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Robotic-Assisted Partial Cystectomy and Segmental Ureterectomy: Analysis of Efficacy and Oncologic Outcomes

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Abstract

Objective: To report on patients undergoing Robot-Assisted Partial Cystectomy (RAPC), and segmental ureterectomy focusing on the operational efficacy and Oncologic Outcomes over a range of clinical, anatomical and pathological variables, as well as the overall oncological efficacy of these organ-sparing approach.

Methods and Patients: We retrospectively examined the robotic surgical database at Ruijin hospital and Huashan hospital to isolate cases of urologic malignancy managed using robotic technology from 2009 to 2016. During this period, 10 patients with biopsy-confirmed urothelial carcinoma of the bladder (cT1-4N0M0) were treated with RAPC plus chemotherapy and/or radiation therapy. And 6 patients with urothelial carcinoma of the ureter (cT0-2N0M0) were treated with RASU plus chemotherapy and/or radiation therapy.

Results: RAPC was performed in 10 patients and the mean total operative time including Cystoscopy was 126.36minutes (90-180), mean estimated blood loss was 95.45mL (50-150). There were no intraoperative complications. The mean postoperative length of stay was 16.54 days (9-42). One patient suffered urine leak, who finally required a secondary operation at 2 weeks after RAPC. 2 patients developed cancer recurrence in the first year after RAPC. For the 6 patient underwent RASU, the mean operative time was 106.67minutes (90-160), and the estimated blood loss was 83.33mL (50-200). Meanwhile, there were no intraoperative complications. The mean postoperative length of stay was 9.67 days (8-15). And the follow-up for these patients showed no recurrence at the 12 months.

Conclusion: RAPC and RASU confer the ability to achieve favorable outcomes. Robotic-assisted organ-sparing surgery should be considered a valid and meaningful option for the patients of bladder and ureter malignancy. Patient selection and accurate risk estimation are important, which immediately affect the oncological outcomes. More practice should be done, especiallyour data of follow-up, which is our major limitation of the study.

Keywords: Urethial cancer; Partial cystectomy; Segmental ureterectomy; Robot-assisted; Complications; Outcomes

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Introduction

Since the first reported robotic-assisted laparoscopic prostatectomy took place in Paris in 2000, there has been a rapid adoption of robotic procedure in urology and another surgical subject [1,2]. The advantages of robotic surgery system whose wide application in the surgery of bladder, prostate, kidney and ureter, include magnified 3D high definition surgical view, improved dexterity with articulating Endo Wrist® instruments with 7 of freedom, etc [3]. Those unique superiorities not only improve the surgical outcome, but also let us review the present operation methods [4].

Organ-sparing surgery in urologic malignancy treatment once has been not highly appraised for its incomplete dissection which may lead to inevitably high risk of recurrence [5-7]. However, with the assistance of robotic surgery, the clinical efficiency of some organ-sparing surgeries such as partial cystectomy and segmental ureterectomy have been reassessed. Partial cystectomy, a comparably shorter, less morbid surgery without the need for urinary diversion, has been represented an option for management of bladder cancer for selected patients according to a series of researches in the past decade [4]. Segmental Ureterectomy (SU) is another procedure in treatment of ureter carcinoma which could keep the kidney for avoiding the Chronic Kidney Disease (CKD) after the surgery

Table 1: Clinical and pathologic characteristics of patients treated with RAPC.

	SEX	AGE	SIZE (cm)	Number	pT	GRADE	pN	OP Time (min)	EBL (ml)	HOPS (d)	Lymph node count	COMMENT	Neo-adjuvant Chemotherapy	Adjuvant Chemotherapy /radiotherapy	Follow-up 12 months
1	M	49	4.1	2	T2b	high	pN0	120	100	9	0/6		yes		Recurrence after 6 months (RC)
2	F	61	3.2	1	T2a	high	pN0	90	100	25	0/4		yes		Recurrence after 8 months (TUR)
3	M	72	3	1	T2b	high	pN0	120	50	15	0/14		yes		
4	M	69	2	1	T1	high	pN0	120	100	20	0/8		yes		
5	M	47	2.2	1	T1	high	pN0	180	150	11	0/6		yes		
6	F	80	8	1	T3a	high	pN0	180	150	42	0/12	Urine leak	no	radiotherapy	
7	M	76	1.8	1	T3a	high	pN1	100	100	9	13-Jan		yes	yes	
8	M	70	1.5,1	2	T1	high	pN0	90	100	17	0/6		yes		
9	M	71	3.1	1	T1	high	pN0	90	50	17	0/9		yes		
10	M	72	2.5	1	T2a*	high	pN0	120	50	10	0/11	Ureter re-implantation	yes		

Table 2: Clinical and pathologic characteristics of patients treated with RASU.

	SEX	AGE	SIZE (cm)	Number	Site	pT	GRADE	pN	OP Time (min)	EBL (ml)	HOPS (d)	Lymph node count	COMMENT	Neo-adjuvant Chemotherapy	Adjuvant Chemotherapy/ radiotherapy
1	M	74	12	1	Left, lower	T2	high	pN0	90	50	9	0/6		no	ye
2	M	48	10	1	Right, mid	T1	high	pN0	160	200	8	0/3		no	radiotherapy
3	M	80	24	1	Left, lower	T1	low	pN0	90	50	9	0/8		no	radiotherapy
4	M	84	20	1	Left, lower	T1	low	pN0	90	50	8	0/8		no	radiotherapy
5	M	82	10	1	Right, lower	T2	high	pN0	90	50	15	0	Postoperative anemia	no	yes
6	M	69	20	1	Right, lower	T2	high	pN0	120	100	9	0		no	yes

[8]. Several evidences show similar oncologic outcomes between traditional nephrouretrectomy (NU) and SU [9].

In this study, we report on our experience with robotic partial cystectomy and segmental ureterectomy, with a focus on perioperative outcomes over a wide range of clinical, anatomical and pathological variables.

Methods and Patients

We retrospectively examined the robotic surgical database at Ruijin hospital and Huashan hospital to isolate cases of urologic malignancy managed using robotic-technology from 2009 to 2016. During this period, 10 patients with TUR biopsy-confirmed urothelial carcinoma of the bladder (cT1-4N0M0) were treated with RAPC plus chemotherapy and/or radiation therapy. And 6 patients with urothelial carcinoma of the ureter (cT0-2N0M0) were treated with RASU. The detailed inclusion criteria we mentioned in the section Discussion.

All robot-assisted surgeries were performed at these two medical institutions by our senior author (Zhoujun Shen) using the da Vinci SI system (Intuitive Surgical, Mountain View, CA, USA). Before the surgery, all patients underwent radiological examine, cytological assessment, anesthesia evaluation, and cystoscopy. Random bladder biopsies performed during TUR for the patients with bladder cancer. The pathology was reviewed by a dedicated genitourinary pathologist. All perioperativecomplications occurring at≤ 90 days of surgery we rerecorded and classified according to the Clavien–Dindo classification of surgical complications [10]. Meanwhile, patients were fully informed about the advantages and disadvantages of organ-sparing therapy, and ultimately selected the final procedure. The treatment protocol was approved by the ethics committee of the institutions.

For RAPC, the main operation sequences were listed as the following: 1. Place the ports for pneumoperitoneum, and a Cystoscopy as a guide for a monopolar laparoscopic scissor to delineate the necessary area of resection on the outside of the bladder. Remove the cystoscope, place aurethral catheter, and dock the robot. 2. The bladder is left attached to the anterior abdominal wall and then carefully opened, avoiding direct manipulation of the tumor. 3. Excising the tumor *en-bloc* with the tumor giving a 2-cm circumferential margin for adequate resection. 4. A distal ureterectomy and ureteric re-implantation if tumor is 2 cm lateral to the ureteral orifice and a frozen section is sent. 5. Place the specimen in a bag and removed. 6. The bladder defect is closed and interrupted double-layer closure, and PLND is performed.

For RASU, the main steps include: 1. Port placement according to the site of the ureteric lesions. 2. Reflection of colon and exposure of the retro peritoneum. 3. Ureteralmobilization. 4. Application of Hem-o-lock clips proximally and distally. 5. Excision of ureteral tumor and frozen sections were routinely sent to assess appropriateness of surgical margins. 6. Intracorporeal Double-J stent placement. 7.

ureteral–ureteral anastomosis, and PLND is performed.

Patients would then follow-up routinely for a standard oncologic and functional surveillance protocol to evaluate for recurrence of malignancy as follows: Standard laboratory basic metabolic panel analysis postoperatively at follow-up clinic visits, CT urography performed approximately 12 weeks after surgery, and cystoscopy at 6 months postoperatively.

Results

The clinical and pathological characteristics of patients treated with RAPC and RASU are summarized in the Table 1 and 2, respectively.

RAPC was performed in 10 patients, including 8 men and 2 women, whose mean age was 65y (47-80). Before the RAPC, 9 patients received cisplatin-based neo-adjuvant chemotherapy. The mean total operative time including Cystoscopy was 126.36 minutes (90-180), mean estimated blood loss was 95.45mL (50-150). There were no intraoperative complications or conversion to pure laparoscopic or open surgery, and no patient received a blood transfusion. The final pathology after RAPC, 4 patients were T1 while 6 patients with MIBC, 2 of which were pT3a. 9 patients had high grade tumor cells both in TUR pathology and RAPC pathology. One patient with TUR confirmed T1 and low grade had T2a and high grade lesion found in the RAPC pathology. All patients had less than 3 tumors and the mean tumor size was 2.71cm (1.0-8.0). All patients underwent PLND during RAPC, and median of 8.9 (4-14) nodes were sent to pathologist. One of these patients had nodal involvement. All patients had a negative surgical margin and no CIS found in the RAPC pathology. One patient suspected ureter involvement and underwent ureteric re-implantation.

The mean postoperative length of stay was 16.54 days (9-42). No patients had UTI or wound infection <90days, but one urine leak, who finally required a secondary operation at 2 weeks after RAPC. Adjuvant chemotherapy/radiotherapy protocol differed among the patients for their own condition. One patient who had reoperation history received radiotherapy and another patient received both adjuvant chemotherapy and radiotherapy. 2 patients developed cancer recurrence in the first year after RAPC. One underwent open RC 6 months after RAPC and another one was performed TUR 8 months for bladder local recurrence.

For the 6 patient underwent RASU (Figure 1), the mean age was 72y (48-84), and all were men. The mean operative time was 106.67 minutes (90-160), and the estimated blood loss was 83.33mL (50-200). Meanwhile, there were no intraoperative complications or conversion to pure laparoscopic or open surgery, and no patient received a blood transfusion. 3 patients were T1 (50%) and the rest were T2 according to the pathology after RASU. 4 patients in this series received PLND. At last, none of patients had lymph nodes involvement. All patients had 1 tumor and the mean tumor size was 1.5cm (1.0-8.0). All patients had a negative surgical margin and no patients underwent ureteric re-implantation.

The mean postoperative length of stay was 9.67days (8-15). No patients had UTI or wound infection <90days, but one postoperative anemia, who received plasma transfusion twice at the 6th and 7th day after RASU. All the patients received adjuvant radiotherapy and 3 received cisplatin-based chemotherapy after the surgery and the follow-up for these patients showed no recurrence at the 12 months.

Discussion

Laparoscopic procedure has become the important technique dealing with urologic disease for its minimal-invasive advantages which gain recognition among the surgeons and patients in the past decades [11]. During this period, laparoscopic technique, from the

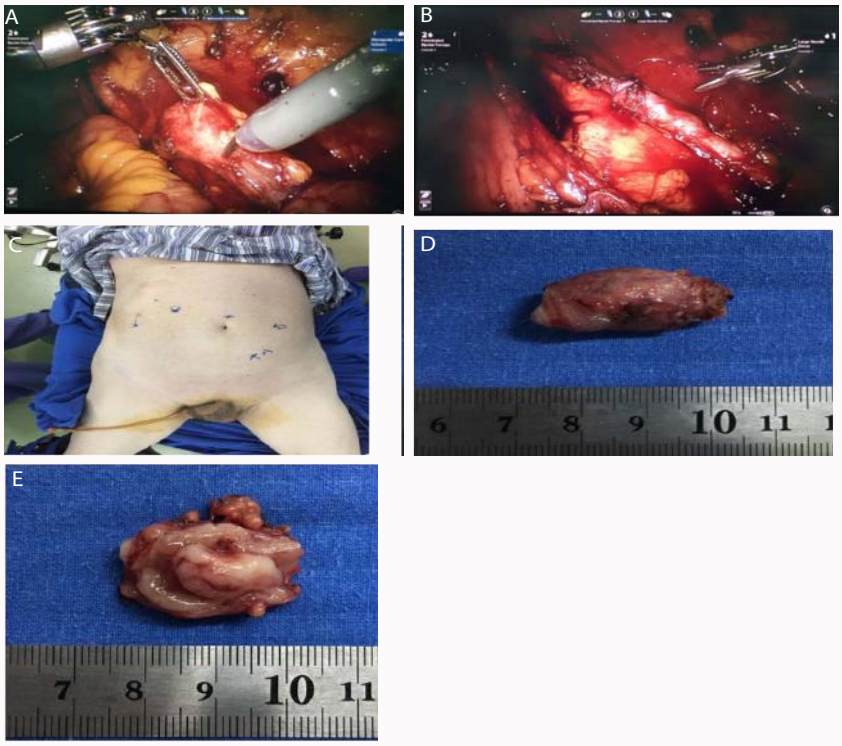

Figure 1: Robotic-assisted segmental ureterectomy (patient 5, right side). A. Ureteral lesion (during RASU); B. Ureteral–ureteral anastomosis; C. Port placement; D. Ureteral specimen; E. Ureteral specimen (open).

first laparoscopic radical prostatectomy in 1992 [12] to robotic-assisted laparoscopic procedure nowadays, has been developing constantly. In addition, the novel surgical methods also promote the continuous improvement and perfection of the concept of urologists and this study mostly focus on the robotic organ-sparing approach.

RAPC

Radical cystectomy with PLND is the gold standard surgical intervention for muscle-invasive bladder cancer [13], which needs reconstruction with a urinary diversion for maintaining the normal function of urination. Yu et al. [14] reported that patients undergoing RARC compared with open RC had fewer inpatient complications (49.1% vs. 63.8%, P=0.035) and fewer deaths (0% and 2.5%, P <0.001). The high risk of complications promotes us searching a method for not only achieving the satisfactory of oncological outcomes but also minimal perioperativemorbidity and complications.

Partial Cystectomy (PC), once have been considered an incomplete surgery for its high risk of recurrence [5,7,15], has shown safety and oncological efficacy among properly selected patients with the assistance of robotic system according to some of last studies. There were several case reports in the past decades showing the advantages of RAPC. Kim et al. [16] reported that 4 patients and Allaparthi et al. [17] 3underwent RAPC, which started as an initial attempt for the feasibility of RAPC. Up to now, David M. Golombos et al. [18] identified 29 patients in 2015 who underwent RAPC. This study showed 5-year overall and recurrence-free survival rates of RAPC were 79% and 68%, respectively [18]. And they demonstrated that RAPC could be an optimal approach for experienced surgeons which would achieve favorable outcomes with low morbidity and reduced hospital stays.

For PC, the selection criteria are critical important, and the tradition data showed only highly-selected patients are suitable for PC. In addition, consideration of the realistic condition that the healthier patients are more likely to receive RC and finally PC accounts for 7–10% of allcystectomies performed in USA [19,20]. In our series, we formulate our tactics as following: 1. No evidence of CIS confirmed by TUR; 2. No involvement of the bladder neck or urethra; 3. The patient's option for bladder-sparing therapy. The exclusion criteria included invasive tumors in the trig one and MIBC with invasion of the prostate. Tumors that were within 2 cm lateral to the ureteral orifice were not excluded from PC. cT2 and solitarycT3 MIBCs were strong candidates for PC.

As arobotic-assisted organ-sparing therapy, the advantages for RAPC include low morbidity and complication rates.Inour10 patients' series, the mean total operative time including Cystoscopy was 126.36minutes (90-180) and mean estimated blood loss was 95.45mL (50-150). No intraoperative complications occurred and no conversion to pure laparoscopic or open surgery. One patient suffered from urine leak, who finally received a secondary operation at 2weeks after RAPC. For hospital stay, RAPC appears to compare quite favorably to reported open series [21], and higher-volume institutions and surgeons yield better outcomes [22]. But the median length of hospital stay in our series was 16 days, which seemed quite different from the previous studies may due to the weak support from community health service in our country.

The risk of recurrence of PC still is our focus of attention, which once was seemed as the major limitation of PC, for it historically recorded range between 40% and 78% [23]. In our short follow-up period, two patients showed local recurrence and received operation for treatment. More data would be displayed next then.

All patients underwent PLND during RAPC in this study, and a median of 8.9 (4-14) nodes were sent to pathologist. One of these patients had nodal involvement and this patient received both adjuvant chemotherapy and radiotherapy. However, the data of RAPC with PLND is still lacking. In the study of David M. Golombos, they performed 90% of their patients and giving a relatively favorable outcome. In the past, the underutilization of PLND during PC is as low as 23%, which may be associated with the poor PC outcomes [24]. Although a more extensive lymphadenectomy may provide more accurate pathologic staging and survival benefits, one must carefully evaluate the risks associated with an extended lymph node dissection [25].

RASU

Nephrouretrectomy (NU) with removal of bladder cuff is the standard surgery for upper tract urothelial carcinoma [26]. However, Nephrectomy is associated with a reduction of global renal function [8]. And patients with impaired renal function would be ineligible to receive cisplatin-based therapy, which may affect the recurrence of the disease.

Segmental Ureterectomy (SU) is an another organ-sparing procedure which used in treatment of ureter carcinoma. SU keeps the kidney for avoiding the chronic kidney disease after the surgery while it has traditionally been associated with high recurrence rates. However, several evidences show recurrent rate has no differences between NU and SU these years. Simonato et al. [9] showed their results in 73 patients with pTa-T3 distal upper tract ureter carcinoma with a 5-year RFS, OS and CSS rates of 82.2, 85.3 and 94.1%, respectively. Jose A. Pedrosa et al. [27] reported are search of total 141 patients that localized recurrence occurred in 31.1% of SU/TU group compared to 27.1% (p = 0.62) of the NU group in 2015. Their results showed no significant survival between surgical approaches for upper tract urothelial cancer.

The selection criteria for our RASU included these: a mid or distal ureteral lesion/obstruction of theipsilateral renal moiety on radiological data; low-grade, superficial pathological findings underwent Cystoscopy and ureteroscopic biopsy; and no bladder lesions. For the 6 patient selected for RASU, the mean age was 72y (48-84), and all were men. All the patients with negative frozen margin during RASU. During the follow-up in the first 12-months, no patients show local recurrence.

Robotic-assisted approach can access the grade and stage more accurately of this disease, which may be critical important for the oncological outcomes of the patients. In our series, 3 patients were T1 (50%) and the rest were T2 according to the pathology after RASU. 4 patients in this series received PLND. At last, none of patients had lymph nodes involvement.

Conclusion

RAPC and RASU confer the ability to achieve favorable outcomes. Robotic-assisted organ-sparing surgery should be considered a valid and meaningful option for the patients of bladder and ureter malignancy. Patient selection and accurate risk estimation are important, which immediately affect the oncological outcomes. More practice should be done, especially our data of follow-up, which is our major limitation of the study.

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