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Case report

Robot-assisted nephroureterectomy for upper urinary tract urothelial carcinoma without intraoperative reposition or redocking

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ABSTRACT

The gold standard for treatment of upper urinary tract urothelial carcinoma remains nephroureterectomy with the ipsilateral bladder cuff excision. With the introduction of robot system, robot-assisted surgery has become popular in the management of urological malignancies. We report a single institute experience of robot-assisted nephroureterectomy (RANU) for the treatment of upper urinary tract urothelial carcinoma (UC) without re-docking the robot system or reposition of the patient. The perioperative and oncologic outcomes are discussed.

1. Introduction

The gold standard for treatment of upper urinary tract urothelial carcinoma is nephroureterectomy with ipsilateral bladder cuff excision. Laparoscopic nephroureterectomy was first reported by Clayman et al[1] in 1991, and since then, it has been shown to have comparable oncologic outcomes when compared with the open method, with the additional advantages of shorter length of hospital stay, decreased blood loss, and decreased analgesic use.[2–6] The most challenging part during laparoscopic nephroureterectomy is management of the distal ureter and excision of the bladder cuff with subsequent bladder reconstruction. Although many techniques have been described for bladder cuff management, there is no consensus regarding the most effective and suitable approach.

With the introduction of the da Vinci robot system (Intuitive Surgical, Sunnyvale, CA, USA), robot-assisted surgery has become popular in the management of urological malignancies. Because the robotic system features facilitating intracorporeal suturing, it has thus been applied successfully to nephrectomy and prostatectomy[7–9]. We report a case series regarding robot-assisted nephroureterectomy for upper urinary tract urothelial carcinoma (UC) without redocking the robot system or repositioning of the patient. We also provide perioperative and oncologic outcomes.

2. Materials and methods

From December 2010 to December 2012, a retrospective chart review was performed at the Taichung Veterans General Hospital to identify patients undergoing robot-assisted nephroureterectomy (RANU) for the treatment of upper urinary tract UC. All operations were performed by a surgeon (Y. C. Ou). Preoperative staging examination and evaluation were completed, including history taking, physical examination, cystoscopy to exclude bladder invasion, and image study using computer tomography (CT scan) or magnetic resonance imaging (MRI) to rule out metastatic lesion. Patients' demographics, operative parameters, complications, and oncologic outcomes were collected and analyzed.

2.1. Surgical technique

Under general endotracheal anesthesia, patients were placed in a modified flank position. The diseased side was kept upright and a 15 degree slight Trendelenburg position was performed. The operating table was flexed appropriately. Robotic ports placement is shown in Fig. 1. A small incision at the periumbilicus region was made and a 12-mm camera port was positioned. Pneumoperitoneum of 15 mmHg CO_2 was created. Three 8-mm da Vinci

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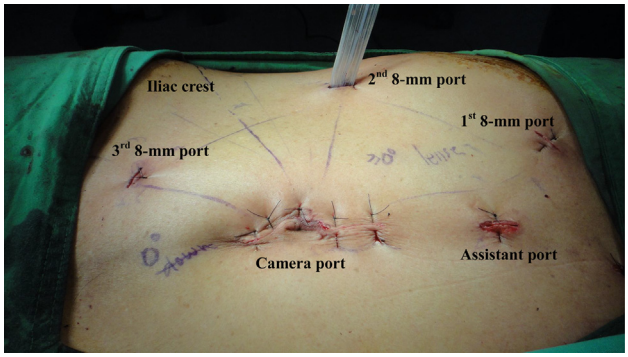

Fig. 1. Ports placement for robotic assisted right-side nephroureterectomy.

ports were placed. The first 8-mm port was ~8 cm cranial to the camera port and the second 8-mm port was placed ~8 cm lateral to the camera port. The first and second 8-mm ports were ~8 cm apart from each other and a triangle shape was formed by the first 8-mm, second 8-mm, and camera ports. One 12-mm assistant port was placed ~4 cm cranial to the camera port. The third 8-mm port was placed ~8 cm caudal to the camera port. Da Vinci was docked toward the patient's back and perpendicular to the patient. A zero degree lens laparoscopy camera was used. The first 8-mm robotic port used the right arm with monopolar curved scissors. The second 8-mm robotic port used the left arm with Maryland bipolar forceps. A ProGrasp forceps (Intuitive Surgical, Sunnyvale, CA, USA) was used to help maintain traction through the assisting port. Dissection of the colon was performed for mobilization. The ureter was identified and dissected cranially to the renal hilum. A hemolock clip was placed on the ureter to prevent downward spillage of malignant cells. The renal pedicle was identified, and the renal artery, vein, and gonadal vein were dissected and ligated using an endoscopic stapler. The kidney was dissected completely and the ureter was dissected to the level of the iliac vessels.

After completing nephrectomy and lymphadenectomy, a 30-degree down lens laparoscopy camera was used and directed toward the bladder. The third 8-mm robotic port was used for the left arm with Maryland bipolar forceps. The second robotic port was used for the right hand with monopolar scissors. ProGrasp forceps were placed at the first robotic port. Dissection of the peritoneum around the lower ureter and lateral urinary bladder wall was performed. The urethral Foley catheter was clamped to let the urinary bladder distend and facilitate extravesical bladder cuff excision. After completing bladder cuff excision, the bladder defect was repaired in two layers using 3-0 vicryl sutures. Normal saline injection through the urethral Foley catheter was performed to test the integrity of the urinary bladder. The specimen, including the kidney and ureter, were removed from the extended umbilical wound.

3. Results

Patient characteristics and perioperative data are shown in Table 1. In all, 13 patients receiving an operation by a surgeon from a single institute were analyzed. The mean (range) age was 72 (48–91) years. The mean operating time was 129 (105–150) minutes. The mean (range) estimated blood loss was 128 (30–500) mL. The mean (range) length of hospital stay was 7 (4–14) days. There were two postoperative complications: pneumonia and brachial nerve injury. The pathology reports are summarized in Table 2. All of the 13 patients had a pathology diagnosis of urothelial carcinoma. Two patients had low grade tumors and the other 11 patients had high grade tumors. Ta tumor was seen in one patient, T1 in three patients, T2 in two patients, T3 in six patients, and T4 in one patient. Lymph node dissection was performed in six (46%) patients with two patients having positive lymph node involvement. Patients with advanced tumors underwent adjuvant chemotherapy. Adjuvant chemotherapy was given to six patients with pT3 tumors and to one patient with a pT4 tumor. The mean (range) follow up was 14 (1–38) months. During the postoperative surveillance, two patients with a high grade pT3 tumor developed urinary bladder recurrence and two patients with high grade pT3 disease had distant metastasis (brain and lung metastasis).

Table 1
Patient demographics and tumor characteristics.

Variables	*N* (%) or mean (range)
No. of patients	13
Sex (M:F)	7:6
Mean age (y)	72 (range 48–91)
Side, n, (R:L)	7:6
Mean operation time (min)	129 (105–150)
Mean EBL (mL)	128 (30–500)
Mean postop hospital stay (d)	7 (4–14)
ASA classification	
I	0 (0)
II	9 (69)
III	4 (31)
IV	0 (0)
Mean BMI	23.7 (16–29)
Complications	2 (15)
Tumor location	
Pelvicalyceal	8 (61)
Ureteral	4 (30)
Pelvicalyceal–ureteral	1 (7)

ASA = The American Society of Anesthesiologists; BMI = body mass index; EBL = estimated blood loss; F = female; L = left; M = male; R = right.

4. Discussion

For the treatment of upper urinary tract UC, nephroureterectomy with ipsilateral bladder cuff excision remains the gold standard. With the introduction of the da Vinci robot system, this robot-assisted surgery has rapidly expanded in the field of urological malignancies. Robotic-assisted prostatectomy has been accepted and developed as an effective method of treatment with

Table 2
Pathological characteristics of RANU patients.

Variables	*N* (%) or mean (range)
Tumor stage	
Ta	1 (8)
T1	3 (23)
T2	2 (15)
T3	6 (46)
T4	1 (8)
Grade	
High	11 (85)
Low	2 (15)
Surgical margins	
Positive	3 (23)
Negative	10 (77)
Lymph nodes	
Positive	2
Negative	4
Not performed	7
Mean follow up (mo)	14 (1–38)
Recurrence	
Bladder recurrence	2 (16)
Local/retroperitoneal	0 (0)
Distant metastasis	2 (15)

RANU = robot-assisted nephroureterectomy.

good oncologic outcomes for prostate cancers.[10] Robot-assisted surgery can also be applied to the management of other urological diseases, such as kidney or bladder disease.[11–13]

For RANU with bladder cuff excision, the most challenging part of the procedure was management of the distal ureter and bladder cuff. This difficulty was magnified for patients with an increased body mass index or deep and narrow pelvic cavity. The robotic assisted surgical system provided three-dimensional and magnified vision that mimics the open method. Because of its increased range of motion and improved access for intracorporeal suture, the da Vinci robotic system could be applied to the management of distal ureter and bladder cuff.

A few case series listed in Table 3 describe the complete robotic approach for nephroureterectomy and bladder cuff excision. Compared with the case series of Park et al[14] and Eandi et al[15], which involved redocking the robot system or repositioning of the patient or patient cart during the operation, our method does not require intraoperative redocking or repositioning and, therefore, has a shorter operation time. Hemal et al[16] and Pugh et al[17] reported a case series involving a robotic approach for nephroureterectomy and bladder cuff excision without redocking or repositioning. The present series has comparable perioperative outcomes with shorter operating times and similar estimated blood loss when compared with the previous studies listed in Table 3. Hospital stays were longer in the present series, which may probably be attributed to different practice patterns between different countries.

There were two cases of operation complications. One patient with end stage renal disease under hemodialysis experienced respiratory failure after the operation because of pulmonary edema. Endotracheal tube intubation was performed and weaning the endotracheal tube was successful after 4 days of antibiotic treatment and proper fluid management. This emphasized the importance of fluid control during the operation for patients with poor renal function which was more prevalent in patients with urinary tract UC. The other patient had brachial nerve palsy after the operation, which resolved spontaneously 6 months later. This demonstrated that good positioning of the patient with all pressure points being padded properly was important to prevent nerve injury or pressure sores.

Two patients experienced urinary bladder recurrence and two patients developed distant metastasis during postoperative surveillance. All of the four patients had high-grade pT3 tumors. Patients with urinary bladder recurrence received transurethral resection of the bladder tumor. Two patients with distant metastasis died from brain metastasis and suffocation. Our results indicate that tumor stage and grade are important prognostic factors regarding outcomes after operations.

Three patients had positive margins over bladder cuff. All of them had bladder UC before which was confirmed by the cystoscopy. This would probably contribute to the positive margin in the present series.

Several limitations exist in the present series. The present study was a retrospective case series with a small sample size and therefore, only limited results could be concluded from our series. Furthermore, the present case series, although it had a good oncologic outcome, had short-term postoperative surveillance with a mean follow up of ~14 months. A larger prospective randomized control study with long-term follow up is needed to determine the most feasible and suitable approach for nephroureterectomy and bladder cuff excision.

Table 3
Comparison of complete robotic assisted RANU procedures.

Reference	Case no.	Operation time (min)	Estimated blood loss (mL0	Hospital stay (d)
Park et al[14]	11	247	106	7
Eandi et al[15]	11	326	200	5
Hemal et al[16]	15	184	103	3
Pugh et al[17]	43	249	133	3
Present series	13	129	128	7

RANU = robot-assisted nephroureterectomy.

5. Conclusion

The robotic procedure without intraoperative repositioning of the patient or redocking of the robot for the treatment of upper urinary tract UC described here, indicates that RANU is a feasible approach. Perioperative and short-term oncologic outcomes were comparable with other series of robotic assisted techniques. Further study with a larger number of patients and long-term follow up are needed in order to evaluate the role of the procedure.

Conflicts of interest

The authors declare that they have no financial or non-financial conflicts of interest related to the subject matter or materials discussed in the manuscript.

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