

# Clinical Application of One-Position Complete Retroperitoneoscopic Nephroureterectomy

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## Research Article

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# Abstract

**Objective:** To explore the surgical method and the clinical efficacy of complete retroperitoneal laparoscopic radical resection of upper tract urothelial carcinoma (UTUC).

**Methods:** A retrospective analysis of 83 patients with upper urothelial carcinoma from January 2016 to December 2019 in the Affiliated Hospital of Xuzhou Medical University was conducted. Among them, 40 patients underwent one-position complete retroperitoneoscopic nephroureterectomy (CRNU) and 43 patients underwent traditional retroperitoneoscopic nephroureterectomy (TRNU). Compare the differences in clinical data, perioperative parameters and postoperative follow-up results of patients with the two surgical methods. CTU and ureteroscopy were used to diagnose.

**Results:** A total of 43 patients (35 males and 8 females) with TRNU were enrolled in this study. Forty patients (31 males and 9 females) received CRNU. The CRNU group had significantly shorter average operation time ( $105.83 \pm 5.80$  min versus  $147.28 \pm 17.58$  min) and lower visual pain score ( $P=0.024$ ). No significant difference was found in age, BMI, T stage, complication, change of albumin and hemoglobin, postoperative hospital stays and tumor recurrence ( $P>0.05$ ).

**Conclusion:** one-position complete retroperitoneoscopic nephroureterectomy is safe and feasible. The curative effect is affirmative. It has the conspicuous advantages in minimally invasive, no posture change, less postoperative pain, less interference with abdominal organ and shorter operation time, which could particularly reduce the workload of operating room nurses without any additional postoperative complications.

## Background

Upper tract urothelial carcinoma (UTUC) is a relatively rare urological malignant tumor, accounting for 5%-6% of upper urinary tract tumors [1]. In recent years, retroperitoneal laparoscopy nephroureterectomy has been used progressively as a minimally invasive treatment substituted for open surgery in China [2], the standard resection limitation of which generally includes the total nephroureterectomy with excision of bladder cuff [3]. However, prevalently, patient's posture should be changed from side-lying position to horizontal position during this surgery after kidney and upper ureter dissociated, in order for the resection of distal ureter and bladder near ureteral orifice. Although transperitoneal approach could also accomplish this laparoscopic procedure without posture changes in western countries, pneumoperitoneum interferences on abdominal organs reflecting in abdominal pain, abdominal distension, bacterial translocation and abdominal cavity implantation metastasis has been paid more great attentions in recent study. In this study, we attempt to suggest the complete retroperitoneal laparoscopic radical resection in patients with UTUC. On the basis of mature retroperitoneal laparoscopy procedures, researching domestic experience and lessons, from January 2016 to December 2019, 83 patients in our hospital treated for UTUC underwent one-position complete retroperitoneoscopic

nephroureterectomy. It brings satisfactory outcomes in terms of short operating time, minimal tissue dissections. The corresponding procedure and results have been summarized as follows.

## **1 Materials And Methods**

### **1.1 General data**

A retrospective analysis of 83 patients with upper urothelial carcinoma from January 2016 to December 2019 in the Affiliated Hospital of Xuzhou Medical University was conducted. Among them, 40 patients underwent one-position complete retroperitoneoscopic nephroureterectomy (CRNU) and 43 patients underwent traditional retroperitoneoscopic nephroureterectomy (TRNU). The irritative symptoms of all patients were gross hematuria with or without affected side waist abdomen ache. CTU and intraoperative ureteroscopy were used to diagnose with the staging of clinical pathology from cT1 to cT2. All patients did not receive chemotherapy, radiotherapy or biological immunotherapy before surgery, and there was no serious underlying disease and history of upper urinary tract surgery. The excluding criteria were the following: patients with bilateral tumor, simultaneous pelvis, and ureter tumor, distant transference, severe cardiorespiratory insufficiency, contralateral renal insufficiency. Informed consent was signed for all patients and the study was approved by the Medical Ethics Committee of our hospital.

### **1.2 Surgical procedures**

#### **1.2.1 One-position complete retroperitoneoscopic nephroureterectomy (CRNU)**

All patients received general anesthesia, and catheterization was completed after general anesthesia. The patients were placed on 90°the lateral decubitus position. The waist bridge was heightened adequately so as to ensure the patient's waist fully extended. A 10 mm skin incision (Port A) was made at 2 cm above the superior iliac spine. Vascular forceps were used to bluntly separate the muscles along the outer edge of the psoas muscle to reach the extraperitoneal. The retroperitoneal dilator fully expanded the peritoneum to form a cavity. A 12 mm trocar was inserted into the incision and carbon dioxide was continuously injected to maintain the pneumoperitoneum pressure at approximately 12–15 mmHg (1 mmHg = 0.133 kPa). A 5mm trocar was placed at the intersection of the anterior axillary line under the 12 ribs (Port B), and a 12mm trocar was placed at the intersection of the posterior axillary line under the 12 ribs (Port C). The fourth trocar (Port D) was symmetrical with Port A along anterior axillary line and formed an isosceles triangle with Port B so as to facilitate the operation of surgeon (Fig. 1). The positions of the four ports were shown in the Fig. 5. The extraperitoneal fat was removed using an ultrasonic scalpel. The boundary between the peritoneal reflex and the perirenal fascia was exposed. The anatomical landmarks such as the psoas muscle, the perirenal fascia and the peritoneal regurgitation were identified. The perirenal fascia was dissected from the dorsal side of the kidney with an ultrasonic

knife and separated. In the renal fat sac, the front and back of the kidney were bluntly separated, and the kidney was free. The ureter was separated to the bifurcation of the level iliac vessels and was clamped with Hem-o-lok in the upper ureter to avoid the spread of cancer cells (Fig. 2). Separated up the ureter along the ureter to the renal pelvis, found the renal pedicle, and freed the renal pedicle. Renal artery was clamped with Hem-o-lok at the distance from renal. At least two hem-o-lok was used to clamped at proximal end of renal artery. Renal vein and genital vein at branch of renal vein were separated, clamped with hem-o-lok and cut them. Keep the ipsilateral adrenal gland intact. Check the surgical area to ensure that there is no active bleeding. Efforts continued to detach from the distal end of the ureter. The surgeon exchanged positions with the assistant and placed the monitor on the foot side. Laparoscope was inserted from Port B as an observation port. Ports A and D were used as manipulative ports to separate the ureter and remove the bladder cuff. The ureter and part of the bladder wall were lifted. Multiple Hem-o-lock clips were used for bladder sleeve resection. The incision in the bladder was sutured with absorbable sutures (Fig. 3). The intact gross specimen of the renal ureter (Fig. 4) was removed from the 12 mm trocar under the enlarged costal margin and the end of the ureter and the resection of the bladder were examined to ensure its integrity. After the bleeding was stopped and the retroperitoneal drainage tube was placed, the incision was sutured.

### **1.2.2 Traditional retroperitoneoscopic nephroureterectomy (TRNU)**

The patients were placed on the lateral decubitus position. Trocar used a conventional retroperitoneal three-hole layout. The affected kidney was removed following the classic radical nephrectomy procedure. The patient was changed to a supine position, disinfected and towed again. The oblique incision of the left lower abdomen was made about 10 cm long. Separate the extraperitoneal and remove the affected kidney, continue to separate the ureter and the bladder cuff. The bladder cuff was completely removed and the bladder incision was closed.

## **1.3 Observation Index**

All patients' preoperative information was collected, such as gender, age, BMI, right or left side, comorbidities. The perioperative indicators include operation time, bleeding volume, postoperative hospital stay, visual pain score, and postoperative complications.

## **1.4 Statistical analysis**

Normally distributed continuous variables were expressed as mean  $\pm$  standard deviation, and continuous variables that do not conform to the normal distribution were expressed as medians (P25, P75). Continuous variables with normal distribution were analyzed by t test, and continuous variables with skew distribution were tested with Mann–Whitney U. Chi-square test or Fisher exact test was used to analyze categorical variables.

## **Results**

A total of 43 patients (35 males and 8 females) with TRNU were enrolled in this study. Forty patients (31 males and 9 females) received CRNU. The average age of the TRNU group was 69 (51, 79) years, and the

average age of the CRNU group was  $68.03 \pm 9.56$  years, with no statistically significant difference ( $P = 0.425$ ). Importantly, there were no significant difference in T stage, location, BMI or the side of tumor ( $P > 0.05$ ) between the two groups. Moreover, the complications of two groups had no significant difference ( $P = 0.346$ ), such as hypertension, diabetes. Overall, there were no significant difference was found in the baseline characteristics between the TRNU and CRNU groups. Notably, the operation time of CRNU ( $147.28 \pm 17.58$  mins) was significantly lower than that of TRNU group ( $105.83 \pm 5.80$  mins,  $P < 0.01$ ). The change of serum albumin before and after the operation reflects the trauma of the patient to a certain extent. However, no significant difference was found in the change in serum albumin between the two surgical methods ( $P = 0.841$ ). Similarly, the changes in hemoglobin and postoperative hospital stay were not significantly different ( $P = 0.789$ ,  $P = 0.431$ , respectively). To evaluate the pain caused by surgery, we compared the visual pain scores of two groups and found that the CRNU pain score was significantly lower than the TRNU ( $P = 0.024$ ). Median follow-up time was 10(6, 18) months in the TRNU group and 9(4, 17.5) months in the CRNU group ( $P = 0.632$ ). There was no significant difference in tumor recurrence between TRNU group and CRNU group.

## Discussion

UTUC accounts for about 5% of urothelial carcinoma [4], with the characteristics of high recurrence and multi-center occurrence. With the advancement of laparoscopic techniques and the accumulation of operative experience, laparoscopic total nephroureterectomy with excision of bladder cuff have been applicable to a growing number of pelvic ureteral cancer patients in many centers since it was successfully performed by Clayman et al in 1991[5, 6]. Recently, laparoscopic nephroureterectomy has replaced open surgery as standard surgical treatment for upper urinary tract epithelial carcinoma because of the less intraoperative bleeding, minimal invasion, quicker recovery and shorter postoperative hospital stay[7–11].

At present there are many surgical approaches for laparoscopic nephroureterectomy. The most common method was the Bishoff method[12], that is, laparoscopic renal and upper ureter resection in the upper abdomen, and lower ureter and partial bladder incision in the lower abdomen. But this procedure is not completely done under the laparoscopy. In 1999, Gill et al[13, 14] reported a complicated laparoscopic radical resection of renal pelvic ureteral cancer. The ureteral bladder wall was firstly treated with lithotomy position, and then supine position was performed through the renal and abdominal ureteral resection surgery. In this operation, two 5 mm cannulas were inserted into the bladder by puncturing the lower abdomen into the bladder, and another surgeon completed ureteral intubation by transurethral insertion of cystoscope. Under the help of grasping forceps of bladder, the inner segment of ureteral bladder wall was cut about 3–4 cm. Then the lasso was placed at the distal end of the free ureteral wall and tightened. Then the electrotomy was continued to remove the entire ureteral wall from the bladder. Ligation of the lasso effectively prevents the leakage of urine in the upper urinary tract, but it could not prevent the leakage of urine containing tumor cells in the bladder, so it still remains the risk of tumor spread. In response to the problem of leaking urine in the bladder and ureteral stump, McDougall et al.[15] proposed a solution: using a linear cutting occluder to perform a sleeve-like resection of the bladder

tissue around the ureteral opening. At the same time, the stump was sealed to avoid the urine leakage and prevent the spread of tumor as possible. This report examined the effects of 10 patients and found no tumor spread after surgery. Chandhoke et al[16] followed up for 3–9 months in patients undergoing bladder-sleeve resection with a straight-lined closure. No resection of bladder staples and formation of stones were found after cystoscopy.

A total of 43 patients (35 males and 8 females) with TRNU were enrolled in this study. Forty patients (31 males and 9 females) received CRNU. The CRNU group had significantly shorter average operation time ( $105.83 \pm 5.80$  min versus  $147.28 \pm 17.58$  min) and visual pain score ( $P = 0.024$ ). No significant difference was found in age, BMI, T stage, complication, change of albumin and hemoglobin, postoperative hospital stays and tumor recurrence ( $P > 0.05$ ). Surgical trauma will put the patient in a state of emergency, and elevated glucocorticoids will cause protein breakdown. The change of serum albumin before and after the operation reflects the trauma of the patient to a certain extent[17]. There was no significant difference in the impact of surgical trauma between the two groups. In addition, we cannot accurately estimate the amount of intraoperative bleeding, so we used the change between preoperative hemoglobin and the first day of postoperative hemoglobin to estimate the amount of bleeding, which was more accurate. Similarly, there was no significant difference was found between TRNU group and CRNU group.

Accordingly, in this study, based on the traditional retroperitoneal laparoscopic radical nephrectomy, a modified four-hole method complete retroperitoneal laparoscopic radical nephrectomy for pelvic and ureteral cancer was performed. After radical nephrectomy and upper ureter dissection, we added the fourth Trocar in the ventral of the sight Trocar which had been located over the iliac crest at the same level. Then, the lens was relocated from the dorsal subcostal Trocar towards the pelvic cavity, and the distal ureter was continued dissociating downward to the bladder wall. Afterwards, multiple Hem-o-lock clips were used for the bladder sleeve resection and absorbable titanium clips were used for clipping the distal bladder incision.

At present, there rarely have reports of the application about complete retroperitoneal laparoscopic radical resection of renal pelvis and ureteral carcinoma. The technique we introduced has the following advantages: 1) Through the establishment of retroperitoneal approach, the anatomical landmark is easy to identify with clear visual field; 2) The application of absorbable clips of the bladder incision reduces the possibility of postoperative bladder calculus; 3) Four-hole operation is beneficial to adjust the operating field to the best; 4) The entire surgical procedure without the need of posture changes, shortening the time of operation and reducing potential safety risks during the movement of patients; 5) On the basis of the retroperitoneal laparoscopic nephrectomy, no additional surgical instrument or special equipment should be added so that there has not been a rise in cost.

Through this study, we have some enlightenments as follows: 1) After finding the upper part of the ureter, Hem-o-lock should be used to clamp the distal ureter in order for blocking the implantation metastasis caused by the influx of proximal urine containing cancer cells; 2) Specimen bag should be used for removing the excision to decrease the occurrence of implantation metastasis to abdominal incision after

complete resection; 3) Operation area should be washed repeatedly with warm sterilized water at about 42°C to destroy the potential escaped cancer cells; 4) Although we do not recommend this new surgical technique in lower ureteral cancer because of the relatively difficult exposure of distal ureter, we are trying to resect the lower ureter and partial bladder first before the dissociate of kidney and upper ureter. The feasibility and the effect on prognosis are still in observation.

In summary, one-position complete retroperitoneoscopic nephroureterectomy for the treatment of UTUC has its advantage in no posture change, less postoperative pain score, minimally invasive and shorter operation time without any postoperative complications such as bladder calculi, higher local recurrence and vesical implantation metastasis probability of cancer.

## **Declarations**

### **Funding**

The study received no funding

### **Compliance with ethical standards**

This manuscript was approved by the Medical College Committee of the Affiliated Hospital of Xuzhou Medical University and the patient has signed the informed consent.

### **Consent for publication**

Not applicable

### **Conflict of interest**

The authors declare that they have no conflict of interest.

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

The datasets used and analyzed during the current study are available from the corresponding author on reasonable request.

### **Authors' contributions**

Yongshuang Xiao collected data about patients with upper urothelial cancer. Tan Chen and Qinghui Li performed data analysis and were the main contributors to writing manuscripts. Rumin Wen reviewed the manuscript. Shuofeng Li was the designer of this study. The final manuscript read and approved by all authors.

### **Acknowledgements**

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## Tables

Table 1 Characteristics and outcomes of the TRNU and CRNU group

Item	TRNU group	CRNU group	P value
Age	69(51,75)	68.03±9.56	0.425
Gender(male/female)	35/8	31/9	0.660
Tumor Laterality(left/right)	22/21	19/21	0.739
Location(pelvis/ureter)	25/18	25/15	0.685
BMI <sup>a</sup> (Kg/m)	25.68±3.39	25.43±3.06	0.729
T stage(T1/T2)	29/14	29/11	0.616
Complication			0.346
Hypertension	3	7	
Diabetes	3	4	
Hypertension and diabetes	3	1	
operation time(min)	147.28±17.58	105.83±5.80	<0.01
Change of albumin(g/L)	6.92±4.67	7.09±2.68	0.841
Change of hemoglobin(g/L)	11.47±8.45	10.70±6.37	0.645
Postoperative hospital stay(day)	7.00(6.00, 9.00)	7.50(5.25, 9.00)	0.431
Postoperative pain score	2(1,2)	1(1,2)	0.024
Follow up (month)	10(6, 18)	9(4, 17.5)	0.632
Surgical site recurrence	0	1	0.482
Regional lymph node recurrence	4	1	0.401
Retroperitoneal recurrence	1	2	0.949
Bladder implant metastasis	3	2	1.000

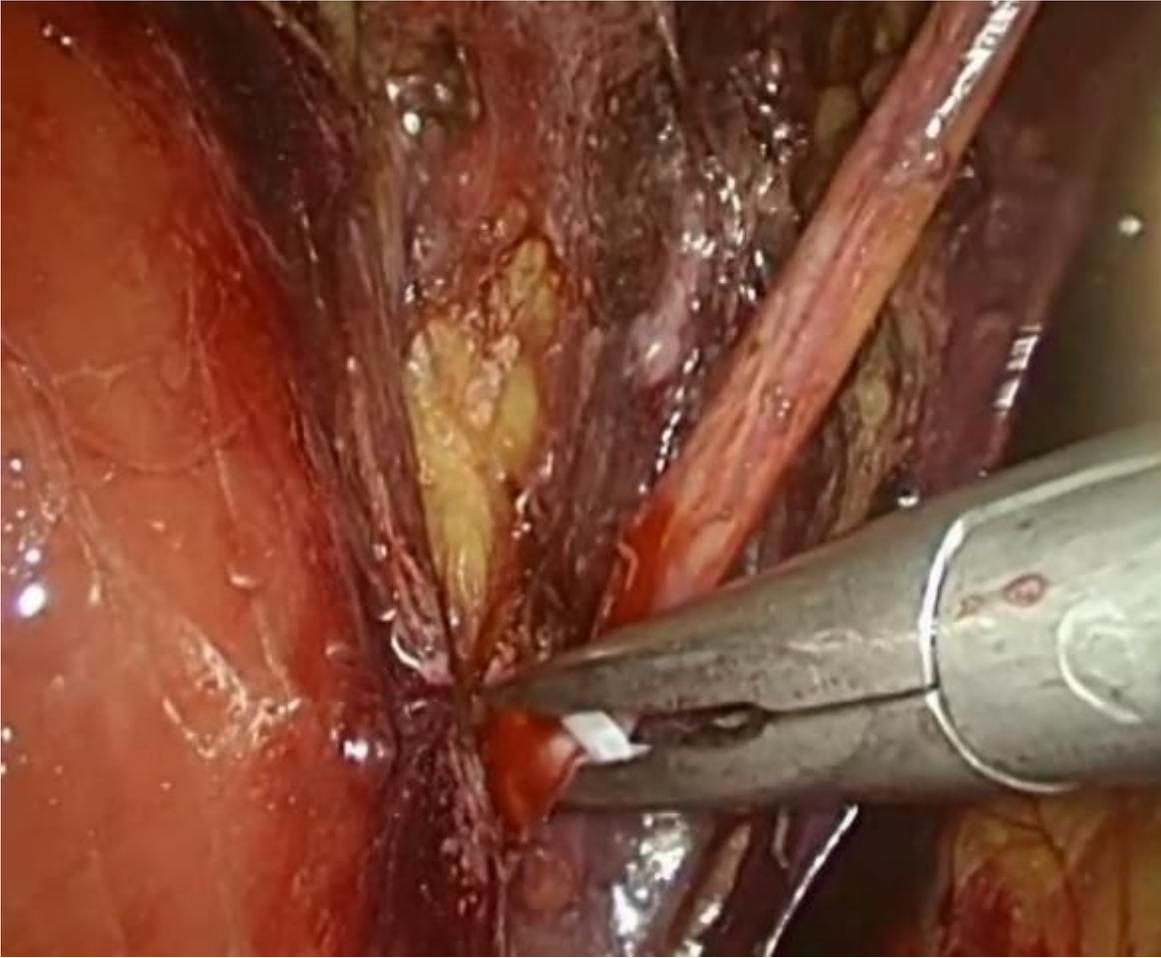
Abbreviations: <sup>a</sup>BMI/body mass index

## Figures



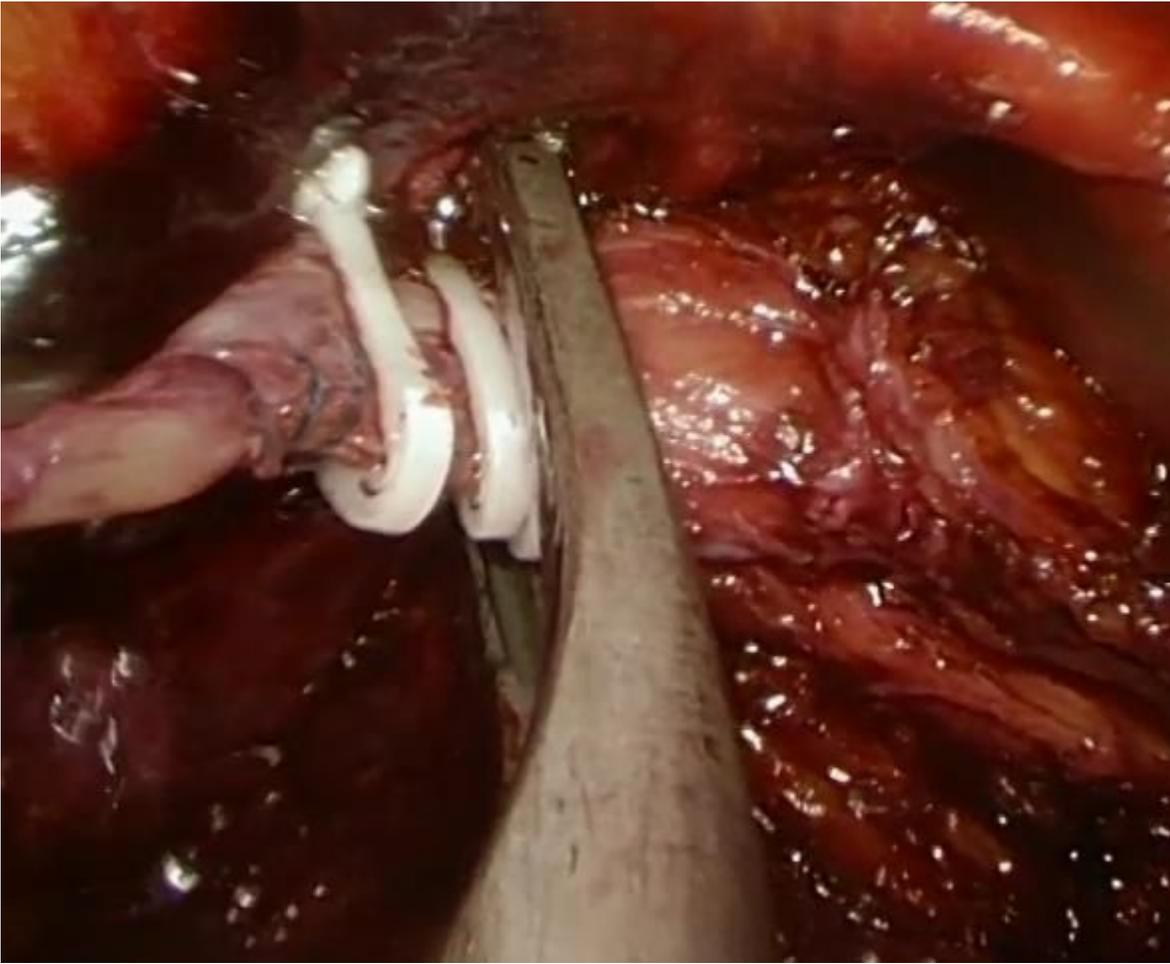
**Figure 1**

The Trocar positions of CRNU.



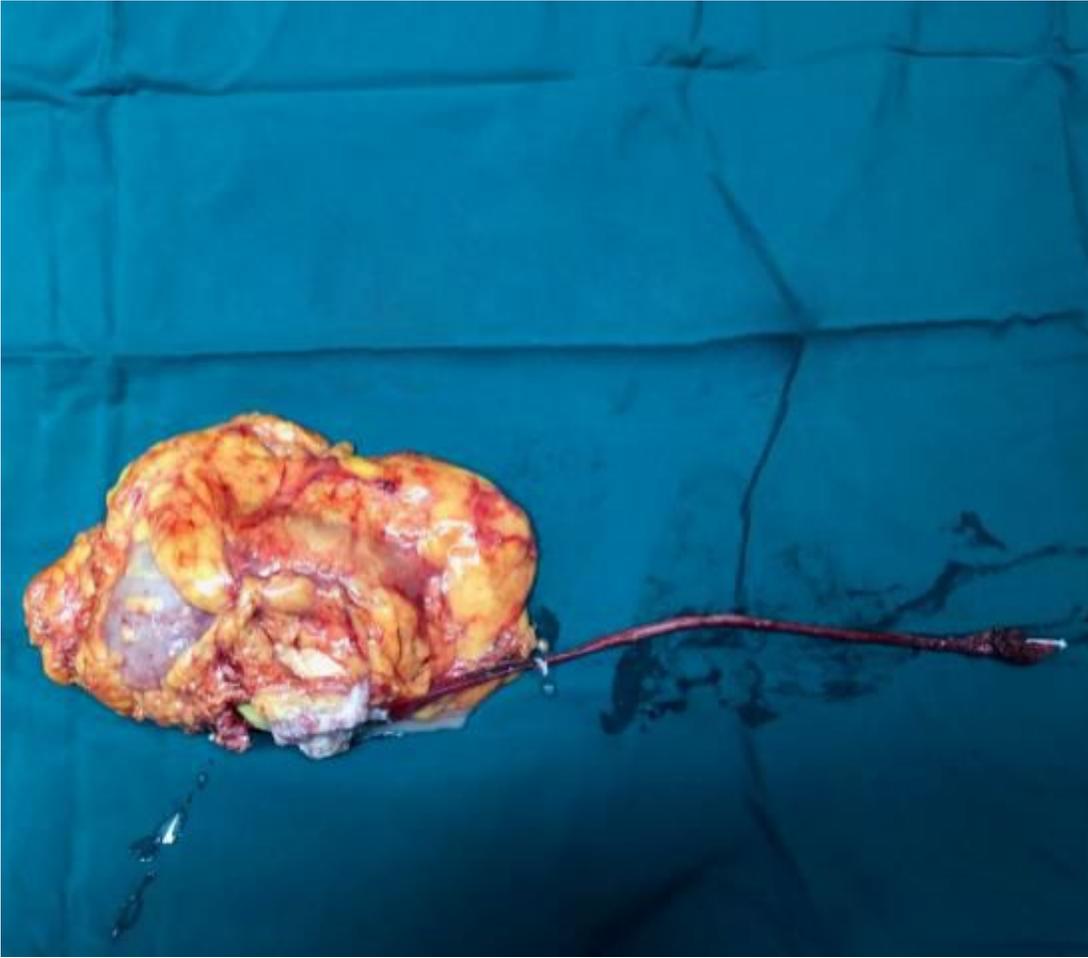
**Figure 2**

Clamp the ureter



**Figure 3**

Sleeve resection of bladder.



**Figure 4**

The intact gross specimen of the renal ureter.

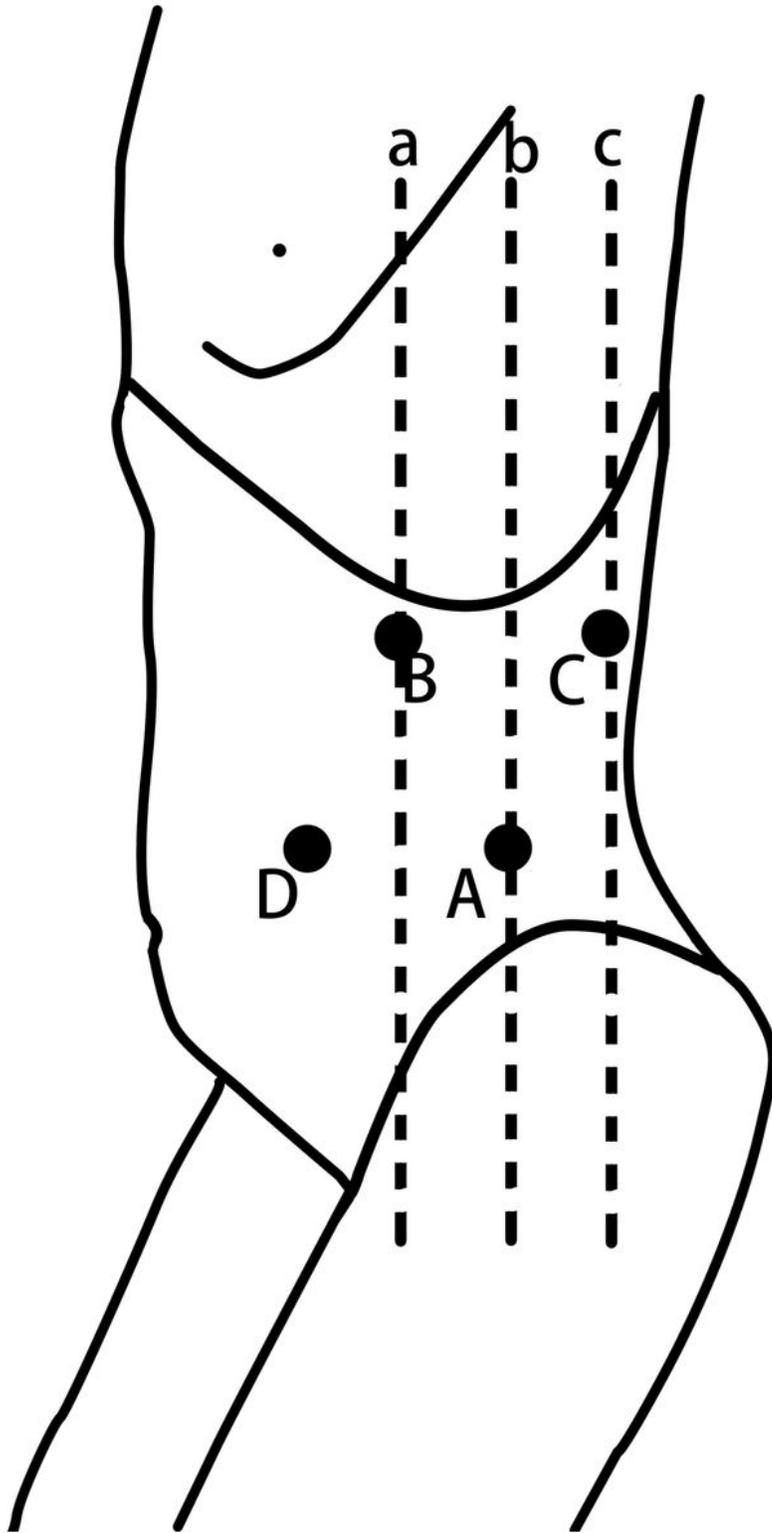


Figure 5

Schematic representation of the laparoscopic port (A–D) and incision wounds in the CRNU group