



Laparoscopic “reverse 7” ileal ureteral replacement for bilateral extensive ureteral strictures performed completely intracorporeally: the initial experience

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Abstract

Purpose To present our initial experience and evaluate the feasibility of the novel technique of completely intracorporeal laparoscopic “reverse 7” ileal ureteral replacement (IUR).

Materials and methods Between December 2018 and September 2019, two patients underwent completely intracorporeal laparoscopic “reverse 7” IUR, which were female patients with bilateral extensive ureteral strictures (BEUS) secondary to radical hysterectomy and pelvic lymph node dissection for cervical cancer and postoperative radiotherapy. Antegrade pyelography and retrograde pyelography showed BEUS preoperatively.

Results The novel technique was performed successfully by the same surgeon without conversion to open surgery. The operating time of each patient was 420 min and 410 min, respectively. Meanwhile, the estimated blood loss of each patient was 120 ml and 100 ml, respectively. There were no major complications during the perioperative period. After ureteral stent was removed, antegrade pyelography postoperatively revealed excellent drainage with the resolution of hydronephrosis in both patients. After removing of ureteral stent and nephrostomy tube, no patients have a complaint about the donor site or the onset of flank pain.

Conclusions To our knowledge, we present the initial experience with completely intracorporeal laparoscopic “reverse 7” IUR. With initial follow-up outcomes, this novel minimally invasive technique appears to be feasible and efficacious in treating BEUS in carefully selected patients.

Keywords Laparoscopy · Ileum · Reconstructive surgical procedures · Ureteral obstruction · Ureteral strictures

Abbreviations

BEUS Bilateral extensive ureteral strictures
IUR Ileal ureteral replacement
CT Computerized tomography

Introduction

As is all known, it is an extreme challenge for the urologist to manage the extensive ureteral stricture, especially for bilateral extensive ureteral strictures (BEUS) [1]. For unilateral extensive ureteral stricture, transureteroureterostomy, Boari bladder flap, renal autotransplantation, and ileal ureteral replacement (IUR) are all recommended to implement [2, 3]. However, for BEUS, IUR seems to be the last resort to avoid nephrectomy or long-term internal ureteral stent or nephrostomy drainage [1]. The IUR is a complicated surgery, which replaces diseased ureter by the distal ileum with adequate blood supply from kidney to bladder intraperitoneally [4]. Among the cases of reporting IUR, cases concerning BEUS were reported using the open approach [3, 5]. With the increasing utilization of laparoscopy and the enriching laparoscopic experience in urological diseases, ureteral replacement can be managed perfectly. On the basis

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of our previous clinical experience and surgical technology of ureteral replacement and ileum interposition [6, 7], BEUS was treated by intracorporeal laparoscopy completely in our institute.

To our knowledge, completely intracorporeal laparoscopic “reverse 7” IUR has not been previously described. We herein describe the initial experience and novel technique.

Materials and methods

Clinical materials

Two patients underwent completely intracorporeal laparoscopic “reverse 7” IUR from December 2018 to September 2019, which was performed by the same surgeon. We retrospectively analyzed the previous medical history, perioperative data, and follow-up outcomes and then presented our initial experience. This study was approved by the Wuhan Union Hospital Ethics Committee. After the full disclosure, both patients consented to participate in the study. Two patients were female with BEUS, which were revealed by preoperative antegrade pyelography and retrograde pyelography (Fig. 1 a, b).

Patient 1 was a 49-year-old female, who was diagnosed with cervical cancer 4 years ago, and was treated by laparoscopic radical hysterectomy for cervical cancer and postoperative radiotherapy. In addition, she was diagnosed with right ureteral stone and underwent rigid ureteroscopic lithotripsy with holmium Yag: laser 2 years ago. Unfortunately, as a result of bilateral hydronephrosis, she had to be

suffering percutaneous nephrostomy tube in the right kidney and ureteral stent in the left ureter 1 year ago. Before the IUR, she endured recurrent urinary tract infection and applied to our team to render her tube free.

Patient 2 was a 56-year-old female, who was also diagnosed with cervical cancer 4 years ago, and was treated by open radical hysterectomy for cervical cancer and postoperative radiotherapy. She suffered bilateral back pain for more than two months and applied to the emergency clinic after her temperature was higher than 39°C. The computed tomography (CT) scan showed bilateral hydronephrosis without calculi, the referral surgeon tried to indwell ureteral stents, which were replaced by bilateral percutaneous nephrostomy tubes later, and then the patient was transferred to our hospital for further treatment.

Preoperative preparation

Preoperatively, the recurrence of cervical cancer or other malignant diseases was excluded. The percutaneous nephrostomy tubes were also performed to replace the ureteral stent preoperatively. The mechanical and antibiotic bowel preparation was conducted according to the routine method.

Surgical technique

After the induction of general anesthesia and endotracheal intubation, the patient was secured to the operating table with both arms adducted, which allowed lateral tilting of the table in a supine position. Bilateral sequential compression stockings and foam pad were applied for preventing deep vein thrombosis and damage to adjacent nerve trunks.

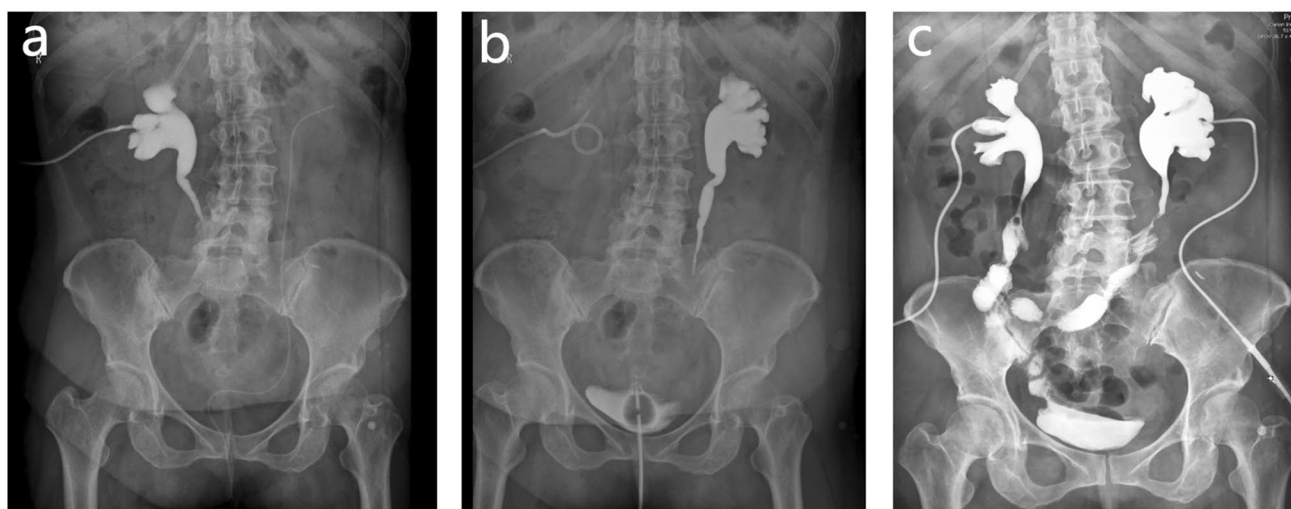


Fig. 1 Preoperative imaging examination. **a** Antegrade pyelography showed the mild-distal stricture of right ureter. **b** Retrograde pyelography showed the mid-distal stricture of left ureter. **c** Follow-up

examination: antegrade pyelography revealed excellent drainage with resolution of bilateral hydronephrosis

Then a nasogastric tube was placed for decompression of the stomach during insufflation, trocar placement, and dissection preoperatively. Bilateral percutaneous nephrostomy tubes were closed temporarily, and a 16-Fr foley catheter was inserted intraoperatively.

A five-port transperitoneal technique was employed (Fig. 2a). First of all, the a port (10-mm trocar) was placed at the superior umbilical crease by the Hasson technique [8], then CO² pneumoperitoneum was achieved at 15 mmHg, and the laparoscope with a 0° camera (Olympus Medical Systems Corp, Japan) was introduced to assess the condition of the abdominal cavity. Secondly, the b port (12-mm trocar) was placed below the subxiphoid, which was 8 cm away from the primary 10-mm trocar, and the c port (12-mm trocar) was placed on the lateral of the right rectus muscle, just below

the level of the umbilicus. The d port (12-mm trocar) was placed at the opposite point corresponding to the second 12-mm trocar when the ileum was considered suitable for ureteral replacement. At last, the e port (5-mm trocar) was placed midway between the umbilicus and the symphysis pubis.

And then, the supine patient was converted to a left lateral decubitus position with a 40° angle, and the line of Toldt was incised to mobilize the ascending colon medially. With the proximal ureter adequately isolated, the dilated ureteral stump (Fig. 3a) was widely spatulated for later anastomosis. Meanwhile, open the right percutaneous nephrostomy tube. Furthermore, the patient was converted to a right lateral decubitus position with a 40° angle, and the left ureter was managed by the same technique (Fig. 3b). The length

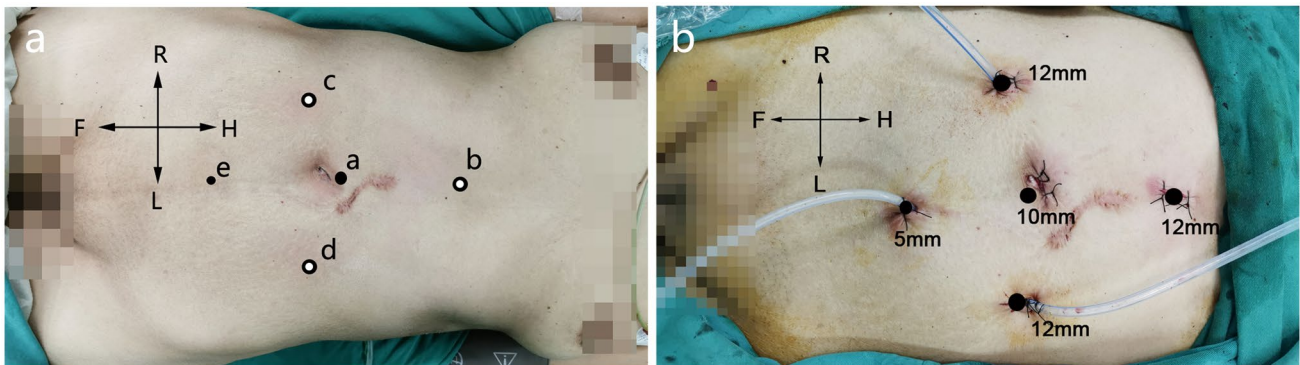


Fig. 2 a Transperitoneal 5-port approach. b Laparoscopic port sites and three drains placement. H head, F feet, L left side, R right side

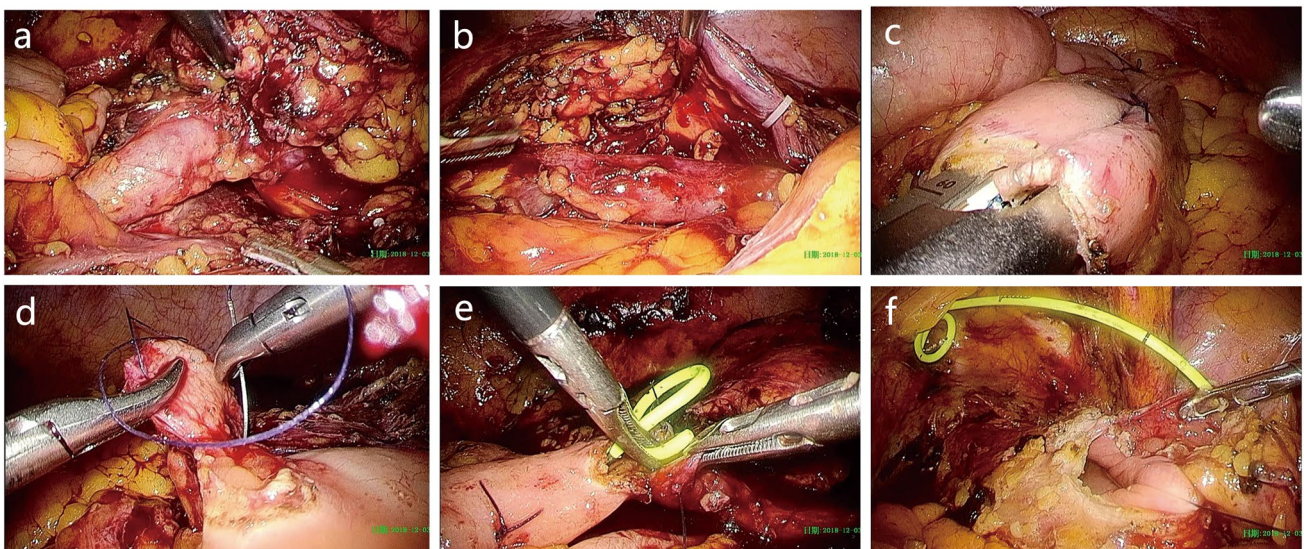


Fig. 3 Intraoperative photographs. a The dilatation of right proximal ureter (white raw). b The dilatation of left proximal ureter (white raw). c The ileum continuity was reestablished intraperitoneally by

the Endo-GIA stapler. d The uretero-ileal anastomosis in the left side. e The uretero-ileal anastomosis in the right side, and a 6-Fr ureteral stent was inserted. f Ileovesical anastomosis

that travels intraperitoneally from left kidney to right one and then to the right wall of bladder was measured, and an appropriate segment of distal ileum was chosen, which was 15 cm proximal to the ileocecal valve and marked by an absorbable suture in the distal and proximal site of the ileal segment. With the help of Endo–GIA stapler (ECR60W, Ethicon Endo-Surgery, USA), the 43-cm ileal segment of patient 1 was marked and mobilized to replace the diseased ureters, which is 46 cm for patient 2, and ileum-to-ileum continuity was reestablished intraperitoneally (Fig. 3c).

After the orientation of the ileal segment checked isoperistaltically, the proximal end of the ileal segment was fixed to the fascia of psoas major muscle adjacent to renal inferior, and then, the anastomosis was performed between the spatulated ureter and the proximal ileal segment in an end-to-side fashion using interrupted 4–0 chromic absorbable sutures (Fig. 3d). The ileal segment was anastomosed to the spatulated ureter on the right side in the same manner without the torsion of the mesentery. Before the closure of right anastomosis, the proximal end of a 6-Fr ureteral stent (Fig. 3e) was inserted into the right renal pelvis, and the distal end of the stent was placed into the bladder at the time of the distal ileal segment anastomosed to the bladder wall.

The distal end of ileal segment was anastomosed to the bladder in an end-to-side, anterior extravesical fashion non-tunneled anastomosis using 3–0 unidirectional, barbed suture, during this period, the distal end of 6-Fr ureteral stent passed ileovesical anastomosis (Fig. 3f). All the mucosa-to-mucosa anastomosis was full-thickness, tension-free, and watertight. The bladder was filled with 300 ml normal saline by the 16-Fr foley catheter placed intraoperatively. There was no apparent saline leaking around the ileovesical anastomosis, and then, three 18-Fr drainage tubes were placed near the pyelo-ileal and ileovesical anastomoses, respectively (Fig. 2b).

Results

The novel technique was performed successfully by the same surgeon without conversion to open surgery or intraoperative complications. The clinical characteristics and surgical outcomes of two patients are summarized in Table 1. The

operating time of each case was 420 min and 410 min, respectively. Meanwhile, the estimated blood loss of each case was 120 ml and 100 ml, respectively. The length of ileum used for ureteral substitution in each patient was 43 cm and 46 cm, respectively. There were no major complications according to the Clavien classification system during the postoperative course [9]. Sodium bicarbonate was applied postoperatively for 3 days to prevent metabolic acidosis. The drainage catheter placed near pyelo-ileal anastomosis was removed 3–4 days postoperatively, and the one near ileovesical was removed 6–7 days postoperatively. The foley catheter was removed 2 weeks postoperatively. The postoperative hospitalization of each patient was 14 days and 15 days.

Each patient was followed up at 3 and 6 months after surgery and about once every six months thereafter. Follow-up was performed with urine test, ultrasound examination, CT scan, and clinical assessment of symptoms. The ureteral stent was removed 8 weeks postoperatively; then, the postoperative antegrade pyelography revealed excellent drainage with resolution of hydronephrosis in both patients. After removing of ureteral stent and nephrostomy tube, no patients have a complaint about the donor site or the onset of flank pain. The follow-up results of urinary analysis showed few leukocytes and mucus. What's more, the follow-up results of the ultrasound examination and CT scan revealed improved hydronephrosis and no urinary calculus.

Discussion

Several options can be performed for extensive and complicated strictures, including transureteroureterostomy, renal autotransplantation, ileal ureteral substitution, and Boari bladder flap [10–12]. Nevertheless, for the BEUS, ileal ureteral substitution is the last and the only feasible choice up to now [3].

Shoemaker reported the first ileal ureter in a woman with tuberculous involvement of the urinary tract in 1909 [13] and later popularization by Goodwin et al. in the late 1950s [14]. Among the studies of bilateral ureters by “reverse 7” IUR, there is no case performed with a

Table 1 Clinical characteristics and surgical outcomes of two patients

Patient	Age (years)	Previous surgery (side)	Operative time (mins)	Estimated blood loss (ml)	Length of the ileal graft (cm)	Surgical complication (Clavien classification)	The postoperative hospitalization (days)
1	49	LRH URSL (right)	420	120	43	None	14
2	56	ORH	410	110	46	None	15

LRH laparoscopic radical hysterectomy, URSL ureteroscopic lithotripsy, ORH open radical hysterectomy

completely intracorporeal laparoscope [5, 15]. With the accumulation of clinical experience in the ileal ureter, the contraindications to an ileal ureteral substitution are summarized, including baseline renal insufficiency with a serum creatinine of greater than 2 mg/dL, outlet obstruction or bladder dysfunction, inflammatory bowel disease, and radiation enteritis [4].

Open IUR traditionally required a large incision with an associated protracted recovery, which is an obvious esthetic disadvantage in comparison with laparoscopic IUR [16, 17]. Therefore, with the rapid development and popularity of laparoscopy technique, laparoscopic ileal ureteral substitution appears to be promising and feasible, which has the potential benefits of a smaller incision, reduced pain, and decreased bowel exposure.

Nevertheless, regarding completely intracorporeal laparoscopic “reverse 7” IUR, skilled laparoscopic techniques and rich clinical experiences of ileum interposition are crucial and essential, which had already been accumulated and affirmed in our cases of laparoscopic ileal conduit urinary diversion [7]. On account of the length of ileal ureter was longer than 15 cm, the antirefluxing technique was not performed in the distal end of ileal ureter in our two patients [18]. By comparing with the open approach, the longer operative time of this study is partly attributed to the conversion of position during different parts of surgery according to the surgeon [3].

Based on our initial experience, there are some technical considerations with regard to our novel technique. First, all the strictures secondary to iatrogenic ureteral injuries should undergo percutaneous nephrostomy tubes 1 month preoperatively, which could preserve renal function and alleviate the preoperative urinary infection. The nephrostomy tube is beneficial not only for managing urinary infection but also for alleviating inflammatory edema of the ureter. Second, in order to identify and isolate the ureter efficiently, we closed the percutaneous nephrostomy tube temporarily, which induced the dilatation of the proximal ureter. In the case of iatrogenic ureteral stricture, significant adhesions and periureteral fibrosis were usually encountered, which can be managed with the help of dilatation of the proximal ureter. Third, the nephrostomy tube can be used to do antegrade pyelography which shows there is leakage or not in the anastomotic site and the dynamics of the replacement ureter. In addition, the ileal ureter should be maintained in an isoperistaltic orientation and all the anastomoses should be completed in a full-thickness, watertight, tension-free manner. [4].

The small sample size and the short follow-up period are two limitations of this study, which is not enough to draw a definitive long-term conclusion. Another significant limitation of this study was its retrospective nature.

All in all, further prospective studies with longer follow-up durations and larger patient cohorts are required to evaluate the long-term outcomes of our novel technique.

Conclusions

To our knowledge, we first present the initial experience with completely intracorporeal laparoscopic “reverse 7” IUR. With initial follow-up outcomes, this novel minimally invasive technique appears to be feasible and efficacious in treating BUES in carefully selected patients.

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Compliance with ethical standards

Conflict of interest All the authors had no conflicts of interest to declare in relation to this article.

Ethical approval All procedures performed in studies involving human participant were in accordance with the ethical standards of the Institutional Review Board of Union Hospital, Huazhong University of Science and Technology, and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Informed consent The authors declared that informed consent was obtained from the individual participant included in this study.

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