10-Year Oncologic Outcomes After Laparoscopic and Open Partial Nephrectomy

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Abbreviations and Acronyms

CKD = chronic kidney disease
GFR = glomerular filtration rate
LPN = laparoscopic PN
OPN = open PN
PN = partial nephrectomy
RCC = renal cell carcinoma
RFS = recurrence-free survival

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Purpose: Open partial nephrectomy has proven long-term oncologic efficacy. Laparoscopic partial nephrectomy outcomes at 5 to 7 years of followup appear comparable to those of the open approach. We present the 10-year outcomes of patients who underwent laparoscopic or open partial nephrectomy for a single clinical stage cT1 7 cm or less renal cortical tumor.

Materials and Methods: Of 1,541 patients treated with partial nephrectomy for a single cT1 tumor between 1999 and 2007 with a minimum 5-year followup, an actual followup of 10 years or greater was available in 45 and 254 after laparoscopic and open partial nephrectomy, respectively.

Results: Median followup after laparoscopic and open surgery was 6.6 and 7.8 years, respectively. At 10 years the overall survival rate was 77.2%. The metastasis-free survival rate was 95.2% and 90.0% after partial nephrectomy for clinical T1a and T1b renal cell carcinoma, respectively ($p < 0.0001$). Baseline differences between patients treated with laparoscopic and open partial nephrectomy accounted for most observed differences between the cohorts. The median glomerular filtration rate decrease was 16.9% after the laparoscopic approach and 14.1% after the open approach ($p = 0.5$). On multivariable analysis predictors of all cause mortality included advancing age (HR 1.52/10 years, $p < 0.0001$), comorbidity (HR 1.33/1 U, $p < 0.0001$), absolute indication (HR 2.25, $p = 0.003$) and predicted recurrence-free survival (HR 1.58/10% increased risk, $p = 0.004$) but not laparoscopic vs open operative approach ($p = 0.13$). Similarly, predictors of metastasis included absolute indication (HR 4.35, $p < 0.0001$) and predicted recurrence-free survival (HR 2.67, $p < 0.0001$) but not operative approach ($p = 0.42$).

Conclusions: The 10-year outcomes of laparoscopic nephrectomy and open partial nephrectomy are excellent in carefully selected patients with limited risk of recurrence for cT1 renal cortical tumors. Overall survival at 10 years is mediated by patient factors such as age, comorbidity and operative indication, and by cancer factors such as predicted recurrence-free survival but not by the choice of operative technique, which depends on surgeon preference and experience.

Key Words: kidney; carcinoma, renal cell; nephrectomy; laparoscopy; outcome assessment (health care)

Partial nephrectomy has become a reference standard for the treatment of small renal masses.[1] OPN provides excellent oncologic and renal functional outcomes at 10 years and beyond.[2,3] Experience with LPN using pure and robot-assisted approaches continues to increase with groups at an increasing number of centers performing these operations for gradually expanding

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indications.[4] Reported outcomes of LPN at 5 to 7 years suggest comparable oncologic outcomes.[5–7]

Since 1,541 and 299 patients have completed 5 and 10 years of followup since OPN and LPN, respectively, done for a clinical T1 renal tumor, we assessed comparative long-term outcomes of PN performed at a tertiary referral center.

MATERIALS AND METHODS

Institutional review board approval was obtained to use data maintained in the Cleveland Clinic kidney cancer patient registry. A total of 875 LPNs and 1,371 OPNs were performed between September 1999 and December 2008 in patients with a radiographically suspicious renal mass thought to be amenable to PN. The LPN and OPN techniques were described previously.[8,9] Clinical, operative and followup information on these patients was collected prospectively and maintained in an institutional review board approved electronic database. Patients with prior or synchronous bilateral localized renal cancer (397), multiple ipsilateral tumors (89), tumor greater than 7 cm (101), or preoperative radiographic evidence suspicious for lymph node or distant metastases (17) were excluded from study. In addition, those who were younger than 18 years (33), had a known familial RCC syndrome such as von Hippel-Lindau disease (26) or were treated with PN for an indication other than suspected renal cancer (42) were excluded. Of the remaining 1,541 patients, who have now completed a minimum 5-year followup since surgery, 625 underwent LPN and 916 underwent OPN for a single localized cT1 renal mass 7 cm or less.

Imperative indications for PN were defined as any of hypertension, diabetes mellitus, coronary artery disease or GFR between 45 and 60 ml/minute/1.73 m^2. Absolute indications included GFR less than 45 ml/minute/1.73 m^2 and/or tumor in a functionally solitary kidney. PN in patients without these conditions was considered elective PN.

Our followup surveillance protocol comprised history, physical examination, and serum creatinine measurement at 1 to 2, 6 and 12 months, and annually thereafter. Radiographic evaluation generally included chest x-ray and computerized tomography or magnetic resonance imaging of the abdomen at 6 months and annually thereafter for 5 years when PN confirmed RCC. In patients who underwent clinical followup elsewhere serum creatinine data and radiographic reports from the referring physician were obtained and entered into our computerized database. Of the 328 patients 21% did not undergo institutional followup 90 days after PN. GFR was estimated using CKD-Epidemiology Collaboration equations.[10] CKD stages were defined by the National Kidney Foundation.[11,12]

Cancer recurrence information was based on clinical and radiographic findings. Overall survival was determined by chart review and telephone contact. Death from any cause was verified using the Social Security Death Index. Cancer specific mortality was attributed to patients with evidence of cancer progression before death and/or according to the codes on the physician prepared death certificate, including ICD-9 189.0 and ICD-10 C64.

The Wilcoxon and Kruskal-Wallis tests were used to compare nonparametric continuous data, and the chi-square and Fisher exact tests were used to compare nominal data according to PN type. We used Kaplan-Meier analysis to evaluate overall and metastasis-free survival with differences between various cohorts tested by the log rank test. Multivariable analysis was performed to evaluate predictors of all cause mortality using a Cox proportional hazard model. Associations are shown as the HR and 95% CI. Predicted oncologic potential was estimated using a nomogram predicting freedom from metastasis at 5 years based on preoperative and postoperative tumor characteristics.[13] Statistical analysis was done using JMP®, version 9.0.

RESULTS

Table 1 shows the clinical and pathological features of 1,541 patients treated with LPN or OPN for a single cT1 renal cortical tumor (7 cm or less). One senior surgeon performed 71% of OPNs and another senior surgeon performed 70% of LPNs. The proportion of tumors treated with LPN increased during the study years from 10% in 1999 to 72% in 2007, representing 81% of cT1a and 33% of cT1b tumors in 2007. Significant differences between the pretreatment characteristics of the LPN and OPN cohorts included radiographic tumor size (2.6 vs 3.5 cm), preoperative renal function (82 vs 74 ml/minute/1.73 m^2) and absolute indication for PN (5.4% vs 30%), respectively ($p < 0.0001$). Several histopathological features of tumors treated with LPN and OPN also differed significantly ($p < 0.0001$). The LPN cohort included smaller tumors (2.5 vs 3 cm), more benign tumors (26% vs 19%), fewer pathological stage T1b or higher cancers (14% vs 33%) and fewer cancers with a greater than 10% predicted likelihood of metastasis (1.3% vs 6.7%).[13] In Cox proportional hazards models nomogram predicted RFS was a significant indicator of overall survival (HR 1.58, 95% CI 1.19–2.00, $p = 0.004$) and distant metastasis (HR 2.67, 95% CI 1.91–3.40, $p < 0.001$, table 2).

Positive surgical cancer margins were reported after 5 LPNs (1.0%) and 2 OPNs (0.3%). None of the 6 patients with a positive parenchymal margin experienced recurrence at a median followup of 5.8 years (range 5.0 to 11.8). However, metastatic disease developed in the patient with a positive vascular margin after a tumor thrombus was removed from a renal vein branch. The patient died 5.8 years after OPN was done for a 6 cm clear cell RCC in a solitary kidney. Another patient underwent completion nephrectomy 2 months after LPN based on suspicion of residual disease but no cancer was found in the specimen.

A minimum 10-year actual followup was available in 45 and 254 patients after LPN and OPN, respectively. In these 299 patients actual overall survival at 10 years was 78% after LPN and 72%