

TRENDS IN NEPHRON-SPARING SURGERY FOR RENAL NEOPLASIA

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ABSTRACT

Objectives. To determine the extent that laparoscopy has replaced open surgery for nephron-sparing surgery in a mature laparoscopic environment.

Methods. The records of all patients at Washington University who underwent nephron-sparing surgery for localized renal masses from 1999 to 2003 were examined for clinical and pathologic information. Information regarding the mass size, surgery type performed, and surgeon training was obtained.

Results. A total of 271 patients underwent nephron-sparing surgery from January 1999 to December 2003. During the study period, the total number of partial nephrectomies increased from 33 per year to 91 per year. The proportion of laparoscopic partial nephrectomy increased from 3% of total cases to 56% of total cases. Open partial nephrectomy decreased from 97% of cases to 24% of cases; however, the absolute number of open partial nephrectomies only decreased from 32 to 22 per year. Laparoscopic cryoablation increased from 0% of cases to 20% of cases. Endourologists increased their frequency of performing open partial nephrectomy, and oncologists increased their frequency of performing laparoscopic renal surgery.

Conclusions. Laparoscopic nephron-sparing surgery has not completely replaced open partial nephrectomy for low-stage renal neoplasia; however, the number of laparoscopic partial nephrectomies has increased rapidly in recent years. Laparoscopic approaches are being performed by all urologists treating renal malignancies at our institution and this reflects changes in the surgical treatment of renal cancer. UROLOGY 68: 732–736, 2006. © 2006 Elsevier Inc.

The management of renal carcinoma has evolved dramatically during the past 15 years with the increased use of laparoscopic and nephron-sparing approaches to treat renal neoplasms. Laparoscopic radical nephrectomy is replacing open radical nephrectomy for the management of renal neoplasia.^{1–3} Importantly, laparoscopic nephrectomy has been widely accepted in the community and is no longer performed solely at high-volume surgical centers.⁴ Open partial nephrectomy (OPN) has also expanded its role. Although, in previous years, it was reserved for patients with compromised renal function or multifocal masses, it has recently been accepted as an alternative to open radical nephrectomy in the elective setting.^{5–7}

Given the rapid technological advances in laparoscopy, coupled with increased experience of laparoscopic surgeons, it is not surprising that laparoscopic nephron-sparing surgery has evolved into a reasonable approach for the treatment of a renal mass. Although the convalescence benefits related to smaller incisions likely mirror that of laparoscopic radical nephrectomy, laparoscopic partial nephrectomy (LPN) is significantly more technically advanced and often requires complex laparoscopic reconstruction.⁸ As a result, ablative techniques, such as laparoscopic cryoablation, have emerged as less technically demanding techniques with promising initial results.^{9,10}

For a new technique to have the greatest impact on patient care, it is critical that its use moves beyond the pioneers, to include all urologists who routinely manage renal carcinoma. We have previously demonstrated that laparoscopic nephrectomy is now performed at our institution by all urologists who manage renal masses.¹ We examined the trends in nephron-sparing surgery to de-

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TABLE I. Changes in frequency of open partial nephrectomy, laparoscopic partial nephrectomy, and laparoscopic cryoablation during 5-year period

Year	OPN	LPN	Cryoablation	Total Cases (n)
1999	32 (97.0)	1 (3.0)	0 (0)	33
2000	31 (83.8)	2 (5.4)	4 (10.8)	37
2001	18 (48.6)	10 (27.0)	9 (24.3)	37
2002	15 (20.5)	40 (54.8)	18 (24.7)	73
2003	22 (24.2)	51 (56.0)	18 (19.8)	91

KEY: OPN = open partial nephrectomy; LPN = laparoscopic partial nephrectomy.
Data in parentheses are percentages.

TABLE II. Mean tumor size for patients undergoing open partial nephrectomy, laparoscopic partial nephrectomy, and laparoscopic cryoablation

Year	OPN		LPN		Cryoablation	
	Mean Tumor Size (cm)	Size Range (cm)	Mean Tumor Size (cm)	Size Range (cm)	Mean Tumor Size (cm)	Size Range (cm)
1999	3.8	1.5–9.0	2	2	—	—
2000	3.3	0.8–17.0	3	2.8–3.2	3	2.8–4
2001	3.35	1.5–6.5	2.19	1.1–3.2	2.38	1.3–3.5
2002	3.37	2.0–8.3	2.67	0.7–9.0	2.22	1.5–3.3
2003	3.86	1.2–9.0	2.76	1.1–6.5	2.86	2–4

Abbreviations as in Table I.

termine the extent that laparoscopic nephron-sparing procedures have replaced OPN.

MATERIAL AND METHODS

After obtaining institutional board approval, we retrospectively reviewed the clinical and pathologic data of 271 patients who underwent OPN, LPN, or cryoablation from January 1999 to December 2003 at a tertiary care academic medical center. Wedge resections were classified as partial nephrectomies. All patients who underwent nephroureterectomy for transitional carcinoma were excluded from the analysis. Renal tumor size criteria were based on the maximal dimension on the imaging study performed. The surgical approach chosen was based on a discussion between the patient and surgeon. The choice between competing techniques was left to the patient after counseling on risks, benefits, and alternatives. No percutaneous renal ablations were performed in the period.

RESULTS

A total of 271 patients had a renal neoplasm on cross-sectional imaging amenable to partial nephrectomy or cryoablation. Renal cell carcinoma was suspected in all cases. Of the 271 patients, 118, 104, and 49 patients underwent OPN, LPN, and cryoablation of a renal tumor, respectively.

SURGICAL PROCEDURES

Table I reflects the changes in frequency of each procedure during the 5-year interval. The total number of nephron-sparing operations increased from 33 in 1999 to 91 in 2003. The percentage of LPNs increased to 56% from 3%, and the percent-

age of laparoscopic cryoablations increased from 0% to 20% during the 5-year period. Although in 1999, only one laparoscopic nephron-sparing procedure was performed, the technique was rapidly adopted. By 2001, the number of laparoscopic procedures exceeded that of open procedures, and by 2002, the number of LPNs exceeded the number of OPNs at any time during the period studied.

SURGICAL APPROACH BY TUMOR SIZE

Table II lists the mean tumor size for each approach. Overall, OPN has been performed for larger size tumors than LPN; however, size was not an absolute criterion determining the approach. By 2002, LPN was performed for selected patients with masses larger than 4 cm. Laparoscopic cryoablation has been limited to tumors less than 4 cm in size.

SURGICAL APPROACH BY UROLOGIC SPECIALTY

Figure 1 shows the trends during the 4-year interval by surgeon type. As shown in Figure 1A, the oncologists performed 75% of the OPNs initially. During the 5 years, this percentage declined. As the endourologists starting doing more LPNs, only 50% of the open cases were performed by oncologists. Importantly, the absolute number of partial nephrectomies did not decline, but initially remained stable and then increased as patients were more receptive to the laparoscopic approach.

Figure 1B shows the changes in the laparoscopic procedure. Initially, only the endourologists per-

COMMENT

The results of this study have clearly shown that a shift has occurred in the method of performing nephron-sparing surgery since 1999 at a major academic tertiary care medical center. Similar to our previous report on radical nephrectomy,¹ the laparoscopic approach has become a popular method for performing nephron-sparing surgery.

The goal of this study was to assess the role of nephron-sparing surgery in a current academic urologic practice. In 2003, we submitted our results illustrating the rapid increase in the role of laparoscopic surgery in renal neoplasia.¹ The study illustrated the growth of laparoscopic nephrectomy between 1997 and 2001, and its role as the standard of care in Stage T1 and T2 renal neoplasia. That study demonstrated that laparoscopic radical nephrectomy had replaced open radical nephrectomy at our institution for Stage T1 and T2 disease. In addition, laparoscopic approaches accounted for approximately 50% of nephron-sparing procedures. Our present data have shown that in 2 years, technology has changed the scope of management even more dramatically. LPN has been expanded to larger lesions and cryoablation fills a niche for lesions less than 4 cm in selected patients.

Despite the widely accepted use of laparoscopic radical nephrectomy, we believe that the role of nephron-sparing surgery has not been compromised. Our data, similar to those of Gill *et al.*,⁸ show that minimally invasive approaches have been expanded and, in practice, often replicate the open technique. If laparoscopic radical nephrectomy were to be performed in patients amenable to partial nephrectomy, we would expect the number of nephron-sparing procedures to decline. Instead, we found that with the minimally invasive approach, our nephron-sparing surgery rate actually increased. The number of LPNs in both 2002 and 2003 vastly exceeded the number of OPNs done in any of the years studied.

The relatively high rate of laparoscopic approaches at our institution could be attributed to several factors. First, patients with smaller lesions, which might be managed with observation and serial imaging, may have elected to undergo a minimally invasive procedure because of the reduced morbidity. This is supported by the fact that the LPN lesions were smaller lesions than were the OPN lesions. Second, because our institution is a laparoscopic referral center, those cases amenable to partial nephrectomy were referred by outside clinicians to our institution for management. These trends are possible reasons, but difficult to quantify retrospectively.

An important finding of our study was the rapidity with which the technique was adopted by en-

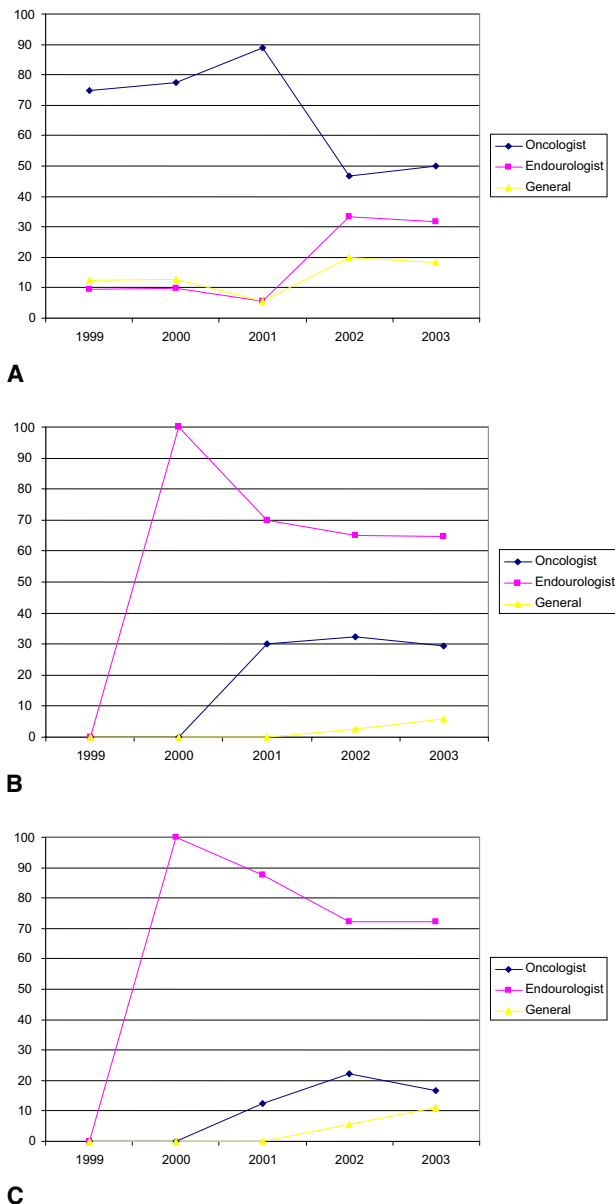


FIGURE 1. Changes in frequency of procedures stratified by training of surgeon. (A) OPN, (B) LPN, and (C) cryotherapy.

formed the LPN. However, by the end of the interval, oncologists and general urologists had increased their proportion to a total of 35% of cases. Importantly, the absolute number of LPNs increased steadily in each group.

Finally, Figure 1C displays the changes in cryotherapy. Similar to the laparoscopic approach, all cases initially performed were done by endourologists. However, during the 4-year period, the oncologists and general urologists started to perform more of the procedures. The absolute number of cryoablations has remained stable in each group during the past few years. This reflects increased use of LPN, rather than dissatisfaction with this technique.

dourologists and then quickly disseminated to other urologic specialists at our institution. About 5 years ago, almost all the partial nephrectomies were performed by oncologists or general urologists on staff. By the end of the 4-year interval, the oncologists performed 50% of OPNs and 30% of LPNs, clearly demonstrating a shift toward the minimally invasive approach. Moreover, our data have shown that it was the endourologists who led the changes in minimally invasive approaches to renal masses and continued to perform the surgery in high volumes, because they are the most experienced with the technique.

Ultimately, however, the distinction between an “oncologist” and a “minimally invasive surgeon” has been blurred at our institution. Just as oncologists picked up LPN, endourologists also exhibited an increase in OPN (Fig. 1). Currently, in 2006, subspecialists in both oncology and laparoscopy have received adequate specialized training in open and laparoscopic renal surgery through residencies, fellowships, and mentoring relationships, and both groups proficiently perform the spectrum of open and laparoscopic renal surgery. To further clarify the issue of training, the endourologists received training in OPN during residency and the oncologists received training in laparoscopy through mentoring relationships with the endourologists. However, a direct comparison of outcomes between the two groups would be difficult because complex OPNs were generally referred to surgical oncologists and complex laparoscopic procedures were referred to the endourologists. This prevented a meaningful comparison.

Despite the increased use of laparoscopic nephron-sparing surgery, OPN has maintained an important presence at our institution. For certain tumors and certain clinical situations, the open approach may be preferred. There are no absolute indications for OPN versus LPN; however, several subjective and objective distinctions influence the surgical approach. Tumor size, tumor location, history of previous surgeries, body habitus, tolerance of pneumoperitoneum, and availability of specialized equipment may play a role in the decision to perform a laparoscopic or an open approach. In addition, because difficulty achieving a negative margin or controlling bleeding during LPN often results in radical nephrectomy, only the most experienced surgeons should perform LPN in a patient with poor renal function or a solitary kidney.

The issue of patient choice in determining treatment cannot be underestimated. The exact indications for LPN, cryoablation, or open nephron-sparing surgery cannot be based on randomized studies, because none currently exist. Some academic debate is still ongoing on whether LPN of-

fers similar long-term oncologic control and renal function as OPN. A similar debate exists on the efficacy of cryoablation.^{9,10} Our approach has been to offer the treatments that are feasible, have an educated discussion on the risks and benefits of all approaches, and allow the patient to decide among the options.

The academic practice model at our institution may serve as a model for the practicing community urologist and academic renal surgeon. The ability to offer all aspects of renal surgical care (both laparoscopic and open) on an institutional and individual basis may be an excellent model for future renal surgeons. Although educational challenges remain for existing practitioners, recent trainees from our institution have been adequately exposed and trained in the complexities of both open and laparoscopic nephron-sparing approaches and likely do not need fellowship training to perform routine procedures. In such a model, the incidence of nephron-sparing approaches does not suffer at the hands of laparoscopy, and conversely, the patients benefit when laparoscopic excision is indicated in feasible cases. Overall, nephron-sparing surgery continues its expansion at our institution, and the trend for renal preservation will likely continue as surgeons offer all techniques. Additional studies are needed to assess the indications and outcomes of the various techniques.

CONCLUSIONS

This retrospective study tracked the changes in nephron-sparing approaches in an academic urologic practice. With dissemination of new laparoscopic surgical techniques throughout all physicians in the practice, OPN has been decreasing in frequency and minimally invasive approaches have increased. This model, which has also been taught to trainees, allows surgeons to offer a complete array of options for patients undergoing renal surgery.

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