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Original Article

# Robot-assisted nephroureterectomy for upper tract urothelial carcinoma: Initial experience

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ABSTRACT

*Objective:* To report our early experience with robot-assisted laparoscopic nephroureterectomy (RANU) for upper tract urothelial carcinoma (UTUC).
*Materials and methods:* Four consecutive patients with a diagnosis of renal pelvic or ureteral urothelial carcinoma underwent RANU. We performed RANU by redocking the robot after the nephrectomy without repositioning the patient for excision of the distal ureter and bladder cuff.
*Results:* Three women and one man with a mean age of 72.3 years and mean body mass index (BMI) of 24.25 kg/m$^2$ underwent RANU for right-sided renal pelvic or ureteral urothelial carcinoma. The mean operative time was 495 minutes (range 390–540 minutes), estimated blood loss was 52.5 mL (range 10–100 mL), and mean hospital stay was 5.5 days. Pathology data revealed all specimens were high grade carcinoma with one specimen each staged Ta, T1, T2, and T3. After a mean follow-up of 14.25 months (range 12–18 months), no intravesical recurrence developed in the bladder, and no patients developed distant metastasis.
*Conclusion:* Our early experience showed that RANU is a safe and feasible minimally invasive procedure for UTUC.


## 1. Introduction

The standard treatment for upper tract urothelial carcinoma (UTUC) is an open nephroureterectomy (NU) with ipsilateral bladder-cuff excision. Laparoscopic nephroureterectomy (LNU) has been considered a feasible and effective procedure to treat UTUC since the first case was reported by Clayman et al in 1991 [1]. A large cohort with long term follow-up showed that LNU provides oncological control comparable to traditional open surgery with the additional advantages of decreased postoperative narcotic use, a shorter hospital stay, and a more rapid convalescence [2–5]. However, the learning curve is steep and this procedure is time-consuming and technique-dependent. It is challenging to manage the distal ureter and bladder cuff during LNU, especially when the tumor is close to the distal third of the ureter as well as the bladder cuff, and suturing of the bladder cuff is needed. Previously, we used an open method to excise the bladder and sutured the bladder cuff though the Gibson wound in a hand-assisted laparoscopic nephroureterectomy to avoid intracorporeal suturing of the bladder cuff, which is a difficult technique [5]. Recently, the da Vinci robot system (Intuitive Surgical Inc., Sunnyvale, CA, USA) was introduced to simplify laparoscopic operations by reducing the technical difficulty of intracorporeal suturing. Herein, we present our early experience with robot-assisted laparoscopic nephroureterectomy (RANU) using a hybrid port and redocking the robot without repositioning the patient.

## 2. Materials and methods

Four consecutive patients received RANU and were not repositioned after the nephroureterectomy. However, the robot was redocked for excision of the distal ureter and bladder cuff.

After general endotracheal anesthesia was induced, the patients were placed in the lateral flank position. A pneumoperitoneum was created after a minilaparotomy procedure was used in the periumbilical region to approach the peritoneal space and a 12-mm camera port was created. The first 8-mm robotic port was

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**Table 1**
Characteristics and perioperative data of RANU patients.

| Patient | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Age (y) | 70 | 72 | 70 | 77 |
| Gender | Male | Female | Female | Female |
| EBL (mL) | 50 | 100 | 10 | 50 |
| Laterality | Right | Right | Right | Right |
| Location | Renal pelvis | Upper ureter | Renal pelvis | Middle ureter |
| Tumor size (maximal diameter, cm) | 2.4 | 1.5 | 3.5 | 2.7 |
| Tumor number | 2 | 1 | 1 | 1 |
| Tumor grade | High | High | High | High |
| ASA | 3 | 3 | 3 | 3 |
| Pathologic tumor stage | pT3 | pTa | pT2 | pT1 |
| BMI (kg/m$^2$) | 24 | 21 | 25 | 27 |
| Operative time (min) | 540 | 540 | 390 | 510 |
| Follow-up time (mo) | 15 | 12 | 12 | 18 |
| Bladder recurrence | Negative | Negative | Negative | Negative |
| Distant metastasis | Negative | Negative | Negative | Negative |

ASA = American Society of Anesthesiologists classification; BMI = body mass index; EBL = estimated blood loss; RANU = robot-assisted laparoscopic nephroureterectomy.

inserted at the axillary line two finger breadths above the anterior iliac crest. The second 8-mm robotic port was set up at the midclavicular line two finger breadths below the 12$^{th}$ rib. One 12-mm assistant working port was inserted midway between the umbilicus and symphysis pubis. Another 5-mm assistant port was created midway between the umbilicus and xiphoid process. We identified the renal hilum by identifying the gonadal vessel and ureter. The renal pedicles were dissected, and the renal artery and vein were divided using Hem-o-Lok (WECK Teleflex Medical, 2917 Weck Drive, Research Triangle Park, NC 27709, USA) or endovascular stapler. The kidney was dissected completely and the ureter was dissected to the level of the bladder. After the radical nephrectomy was completed, the robot was redocked to manage the distal ureter. We switched the port for the first robotic instrument arm to the 12-mm assistant port, and the port for the second robotic instrument arm to the port for the first arm. The assistant port (hybrid port), which allowed a 12-mm port to be inserted with an 8-mm robotic port, was converted to the port for the second arm as reported by Park et al [6]. The ureteric orifice defect was closed in two layers with 3–0 Monocryl (Ethicon, a Johnson and Johnson company, Guaynabo 00969, Puerto Rico) sutures. Then, we tested the integrity of the bladder closure by filling the bladder with 150 mL of normal saline. The periumbilical wound was extended to 4 cm for extraction of the kidney and ureter. The specimens were extracted in an entrapment bag. All RANUs were successfully completed with the robot, with no conversion to open surgery. Adjuvant intravesical chemotherapy and systemic chemotherapy was not administered after the nephroureterectomy.

The long-term oncologic outcomes, including survival status, bladder recurrence, and metastasis, were recorded by reexamination of the patients in outpatient clinics. The patients were followed every 3 months for the first 2 years. All patients received a physical examination every 3 months, urine cytology, urinalysis, and blood biochemical examinations every 6 months, and chest radiography, intravenous urography, and abdominal computed tomography or magnetic resonance imaging every year. Cystoscopy follow-up was performed every 3 months during the first 2 years.

## 3. Results

The characteristics of the patients are shown in Table 1 with the operative results. There were no perioperative complications in any patient. On pathologic examination, pathologic tumor stage 3 (pT3), pT2, pT1, and pTa urothelial carcinomas were identified in one patient each. There were no positive surgical margins in any patient.

Follow-up cystoscopy found no evidence of bladder recurrence and no distant metastasis was identified.

## 4. Discussion

Our experience shows that RANU is a safe and feasible technique for UTUC. During the operation, the operative field is magnified and a three-dimensional view is provided for surgeons to easily identify anatomical landmarks. The biggest advantage of the robot system in RANU is intracorporeal suturing, which could be applied to bladder cuff excision and bladder suturing. The disadvantages of the da Vinci system include its high cost, the need for training, a lack of tactile sensation, and the docking time. We found that we could minimize the mean blood loss to less than 100 mL by viewing the anatomical landmarks during the nephrectomy and bladder cuff resection with the superior three-dimensional view. With this excellent exposure, it is easy for beginners in laparoscopic urologic surgery to finish the procedures.

Rose et al [7] reported the first case of robot-assisted retroperitoneal NU for left ureteral urothelial carcinoma in 2006 and suggested RANU with a retroperitoneal approach is feasible. Interestingly, they excised the bladder cuff by an open method. It may be difficult to manage the distal ureter and bladder cuff with a totally robot-assisted method because the retroperitoneal space is limited, especially in Asian patients. Since RANU was first reported, use of the transperitoneal approach has become popular in major centers worldwide. The retroperitoneal space is limited and relatively small for a robot system setting, especially in Asian patients. With transperitoneal RANU, Nanigian et al [8] performed a distal ureterectomy by a novel technique. They instilled 250 mL of fluid into the bladder via a Foley catheter, and incised the dome of the bladder and the ureteric orifice. Closure of the bladder at the dome and ureteric orifice defect followed in two layers. However, their technique is a so-called hybrid procedure because they used a conventional laparoscopic method for the nephrectomy and the robotic system was only applied when they managed the bladder cuff [8]. Hu et al [9] treated nine cases of RANU by two methods. They repositioned five patients from the flank to the lithotomy position after laparoscopic nephrectomy and did not reposition the other four patients. In our series, we performed RANU by redocking the robotic system but not repositioning the patient. Park et al [6] also reported the technical feasibility of RANU using the da Vinci robot system for the entire procedure. Their technique could replicate the open surgical technique, and they suggested that it is safe and adheres to oncological principles. They introduced the hybrid-port technique and completed RANU without repositioning the patient and movement of the patient cart. Thus, they shortened the operative time, and had better exposure of the distal ureterectomy and easier closure of the bladder cuff. Hemal et al [10] successfully treated 15 cases of UTUC by RANU, and did not reposition the patient or redock the robotic system. Although our case number was small, our perioperative data is comparable with these reports.

In conclusion, our RANU procedure is a feasible and safe technique with short-term oncological control for UTUC.

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