Variation in Surgical Margin Status by Surgical Approach among Patients Undergoing Partial Nephrectomy for Small Renal Masses

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Abbreviations and Acronyms

LPN = laparoscopic PN

OPN = open PN

PN = partial nephrectomy

PSM = positive surgical margin

RCC = renal cell carcinoma

RPN = robotic PN

SRM = small renal mass

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Editor's Note: This article is the first of 5 published in this issue for which category 1 CME credits can be earned. Instructions for obtaining credits are given with the questions on pages 1834 and 1835.

Purpose: We assessed the relationship of surgical margins across different surgical approaches to partial nephrectomy in patients with clinical T1a renal cell carcinoma in a population based cohort.

Materials and Methods: We used NCDB (National Cancer Database) to identify all patients who underwent partial nephrectomy for clinical T1a renal cell carcinoma (tumor size less than 4 cm) from 2010 to 2011. The primary outcome was surgical margin status in patients treated with partial nephrectomy by the open, laparoscopic or robotic approach. Multivariable logistic regression analysis was done to identify patient, hospital and surgical factors associated with positive surgical margins.

Results: Partial nephrectomy was done in 11,587 patients, including open, laparoscopic and robotic nephrectomy in 5,094 (44%), 1,681 (14%) and 4,812 (42%), respectively. Mean ± SD age was 56 ± 12 years. Overall 806 patients (7%) had positive surgical margins. The positive surgical margin prevalence was 4.9%, 8.1% and 8.7% for the open, laparoscopic and robotic approaches, respectively ($p < 0.001$). Laparoscopic and robotic partial nephrectomy had a higher adjusted OR for positive surgical margins (OR 1.81 and 1.79, respectively, each $p < 0.001$) than open nephrectomy. When stratified by hospital type, differences in positive surgical margin rates remained, such that patients treated at academic medical centers who underwent laparoscopic and robotic partial nephrectomy had a higher adjusted OR (1.38, $p = 0.074$ and 1.73, $p < 0.001$, respectively) than patients treated with open partial nephrectomy.

Conclusions: Laparoscopic and robotic partial nephrectomy is associated with higher positive surgical margin rates compared to open partial nephrectomy for clinical T1a renal cell carcinoma. The effect of margin status on long-term oncologic outcomes in this context remains to be determined.

Key Words: kidney; carcinoma, renal cell; nephrectomy; minimally invasive surgical procedures; outcome and process assessment (health care)

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Approximately 60,000 patients are diagnosed with RCC in the United States each year.[1] It is well recognized that the incidence of SRMs has been increasing due the greater use of cross-sectional imaging.[2] Currently clinical practice guidelines recommend PN for T1a renal masses (less than 4 cm) based on observational studies suggesting a lower risk of chronic kidney disease, cardiovascular disease and all cause mortality.[3–5]

While OPN represents the traditional surgical treatment for SRMs, advances in treatment technology have led to the introduction of laparoscopic and robotic approaches. Thus, these minimally invasive surgeries have increasingly become the preferred approaches for patients and urological surgeons. Several studies have suggested that OPN, LPN and RPN are equivalent with respect to perioperative outcomes and oncologic efficacy.[6,7] Moreover several studies suggest that LPN and RPN are superior to OPN regarding intraoperative blood loss, length of hospital stay and improved convalescence.[6,8,9] Additionally RPN decreases warm ischemia time compared to LPN, which could prevent significant loss of renal function postoperatively.[9,10]

In the surgical management of localized tumors a key principle of oncologic care is complete excision of the tumor with a negative surgical margin. The PSM incidence has been reported to range between 0% and 11% for OPN,[6,8,9,11,12] between 0.8% and 4% for LPN,[6,8,13–17] and between 2.2% to 5.7% for RPN.[9,13,18–20] Comparative studies evaluating the PSM rate among OPN, LPN and RPN have shown no statistically significant difference in regard to PSM and surgical approach.[6,8,9,13] However, a limitation is the generalizability of results since most studies originated from high volume, single institution studies. To date only 1 population based cohort study has been done to evaluate the incidence of PSMs in PN and it showed a PSM rate of 10%.[21] However, this study did not distinguish PSM rates among different surgical approaches.

Since RPN has become more widely used as the minimally invasive approach in patients with a SRM undergoing surgery, in particular with the greater diffusion of robotic surgery, it is essential to evaluate whether RPN is associated with equivalent rates of PSMs.[22,23] In this context we assessed the relationship of surgical margin status and surgical approach in a population based cohort of patients undergoing PN. We also aimed to identify other patient and hospital characteristics associated with PSM for PN.

MATERIALS AND METHODS

Data Source

In this study we used NCDB to examine the surgical margin status in patients undergoing PN. NCDB, a joint program of the CoC (Commission on Cancer) and the ACS (American Cancer Society), serves as a nationwide oncology outcomes database for more than 1,500 hospitals with commission accredited cancer programs in the United States and Puerto Rico.[24] Approximately 70% of all newly diagnosed cases of cancer are reported to NCDB. For study purposes differences between laparoscopic or robotic surgery became available starting in 2010.

Study Population

Overall 15,758 adult patients with histologically confirmed RCC (histological codes 8140, 8255, 8260, 8310, 8312, 8316, 8317, 8318, 8319 or 8323) identified by ICD-O-3 code C64.9[25] who also underwent PN (code 30) in 2010 and 2011 were identified. We elected to limit our study population from 2010 to 2011 because robotic surgery treatment codes were only available for these years. We excluded 248 patients from the analytical cohort who were coded as having undergone no surgical procedure at the primary site in the treatment variable as well as 251 in whom the surgical margin was coded as not evaluable or unknown. Also excluded from the analytical cohort were 256 patients treated with LPN or RPN that was converted to OPN. We then limited our study population to patients with masses identified as 4 cm or less, or stage T1a (tumor size codes 0-40 and 991-994), resulting in 11,587 patients in the final analytical cohort.

Study Covariates and Outcomes

For each patient the age at diagnosis, race, gender, insurance status, 2000 census tract annual median income, geographic region, location (rural, metropolitan and urban), Charlson-Deyo comorbidity score, and tumor size, grade and histology were assigned using NCDB data. Histological codes 8140 (adenocarcinoma), 8310 (clear cell adenocarcinoma not otherwise specified) and 8312 (RCC) were combined and reclassified as clear cell. Histological codes 8255 (adenocarcinoma with mixed subtypes or alveolar adenocarcinoma), 8323 (mixed cell adenocarcinoma), 8318 (renal cell carcinoma sarcomatoid) and 8319 (collecting duct) were combined and reclassified as mixed, collecting duct or sarcomatoid. Histological codes 8260 (papillary), 8316 (cystic) and 8317 (chromophobe) were analyzed as independent variables in the regression model.

We also evaluated surgical approach (OPN, LPN or RPN) and hospital type. Hospital types analyzed included community cancer programs, comprehensive community cancer programs and academic/research programs. At community cancer programs more than 100 patients are treated per year whereas at comprehensive community cancer and academic/research programs greater than 500 per year are treated. In addition, academic/research programs have at least 4 graduate medical education programs.

The primary outcome was surgical margin status. PSM status was defined by NCDB codes as residual tumor not otherwise specified, or microscopic or macroscopic residual tumor. Patients without codes for residual, microscopic or macroscopic residual disease were categorized as having negative surgical margins. Each patient in NCDB is also assigned a facility identification code unique to the