site of ureter, leaving periureteral sheath and blood supply of rest part conserved. By alternately repairing the upper and lower ureteral strictures, maximum protection of ureteral blood supply was achieved. The interval time between two surgeries was set as 8 weeks, which can guarantee scare tissue of anastomotic site stabilized and sufficient neovascularization formed.⁽¹²⁻¹⁴⁾ We do not recommend longer interval time due to risks of renal function deterioration and nephrostomy tube falling out. As for the repairing sequence, although all the patients in our report received upper stricture repair firstly due to preference of the surgeon, we presume the reversed repairing sequence is also practicable and further relevant control study should continue in future. There are also some limitations of our surgical procedures. First of all, the two-stage laparoscopic repair is mainly suitable for two-level ureteral strictures with short lesion length (usually the stricture length should be no longer than 3 cm), otherwise the anastomosis may fail due to overwhelming anastomotic tension. Secondly, for strictures that are located too closely to each other (usually < 10cm), the second stage laparoscopic repair may not be achieved. Among our patients, the only one that converted to open surgery in second-stage operation is also the one that has the narrowest interval distance (8cm). Because when the two stricture lesions are too close, the second operation may share the same operational area with the first one. As is well-known, the severe tissue adhesion of surgical region caused by the first surgery will bring extreme inconvenience to second laparoscopic operation. Lastly, due to the relatively long period of the whole treating procedures, patients with unfavorable general conditions or residual renal function less than 25%, should be under careful evaluation before being selected for two-stage laparoscopic surgery. One female patient in our study developed kidney atrophy after surgery and renogram showed remained function of the diseased kidney was under 10% by now. We consider this outcome is largely related to the severe hydronephrosis of this patient and long duration of the whole treating process. Although nephrostomy tube can temperately alleviate hydronephrosis, longtime indwelling drainage device can also damage renal function.⁽¹⁵⁾

CONCLUSIONS

Two-stage laparoscopic repair is a feasible and effective treatment for two-level ureteral strictures. But its indication is relatively narrow and confined to ureteral strictures located in two sites with sufficient interval

distance and minor stricture length.

ACKNOWLEDGEMENT

We thank for the support from National Natural Science Foundation of China (No. 81570627) and Natural Science Fund for Youth in Hunan Province (No. 2015JJ3162).

CONFLICT OF INTEREST

No competing interests exist.

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