

# A New Surgical Technique of Combination Retroperitoneal with Transperitoneal Laparoscopic Nephroureterectomy in a Single Position and Comparative Outcomes

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## Research

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# Abstract

**Background** The traditional surgical treatment for upper urinary tract urothelial carcinoma (UTUC) is time-consuming owing to changing the surgical position and larger surgical trauma because of open surgery in handling the distal ureter. Therefore, we created a new surgical technique of combination retroperitoneal with transperitoneal (CRT) laparoscopic nephroureterectomy (LNU) in a single position and to reported our early outcomes. **Methods** From January 2017 to October 2018, a total of 45 patients underwent LNU by a single surgeon at our department, of whom 25 patients underwent standard technique and 20 patients underwent CRT technique. Relevant clinical data were collected including each patient's characteristics, surgical outcomes, and follow-up results. A comparative analysis between standard LNU cases and CRT LNU cases was performed. **Results** LNU was performed successfully on all 45 patients. There was no significant difference in patients' characteristics. Compared to standard group, patients in CRT group had shorter operative time, less estimated blood loss (EBL), lower visual analogue scale (VAS) pain score and less scar (  $P < 0.001$ ). The mean time of surgical drain stay decreased from 4.2d to 2.8d and median hospital stay after surgery decreased from 5d to 3d (  $P < 0.001$ ). The complication rates did not show statistic difference between the two groups within the first 30 days postoperatively (  $P = 0.258$ ). For the long-term complications, the incidence of abdomen bulge or incisional hernia in CRT group was less than that in the standard group (  $P < 0.001$ ). **Conclusion** The CRT technique, which combines both the advantages of retroperitoneal and transperitoneal approaches, is a more minimally invasive, simplified and effective way to perform the LNU.

## 1. Introduction

Upper urinary tract urothelial carcinoma (UTUC) is a relatively rare urothelial neoplasm, accounting for about 5–10% of all urothelial carcinoma[1]. However, its high recurrence rate and rapid progression seriously affect the prognosis of patients. Nephroureterectomy with bladder cuff excision is the current gold standard for the treatment of UTUC[1]. Because of the low incidence of perioperative complications and the similar oncology control effect to open surgery, laparoscopic nephroureterectomy (LNU) is preferred in the majority of medical centers[2].

Transperitoneal approach and retroperitoneal approach as two common methods in LNU, have their own advantages and disadvantages. Compared to retroperitoneal approach, it's easier to recognize anatomic landmarks during a transperitoneal approach, and it owns larger surgical space, which makes it easier to find the most appropriate angle for manipulating tissues. However, one of the accepted disadvantages is that the identification and mobilization of renal pedicle could be more difficult and time consuming[3]. The standard surgical technique is now widely used in most of the centers. After laparoscopic resection of the kidney and proximal ureter segment with the patients placed in the lateral decubitus position, the distal ureter together with a cuff of bladder around the ureteric orifice are removed by open surgery when the patients' position must be changed to the supine position. Therefore, the operation time will be greatly prolonged due to the position change during operation, and open surgery will bring larger surgical trauma.

To solve the above problems, we created a new surgical technique which combined both the advantages of retroperitoneal approach with transperitoneal approach, and named it CRT technique. The operation can be accomplished by adjusting the inclination of operating table, without changing the patients' position. The aims of the present study are to introduce our novel technique of CRT LNU, and to compare the early outcomes with the standard technique.

## **2. Patients And Methods**

### **2.1 Patients**

From January 2017 to October 2018, a total of 45 patients who underwent LRU at our department by one surgeon with extensive laparoscopic surgical experiences were retrospectively analyzed in this study, of whom 25 patients underwent standard LNU from January to December 2017, while 20 patients underwent CRT LNU from January to November 2018. The indications for surgery included (1) Patients diagnosed with UTUC by preoperative biopsy or imaging, (2) Renal or ureteral tuberculosis that cannot be treated conservatively, (3) Patients with duplication of kidney and ureter requiring surgical treatment. Preoperative evaluation consisted of standard history and physical exam, basic laboratory blood, cardiac and pulmonary work-up as indicated. All patients were examined by magnetic resonance (MRI) or enhanced computed tomography (CT) examination before operation and all UTUC patients had no metastatic disease. All patients had a normal renal function on the unaffected side.

All patients' characteristics, intraoperative, post-operative and follow-up parameters were recorded. Complications were analyzed according to the Clavien-Dindo classification[4].

### **2.2 Surgical technique**

#### **2.2.1 CRT technique**

After general anesthesia, patients were placed in standard 90° full flank position and secured to the table, then the table was rotated to maximize exposure of the kidney (Fig. 1). The layout of the trocar was shown in Fig. 2. A 2-cm incision was made at the center between the 12th rib and the erector spinae muscle (port B), the retroperitoneal space was entered by blunt finger dissection. After a retroperitoneal working space had been created using a balloon dissector, a 10-mm trocar was inserted at the middle axillary line 3 cm cephalad to the iliac crest (port A), and another 5-mm trocar was placed at the tip of the 11th rib (port C). After the pneumoperitoneum was created, laparoscopic camera and instruments were placed into port A, B and C, respectively. By dissecting along the psoas muscle, the posterior surface of the kidney was reflected medially. Then renal pedicle was identified with dissection of the renal artery and vein (Fig. 4). After the renal vessels were isolated and clipped successively by Hem-o-lok clips, kidney was mobilized outside the perirenal fascia. The adrenal gland was spared in all cases unless involvement was suspected. The ureter was then mobilized caudally toward the level of iliac vessels. A surgical drain was inserted through port C after the operation region was confirmed to have no active bleeding.

Then, the patients were modulated to 30° flank position by adjusting the table and another three trocars were inserted around the umbilicus (Fig. 3). With a 10-mm trocar at the lower level of the umbilicus (port E), a 5-mm trocar at the midpoint of the line between the umbilicus and the anterior superior iliac spine (port D), and the last 12-mm trocar was placed 2 cm cranial to the pubic symphysis in the middle line (port F). The positions of all trocars would be adjusted according to actual individuals. The camera was then moved to caudal through port E and the useless trocar wounds were closed by surgical assistant at the same time. The posterior peritoneum was dissected and the mobilized kidney was pulled into abdominal cavity. The ureter was dissected caudally to the bladder wall and was excised with a cuff of bladder around the ureteric orifice (Fig. 5). The entire nephroureterectomy specimen was put into a specimen bag and removed through an approximately 5-cm abdominal median suprapubic incision.

## 2.2.2 Standard technique

Following the laparoscopic radical nephrectomy, the patient was then placed in supine position and was re-prepared and draped for the next open surgery. The distal ureter and bladder cuff were then dissected through a nearly 10-cm lower-abdominal oblique incision, through which the specimen was removed. Lymph node dissection was not performed routinely for UTUC patients.

## 2.3 Statistical Analysis

All data were analyzed using SPSS version 21.0. Mean values with standard deviations were computed and reported for continuous data in normal distribution. Nonnormally distributed continuous data were described by median and interquartile range. An independent Student's t-test or Mann-Whitney U-test was used for comparison of normally distributed or nonnormally distributed continuous variables, respectively. Categorical variables were compared with Chi-square test. For all statistical tests,  $P < 0.05$  was considered to indicate a significant difference.

## 3. Results

Patients' characteristics are shown in Table 1. There was no significant difference between the two groups in age, sex distribution, BMI, disease category, location of UTUC, side distribution and American Society of Anesthesiologists (ASA) score.

Table 1  
Characteristics of patients

Variables	CRT Technique (n = 20)	Standard Technique (n = 25)	P <sup>¶</sup>
Age (mean ± SD), years	63.3 ± 13.7	65.1 ± 7.5	0.571
Male, n (%)	11 (55%)	15 (60%)	0.736
BMI (mean ± SD), kg/m <sup>2</sup>	23.9 ± 3.1	22.9 ± 2.5	0.986
Disease, n (%)			0.177
UTUC	17 (85%)	23 (92%)	
Tuberculosis	1 (5%)	2 (8%)	
Duplication of kidney and ureter	2 (10%)	0	
Location of UTUC, n (%)			0.676
Renal pelvis	10 (59%)	12 (52%)	
Upper middle ureter	7 (41%)	11 (48%)	
Side, n (%)			0.841
Left	11 (55%)	13 (52%)	
Right	9 (45%)	12 (48%)	
ASA score, n			0.841
1–2	18	24	
3	2	1	
Abbreviations: CRT: combined retroperitoneal with transperitoneal; BMI: Body mass index; UTUC: Upper urinary tract urothelial carcinoma; ASA: American Society of Anesthesiologists.			

All cases were completed successfully without conversion to open surgery. Perioperative parameters are shown in Table 2. Compared to standard group, patients in CRT group had shorter operative time, less estimated blood loss (EBL), lower visual analogue scale (VAS) pain score and less scar ( $P < 0.001$ ). The mean operative time was 116 minutes for CRT group and 194 minutes for standard group. The median EBL was 50 ml for CRT group and 100 ml for standard group. The mean VAS pain score was 1.4 for CRT group and 2.8 for standard group and the median length of scar for CRT group was 6 cm, whereas for standard group it was 11 cm. The mean time of drain duration decreased from 4.2d in standard group to 2.8d in CRT group and median hospital stay after surgery decreased from 5d in standard group to 3d in CRT group ( $P < 0.001$ ). There was no statistical difference in other parameters (transfusion, ICU after surgery, time of intake of liquid diet, time of ambulation and time of urethral catheter).

Table 2  
 Perioperative outcomes and postoperative complications

Variables	CRT Technique (n = 20)	Standard Technique (n = 25)	P
Operative time (mean ± SD), min	116.3 ± 34.9	194.4 ± 38.1	0.001
EBL (median [IQR]), ml	50 (30–50)	100 (80–150)	0.001
Transfusion, n (%)	0	1 (4%)	1.000
ICU after surgery, n (%)	2 (10%)	4 (16%)	0.883
VAS pain score after surgery (mean ± SD)	1.4 ± 0.7	2.8 ± 1.0	0.001
Time of intake of liquid diet (median [IQR]), days	1 (1–1)	1 (1–1.5)	0.084
Time of ambulation (mean ± SD), days	1.1 ± 0.3	1.2 ± 0.5	0.438
Time of surgical drains (mean ± SD), days	2.8 ± 0.7	4.2 ± 0.9	0.001
Catheterization time (median [IQR]), days	1.5 ± 0.6	1.5 ± 0.7	0.917
Hospital stay after surgery (median [IQR]), days	3 (2–4)	5 (4–6)	0.001
Length of the scar (median [IQR]), cm	6 (5–6)	11 (10–12)	0.001
30-day complication rates, n (%)			0.258
None	16 (80%)	17 (68%)	
Minor (I–II)	4 (20%)	8 (32%)	
Major (III–V)	0	1 (4%)	
Hypogastric bulge or incisional hernia, n (%)	1 (5%)	16 (64%)	0.001
Abbreviations:: CRT: combined retroperitoneal with transperitoneal; SD: Standard deviation; EBL: Estimated blood loss; IQR: Interquartile range; ICU: Intensive Care Unit; VAS: visual analogue scale.			

The complication rates did not show statistic difference between the two groups within the first 30 days postoperatively (P = 0.258). In the CRT group, 4 patients (20%) experienced at least one complication and

all of them were minor complications (Grade 1–2). In the standard group, 8 patients (32%) experienced at least one complication, and majority of these complications were minor, except one patient simultaneously experienced deep vein thrombosis—a major complication (Grade 3–5) and underwent interventional treatment. The most common minor complications were fever, urinary infection and incision fat liquefaction. Notably, 3 patients experienced incision fat liquefaction in standard group, whereas no patient experienced this complication in CRT group. For long-term complications, 16 patients (64%) in standard group experienced hypogastric bulge or incisional hernia at about 5 to 10 months postoperatively, but only 1 patient in CRT group experienced hypogastric bulge, there was statistical difference ( $P < 0.001$ ). Except for 2 patients in standard group who underwent herniorrhaphy, most of them did not require surgical treatment.

There was no significant difference in pathological outcomes between the two groups in UTUC patients (Table 3). The median follow-up time was 20 and 9 months for standard and CRT groups, respectively. Four patients (17%) in standard group suffered local recurrence and two patients (9%) suffered cancer metastasizing to lung and liver respectively. In CRT group, 1 patient (6%) suffered cancer metastasizing to lung, while no patient experienced local recurrence.

Table 3  
Pathological and oncological outcomes

Variables	CRT Technique (n = 17)	Standard Technique (n = 23)	P <sup>†</sup>
Pathological T stage, n (%)			0.663
T1	3 (18%)	5 (22%)	
T2	10 (59%)	14 (61%)	
T3	4 (24%)	3 (13%)	
T4	0	1 (4%)	
Local recurrence, n (%)	0	4 (17%)	
Metastasis, n (%)	1 (6%)	2 (9%)	
Abbreviations: CRT: combined retroperitoneal with transperitoneal.			

## 4. Discussion

The standard treatment for UTUC has traditionally consisted of open nephroureterectomy with excision of a bladder cuff. With technical improvements, LNU has been applied to patients extensively since the first case presented by CLAYMAN[5]. A series of studies have shown that LNU has similar oncologic outcomes compared to the open technique[6–8]. The standard LNU, which was used in most of centers, was divided into two steps. After retroperitoneal laparoscopic nephrectomy, the distal ureter with a cuff of

bladder was excised through a lower-abdominal incision when patients' position was needed to be changed. Besides of time consuming, large injure and more blood loss, the ureteric orifice was always difficult to be removed completely because of its deep position.

The CRT technique we present here, which combines the advantages of both retroperitoneal (easy to mobilize and handle the renal pedicle) and transperitoneal (easy recognition of anatomic landmarks and large working space) approaches, has the following numerous advantages.

More extensive surgical indications. Besides UTUC and renal tuberculosis, duplication of kidney and ureter is very suitable for CRT technique. As very close to upper pole ureter and its deep anatomical position, the lower pole moiety can be easily injured inadvertently in open surgery, which will be preserved well in laparoscopic surgery. Patients with the history of ipsilateral herniorrhaphy or renal transplantation may not be good candidates for a second hypogastric open surgery, but it will be managed successfully with CRT technique. In the current study, two patients with the history of ipsilateral herniorrhaphy or renal transplantation accepted CRT LNU respectively, and got good postoperative recovery.

Shorter operation time and less blood loss. Homayoun et al.[9] reported a simplified approach of transperitoneal robot-assisted nephroureterectomy, which requiring no patient repositioning or robot redocking. Their mean operation time and median EBL was 300 minutes and 200 ml. The reasons for less operation time of CRT technique are as follows: Firstly, It's more convenient and time saving to manage renal pedicle and nephrectomy through retroperitoneal approach, which takes 30 to 55 minutes generally; Secondly, The surgeon can choose the best angle to get the most sufficient exposure through moving camera among trocars; Thirdly, avoiding patients' repositioning, once more sterilization and draping during operation can save an amount of time. Fourthly, it is time saving for closing a smaller incision, which takes about 20 minutes in CRT group.

More minimally invasion and enhanced recovery. Compared to standard technique, CRT technique has shorter incision length, less painful, less time of surgical drains and less hospital stay after surgery. Three patients experienced incision fat liquefaction resulted from long operation and retractor time in standard group, which need much more time of wound caring.

Lower incidence of postoperative abdomen bulge or incisional hernia. In addition to the commonly recognized factors such as incision infection, old age, and high BMI, many studies have shown that the injury of muscle and neurovascular bundle (NVB) were significant risk factors for the occurrence of postoperative abdomen bulge or incisional hernia[10, 11]. Some studies have also reported that increased incision length, prolonged operation time and long-term using of retractors during surgery were statistically significant factors in the development of incisional hernia[12, 13]. In the present study, the incidence of postoperative abdomen bulge or incisional hernia in CRT group was less than that in standard group, the reasons may be related to the above factors.

Better oncological outcomes. Although no significant difference was detected in the disease free survival (DFS) between the two groups, CRT technique has more appropriate angle and space to achieve

completely resection of distal ureter and bladder cuff. In the present study, there were three cases suffering local recurrence in standard group, while no recurrence in CRT group. With the time extending, there may be significant survival benefits in patients with CRT technique.

Additionally, compared to standard technique, which needs at least three to four staffs, two or three staffs are enough for CRT technique.

There were several limitations in this study. First, it was a non-randomized retrospective study, and limitations may have existed in the study design account for selection bias. Second, the sample size was not large enough to make the convincing conclusion. Third, the follow-up period of our study was too short to obtain more significant differences between the two groups, especially in oncological outcomes. More large-sample and high-quality RCTs are needed to confirm these preliminary findings.

## **5. Conclusions**

CRT technique is a practical, simplified and more effective way in LNU, which combines both the advantages of retroperitoneal and transperitoneal approaches. It can be accomplished with the benefits of less operating time, less blood loss, faster recovery, more minimal invasion and possible better oncological outcomes. However, larger samples with longer follow-up are needed to confirm these preliminary findings.

## **Abbreviations**

UTUC: Upper urinary tract urothelial carcinoma; CRT: Combined retroperitoneal with transperitoneal; LNU: laparoscopic nephroureterectomy; EBL: Estimated blood loss; VAS: Visual analogue scale; ASA: American Society of Anesthesiologists

## **Declarations**

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### **Availability of data and materials**

Data used and/or analyzed in the current research can be obtained from the corresponding author on reasonable request.

## Author contributions

LM Song: Project development, Main surgeon of patients. WK Wang and QX Zhao: Data collection, Manuscript writing. YW Wen, XG Zhou, H Han and XD Zhang: Assistant surgeons of patients. All authors reviewed the manuscript, contributed sufficiently to the scientific work and therefore share collective responsibility and accountability for the results.

## Ethics approval and consent to participate

This study was approved by the Research Ethics Committee in our hospital (China). Each enrolled patient provided written informed consent. All information was handled following relevant ethical and legal standards.

## Consent for publication

Informed consent was obtained from the patients.

## Competing interests

The authors declare that they have no competing interests.

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## Figures



**Figure 1**

Patient position. The patient was placed in standard 90°full flank position and secured to the table, then the table was rotated to maximize exposure of the kidney.



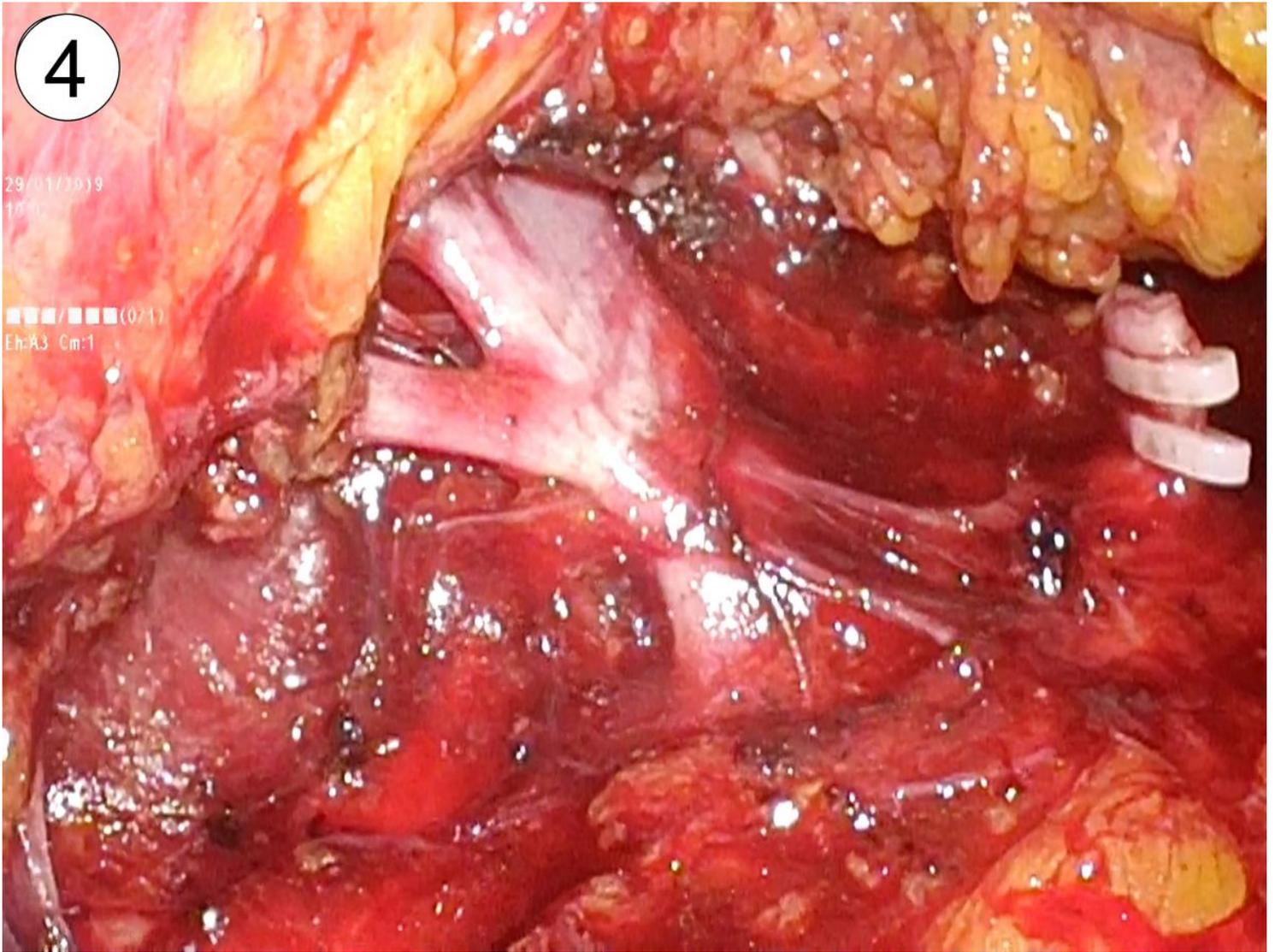
**Figure 2**

Trocar placement in retroperitoneal operation. A 2-cm incision was made at the center between the 12th rib and the erector spinae muscle (port B), a 10-mm trocar was inserted at the middle axillary line 3 cm cephalad to the iliac crest (port A), and another 5-mm trocar was placed at the tip of the 11th rib (port C).



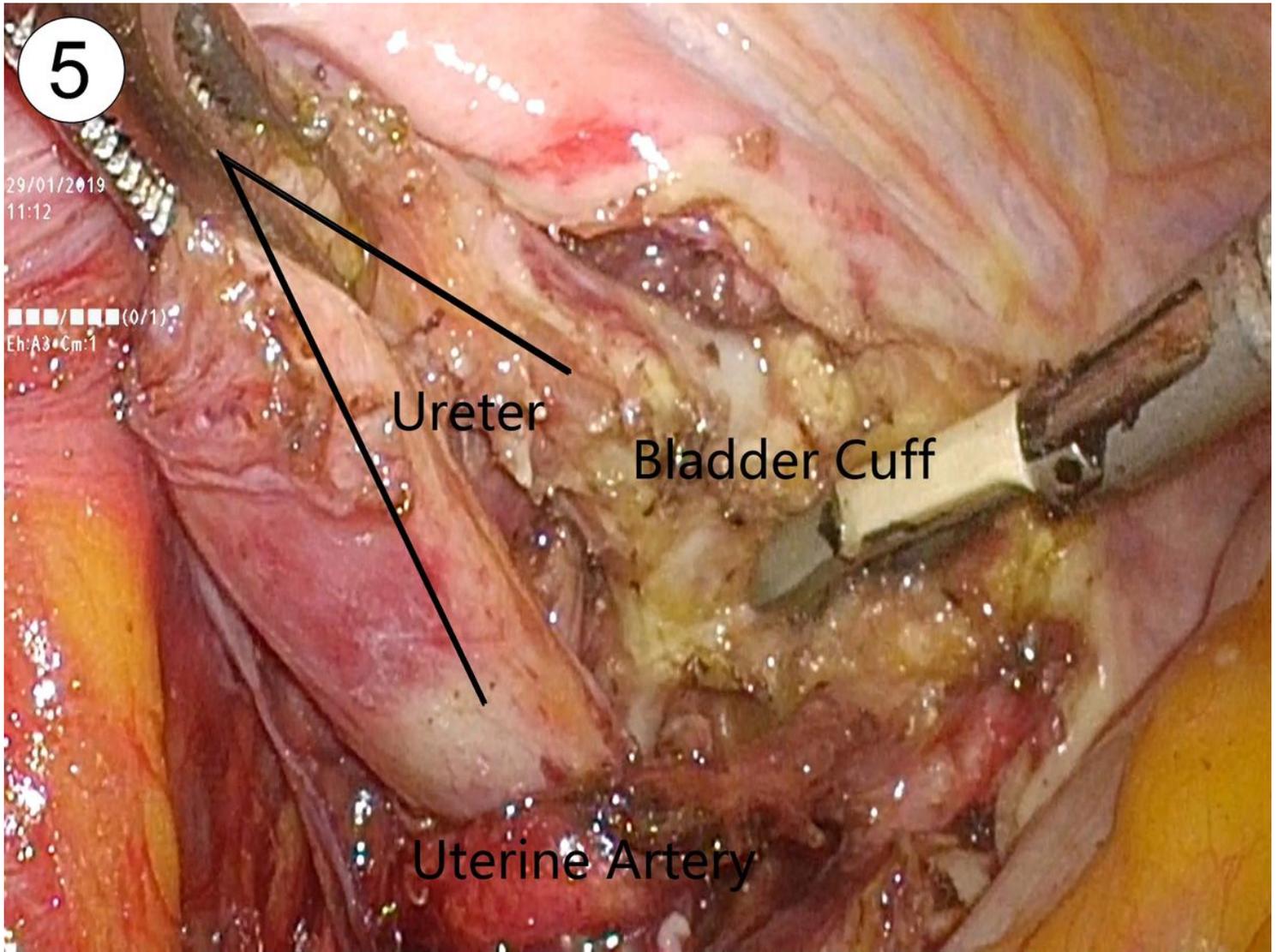
**Figure 3**

Trocar placement in transperitoneal operation. A 10-mm trocar at the lower level of the umbilicus (port E), a 5-mm trocar at the midpoint of the line between the umbilicus and the anterior superior iliac spine (port D), and the last 12-mm trocar was placed 2 cm cranial to the pubic symphysis in the middle line (port F).



**Figure 4**

Dissection of renal pedicle through retroperitoneal approach. By dissecting the surrounding tissues of the kidney along the psoas muscle, the posterior surface of the kidney was reflected medially. Then renal pedicle was identified with dissection of the renal artery and vein.



**Figure 5**

Dissection of distal ureter and bladder cuff through transperitoneal approach. The ureter was dissected caudally to the bladder wall and was excised with a cuff of bladder around the ureteric orifice.