Original Article

Initial satisfying experience of total retroperitoneal laparoscopic radical nephroureterectomy: a retrospective comparative research

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Background: Radical nephroureterectomy (RNU) is the principal method for treatment of high-risk upper urinary tract urothelial carcinoma (UTUC). The transperitoneal approach is associated with poor disease progression, but the distal ureter-bladder cuff (DUBC) resection through retroperitoneal laparoscopic approach is difficult. This study proposed a modulated RNU technique, namely, total retroperitoneal laparoscopic radical nephroureterectomy (tRLRNU), with its advantages of DUBC resection and requiring fewer trocars etc. The efficiency, safety, and short-term impacts were retrospectively compared with total transperitoneal laparoscopic radical nephroureterectomy (tTLRNU).

Methods: Total of 12 patients who received tRLRNU and 28 patients who received tTLRNU were enrolled. The choice of surgical approach was random and their data were retrospectively analyzed. During tRLRNU, the laparoscope was versed towards the caudal direction and a retroperitoneal laparoscopic ureterectomy was performed. The bladder cuff was entirely transected and the bladder incision was sutured. The tRLRNU cases were compared with the tTLRNU cases in terms of general clinical data, pathologic parameters, peri-operative parameters, adjuvant therapy, and short-term outcomes. The independent samples *t*-tests, chi-square tests, and Fischer exact tests were used to analyze the differences.

Results: There were no significant differences in the basic patient characteristics between the 2 groups. The data were comparable. There were significantly fewer trocars utilized in tRLRNU group compared to tTLRNU group (P=0.0008). tRLRNU group experienced less blood loss (98.33±61.32 versus 170.71±121.32 mL; P=0.017), smaller drainage volume (182.08±163.60 versus 1,924.82±3,370.02 mL; P=0.011), and shorter extubation time (5.67±1.07 versus 8.57±6.96 days; P=0.040) compared to tRLRNU group. There were no statistically differences in the other peri-operative parameters, including whole operation time, transfusion, visceral and vascular injuries, open conversion, post-operative bleeding, recovery time of intestinal function, and discharge time. The patient outcomes in tTLRNU group at 6 months were significantly worse than that of tRLRNU group by comparing progression-free survival, progression survival and mortality (P=0.039).

Conclusions: The tRLRNU was potentially safer, minimally invasive, and more effective compared to the tTLRNU. Due to the small sample size, short follow-up time and no randomization of the study, future comparative studies are warranted to further analyze long-term outcomes of tRLRNU.

Keywords: Total retroperitoneal laparoscopic radical nephroureterectomy (tRLRNU); single position; upper urinary tract urothelial carcinoma (UTUC); distal ureter-bladder cuff (DUBC)

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Introduction

The current recommendation for low-risk upper urinary tract urothelial carcinoma (UTUC) is kidney-sparing surgery, and for patients with high-risk UTUC, radical nephroureterectomy (RNU), retroperitoneal lymph node dissection (RPLND), and/or perioperative platinum-based combination chemotherapy is recommended (1-3). For RNU, since bowel function recovers much faster and the urinary implantation is more limited, the retroperitoneal approach is commonly considered during open surgery. Laparoscopic radical nephroureterectomy (LRNU) was associated with limited morbidity. However, this technique was not widely applied clinically until a more efficient and oncologically appropriate management of the distal ureter-bladder cuff (DUBC) could be established (4).

There are several methods to manage the DUBC, including, the ureteral unroofing technique, the pluck technique, the transvesical laparoscopic technique, the stripping technique (4), ureteral intussusception (5), and the modified stripping technique. All these techniques have their own advantages (entire resection of DUBC, avoiding of open approach for DUBC) and disadvantages (position changement and potential implantation, etc.), but none resulted in a total laparoscopic method (6). Compared with the retroperitoneal approach, the transperitoneal approach has been associated with poor disease progression (7). The total transperitoneal laparoscopic radical nephroureterectomy (tTLRNU) technique was later introduced (8), but it also faced intestinal complications, intraperitoneal tumor dissemination, etc. So, the total retroperitoneal laparoscopic radical nephroureterectomy (tRLRNU) technique was needed.

Since the rigid ureteroscopy can pass through the entire ureter and even across the ureteropelvic junction, this suggested that there is a theoretic potential straight passage connecting the peri-renal space and peri-DUBC space, which is not obstructed by the iliac bone. Herein, we present the tRLRNU (single-position) technique devised by Dr. Pan in 2019, which consists of the following 2 parts: (I) retroperitoneal laparoscopic nephrectomy under conventional retroperitoneal laparoscopic view; and (II) ureterectomy under caudal retroperitoneal laparoscopic view (the laparoscopic camera turned to the opposite direction to achieve the caudal view), by which the curation of DUBC was made through a narrow passage.

This report verified the efficiency and the safety of the tRLRNU technique. We present the following article in accordance with the STROBE reporting checklist (available at https://tau.amegroups.com/article/view/10.21037/tau-22-270/rc).

Methods

Patient selection

A total of 40 patients who accepted LRNU treatment in the Department of Urology, Ruijin Hospital, between November 2018 and October 2021, were enrolled in this retrospective study. Out of the 40 patients, 12 underwent tRLRNU (by Dr. J Pan), while the remaining 28 were treated using the single-position tTLRNU technique. All patients have signed operation consents, and the choice of surgical approach of tTLRNU or tRLRNU was random. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by the Ruijin Hospital Ethics Committee (No. 144, Year 2021).

tRLRNU (single-position)

Patients were placed in the lateral decubitus position and the operation was divided into two portions, the nephrectomy and the ureterectomy.

During nephrectomy, three trocars were positioned in the shape of an equilateral triangle (*Figure 1A*). The observation trocar (T1) was placed on the median axillary line, and the 2 operating trocars (T2, T3) were positioned on the anterior axillary line and the posterior axillary line, respectively. A pneumoperitoneum pressure of 15 mmHg was maintained. The observation direction was via the patient's head.

The peri-renal fat was removed. The Gerota's fascia was incised. A division along the psoas muscle was made and the renal pedicle was exposed. The main renal artery and vein were transected after having been blocked by Hem-o-Lok™ (Ethicon Endo-surgery, Johnson & Johnson, Cincinnati, OH, USA). A Hem-o-Lok was also utilized to block the ureter and then the kidney was further entirely resected.

During ureterectomy, the observation direction was changed to be via the patient's feet, and this was referred to as caudal laparoscopy. The pneumoperitoneum pressure was also maintained at 15 mmHg. The bladder was irrigated with 40 mg pirarubicin, which would not be unblocked until the curation of the bladder cuff (BC) began. In the majority of cases, after the peritoneum and the fascia of the abdominal wall were further separated, an additional trocar

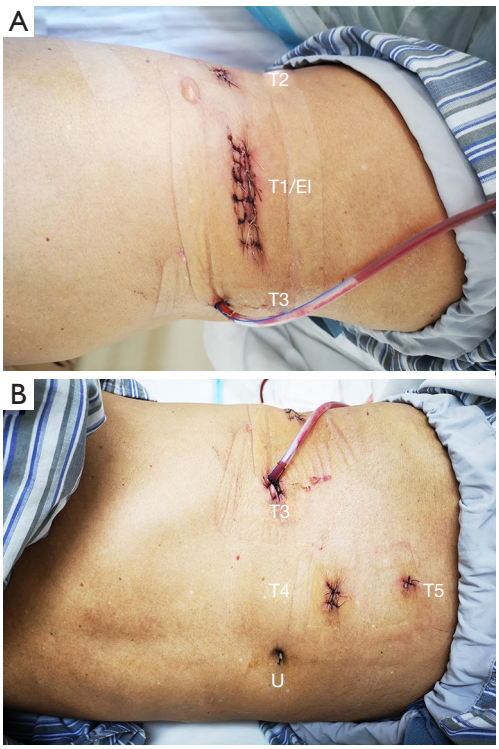

Figure 1 Lateral decubitus and trocar distribution in tRLRNU. (A) Trocar 1–3: in nephrectomy part, T1 is observatory trocar; T2 and T3 are operating trocars. In ureterectomy part, T1 and T3 successively function as observatory trocars, while all T1–3 could be as operating trocars. (B) Trocar 3–5: T3 serve as observatory trocars for ureterectomy; T4 serves as the observatory trocar for pelvic lymph node dissection. All T3–5 could function as operating trocars for ureterectomy and pelvic lymph node dissection. tRLRNU, total retroperitoneal laparoscopic radical nephroureterectomy; T, trocar; EI, enlarged incision (for the removal of specimen); U, umbilicus.

(T4) was placed pararectus abdominis at the level of the umbilicus. Under special circumstances, a second additional trocar (T5) could be placed through the lower lateral abdomen, further towards the patient's feet (*Figure 1B*).

The ureter was continuously separated towards the Waldeyer sheath through a narrow passage between the peritoneum and the pelvic wall (*Figure 2A*). The external iliac vessels should be strictly protected (*Figure 2B*). The Waldeyer sheath was incised (*Figure 2C*) and the BC was clearly exposed (*Figure 2D*). A stitch was made with 3-0 V-Loc™ (Covidien, Mansfield, MA, USA) to prevent the collapse of the bladder wall during the suturing. Evacuation of the bladder, an *en-bloc* resection of BC (*Figure 2E*), followed by a two-layer running suture of the incision was performed (*Figure 2F*). The incision of T1 was enlarged and the whole specimen was removed (*Figure 3*).

tTLRNU (single-position)

Patients were placed in the healthy lateral decubitus position and the operation consisted of two portions. Three trocars were placed in the shape of an equilateral triangle (paraumbilical, anterior axillary line on the level of the navel, and pararectus abdominis subcostal point) during the nephrectomy procedure. One additional pararectus abdominis trocar was placed at the feet (a trocar may be placed at the para-anterior superior iliac spine) during the ureterectomy procedure. The bladder wall was not stitched until the BC was *en-bloc* resected. A two-layer running suture of the incision was performed with 3-0 V-Loc.

Parameters

General patient characteristics were collated and analyzed, including gender, age, body mass index (BMI), original symptoms, onset of original symptoms, as well as the side and affected side pre-operative glomerular filtration rate (GFR).

The pathological parameters examined included tumor load (measured by pathologists), pathological type, and progression of UC.

The peri-operative parameters examined included whole operation time (OT_w) (recorded by the anesthesiologists), nephrectomy time in the tRLRNU group (recorded by the surgeon), DUBC resection time in the tRLRNU group (recorded by the surgeon), number of trocars, bladder irrigation of pirarubicin during operation, blood loss (BL), transfusion, visceral damage, open conversion, post-operative leakage, post-operative bleeding, post-operative defecation time, discharge time, and post-operative ileus.

Adjuvant therapy such as immediate bladder irrigation (IBI) of pirarubicin, chemotherapy and immune checkpoint therapy (ICT), and short-term and long-term outcomes of the UTUC patients were recorded and compared between the two groups.

Statistical analysis

The SPSS 23.0 software was used to analyze the data. The data are presented as mean ± standard error of the mean (SEM). Homogeneity tests of variance, the independent

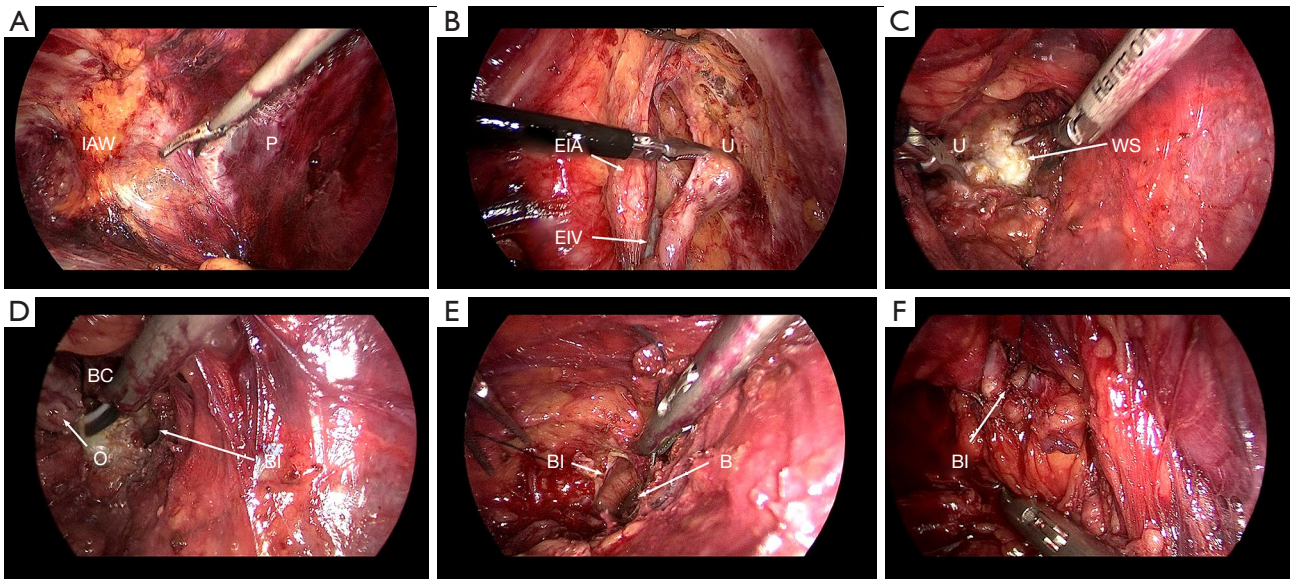

Figure 2 Procedures during tRLRNU. (A) The peritoneum and the fascia of the abdominal wall were further separated. (B) The ureter was continuously separated towards the Waldeyer sheath through a narrow passage between the peritoneum and the pelvic wall. (C) The Waldeyer sheath was incised. (D) The BC was clearly exposed. (E) An *en-bloc* resection of the ladder cuff was performed. (F) A two-layer running suture of the incision was performed. tRLRNU, total retroperitoneal laparoscopic radical nephroureterectomy; IAW, inferior abdominal wall; P, peritoneum; EIA, external iliac artery; EIV, external iliac vein; U, ureter; WS, Waldeyer sheath; BC, bladder cuff; O, orifice; BI, bladder incision; B, balloon.

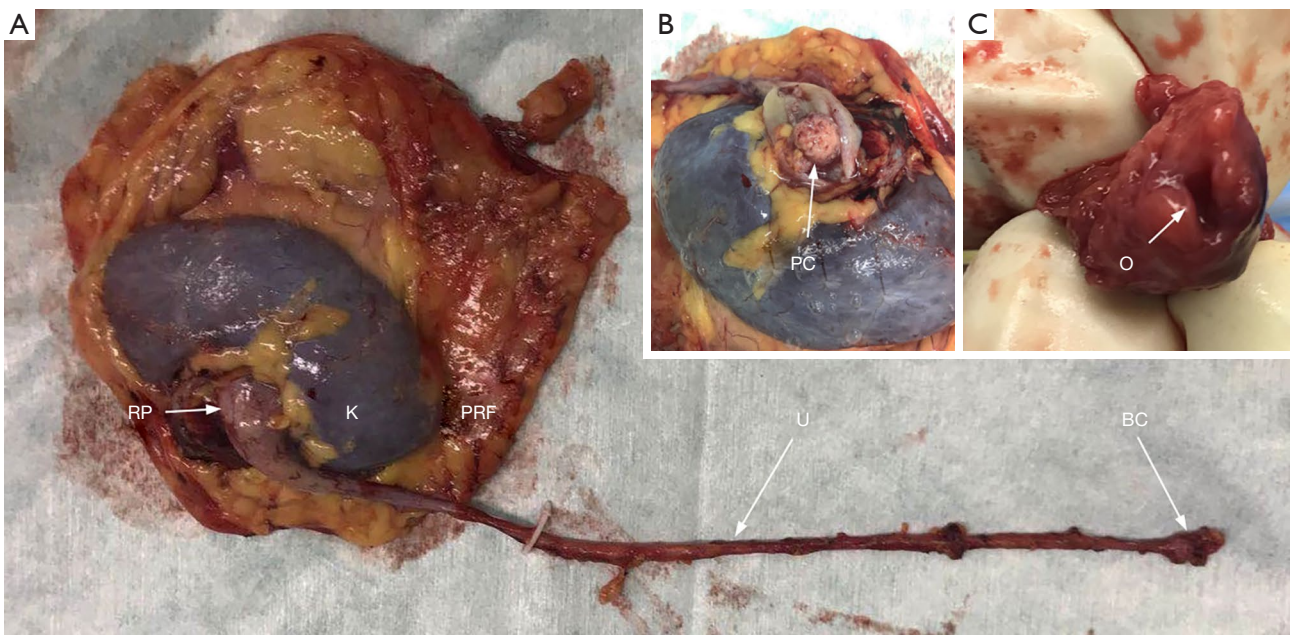

Figure 3 Specimen of tRLRNU. (A) Entire specimen. (B) Pelvic tumor. (C) Bladder cuff. tRLRNU, total retroperitoneal laparoscopic radical nephroureterectomy; RP, renal pelvic; K, kidney; PRF, peri-renal fat; U, ureter; BC, bladder cuff; PC, pelvic carcinoma; O, orifice.

samples *t*-tests, chi-square tests, and Fischer exact tests were used to analyze the differences between the two groups. Differences were considered statistically significant when P<0.05.

Table 1 General patient characteristics

Parameters	tRLRNU group (n=12)	tTLRNU group (n=28)	P value
Gender, n (%)			0.284
Male	8 (66.67)	19 (67.86)	
Female	4 (33.33)	9 (32.14)	
Age (years), mean ± SEM	68.50±8.52	70.86±7.00	0.366
BMI (kg/m^2), mean ± SEM	24.88±2.59	24.74±3.37	0.902
Side, n (%)			0.264
Left	8 (66.67)	17 (60.71)	
Right	4 (33.33)	11 (39.29)	
GFR (mL/min), mean ± SEM			
Affected side	28.56±9.14	24.98±8.77	0.419
Healthy side	42.14±4.74	35.43±12.45	0.092
Bladder lesions, n (%)	3 (25.00)	1 (3.57)	0.067
Distant metastasis, n (%)	0 (0.00)	0 (0.00)	1.000

tRLRNU, total retroperitoneal laparoscopic radical nephroureterectomy; tTLRNU, total transperitoneal laparoscopic radical nephroureterectomy; BMI, body mass index; GFR, glomerular filtration rate; SEM, standard error of the mean.

Results

Basic patient characteristics

There were no significant differences in the basic patient characteristics between the tRLRNU group and the tTLRNU group (*Table 1*).

Pathological parameters

There was no significant difference in the progression of UTUC between the two groups (*Table 2*).

Peri-operative parameters

There were significantly fewer trocars utilized in the tRLRNU technique group compared to the tTLRNU group (P=0.0008). The tTLRNU technique was associated with significantly more BL (170.71±121.32 versus 98.33±61.32 mL; P=0.017), greater post-operative drainage volume (1,924.82±3,370.02 versus 182.08±163.60 mL; P=0.011), and longer extubation time (8.57±6.96 versus 5.67±1.07 days; P=0.040). There were no statistical differences in the other peri-operative parameters, such as OT_w, transfusion, visceral and vascular injuries, open conversion, post- operative bleeding, post-operative ileus, recovery time of intestinal function, and discharge time (*Table 3*).

Adjuvant therapy and outcomes of UTUC patients

In the tRLRNU group, IBI of pirarubicin was performed

Table 2 Pathological parameters in patients undergoing tRLRNU and tTLRNU

Parameters	tRLRNU group (n=12)	tTLRNU group (n=28)	P value
Tumor load (mm^3), mean ± SEM	15,343.75±17,995.67	30,198.70±37,883.42	0.101
Progression of UTUC, n (%)			
High grade	10 (83.33)	26 (92.86)	0.273
pTa	3 (25.00)	2 (7.14)	0.630
pT1	4 (33.33)	10 (35.71)	
pT2	1 (8.33)	4 (14.29)	
pT3	3 (25.00)	9 (32.14)	
pT4	1 (8.33)	3 (10.71)	
BC cut edge positive	0 (0.00)	2 (7.14)	0.485
Lymph node invaded	0 (0.00)	1 (3.57)	0.700

tRLRNU, total retroperitoneal laparoscopic radical nephroureterectomy; tTLRNU, total transperitoneal laparoscopic radical nephroureterectomy; UTUC, upper urinary tract urothelial carcinoma; BC, bladder cuff; SEM, standard error of the mean.

Table 3 A comparison of the peri-operative parameters between patients in the tRLRNU group and the tTLRNU group

Parameters	tRLRNU group (n=12)	tTLRNU group (n=28)	P value
OT_w (min), mean ± SEM	182.17±34.37	163.18±42.02	0.177
OT_m (min), mean ± SEM	119.83±29.50	–	–
Nephrectomy time (min), mean ± SEM	54.36±17.41	–	–
DUBC resection time (min), mean ± SEM	64.33±18.13	–	–
Trocar number (rank, frequency), mean ± SEM	4.17±0.72	5.11±0.31	0.0008
Blood loss (mL), mean ± SEM	98.33±61.32	170.71±121.32	0.017
Transfusion, n (%)	0 (0.00)	2 (7.14)	0.485
Visceral damage, n (%)	0 (0.00)	0 (0.00)	1.000
Vascular injury, n (%)	0 (0.00)	0 (0.00)	1.000
Open conversion, n (%)	0 (0.00)	0 (0.00)	1.000
Recorded drainage volume (mL), mean ± SEM	182.08±163.60	1,924.82±3,370.02	0.011
Post-op bleeding, n (%)	0 (0.00)	1 (3.57)	0.700
Post-op fever, n (%)	0 (0.00)	2 (7.14)	0.485
Post-op ileus, n (%)	0 (0.00)	0 (0.00)	1.000
Recovery time of intestinal function (days), mean ± SEM	1.67±0.49	1.82±0.39	0.295
Extubation time (days), mean ± SEM	5.67±1.07	8.57±6.96	0.040
Discharge time (days), mean ± SEM	6.92±1.44	7.50±3.91	0.621

tRLRNU, total retroperitoneal laparoscopic radical nephroureterectomy; tTLRNU, total transperitoneal laparoscopic radical nephroureterectomy; OT_w, whole operation time; OT_m, main operation time (nephrectomy time + DUBC resection time); DUBC, distal ureter bladder cuff; SEM, standard error of the mean.

in 100.00% of patients before the curation of the BC, while in the tTLRNU group, IBI was only performed in 10.71% of patients (P<0.0001). Most patients received adapted adjuvant intravenous chemotherapy (75.00% in both group; P=0.307), with the tRLRNU group and the tTLRNU group receiving 2.25±1.36 and 2.50±1.80 cycles, respectively (P=0.888). ICT was utilized in the tTLRNU group (17.86%; P=0.149). The patient outcomes at 6 months were significantly worse in the tTLRNU group compared to the tRLRNU group by comparing progression-free survival, progression survival and mortality (P=0.039). The outcomes at 12 months were better in the tRLRNU group compared to the tTLRNU group, but there was no statistical difference between the 2 groups (*Table 4*).

Discussion

Within the field of laparoscopy, there are several approaches for RNU depending on the management of the DUBC. In the Washington University approach, transperitoneal laparoscopic nephrectomy is combined with the ureteral unroofing technique. The disadvantages of this technique include the requirement for transection of the superior vesical pedicle and the contralateral ureteral orifice is generally not visible during the extravesical placing of the stapler over the trigone. Furthermore, this technique cannot be performed by the retroperitoneal laparoscopic technique and a fluoroscopy is required. In addition, the staple line in the bladder may lead to potential formation of bladder stones (5).

It was also reported that the transperitoneal approach was associated with poorer disease progression compared to the retroperitoneal approach (7). The main techniques for DUBC combined with laparoscopic nephrectomy can be divided into the following three main types: (I) intravesical technique; (II) transvesical technique (Cleveland Clinic approach); and (III) extravesical technique (5). The intravesical technique can be further subdivided into

Table 4 Adjuvant therapy and outcomes in the patients in the tRLRNU and tTLRNU groups

Parameters	tRLRNU group (n=12)	tTLRNU group (n=28)	P value
IBI of pirarubicin, n (%)	12 (100.00)	3 (10.71)	<0.0001
Chemotherapy (GC)			
N (%)	9 (75.00)	21 (75.00)	0.307
Cycles (n), mean ± SEM	2.25±1.36	2.50±1.80	0.888
ICT, n (%)	0 (0.00)	5 (17.86)	0.149
Local recurrence, n (%)			
Renal fossa	1 (8.33)	2 (7.14)	0.459
Peri-BC	1 (8.33) (in bladder cavity)	3 (10.71) (in bladder cavity)	0.430
Bladder non-peri-BC	1 (8.33)	3 (10.71)	0.430
Metastasis, n (%)			
Lymph node	1 (8.33) (retroperitoneal space and mediastinum)	2 (7.14) (retroperitoneal space, mediastinum, neck, supraclavicular area)	0.459
Distance	1 (8.33) (lung, abdominal wall)	3 (10.71) (lung, liver and spinal column, abdominal wall)	0.430
3 months, n (%)			0.373
PFS	11 (91.67)	24 (85.71)	
PS	1 (8.33)	4 (14.29)	
Death	0 (0.00)	0 (0.00)	
6 months (10 *vs.* 28 cases), n (%)			0.039
PFS	9 (90.00)	19 (67.86)	
PS	0 (0.00)	9 (32.14)	
Death	1 (10.00)	0 (0.00)	
12 months (10 *vs.* 26 cases), n (%)			0.181
PFS	8 (80.00)	13 (46.43)	
PS	1 (10.00)	11 (39.29)	
Death	1 (10.00)	2 (7.14)	

tRLRNU, total retroperitoneal laparoscopic radical nephroureterectomy; tTLRNU, total transperitoneal laparoscopic radical nephroureterectomy; IBI, immediate bladder irrigation of pirarubicin; GC, gemcitabine plus cisplatin chemotherapy; ICT, immune checkpoint therapy; BC, bladder cuff; PFS, progression-free survival; PS, progression survival.

the pluck technique and the stripping technique. The 2 types of extravesical method include the open technique (Gibson incision or an infraumbilical incision) (9) together with cystoscopy (position of ureteral catheter) (5), and the total retroperitoneal laparoscopic technique, which was introduced in this article.

In the pluck intravesical technique (introduced by Keeley and Tolley), the ureteral orifice, the surrounding BC, and the transmural ureter are generously resected up to the perivesical fat, which minimizes operative time to 2.5 hours and reduces the risk of tumor seeding by identifying and clipping the midureter early during the laparoscopic nephrectomy. The disadvantages include lack of prior cystoscopic mobilization of the distal juxtavesical ureter (laparoscopic difficulties); difficulty confirming the removal of the entire ureter; unoccluded distal ureter and continued urinary extravasation; tumor cell spillage and peri-vesical recurrence (directly T3); and risk of common iliac artery

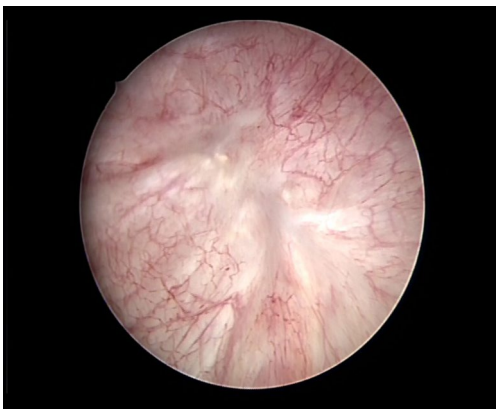

Figure 4 Bladder incision scar under cystoscopy post-tRLRNU. tRLRNU, total retroperitoneal laparoscopic radical nephroureterectomy.

thrombosis, due to the need to cross the common iliac artery when handling the distal ureter (5). Hayashi *et al.* modified the pluck technique with the open surgical approach (10).

The stripping technique, introduced by Willis *et al.* (4) and modified by Wein *et al.* (11), Angulo *et al.* (12), and Nakamura *et al.* (13), involves a small device placed in the ureter in advance for the purpose of pulling the distal ureter entirely into the bladder after the laparoscopic portion. The excision of the distal ureter can be performed by open surgery or resectoscope (4). The mean operation time of the modified technique by Angulo *et al.* was 140 minutes (12) due to 3 positions. The modified technique by Nakamura *et al.* lasted 262 minutes. The stripping technique can also cause tumor cell spillage and peri-vesical recurrence (9), and even skin incision implantation. The recurrence rate associated with the stripping technique (24.0%) was higher than that associated with the pluck technique (19.3%) (13).

The transvesical technique, in which two transvesical ports are needed to tightly position an Endoloop around the ureteral orifice, was introduced by the Cleveland Clinic. A circumferential incision is made with a Collin knife around the ureteral orifice during cystoscopy. The bladder rent is not suture-repaired. Although the risk of urine leakage from the upper urinary tract is avoided (4), urine extravasation from the bladder and irrigated fluid extravasation was obvious, which may cause tumoral implantation. Furthermore, the operative time was lengthened by 60–90 minutes (4).

The application of the extravesical technique during open surgery, tTLRNU (by Ghazi *et al.*) (8), and robotic-assisted laparoscopic radical nephroureterectomy (RALRNU) (by Hemal *et al.*) (14) have been previously reported in the literature. Although a standard BC may be obtained through an anterior cystotomy by open technique, it risks a compromise of the contralateral ureteral orifice during placement of the extravesical right-angle clamp (4). The peri-operative and 5-year intravesical recurrence-free survival of RALRNU was similar to that observed with LRNU, while the lower 5-year retroperitoneal recurrence-free survival and cancer-specific survival in RALRNU was worse (15).

LRNU has been shown to be more effective and safer than open RNU (5), and transperitoneal RNU has been associated with worse disease progression compared to retroperitoneal RNU (7). Although there are many techniques for dealing with the DUBC, the tRLRNU technique might be considered the most ideal based on absence of tumor and reduced incidence of complications.

In this article, the RNU was completely performed under retroperitoneal laparoscope in single-position. The new technique was compared with tTLRNU. In our experience, the single-position technique of tTLRNU was not convenient to perform, because of the awkward operating angle of the surgeon's hands, the narrow operation area, and the interference between the laparoscopic instruments controlled by the surgeons. The inconvenience led to more BL, one case of incomplete BC resection (which had severe recurrence in DUBC), and one case of post-operative bleeding. While tRLRNU was also associated with an uncomfortable operator position during the DUBC resection (due to patient's arm), and limited operation space, the operating angle was less uncomfortable and there was less interference with the activity of the instruments. Furthermore, tRLRNU did not significantly prolong the operation time, with the mean OT_w being 182.17±34.37 minutes. Excluding the time of constructing the operating passages, laparoscopic equipment removal, exchange of surgeon positions, specimen removal, and closing of incisions, the main operation time (OT_m) consisted of the nephrectomy time (54.36±17.41 minutes) and the DUBC resection time (64.33±18.13 minutes) was shortened. The shortest OT_m of tRLRNU was 83 minutes, in which nephrectomy time was 36 minutes and the DUBC resection time 47 minutes. The shortest DUBC resection time of tRLRNU was only 32 minutes. The DUBCs were resected completely (*Figure 4*).

It was noticeable that the tRLRNU technique required fewer trocars (generally requiring 4 trocars, with a minimum of 3 trocars) compared to the tTLRNU technique (requiring at least 5 trocars). The approach along the iliac wing was

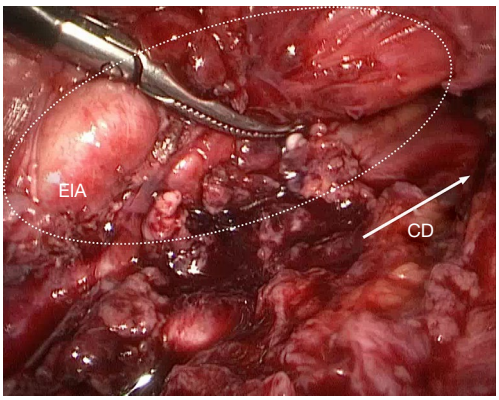

Figure 5 Dorsal direction sight for the RPLND area (roughly within the dotted line). RPLND, retroperitoneal pelvic lymph node dissection; EIA, external iliac artery; CD, caudal direction.

more minimally-invasive and reasonable. Furthermore, no severe complications in the peri-operative period were observed for the tRLRNU group. In contrast, the tTLRNU group presented with increased drainage volume, which was mainly related to delayed exudation, and 2 febrile cases.

The IBI (during operation) rate was significantly higher in the tRLRNU group compared to the tTLRNU group, and the ICT was utilized by patients in the tTLRNU group but not by patients in the tRLRNU group, both might have affected the statistical comparison of the two groups in terms of the recurrence in peri-BC vesical implantation. During the follow-up of the UTUC, the peri-BC recurrence rates and the non-peri-BC intravesical recurrence rates were similar between the two groups. But the entire outcomes of the tRLRNU group appeared to be superior to that of tTLRNU group, especially at 6 months. These results concur with previously reported literature (7). We speculate that the advantage will be more pronounced at 12 months as cases accumulate.

The RPLND for UTUC was delicate to perform under caudal laparoscopy, because of the visual obstruction caused by external iliac artery. However, one case with tumor reduction provided better resolution. In this case, the tumor invaded the external iliac vessels and we added a 5th trocar, which was positioned further towards the caudal direction, thus the visual field of the laparoscope faced the RPLND area (dorsal direction sight, T4 as observation trocar). Although we just did cytoreductive surgery for him, not tRLRNU, but it revealed a potential possibility for performing RPLND (*Figure 5*).

Conclusions

In conclusion, the tRLRNU technique was potentially safer, minimally-invasive, and more effective for UTUC. A surgical template for RPLND through tRLRNU technique might be applicable. Due to the small sample size and no randomization of the study, future comparative studies are warranted to further analyze strengths, weaknesses and long-term outcomes of the tRLRNU technique.

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Footnote

Reporting Checklist: The authors have completed the STROBE reporting checklist. Available at https://tau.amegroups.com/article/view/10.21037/tau-22-270/rc

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Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by the Ruijin Hospital Ethics Committee (No. 144, Year 2021). All patients have signed operation consents.

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