Original Article

The incidence and pattern of renal cell carcinoma recurrence after robotic partial nephrectomy

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Abstract

Background: Robotic partial nephrectomy (RPN) is a rapidly growing treatment for small renal mass (SRM). In fact, RPN has shown good functional and oncologic outcome. In this manuscript, we are reporting on the incidence and pattern of recurrence of renal cell carcinoma (RCC) treated with RPN.

Patients and Methods: We reviewed prospectively collected data of patients who underwent RPN between September 2009 and March 2018. We selected patients with final pathologic diagnosis of RCC after the resection of their SRM. We described the incidence and pattern of recurrence in the patients who had it.

Results: A total of 335 patients with SRM underwent RPN. We found 269 patients to have RCC on the final pathologic evaluation of the SRM. Eight cases of recurrence were found with a recurrence rate of 2.9% after the mean follow-up period of 31 months (range 18–72). The pattern of recurrence presented as follows: two patients (0.7%) had trocar site recurrence (TSR), one patient (0.37%) had locoregional recurrence, and three patients (1.1%) had recurrence of the disease at the resection bed. Two patients (0.7%) developed second primary tumor in the other kidney. No cancer-related mortality occurred during the follow-up period.

Conclusion: TSR, locoregional recurrence, tumor bed recurrence, and contralateral tumor development are observed patterns of RCC recurrence after RPN. Recurrence was seen in up to 72 months. RPN provides great cancer control and high cure rate when utilized to treat RCC presenting as SRM.

Keywords: Nephron-sparing surgery, renal cell carcinoma, robotic partial nephrectomy, small renal mass

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INTRODUCTION AND OBJECTIVE

Renal cell carcinoma (RCC), with steadily increasing incidence, has become the third most commonly diagnosed urologic cancer in the United States.[1] This is related to the increase in the utilization of diagnostic cross-sectional imaging and detection of incidental small renal masses (SRMs), leading to stage migration of the disease.[2,3] Surgical resection has always been the treatment of choice for localized RCC.[4-6] Nephron-sparing surgery (NSS) for RCC, when technically feasible, is proven to be of equal oncologic outcome to radical nephrectomy.[4] Multiple studies had demonstrated acceptable oncologic and improved functional outcomes when NSS was utilized to treat SRM.[5] Besides, decreased cardiovascular morbidity with preservation of renal function has become a known benefit of the NSS.[6]

Robotic partial nephrectomy (RPN) has an established role in the treatment of RCC with an oncologic outcome that is

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comparable to open approach.[7] RPN established its niche as minimally invasive approach to treat SRM since pure laparoscopic approach has been difficult to adopt due to its long, steep learning curve.[7] The da Vinci® robotic surgical system improves the dexterity, increases visualization, and filters the tremor of the operating surgeon. It also enhances ergonomic setting to boost the surgeon's personal comfort.[8] The adoption of the robotic technique in NSS increased, leading to growth in experience with RPN to treat SRM.[7,8] The technique and both functional and oncologic outcome of RPN were replicated by multiple authors from different centers.[9,10] The 5-year cancer-free survival after robotic, laparoscopic, and open NSS for malignant renal masses was reported to be around 91%.[11] RPN was adopted in our institute since September 2009 as the treatment of choice for SRM. In this article, our aim is to report on the oncologic outcome and describe the recurrence pattern of RCC in patients with RCC-treated RPN at our institute.

PATIENTS AND METHODS

We reviewed, with IRB approval, prospectively collected data of the patients who underwent RPN for solid and cystic renal mass. We studied the medical record of patients with final diagnosis of any variant of RCC to identify patients who had recurrence of the disease. From September 2009 to March 2018, RPN was utilized routinely to treat patients with SRM (<4 cm) and selectively in the treatment in larger mass (4–7 cm) at our institute. The indication for RPN was either enhancing solid renal mass, or cystic renal mass classified as Bosniak IIF, III or IV.[12] RENAL nephrometry, first described by Kutikov and Uzzo, was used to guide our decision to perform partial nephrectomy. The score is built on five anatomical features of the renal mass [Table 1]. Four out of the five components are scored on a 1, 2, or 3. The fifth indicates whether the tumor is anterior or posterior.[13] RPN was done transperitoneally with mobilization of the colon medially. The renal hilum was isolated, and the tumor was exposed and then resected under variable warm ischemia time (WIT) ranging from 0 to 34 min. Off-clamp RPN was adopted in certain cases with the technique described by Lamoshi and Salkini.[14] Tumor resection was achieved according to the standard technique.[15] Hilar clamping, when utilized, was achieved using bulldog clamps or laparoscopic Satinsky clamp according to the situation and complexity of the hilum. After the resection, the tumor was placed in all the cases in Endo Catch™ specimen pouch. Renorrhaphy was initially performed according to the standard technique.[15] However, we modified the technique by eliminating the closure of the collecting system and that shortened the WIT in the last 225 cases utilizing the technique described by Williams *et al*.[16] All specimens were analyzed by dedicated uropathologists. The Fuhrman Grade (FG) was utilized for grading of the tumors.[2,3] A positive surgical margin (PSM) was defined as the extension of tumor to the inked surface of the resected specimen on the final microscopic pathologic evaluation. Every patient was admitted to the hospital after surgery for a minimum of 24 h and had continuous vital sign monitoring during the first 2-h stay. They also had laboratory testing of basic metabolic panel and complete blood count. All patients were followed using computed tomography scan or magnetic resonance imaging of the abdomen and pelvis with contrast media. The first surveillance imaging was performed 6 months after surgery and at variable period according to the risk of recurrence.

RESULTS

We studied 269 (81%) patients with a final diagnosis of RCC out of the 335 patients who underwent RPN at our institute. The mean age of the patients was 67 years (ranging from 28 to 81), and 183 were male (58%) as in Table 2.

The mean RENAL nephrometry score for the resected masses was 6.4 (ranging from 4 to 10). The pathological distribution of the tumors was as follows: 192 (71%) patients had clear cell RCC, 50 (19%) patients had papillary RCC, 16 (6%) patients had chromophobe RCC, and 11 (4%) patients had unclassified RCC. Forty-five (17%) patients had FG 1 tumor, 187 (70%) patients had Grade 2 tumors, and 37 (14%) patients had Grade 3 tumors. None of the patients had Grade 4 tumors. The tumors were distributed into 215 (80%) T1a, 42 (16%) T1b, and 12 (4%) T3a. Tumor characteristics are displayed in Table 3.

Table 1: R.E.N.A.L nephrometry score

Point given	1	2	3
Radius of the Tumor (cm)	≤4	>4 but <7	≥7
Exophytic/Endophytic	≥50	≤50	Completely Endophytic
Nearness to the collecting system			
Anterior/Posterior	No points given, a for anterior and *P* for posterior tumor		
Location in relation to polar lines	Entirely above or below the polar line	Crosses	Entirely between the polar lines

Table 2: Patient Demographics

RPN	335 patients
Studied RCC	269 (81%)
Age	67 (28-81) Years
Female/Male	86/183 (47%)

Table 3: Tumor characteristics

Parameter	Value
R.E.N.A.L nephrometry score	6.4 (4-10)
Clear Cell RCC	192 (71%) patients
papillary RCC	50 (19%) patients
Chromophobe RCC	16 (6%)
unclassified RCC	11 (4%)
Furman Grade 1	45 (17%)
Furman Grade 2	187 (70%)
Furman Grade 3	37 (14%)
Furman Grade 4	0
T1a 42.	215 (80%)
T1b	42 (16%)
T3a	12 (4%)

Two patients (0.7%) with malignant tumors had positive margin in the final pathology. The first positive margin was T1a, clear cell RCC, and FG 1. The second margin was T1b, papillary RCC, and FG 2. Tumor was violated in 11 cases during the surgery (4%), 7 patients (63%) of them were cystic clear cell RCC G1, and one patient (9%) had papillary RCC, FG 2, and T1b tumor. The remaining 3 (27%) violations happened in solid clear cell RCC, FG 2, and T1a tumors.

During the mean follow-up period of 39 months (ranging 6–96), we identified 8 (2.9%) cases of RCC recurrence, as in Table 2. The average lag time from the RPN and recurrence was 31 months (18–72). The pattern of recurrence presented as follows [Table 4]: two patients (0.7%) had trocar site recurrence (TSR) [Figure 1], one patient (0.37%) had locoregional recurrence with infiltration of the disease in the perinephric fat and/or lymph nodes [Figures 2 and 3], and three patients (1.1%) had recurrence of the disease at the resection bed [Figure 4]. Two patients (0.7%) developed second primary tumor in the other kidney. No cancer-related mortality occurred during the follow-up period.

DISCUSSION

RPN using the da Vinci® Robotic Surgical System (Intuitive Surgical®, Sunnyvale, Calif) is one of the fastest growing forms of MIS in the US Despite safety concerns. RPN has become the treatment of choice for SRM as it is continuously showing outstanding oncologic outcome, and at the same time, maintaining good renal function.[15] In fact, the feasibility and safety of the technique have been demonstrated by many authors.[15,16] It was proven that the required skills for robotic approach may be gained faster than what is needed in the classical laparoscopic skills.[17,18]

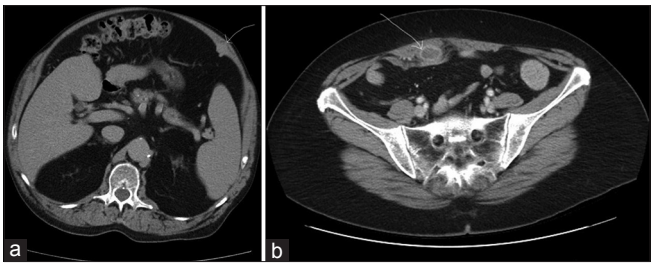

Figure 1: (a and b) Trocar site recurrence

Figure 2: Locoregional recurrence

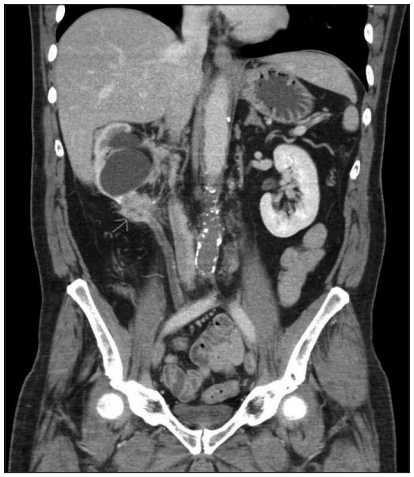

Figure 3: Locoregional recurrence

This study describes the nature and locations of recurrence of clinically T1, RCC treated with RPN. Peyronnet *et al*. proved in his multicenter analysis of 1800 partial nephrectomies that RPN has superior oncologic outcome compared to open and laparoscopic approach.[19] However, most of the other studies were unable to show any oncologic difference.[10,18] We were able to demonstrate comparable oncologic outcome to what has been published in the literature about RPN.[10,18,19] The recurrence rate was 2.9% in our study with statistically acceptable sample

Table 4: Patient who had RCC recurrence after RPN and the type of recurrence

Patient	1	2	3	4	5	6	7	8
Pathologic Type	Clear cell	Papillary	Clear cell	Papillary	Papillary	Papillary	Clear cell	Clear
Tumor Grade	G2	G3	G2	G3	G2	G2	G3	G2
Tumor	T1a	T1b	T3a	T1a	T1b	T1a	T3a	T1b
Timing of the recurrence (months)	18	20	20	24	30	36	36	72
Location of the recurrence	Trocar site	Regional	Tumor bed	Tumor bed	Second primary	Second primary	Tumor bed	Trocar site
Age	80	56	64	72	65	75	69	68
Sex	male	male	female	male	female	male	female	female

Figure 4: Recurrence at the tumor bed

size of 269. The tumor variants, stage, and grade was found to be similar to what has been published in the literature.[10,18,19] We, in this study, report on a single-center solo surgeon (MWS) experience with RPN in the treatment of RCC. That, in fact, enabled us to avoid variability in technique and instrumentation and account for the learning curve. However, it makes it fall into the trap of reporting and selection bias. We had a similar period of follow-up compared to other RPN series with almost similar rate of recurrence when compared to other studies as eight patients developed recurrence out of 269 patients with RCC treated with RPN (2.9%). Peyronnet *et al*. reported a recurrence rate of 5.5% in his multi-institutional data.[19] The main difference is that our data are derived from single-surgeon performance that may explain the lower rate of positive margin and recurrence. Cleveland clinic group reported 11% of recurrence in their hybrid cases of robotic, laparoscopic, and open partial nephrectomy.[11] In this study, we described neglected pattern of RCC recurrence after RPN, that is, TSR with an incidence rate of 0.7%. TSR is underreported in both RPN and laparoscopic partial nephrectomy. We found few reports of TSR in laparoscopic radical nephrectomy and hand-assisted laparoscopic radical nephrectomy.[20,21] In 2008, Masterson and Russo from Memorial Sloan Kettering Cancer Center reported on a case of combined locoregional and trocar site seeding after laparoscopic partial nephrectomy.[22] However, we found both types of recurrences in different patients. The etiology of TSR is likely to be multifactorial, involving tumor biology, local wound and general host immune processes, gas ambiance, and surgical factors. Similar factors are likely to be involved in the etiology of intraperitoneal dissemination, which can occur during both laparoscopic and open surgery.[20-22] In fact, Song *et al*. reported for the first TSR involving the camera trocar in robotic surgery after partial nephrectomy.[23] We reported in our series two cases. The first case of TSR was involving the robotic 8-mm metal trocar and the second was involving the assistant trocar. Interestingly, our second case presented 7 years after the surgery. None of the TSR was the camera trocar or tumor excision site. The risk of locoregional recurrence after laparoscopic and open surgery is well known in cancer literature, and it is well reported in Gynecology and Surgical Oncology.[24] Our findings showed that high grade, larger tumor, and papillary types are the surrogate with recurrence. This was compatible with what has been reported in the literature.[11,20-23]

We found only two cases of recurrence at the resection bed, and that echoes what has been published in the literature.[11] Positive resection margin, tumor violation during surgery was not associated with recurrence, contrary to what has been reported by Petros *et al*. in their large group long-term follow-up.[25] We had low number of PSM making it difficult to draw statistical conclusion. This study represents one large single center and surgeon experience with RPN, with acceptable length of follow-up. We still recommend longer follow-up and encourage more reporting on the outcome of RPN.

CONCLUSION

RPN yielded low rate of RCC recurrence at our institute. Tumors with Fuhrman histologic Grade ≥3, larger tumors ≥4 cm, and tumors with local invasion T3 tumors are more likely to recur. Papillary type RCC was found to be surrogate with recurrence. Positive margin and violation of the tumor during resection did not translate into recurrence in our series.

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Conflicts of interest
There are no conflicts of interest.

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