Minimally Invasive Partial Nephrectomy for Single Versus Multiple Renal Tumors

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Abbreviations and Acronyms

eGFR = estimated glomerular filtration rate

ICU = intensive care unit

NSS = nephron sparing surgery

PN = partial nephrectomy

SCr = serum creatinine

WIT = warm ischemia time

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Purpose: We report the perioperative outcomes of robotic/laparoscopic partial nephrectomy for multiple tumors at a single operative session. Outcomes were compared with those of a matched pair cohort treated with partial nephrectomy for a single renal tumor.

Materials and Methods: We retrospectively reviewed a prospectively maintained database from 2001 to 2010 and identified 33 patients who underwent partial nephrectomy for multiple tumors. They were matched 1 to 1 with 33 patients treated with partial nephrectomy for a single tumor. The multiple and single groups were matched for dominant tumor size (3.2 and 3.3 cm, p = 0.61), patient age (60 and 57 years, p = 0.59) and baseline estimated glomerular filtration rate (79.7 and 91.8 ml per minute/1.73 m^2, p = 0.11), respectively.

Results: A total 114 tumors were excised, including 81 in the multiple cohort. There was a median of 2 tumors per kidney (range 2 to 6). In the multiple and single tumor groups estimated blood loss (250 and 235 ml, p = 0.46) and warm ischemia time (19 and 30 minutes, respectively, p = 0.18) were similar. Median operative time (300 vs 217 minutes, p = 0.002) and hospital stay (3 vs 1 days, p = 0.005) were longer in the multiple group. There were 2 conversions to laparoscopic radical nephrectomy per group. Overall, complications developed in 11 (33%) vs 7 patients (21%) treated with partial nephrectomy for multiple vs single tumors (p = 0.40). Median estimated glomerular filtration rate at discharge home was 62.8 vs 67.6 ml per minute/1.73 m^2 in the multiple vs single tumor groups (p = 0.53). Histology confirmed malignancy in 82% and 67% of patients, respectively (p = 0.26). One recurrent tumor in the multiple group had a focal positive margin.

Conclusions: Robotic/laparoscopic partial nephrectomy can be safely performed for multiple ipsilateral tumors with perioperative outcomes similar to those in patients with a solitary tumor.

Key Words: kidney, kidney neoplasms, laparoscopy, robotics, nephrectomy

Nephron sparing surgery is established as the standard of care for most surgical small renal tumors when technically feasible.[1–3] While the majority of sporadic renal tumors are solitary, multifocality has been reported in 5.4% to 25% of patients with tumors smaller than 5 cm.[4,5] While radical nephrectomy is convenient for patients with multiple tumors in the elective setting, it may not be optimal, given the relatively higher incidence of metachronous contralateral renal lesions in patients with multiple renal tumors.[6]

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Although NSS in the setting of multiple ipsilateral synchronous tumors is desirable, it may present significant technical challenges. Specifically, it may include prolonged WIT, technical challenges with reconstructing several renal defects, and a potentially increased risk of postoperative bleeding and urine leak from a larger overall kidney resection surface area. As experience with robotic and laparoscopic PN has increased in the last several years, surgical indications have been carefully extended to include larger tumors, tumors in difficult anatomical locations, tumors in a solitary kidney, patients with renal insufficiency and patients with multiple tumors.[7,8] Our minimally invasive NSS strategy for multiple ipsilateral synchronous tumors has evolved in the last decade from relying heavily on some form of ablation (cryoablation or radio frequency), at least for tumors in difficult locations, to our most current strategy of multiple simultaneous excisions using our zero ischemia technique.[9–11]

We present a matched pair comparison of perioperative outcomes in patients treated with robotic or laparoscopic PN for multiple synchronous ipsilateral renal tumors at a single operative session vs those treated with laparoscopic PN for a single tumor.

PATIENTS AND METHODS

Between November 2001 and September 2010 robotic or laparoscopic PN was performed in 900 patients with a sporadic renal tumor. The same team of surgeons performed the procedures at our 2 institutions. Data were prospectively collected in institutional review board approved databases. We identified 33 patients (3.6%) with multiple synchronous ipsilateral tumors treated with PN, of which each was resected at the same surgical session. We retrospectively compared these patients with a matched pair cohort that underwent PN for a single tumor. The groups were matched 1 to 1 for dominant tumor size, baseline eGFR and patient age. While the overall study period was similar in the 2 groups (2001 to 2010), most cases in the multiple tumor cohort were treated between 2008 and 2010.

Our technique of robotic and laparoscopic PN evolved during this study period and it was previously described.[11,12] In our initial experience all steps of laparoscopic and robotic PN were performed with en bloc clamping of the renal hilum. Subsequently, we developed an early unclamping technique, in which the hilum was clamped only for the duration of tumor excision and the first layer of the corticomedullary renorrhaphy, thereby decreasing WIT duration more than 50%.[12] Our most recent zero ischemia technique eliminates global renal ischemia by using anatomical superselective arterial microdissection to control the tertiary/distal arterial branches that supply only the tumor and immediate peritumor parenchyma.[11]

Hemorrhage was defined as bleeding requiring angiographic or operative intervention. WIT was considered the duration that the main renal artery was clamped. Patients who underwent zero ischemia PN and those in whom PN was converted to radical nephrectomy were excluded from WIT analysis. Renal function outcomes were assessed at baseline and discharge home by SCr and eGFR in ml/minute/1.73 m^2 using the Modification of Diet in Renal Disease equation. Complications were recorded using the modified Clavien-Dindo classification.[13] Urine leak was defined as increased drain output for longer than 7 days with drain fluid creatinine at least 2 times greater than SCr. Tumor size in the multiple tumor group was based on the largest diameter of the dominant tumor on preoperative computerized tomography. The amount of renal parenchyma spared was recorded as the percent of kidney spared at the end of the PN procedure according to the subjective assessment of the surgeon and assistants. The indication for PN was considered imperative when the patient had bilateral tumors, a solitary kidney, von Hippel-Lindau disease, chronic kidney disease (eGFR less than 45 ml/minute/1.73 m^2) or a contralateral nonfunctional kidney.

SAS®, version 9.2 was used to calculate the propensity score for each patient based on baseline eGFR, clinical tumor size and age. This propensity score was then used to achieve pairwise matching of multiple vs single tumor cases. The Fisher exact test was used to examine the association between categorical variables and the Wilcoxon rank sum test was used to examine differences in not normally distributed continuous variables. All p values reported are 2 sided and $p < 0.05$ was considered statistically significant.

RESULTS

Overall 66 patients underwent robotic (2) or laparoscopic (64) PN to remove a total of 114 tumors. In the group treated with PN for multiple tumors 33 patients underwent excision of a total of 81 tumors (mean 2.45 per kidney, range 2 to 6). In the single vs multiple tumor groups median patient age was 57 (range 35 to 78) vs 60 years (range 22 to 76), median dominant tumor size was 3.3 (range 1.1 to 10) vs 3.2 cm (range 1.2 to 10) and baseline eGFR was 91.8 (range 36.6 to 127.4) vs 79.7 ml per minute/1.73 m^2 (range 31 to 143.8) (tables 1 and 2). The groups were also similar in gender, laterality distribution, body mass index and American Society of Anesthesiologists score. Median secondary tumor size in the multiple tumor group was 1.7 cm (range 0.7 to 5.5). More patients treated with PN for multiple tumors had an imperative indication for NSS (58% vs 15%, $p < 0.001$) as well as bilateral tumors (30% vs 3%, $p = 0.006$).

Comparing the single vs multiple tumor groups, the transperitoneal approach was used in 82% vs 97% of cases ($p = 0.1$) and the early unclamping technique was used in 29% vs 39% ($p = 0.6$). We used the zero ischemia technique in 4 patients (13%) with multiple tumors (table 1). The single and multiple tumor groups were similar in estimated blood loss (235 vs 250 ml, $p = 0.46$), WIT (30 vs 19 min-