Comparative Outcomes and Assessment of Trifecta in 500 Robotic and Laparoscopic Partial Nephrectomy Cases: A Single Surgeon Experience

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Abbreviations and Acronyms

CCI = Charlson comorbidity index
GFR = glomerular filtration rate
LPN = laparoscopic PN
PN = partial nephrectomy
RPN = robotic PN
WIT = warm ischemia time

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Purpose: We report a comparative analysis of a large series of laparoscopic and robotic partial nephrectomies performed by a high volume single surgeon at a tertiary care institution.

Materials and Methods: We retrospectively reviewed the medical charts of 500 patients treated with minimally invasive partial nephrectomy by a single surgeon between March 2002 and February 2012. Demographic and perioperative data were collected and statistically analyzed. R.E.N.A.L. (radius, exophytic/endophytic properties, nearness of tumor to the collecting system or sinus in mm, anterior/posterior and location relative to polar lines) nephrometry score was used to score tumors. Those scored as moderate and high complexity were designated as complex. Trifecta was defined as a combination of warm ischemia time less than 25 minutes, negative surgical margins and no perioperative complications.

Results: Two groups were identified, including 261 patients with robotic and 231 with laparoscopic partial nephrectomy. Demographics were similar in the groups. The robotic group was significantly more morbid (Charlson comorbidity index 3.75 vs 1.26), included more complex tumors (R.E.N.A.L. score 5.98 vs 7.2), and had lower operative (169.9 vs 191.7 minutes) and warm ischemia (17.9 vs 25.2 minutes) time, intraoperative (2.6% vs 5.6%, each $p < 0.001$) and postoperative (24.53% vs 32.03%, $p = 0.004$) complications, and positive margin rate (2.9% vs 5.6%, $p < 0.001$). Thus, a higher overall trifecta rate was observed for robotic partial nephrectomy (58.7% vs 31.6%, $p < 0.001$). The laparoscopic group had longer followup (3.43 vs 1.51 years, $p < 0.001$) and no significant difference in postoperative changes in renal function. Main study limitations were the retrospective nature, arbitrary definition of trifecta and shorter followup in the RPN group.

Conclusions: Our large comparative analysis shows that robotic partial nephrectomy offers a wider range of indications, better operative outcomes and lower perioperative morbidity than laparoscopic partial nephrectomy. Overall, the quest for trifecta seems to be better accomplished by robotic partial nephrectomy, which is likely to become the new standard for minimally invasive partial nephrectomy.

Key Words: kidney; carcinoma, renal cell; laparoscopy; robotics, prostatectomy

Nephron sparing surgery is the mainstay therapy for small renal masses.[1] Of available nephron sparing techniques LPN offers faster convalescence, lower analgesia use and comparable outcomes compared to open PN, although in the hands of expert surgeons.[2] On the other hand, longer

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WIT and a higher likelihood of perioperative morbidity can be expected in patients with larger tumors, especially at low volume centers, due to the inherent challenges of LPN.[3,4]

The features of the da Vinci® robotic platform are likely to facilitate a complex procedure such as PN. Thus, RPN might offer better outcomes than LPN, while keeping the benefits of a minimally invasive procedure.

Several comparative studies in the last few years showed the equivalence of LPN and RPN[5,6] or suggested a trend toward better outcomes in favor of RPN.[7,8] In a previous matched cohort study we found that RPN represents an effective, safe alternative to LPN.[5]

We report a comparative analysis of a large series of LPNs and RPNs performed by a high volume single surgeon at a tertiary care institution.

PATIENTS AND METHODS

Study Population

We retrospectively reviewed the medical charts of 500 consecutive patients in whom minimally invasive PN was performed by a single surgeon (JHK) between March 2002 and February 2012. All data were obtained from our prospectively maintained institutional review board approved database. Missing imaging studies in laparoscopic cases were requested from our imaging library. Eight imaging studies of the laparoscopic population were unavailable or defective vs 1 in the robotic population. Two study groups were identified, including the RPN group of 269 patients and the LPN group of 231.

Surgical Technique

The LPN procedure was performed according to a previously described technique.[9] Essential steps include renal defatting, maintaining fat over the tumor, laparoscopic ultrasound to score the resection line, en bloc hilar clamping, tumor excision with cold scissors, suture repair of the collecting system and sutured renorrhaphy over a hemostatic bolster (fig. 1, *A*). The RPN technique included tumor identification under ultrasound guidance and its demarcation, hilar clamping and tumor excision

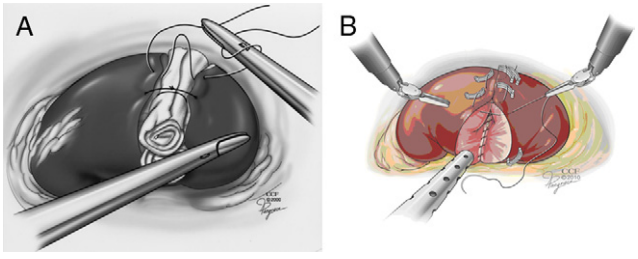

Figure 1. Renal capsule closure. *A,* standard technique using interrupted sutures over cellulose bolster. *B,* nonbolster continuous horizontal mattress stitch with intermittent placement of sliding Hem-o-lok® clips.

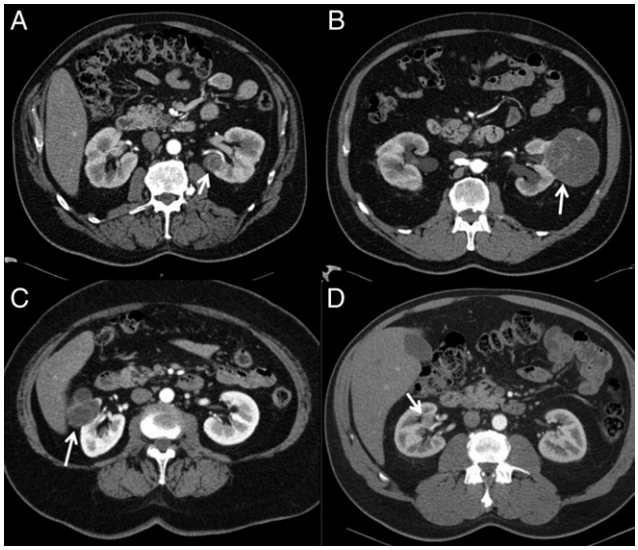

Figure 2. Computerized tomography sections from RPN population. *A,* left posterior hilar tumor (arrow). *B,* large left interpolar posterior tumor (arrow). *C,* large right interpolar tumor (arrow). *D,* complex hilar right tumor (arrow).

renorrhaphy using a continuous horizontal mattress stitch for capsule closure (fig. 1, *B*). Early in the experience standard interrupted bolstered renorrhaphy was adopted for capsule closure.[10]

Data Analysis

Renal function was estimated by the Modification of Diet in Renal Disease formula. To account for complexity, tumors were scored according to the R.E.N.A.L. scoring system with tumors of moderate and high complexity (score 7 to 12) considered complex (fig. 2).[11] Based on this definition, we documented the annual rate of complex cases. Postoperative complications were graded according to the Clavien-Dindo score.[12] Demographics and perioperative outcomes were statistically analyzed and compared between the 2 groups.

The number of annual PNs for this surgeon were recorded and distributed between robotic and laparoscopic cases. We defined a trifecta as the combination of WIT less than 25 minutes, as suggested by Thompson et al,[13] plus negative surgical margins as a surrogate of oncological safety, and no complications intraoperatively and up to 3 months postoperatively as a surrogate of surgical quality. Trifecta is a term commonly used to describe favorable clinical outcomes of radical prostatectomy.[14] Overall trifecta rates were calculated for each group. To account for any learning curves, trifecta rates were also calculated in series of a minimum of 25 and a maximum of 50 consecutive cases. These 2 values were suggested in the literature as the number of cases required to move past the learning curve for LPN and RPN.[8,15]

Data are presented as the mean ± SD and the percent frequency for continuous and categorical variables, respectively. Categorical variables were compared using the Pearson chi-square test. Continuous variables were compared using the Student t test for normally distributed data or the Mann-Whitney U test, as appropriate. Univar-