Robot Assisted Laparoscopic Partial Nephrectomy: Initial Experience

Robert P. Caruso, Courtney K. Phillips, Eric Kau, Samir S. Taneja* and Michael D. Stifelman†,‡

From the Department of Urology, New York University School of Medicine, New York, New York

Purpose: Advances in laparoscopy have made laparoscopic partial nephrectomy a technically feasible procedure but it remains challenging to even experienced laparoscopists. We hypothesized that robotic assisted laparoscopic partial nephrectomy may make this procedure more efficacious than the standard laparoscopic approach.

Materials and Methods: Ten patients with a mean age of 58 years and mean tumor size of 2.0 cm underwent robotic assisted laparoscopic partial nephrectomy and another 10 with a mean age of 61 years and mean tumor size of 2.18 cm underwent laparoscopic partial nephrectomy, as performed by a team of 2 surgeons (MS and ST) between May 2002 and January 2004. Demographic data, intraoperative parameters and postoperative data were compared between the 2 groups.

Results: There were no significant differences in patient demographics between the 2 groups. Intraoperative data and postoperative outcomes were statistically similar. In the 10 patients who underwent robotic assisted laparoscopic partial nephrectomy there were 2 intraoperative complications. There was 1 conversion in the laparoscopic partial nephrectomy group.

Conclusions: Robotic assisted laparoscopic partial nephrectomy is a safe and feasible procedure in patients with small exophytic masses. The robotic approach to laparoscopic partial nephrectomy does not offer any clinical advantage over conventional laparoscopic nephrectomy.

Key Words: kidney, nephrectomy, laparoscopy, robotics

Advances in laparoscopic surgery have made LPN a technically feasible procedure. Although patients with exophytic renal masses less than 4 cm are ideal candidates for LPN, select patients with larger, more endophytic tumors may be considered for LPN, especially in the setting of suboptimal renal function, a solitary kidney, bilateral tumors or a genetic predisposition to renal tumors.[1,2]

The largest obstacle to the widespread use of LPN is the technical difficulty involved. Tumor excision, hemostasis and reconstruction of collecting system defects involve a significant amount of intracorporeal suturing, which is time-consuming for even experienced laparoscopists. In cases that require renal artery clamping ischemic time becomes an even more significant factor.

The da Vinci® surgical system, which was Food and Drug Administration approved in 2000, has been used to perform radical prostatectomy, pyeloplasty, simple and donor nephrectomy, and recipient renal hilar anastomosis.[3–5] Advantages of the robot are 3-dimensional stereoscopic optics, computer elimination of tremor, 6 degrees of instrument wrist motion and scaled down movement. Theoretically these differences allow more precision in a smaller operative field and they are particularly useful in procedures that involve extensive suturing.

We have previously reported our technique and our RALPN series[6] but had not yet examined whether this approach was superior to standard laparoscopy. Given these purported advantages, we hypothesized that this approach may facilitate excision, hemostasis and reconstruction, thereby decreasing operative time, blood loss and ischemic time. Before this study we performed more than 50 standard LPNs and multiple urological procedures with the da Vinci® system, including dismembered pyeloplasty, cyst marsupialization and radical nephrectomy.

MATERIALS AND METHODS

Ten consecutive patients underwent RALPN from May 2002 to October 2003, as performed by the same team of 2 surgeons (MS and ST). Trocars were placed in a standard configuration with adjustments made for tumor location. The technique has been described previously.[6]

Briefly, standard laparoscopy was used to mobilize the kidney, isolate the hilum and expose the tumor capsule. The robot was then secured. The primary surgeon unscrubbed and sat at the robotic console, while the side surgeon performed the necessary tasks at the table. The finger of a cut glove was used to place and store fibrin soaked Gelfoam® and Surgicel® bolsters in the abdomen until they were needed after tumor excision. A laparoscopic ultrasound probe was used to define the deep and lateral tumor margins. The renal capsule was scored, leaving a 1 cm margin around the tumor. Mannitol (12.5 gm) was administered intravenously before clamping. No attempt was made to cool the kidney and the hilar vessels were occluded by the side surgeon with a laparoscopic bulldog clamp. The console surgeon then excised the tumor with the robotic endoscopic

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† Correspondence: Department of Urology, New York University School of Medicine, 150 East 32nd St., Suite 2, New York, New York 10016 (telephone: 646-825-6325; FAX: 646-825-6397; e-mail: Michael.Stifelman@msnyuhealth.org).

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shears and a Maryland bipolar device, while the side surgeon provided exposure and suction. Excision depth depended on visual cues and frozen sections from the resection base. After excision the tumor was placed beside the kidney or on top of the liver for later retrieval.

The right and left robotic arms were then exchanged for needle drivers. The side surgeon passed in 2-zero polyglactin sutures on CT-1 needles, which were used to ligate large perforating vessels and close collecting system defects. The base of the defect was cauterized with a TissueLink™ hook electrode and packed with a fibrin soaked Gelfoam® plug. The sterile side surgeon then activated the fibrin glue with thrombin injected percutaneously through a spinal needle. Surgicel® bolsters were placed in the defect and 2 or more 2-zero polyglactin mattress sutures on CT-1 needles were used to reapproximate the renal capsule. The kidney was placed back on stretch and the vascular bulldog clamp was removed. After hemostasis was confirmed the specimen was retrieved. A Jackson-Pratt drain was placed, all trocars were removed and the incisions were closed.

In all patients demographic, historical, intraoperative, postoperative and pathological data were recorded. These data were compared to data on 10 consecutive patients who underwent standard LPN without the robot. These surgeries were also performed by the same team of 2 surgeons from March 2003 to January 2004 using the same steps outlined. The Mann-Whitney U test for numerical variables and the chi-square test for nominal variables were performed to determine whether there were any statistically significant differences between the 2 groups in the mentioned parameters.

RESULTS

Ten patients underwent RALPN and another 10 underwent LPN. The table lists preoperative characteristics in the 2 groups. There were no significant differences between the 2 groups in patient age, American Society of Anesthesiologists class, body mass index, mean lesion size, location, and preoperative hematocrit and creatinine.

The table also lists intraoperative and postoperative data. There were no statistically significant differences in operative time, ischemic time, EBL, hospital stay, change in creatinine and change in hematocrit between the 2 groups.

Preoperative characteristics, intraoperative parameters and postoperative outcomes in patients with RALPN and LPN

	RALPN	LPN	p Value
No. pts	10	10	
Av age	58	61	0.84
Av American Society of Anesthesiologists class	2.1	2.6	0.19
Av body mass index	28.1	28.5	0.95
Av lesion size (cm)	1.95	2.18	0.46
No. tumor pole position:			0.46
Lower	4	5	
Mid	3	1	
Upper	3	4	
Av preop creatinine (mg/dl)	0.97	1.07	0.54
Av preop hematocrit (ml/dl)	43.2	41.0	0.12
Av operative time (mins)	279	253	0.11
Av ischemic time (mins)	26.4	29.3	0.24
Av EBL (cc)	240	200	0.90
Av discharge creatinine (mg/dl)	1.05	1.06	0.90
Av discharge hematocrit (ml/dl)	36.3	34.2	0.16
Av stay (days)	2.60	2.65	0.89

There were no cases of postoperative renal insufficiency and no patients in either group required blood transfusion.

There were 2 intraoperative complications in the RALPN group. In 1 case bleeding after removal of the vascular clamps necessitated conversion to a hand assisted approach. EBL was 300 cc and postoperative hematocrit was 31.7 ml/dl. In the other case back bleeding and poor visualization required conversion to an open procedure. EBL was 500 cc and postoperative hematocrit was 34 ml/dl. In the LPN group there was 1 conversion to open surgery for excessive back bleeding. Hospital stay in these 3 patients was not negatively impacted (2, 3 and 2 days, respectively). Only 1 patient in the entire series received blood transfusion. In this woman anemia did not result from LPN (EBL was 50 cc) but from transabdominal hysterectomy, which was performed after our procedure.

Postoperative complications were urinary retention in 1 patient who underwent RALPN, prolonging hospital stay by 1 day, and colonic pseudo-obstruction in 1 patient with LPN who had a history of 3 idiopathic episodes of partial bowel obstruction. This patient required treatment with neostigmine, colonoscopy and a multi-agent bowel regimen, prolonging hospital stay to 6 days.

Pathological examination of the excised lesions and frozen sections of the deep margins were performed in all cases. In the RALPN group 5 patients had clear cell RCC, 3 had chromophobe RCC, 1 had leiomyomatous angiomyolipoma and 1 had oncocytoma for an 80% malignancy rate. All margins were negative. In the LPN group 4 patients had clear cell RCC, 3 had oncocytoma, 2 had leiomyomatous angiomyolipoma, 1 had papillary RCC and 1 had inflammatory renal dysplasia for a 50% malignancy rate. Additionally, 1 oncocytoma in the LPN group had a negative margin intraoperatively but was found to have a positive margin on formal pathological review of the entire specimen.

DISCUSSION

In the last 20 years 2 techniques have revolutionized the treatment of renal masses, including laparoscopic radical nephrectomy and NSS. Laparoscopic radical nephrectomy was first described in 1991 by Clayman et al.[7] Although this first procedure required almost 7 hours, significant improvements in experience, technique and instrumentation have dramatically decreased operative time. Even in its earliest incarnations laparoscopic nephrectomy resulted in significantly decreased hospital stay, recovery time and pain medicine requirements.[8] These improved outcomes have remained durable.[9] Today the surgery can be performed in 2 hours with as few as 3 port sites,[9,10] markedly decreasing blood loss and complications rates. Laparoscopic radical nephrectomy is now the standard of care for all except a few advanced or extremely large renal masses.

After the advent of laparoscopic radical nephrectomy the oncological efficacy of NSS was demonstrated.[7] In 1890 NSS was first described[11] but the morbidity of the procedure limited its practical application. Since then, advances in renal hypothermia, imaging and hemostasis have permitted its widespread application and several series have demonstrated disease specific survival and recurrence rates similar to those of radical nephrectomy.[12,13] Most contemporary series have demonstrated disease specific survival rates of greater than 90% with recurrence rates of less than 5%.[14–17]