Robotic Partial Nephrectomy for Cystic Renal Masses: A Comparative Analysis of a Matched-paired Cohort

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OBJECTIVE To compare the outcomes of robotic partial nephrectomy (RPN) for cystic and solid renal neoplasms.

METHODS Our RPN database was queried to identify consecutive patients who underwent RPN for cystic and solid renal masses in the period between July 2007 and July 2013. Cystic renal masses were diagnosed on cross-sectional imaging (computed tomography or magnetic resonance imaging). Matching was done between the patients with cystic renal masses and patients with solid renal masses (1:1 matching) by age, gender, tumor size, and nephrometry score.

RESULTS Of 647 cases, 55 patients with cystic masses (group 1) were matched with 55 patients with solid tumors (group 2). There was no cyst rupture or positive surgical margin observed in group 1. The volume of resected rim of healthy renal parenchyma surrounding the tumor was the same for both groups ($P = .9$). There was no difference between the groups in terms of percentage of glomerular filtration rate preservation postoperatively (85% vs 86%; $P = .94$). There was no difference in term of overall complications between the 2 groups. Thirty patients (54.5%) in group 1 and 47 patients (85.5%) in group 2 had renal cell carcinoma ($P = .0001$).

CONCLUSION RPN can be safely and effectively performed when treating a suspicious cystic renal neoplasm with outcomes resembling those obtained for solid masses. Thus, when a cystic renal mass in encountered, nephron-sparing surgery can be offered and RPN represents an effective tool for this approach. UROLOGY 84: 93–98, 2014. © 2014 Elsevier Inc.

Partial nephrectomy currently represents the main treatment modality in the management of small renal masses.[1] Cystic renal masses possess heterogeneous characteristics and pose unique challenges from diagnostic, operative and pathology points of views. The feasibility of laparoscopic nephron-sparing surgery for cystic renal masses has been previously described.[2]

Since its introduction, robotic partial nephrectomy (RPN) has been increasingly adopted and its indications are rapidly expanding.[3] However, published data with regards to the role of RPN in the management of cystic renal masses remain sparse.

Herein, we report on our experience with RPN for cystic renal masses, and we provide a comparative analysis of the outcomes in this setting against those obtained with RPN for solid renal masses.

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MATERIAL AND METHODS

Study Population

Our institutional review board–approved database was queried to identify consecutive patients who underwent RPN for cystic and solid renal masses in the period between July 2007 and July 2013. Cystic renal masses were diagnosed on cross-sectional imaging (computed tomography or magnetic resonance imaging). Radiology report was used to assess cyst complexity according to Bosniak classification.[4,5]

Decision for surgical intervention was based on Bosniak classification and radiologic changes during the period of surveillance. One-to-one matching was done between the patients with cystic renal masses (group 1) and consecutive patients with solid renal masses (group 2) from our RPN database.

Groups were matched by age, gender, tumor size, and nephrometry score to ensure patients and tumors were comparable at baseline. Three surgeons in our Center performed the RPN operations.

Surgical Technique

Our surgical technique for RPN has been previously described in detail.[6] After initial mobilization of colon and dissection of renal hilum, Gerota's fascia is opened in an area adjacent to the renal mass and dissection is performed along the renal capsule until the mass is exposed. The perirenal fat is cleared circumferentially around the mass, allowing for visualization of 1-2 cm

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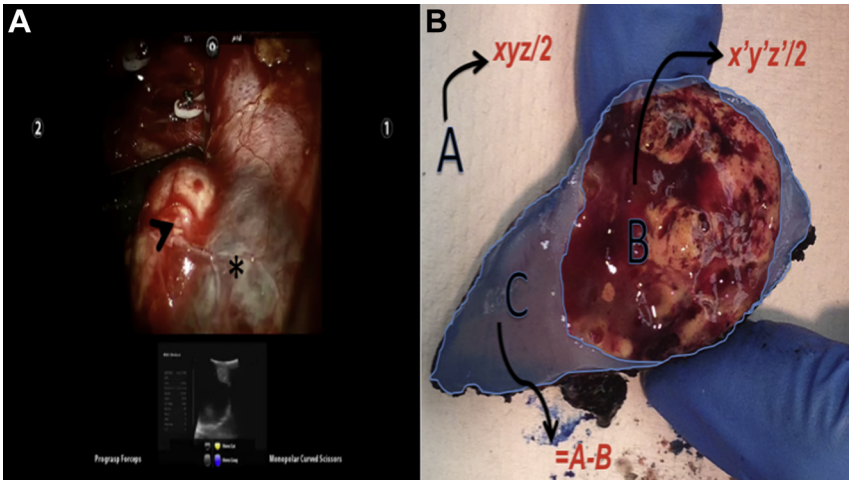

Figure 1. **(A)** Intraoperative laparoscopic view of a Bosniak IV renal cyst at the time of RPN showing a lower pole renal cyst (*) with a solid component (arrowhead). Inset of ultrasound of corresponding image, demonstrating ultrasonic view of the cystic and solid components. **(B)** Tumor volume is obtained from pathology assessment and calculated by ellipsoid formula (B) where x′, y′, and z′ are the tumor dimensions on pathology assessment. Partial nephrectomy specimen volume is calculated by the ellipsoid formula (A), where x, y, and z are the specimen dimensions measured by pathologist. Assessment of the volume of the rim of healthy renal parenchyma (C, shaded area) is made by subtraction of these values (C = A − B). RPN, robotic partial nephrectomy. (Color version available online.)

of normal parenchyma, which is needed for subsequent renal reconstruction.

Intraoperative ultrasound imaging is used to accurately pinpoint the location, depth, and borders of the mass. If available, a drop-in flexible ultrasound probe (ProART Robotic Drop-In Transducer 8826; BK Medical, Peabody, MA) provides the advantage of being directly controlled by the console surgeon.[7] In case of an endophytic lesion, the use of intraoperative imaging becomes mandatory[8] (Fig. 1A). Margins of resection are scored with cautery before proceeding with hilar clamping and tumor excision. Robotic bulldog clamps are used to control renal vessels. Zero ischemia is used selectively. Renorrhaphy is performed by using 2 layers of sutures, as previously described. Subsequently, the specimen is placed in the laparoscopic sac and removed from an extended lower quadrant port site. Diligent care must be taken to make the extraction incision large enough to avoid rupturing the specimen, possibly precluding accurate pathologic examination for margin status and staging.

In case of a cystic mass, the most relevant challenge is to avoid any inadvertent cyst puncture during tumor mobilization or excision while obtaining an adequate margin of normal parenchyma. Thus, any forceful retraction or direct manipulation of the exophytic component of the mass should be avoided as this can lead to cystic wall rupture. Keeping some peritumoral fat as a handle is a useful maneuver to achieve this. Cases in which a complex cyst is adjacent to an enhancing solid mass, we prefer en bloc resection of both lesions and using single renorrhaphy.

Analysis

Patient demographics (American Society of Anesthesiologists [ASA] score and baseline renal function), tumor characteristics (tumor size, RENAL nephrometry score and its components), surgical outcomes (operative [OR] time, warm ischemia time [WIT], estimated blood loss, pelvicaliceal system [PCS] repair, complications, and hospital stay), as well as pathologic findings (stage, grade, margin status, and volume of rim of healthy renal parenchyma removed along with tumor), and short-term oncologic and functional outcomes in the cystic group were assessed and compared to those obtained in the matched counterparts who had undergone RPN for a solid renal masses during the same time period.

Matching of patients with solid and cystic tumors was done with a 1:1 ratio based on renal score (within 1), gender, and age (within 7 years) using the nearest neighbor-matching method. The R package was used for matching (R Development Core Team, www-r-project.org, accessed January 25, 2014).

Renal function was assessed by calculating the estimated glomerular filtration rate (eGFR) using the modification of diet in renal disease formula. Preservation of eGFR was defined as a ratio of postoperative glomerular filtration rate (GFR) (obtained at least 30 days after surgery) to preoperative GFR. Margin status was assessed by final pathologic evaluation. Volumes of tumor and partial nephrectomy specimen were calculated from pathology report using ellipsoid formula (0.5xyz).[9] Rim of unaffected renal parenchymal volume was calculated by deducting the volume of the tumor from the total volume of partial nephrectomy specimen (Fig. 1B). Postoperative complications were graded according to Clavien classification.[10]

For continuous data with normal distribution, variables were presented as mean ± standard deviation. The mean values are compared using the student *t* test. For variables with non-normal distribution, data is presented as median (interquartile range [IQR]) and the groups are compared using the Mann-Whitney *U* test. Categorical variables are compared using the chi-square test. Significance was set at $P < .05$. Analysis was performed using SPSS version 21 software (SPSS Statistics; IBM Corp, Armonk, NY).

RESULTS

Overall, 647 patients underwent RPN during the study period. Fifty-five patients with cystic masses (group 1) were matched with 55 patients with solid renal tumors (group 2). There was no difference in terms of age,