



# Transurethral Electric Coagulation Combined With Retroperitoneal Laparoscopic Nephroureterectomy for Upper Urinary Urothelial Carcinoma

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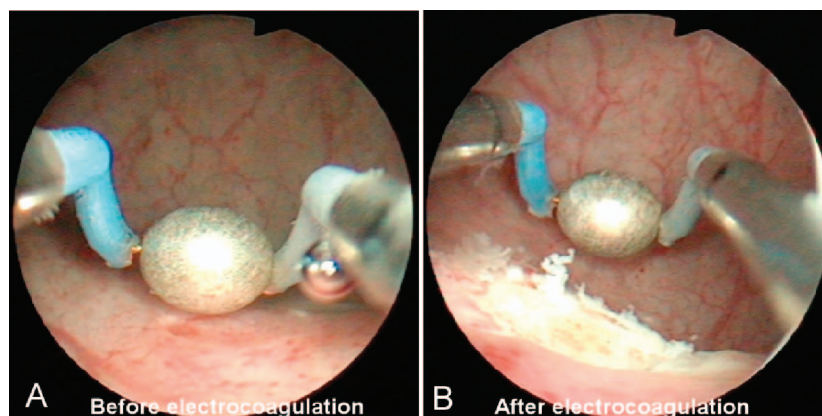
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Retroperitoneal laparoscopic nephroureterectomy (LNU) combined with transurethral electric resection of ipsilateral bladder cuff is widely accepted to treat the upper urinary tract urothelial carcinoma (UUT-UC). To reduce the local recurrence rate, we improved the procedure from electric resection to electric coagulation. From May 2008 to July 2012, of all the 156 retroperitoneal LNU patients, 76 cases (test group) were performed with LNU combined with electric coagulation, and 80 cases (control group) were with electric resection. For the clinical outcomes, the hospital stay in the test group was shorter ( $5.2 \pm 2.6$  days versus  $8.2 \pm 3.4$  days;  $P < 0.05$ ), and the 1-year tumor recurrence rate was much lower (1.6% versus 13.3%,  $P < 0.05$ ). There was no difference in operation time and blood loss between groups. Retroperitoneal LNU combined with electric coagulation is technically feasible and safe with lower tumor recurrence rate and shorter hospital stay.

**Key words:** Retroperitoneal nephroureterectomy – Upper urinary tract – Urothelial carcinoma – Transurethral electric coagulation

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**Fig. 1** The bladder mucosa around ureteral orifice and ureter mucosa located in bladder wall were coagulated. (A) before electrocoagulation; (B) after electrocoagulation.

With the rapid development of laparoscopic technique, laparoscopic nephroureterectomy (LNU) has gradually replaced the open surgery, and become a new standard for treating upper urinary tract urothelial carcinoma (UUT-UC).<sup>1-3</sup> The aim of LNU for UUT-UC is to reduce the operation damage and minimize the tumor metastasis and local planting. Nontumor is regarded as one of the most important principles to treat the UUT-UC.<sup>4-5</sup> Retroperitoneal LNU combined with transurethral electric resection of an ipsilateral bladder cuff could indeed decrease the damage,<sup>6</sup> however, it may fail to decrease tumor metastasis and local recurrence rate, or even increase external bladder planting. We improved the surgical method from electric resection to electric coagulation. A retrospective analysis on 76 cases with UUT-UC who underwent retroperitoneal LNU combined with transurethral electric coagulation from February 2010 to July 2012 was summarized as below.

## Materials and Methods

### *Clinical data*

Seventy-six cases of UUT-UC without distant metastasis were included in a test group from February 2010 to July 2012, including 45 males and 31 females (age range, 32 to 85 years old; mean 57.8 years old). For 43 cases, tumors were located in renal pelvis; for another 33 cases, tumors were located in upper or middle ureter. All cases were diagnosed by ultrasound, intravenous urogram (IVU), computed tomography (CT), computed tomography urogram (CTU), or magnetic resonance urogram (MRU). Among them, 10 cases were confirmed by IVU, 35 cases by CT or CTU, 22 cases by MRI or MRU, and 9 cases were confirmed by ureteroscopy combined with imaging results. Positive exfoliative cytology

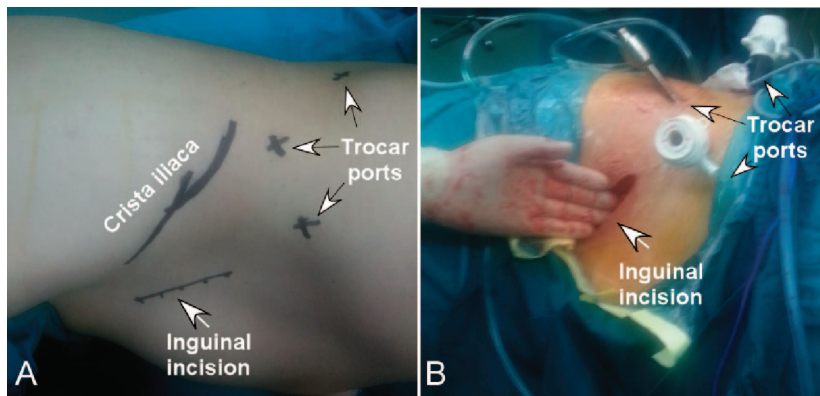
was found in 10 cases. Distant metastasis was not detected in any case. Bladder tumor was not found in all cases by cystoscopic examination. In the control group, from May 2008 to June 2011, 80 cases of patients with UUT-UC were performed LNU combined with transurethral electric resection at our hospital, there were no significant differences in age, sex, and tumor location between the 2 groups. The protocols for this study were approved by the Ethical Committee of Yantai Yuhuangding Hospital.

### *Excluding criteria*

The excluding criteria were the following: bilateral tumor, tumor penetrating to serous membrane, tumor on the lower ureter, tumor with node metastasis, tumor with bladder carcinoma, simultaneous pelvis and ureter tumor, squamous-cell carcinoma and adenocarcinoma.

### *LNU procedure*

For test group: With lithotomy position, 1 to 2 cm bladder mucosa around ureteral orifice and ureter mucosa located in bladder wall were coagulated thoroughly (Fig. 1). The patients were then placed in lateral position for laparoscopic nephrectomy (Fig. 2). The ureter was mobilized sufficiently under laparoscopy in all cases. In 45 cases, ureter was mobilized to the bladder, then the ureter was lifted up, thus the bladder was spindle-shaped. The proximal and distal end (on the bladder wall) was clipped with 1 and 2 Hemo-lock respectively, specimens were pulled out by inguinal or lumbar incision (Fig. 3). In 31 cases, due to difficulty of mobilizing the distal ureter to bladder wall, inguinal incision was needed. Through a 5 to 8 cm inguinal incision, ureter mobilization was performed continuously to the bladder, the ureter was lifted up,



**Fig. 2** The patients were placed in lateral position for laparoscopic nephrectomy. The detailed trocar port sites and inguinal incision were shown in (A) and (B).

proximal and distal end (on the bladder wall) was clipped with 1 and 2 Hemo-lock respectively, specimens were pulled out by inguinal incision.

For control group: With lithotomy position, 1to2 cm bladder wall around ureteral orifice was cut to fat tissue outside the bladder wall. The patients were then placed in lateral position for laparoscopic nephrectomy. The ureter was mobilized to the level of iliac vessel, then it was dragged upward. Specimens were taken out from inguinal incision or lumbar incision.

#### *Postoperative bladder irrigation and follow-up*

In the test group, the bladder irrigation chemotherapy with epirubicin (40 mg dissolved in 50 mL physiologic saline) was begun within 24 hours after operation; in the control group, the bladder irrigation chemotherapy with epirubicin was begun 1 week after operation. Cystoscopy was performed every 3 months in the first 2 years after operation and every 6 months after 2 years. The recurrent cases were recommended for further examination and treatment.

#### *Statistical analyses*

All data were analyzed and processed by SPSS 11.0 software (IBM Corp., Armonk, NY), operation time, operation blood loss, hospitalization duration and

tumor recurrence between 2 groups were compared by T test or  $\chi^2$  test.

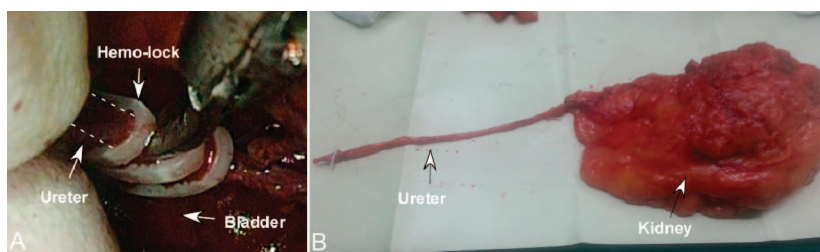
#### *Results*

All operations of 156 UUT-UC cases were performed successfully, without death or severe complications. There were no significant differences in mean operation time, blood loss, tumor stage, and tumor grade between groups. The hospital stay of test group was shorter than that of the control group ( $5.2 \pm 2.6$  days versus  $8.2 \pm 3.4$  days;  $P < 0.05$ ). One-year recurrence rate of the test group was lower than that of the control group (1.6% versus 13.3%;  $P < 0.05$ ). The detailed data was shown in Table 1.

#### *Discussion*

Compared with open surgery, LNU has the advantages of small trauma, low blood loss, and quicker recovery with similar therapeutic effect.<sup>4,7-9</sup> There are 2 approaches for the LNU procedure, transperitoneal and retroperitoneal route. The retroperitoneal approach is featured by less interference to abdomen organs and quicker recovery of intestinal function, and it is widely appreciated by urologists and patients.<sup>10-11</sup>

Bladder tumor recurrence might happen easily after the operation of upper urinary tract tumor,



**Fig. 3** The proximal and distal end of ureter (on the bladder wall) was clipped with 1 and 2 Hemo-locks respectively (A); specimen was then taken out (B).

Table 1 Characteristics and outcomes of test and control group

	Test group (n = 76)	Control group (n = 80)	P value
Age (y) ( $\bar{X} \pm s$ )	57.8 $\pm$ 5.7	58.2 $\pm$ 5.5	0.6562
Sex (M/F) (n)	45/31	50/30	0.674
Tumor (n right/left)	40/36	41/39	0.863
Tumor location (n)			0.908
Pelvis	43	46	
Upper and middle ureter	33	34	
Operation time (min) ( $\bar{X} \pm s$ )	101.6 $\pm$ 13.2	104.3 $\pm$ 11.6	0.1762
Operation blood loss (mL) ( $\bar{X} \pm s$ )	67.0 $\pm$ 12.7	70.0 $\pm$ 20.5	0.2765
Hospital stay (d) ( $\bar{X} \pm s$ )	5.2 $\pm$ 2.6	8.2 $\pm$ 3.4	< 0.0001*
Tumor stage (T1/T2/T3) (n)	29/27/20	32/29/19	0.931
Tumor grade (G1/G2/G3) (n)	19/43/14	19/43/18	0.820
Follow-up (m)	15.1 $\pm$ 4.6	25.9 $\pm$ 10.5	< 0.0001*
1-year tumor recurrence rate (n/%)	1 (1.6%) (n = 62)	10 (13.3%) (n = 75)	0.012*

\*Statistically significant

with a recurrence rate of 15% to 50%.<sup>12</sup> For tumors located in the renal pelvis or ureter, transurethral electric resection combined with retroperitoneal laparoscopy indeed has advantages of small damage, little blood loss, and quick postoperative recovery.<sup>11-12</sup> However, tumors in the middle or lower ureter may spread out easily from the “open” end of ureter, and induce planting and dissemination. In patients with local tumorous invasion, adhesion of pelvic cavity, or pelvic operation history, pulling the ureter may cause ureteral breakage.

The aim of laparoscopic surgery for tumors is to decrease the operation damage while ensuring the “radical” excision of tumor. “Non-tumor” is regarded as the most important principle in the LNU for UTT-UC. Since tumor cells in renal pelvis and ureter could exfoliate easily, the damage to renal pelvis, ureter, and bladder may result in tumor planting during operation. There are several techniques of distal ureteric excision:<sup>8,13</sup> (1) cystoscopic detachment of ureter without ligation or stapling;<sup>14</sup> (2) cystoscopic detachment of ureter with ureteric stripping technique;<sup>15</sup> (3) extravesical laparoscopic stapling of ureter; (4) cystoscopic detachment of the ureter with endoscopic ligation or stapling;<sup>16</sup> and (5) open excision of bladder cuff.<sup>17</sup> The technique of distal ureteric excision is still debatable, and the data reporting is also inconsistent.

For the widely used transurethral electric resection, the bladder wall around the ureteral orifice was cut through to the fat tissue, and left an open end of the ureter.<sup>10</sup> Since the integrity of urinary tract was broken, the spillage of tumor cells from ureter into the perivesical space may result in tumor planting when lifting up the ureter. Bladder instillation of a chemotherapeutics drug at 1 week after

operation may miss the appropriate time to kill the tumor cells.

Since the retroperitoneal LNU combined with transurethral electric resection has the above severe shortcomings, we improved the surgical procedure and postoperative bladder irrigation as follows: (1) Changing the transurethral electric resection to electric coagulation. The bladder wall around ureteral orifice was coagulated in full-thickness with full integrity of urinary tract. Even if the tumor cells exfoliated from the primary lesion, they still kept in a closed system; (2) Mobilizing the ureter to bladder wall thoroughly, instead of pulling out the ureter by hand. Pulling the ureter may cause ureteral rupture or transection; (3) When resecting the ureter from bladder, the hemo-locks were used to seal the ureteral terminal and bladder wall. Thus the tumor cells could not spread to the surgical field; (4) Since the bladder was kept enclosed by hemo-lock, the first bladder irrigation chemotherapy could be performed immediately after operation or within 24 hours. The possible exfoliative tumor cells would be killed before implanting and proliferating in bladder. Meanwhile, the catheter could be removed 2 to 3 days after surgery without worrying about the leakage of urine.

Overall, transurethral electric coagulation combined with retroperitoneal laparoscopic nephroureterectomy for upper urinary urothelial carcinoma had the advantages of shorter hospital duration, less tumor cell planting, and lower tumor recurrence rate. It was technically feasible and safe in treating upper urinary tract urothelial carcinoma, and has the potential to be widely accepted and popularized in future.

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Jiantao Wang and Shengqiang Yu contributed equally to this work.

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