Laparoscopic Partial Nephrectomy for Completely Intraparenchymal Tumors

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Abbreviations and Acronyms

LPN = laparoscopic PN

PN = partial nephrectomy

RCC = renal cell carcinoma

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Purpose: Management for intraparenchymal renal tumors represents a technical challenge during laparoscopic partial nephrectomy since, unlike exophytic tumors, there are no external visual cues on the renal surface to guide tumor localization or excision. Also, hemostatic renorrhaphy and pelvicalyceal suture repair in these completely intrarenal tumors create additional challenges. We examined the safety and technical feasibility of this procedure in this cohort.

Materials and Methods: Of 800 patients who underwent laparoscopic partial nephrectomy 55 (6.9%) had completely intraparenchymal tumors. Technical steps included intraoperative ultrasound guidance of tumor resection, en bloc hilar clamping, cold excision of tumor and sutured renal reconstruction.

Results: Mean tumor size was 2.3 cm (range 1.0 to 4.5), mean blood loss was 236 cc (range 25 to 1,000) and mean warm ischemia time was 29.9 minutes (range 7 to 57). There were no positive margins. When we compared laparoscopic partial nephrectomy for intraparenchymal tumors to the same procedure in another 3 tumor groups, including completely exophytic tumors, tumors infiltrating up to sinus fat and tumors infiltrating but not up to sinus fat, there were no statistically significant differences among the groups in complications, positive margin rate, blood loss, or tumor excision or warm ischemia time.

Conclusions: Laparoscopic partial nephrectomy for completely intrarenal tumors is a technically advanced but effective, safe procedure. Facility and experience with the technique, effective use of intracorporeal laparoscopic ultrasound and adherence to sound surgical principles are the keys to success. Most recently we have performed laparoscopic and robotic partial nephrectomy for such completely intrarenal tumors using a zero ischemia technique.

Key Words: kidney; carcinoma, renal cell; laparoscopy; nephrectomy; ischemia

Since its inception[1] and with ever increasing use, LPN has continued its evolution to wide acceptance as treatment for appropriately selected, small renal tumors. The distinct advantages of the procedure are a superior patient recovery profile, and excellent cancer control and functional outcomes.[2,3] Reliable intracorporeal sutured parenchymal hemostasis and watertight pelvicalyceal system repair along with adjunctive use of biological hemostatic and sealant agents[4] makes feasible the excision of even deep, centrally located tumors.[5]

Despite such advances LPN remains a technical challenge that is

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usually reserved for centers of excellence. The rigors of warm ischemia, decreased tactile feedback and facility with intracorporeal suturing add to the many challenges of the procedure. However, our group and others have reported that other challenging anatomical situations are amenable to LPN, including hilar and central tumors.[6,7]

When performing LPN for a completely intraparenchymal tumor that is not visualized at all on the kidney surface, the lack of any external visual cues requires precise use of intraoperative ultrasound to guide margin negative resection. We report our series of completely intrarenal tumors treated with LPN. We examined the technical feasibility of this procedure.

MATERIALS AND METHODS

Via database analysis we retrospectively reviewed the records of all patients who underwent LPN from January 1, 2001 to April 1, 2009. Institutional review board approval was obtained before initiating the study. Upon review 55 patients were identified who underwent LPN for completely intraparenchymal tumors, as performed by 1 surgeon (ISG). Intraparenchymal tumors were defined as tumors with no exophytic component on preoperative radiological imaging and that were not laparoscopically visible on the kidney surface intraoperatively. Data were accrued from a prospectively maintained computerized database and from hospital charts.

The technical steps of this procedure include intraoperative ultrasound guidance of tumor resection, en bloc hilar clamping, cold excision of tumor and sutured renal reconstruction. Our technique was previously described in detail.[4] Briefly, an open ended ureteral catheter attached to a syringe filled with dilute indigo carmine is placed under direct cystoscopic vision to facilitate intraoperative recognition of collecting system entry. A transperitoneal or a retroperitoneal approach is used depending on tumor site. Some posterior tumors are approached retroperitoneoscopically while most other tumors are approached transperitoneally. Using a 4 or 5 port technique the ureter and gonadal vein are identified and traced to the hilar area. With the transperitoneal approach hilar vessels are not individually dissected but dissected en bloc and then clamped en bloc with a laparoscopic Satinsky clamp. With the retroperitoneal approach the renal artery and vein are dissected individually and controlled with laparoscopic bulldog clamps.

Tumor excision is accomplished in similar fashion regardless of approach. Under intracorporeal ultrasound guidance the tumor margins and the extent of parenchymal involvement are accurately delineated and the kidney capsule is scored to guide tumor resection with an adequate margin of normal parenchyma. A radiologist is not present for each case. Given our experience with intraoperative ultrasound, the presence of a radiologist is not mandatory. The tumor is excised with cold scissors. Hemostatic suturing is done in running fashion to control transected parenchymal vessels and pelvicalyceal reconstruction is performed with a running 3-zero polyglactin suture.

Dilute indigo carmine solution is injected retrograde to identify collecting system entry, allowing watertight suture closure. In certain cases a Surgicel® bolster is placed in the defect and fixed in place with interrupted No. 1 polyglactin sutures, which are tied over the top of the bolster. A biological hemostatic agent is applied between the bolster and the resection bed as an adjunctive hemostatic measure. The vascular clamp is removed, and hemostasis and global kidney perfusion are confirmed. A suction drain is placed in transperitoneal cases and a Penrose drain is placed in retroperitoneal cases.

Statistical analysis was done to compare the intraparenchymal cohort with another 3 cohorts in which LPN was performed, including completely exophytic tumors, tumors infiltrating but not up to sinus fat and tumors infiltrating up to sinus fat (figs. 1 and 2). The groups were then compared on key outcome indexes, including intraoperative, postoperative and late complications, surgical margin status, warm ischemia and tumor excision time, blood units transfused and blood loss.

For discrete binary outcomes marginal association between tumor types and outcomes were tested by chi-square or Fisher exact statistics. Conditional associations were tested by Cox-Mantel-Haenszel statistics for matched tumor size. Logistic regression was used to adjust for additional covariates. For continuous outcomes the marginal effects of LPN on different tumor types were tested by ANOVA. Additional covariates were adjusted for on linear regression.

RESULTS

Of the 800 patients whom we identified 55 (6.9%), including 32 men (58%) and 23 women (42%), had a completely intraparenchymal tumor. At baseline mean body mass index was 28 kg/m^2 (range 19 to 42.8) and median American Society of Anesthesiologists score was 2 (range 1 to 4). Mean age was 57.8

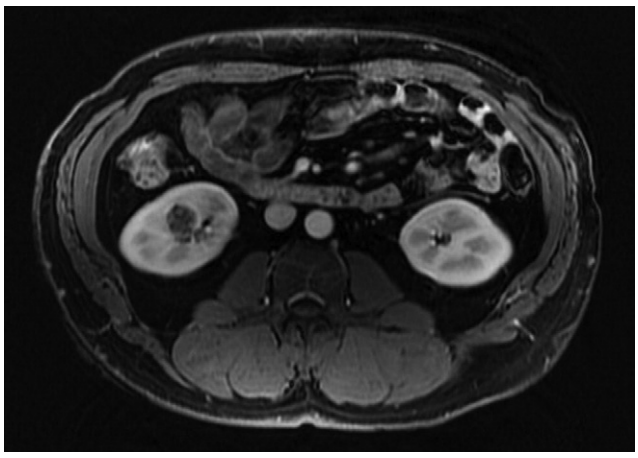

Figure 1. Computerized tomography shows representative completely intraparenchymal right renal tumor.