

# SURGICAL TREATMENT OF RENAL NEOPLASIA: EVOLVING TOWARD A LAPAROSCOPIC STANDARD OF CARE

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## ABSTRACT

**Objectives.** To determine the extent to which laparoscopy has replaced open surgery for renal malignancy.

**Methods.** The records of all 537 patients at Washington University who underwent surgery for localized renal malignancies from January 1997 to December 2001 were examined for clinical and pathologic information.

**Results.** The total procedures per year increased from 1997 to 2001, but the distribution of pathologic stages throughout the 5 years was similar. In 1997, laparoscopic approaches were used in 15% of cases; this increased to 65% by 2001. Nephron-sparing surgery (NSS) was used in 31% to 42% of patients yearly, but laparoscopic NSS increased in frequency. By 2001, only 3.3% of T1 tumors were removed by open radical nephrectomy compared with 55% treated by laparoscopic nephrectomy. The rest of the T1 tumors in 2001 were treated by open partial nephrectomy (20.2%) or laparoscopic NSS (21.3%). In 2001, 61% of T2 lesions were treated laparoscopically, an increase from 37% in 1997. Most open radical nephrectomies in 2001 were performed for T3 disease. The number of surgeons performing laparoscopic renal surgery has increased at our institution, from two in 1997, both endourologists, to eight in 2001, representing the entire urology faculty that treats renal cancer.

**Conclusions.** Laparoscopic radical nephrectomy has replaced open radical nephrectomy for low-stage renal neoplasia. Although laparoscopic NSS is increasing in frequency, it has not yet replaced open partial nephrectomy. At our institution, the laparoscopic approach has become the standard of care when radical nephrectomy is needed for T1 or T2 renal cancer. UROLOGY 62: 821–826, 2003. © 2003 Elsevier Inc.

The management of renal masses has undergone a rapid evolution during the past decade. Lesions that historically would have been treated with open radical nephrectomy are now routinely managed with nephron-sparing techniques and/or laparoscopy. Since pioneers in nephron-sparing surgery (NSS) and laparoscopy have demonstrated these operations' efficacy, these techniques are becoming increasingly popular and are being integrated into general practice.

In 1990, Clayman *et al.*<sup>1</sup> performed the first laparoscopic radical nephrectomy for a renal neoplasm. Since then, the laparoscopic approach to renal surgery has become increasingly popular, with surgeons reporting series of radical and simple nephrectomy, pyeloplasty, partial nephrectomy, nephropexy, pyelolithotomy, and donor nephrectomy.<sup>2–13</sup> The laparoscopic approach offers significant advantages over open renal surgery, including shorter hospital stay, shorter convalescence, less blood loss, and improved cosmesis.<sup>3,14</sup> Laparoscopic nephrectomy has traditionally been performed by endourologists who receive fellowship training in laparoscopy. Therefore, endourologists, rather than urologic oncologists have reported most large series of laparoscopic radical nephrectomy. However, as data have accumulated that laparoscopic radical nephrectomy offers similar survival rates to open approaches,<sup>2,4</sup> its application is spreading from the surgical armamentarium

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of laparoscopists to that of surgical oncologists and general urologists.

NSS has been shown to exert similar cancer control as radical nephrectomy for tumors less than 4 cm.<sup>15</sup> Although traditionally used as a modality of therapy when renal function is impaired, partial nephrectomy is now also used electively when the patient has a normal contralateral kidney. In this regard, endourologists have continued to refine the laparoscopic techniques for NSS to make minimally invasive procedures available.<sup>8,10</sup> Hand-assisted laparoscopy has also been used to facilitate laparoscopic partial nephrectomy.<sup>16</sup>

Our institution has seen a gradual trend away from routine open radical nephrectomy toward renal-sparing procedures and laparoscopy. The philosophy of our endourologic team has been that laparoscopy is a technique rather than a discipline. As such, it was the goal of our endourologists to teach laparoscopic surgery to urologic oncologists and general urologists. The goal of this study was to assess to what extent laparoscopy has replaced open surgery in the treatment of renal neoplasia on an institutional basis.

## MATERIAL AND METHODS

From January 1997 to December 2001, a total of 537 patients underwent a surgical procedure at Washington University for a renal mass suspicious for renal cell carcinoma (RCC). Patients undergoing nephroureterectomy for transitional cell carcinoma were excluded from this study. Open and laparoscopic wedge resections were classified as partial nephrectomies. The records of the 537 patients were retrospectively reviewed after receiving institutional review board approval and the clinical and pathologic data were obtained reflecting 1997 TNM renal carcinoma staging.<sup>17</sup> In all cases, the patient and treating physician together decided on the surgical approach on the basis of the patient's radiographic findings, comorbidities, renal function, and surgeon experience. Not all patients were offered every surgical approach; rather the approach was tailored to each case. No patients were offered radical nephrectomy if they had tumors amenable to partial nephrectomy and had pre-existing renal insufficiency.

## RESULTS

All 537 patients had a surgical lesion, defined as a suspicious renal mass by cross-sectional imaging. RCC was suspected in all cases, and thus radical nephrectomy, partial nephrectomy, or cryoablation was performed with an open or laparoscopic technique. Overall, 460 (86%) of 537 lesions were RCC, representing 80% to 89% of lesions on a year-by-year basis. Other pathologic entities were oncocytoma, angiomyolipoma, sarcoma, metastasis, and complex benign cysts.

### *SURGICAL PROCEDURES*

Table I summarizes the frequencies of each surgery by the year. Laparoscopic procedures ac-

counted for 16 (16%) of 99 procedures in 1997 and increased to 87 (65%) of 133 by 2001. Laparoscopic NSS (cryoablation and partial nephrectomy) slowly increased in frequency from 0 cases in 1997 to 20 cases by 2001. In 1999, hand-assisted nephrectomy was first performed at Washington University and accounted for 18 procedures by 2001.

### *SURGICAL APPROACH TO RADICAL NEPHRECTOMY BY STAGE*

Figure 1 demonstrates the change in the approach to radical nephrectomy by pathologic stage. For T1 lesions treated with radical nephrectomy, the open approach was used in 73% of cases in 1997; by 2001, it was only used in 6% of cases (Fig. 1A). For T2 lesions treated with radical nephrectomy, the laparoscopic approach steadily increased and in 2001 accounted for most cases (Fig. 1B). For T3a lesions, the open and laparoscopic approaches were used with similar frequency in 2001 (Fig. 1C). A yearly shift to the laparoscopic approach for all tumors has continued. The declines in the use of laparoscopy in 1998 and 1999 reflect that the busiest laparoscopist was on an academic sabbatical.

### *SURGICAL TREATMENT OF T1 LESIONS*

Studies have shown that small T1 renal lesions (4 cm or less) may be treated by open partial nephrectomy, with similar cancer control as by radical nephrectomy.<sup>15</sup> Thus, we chose to analyze the changes in the treatment of these renal lesions in two cohorts: T1 lesions 4 cm or less and T1 lesions 4 to 7 cm.

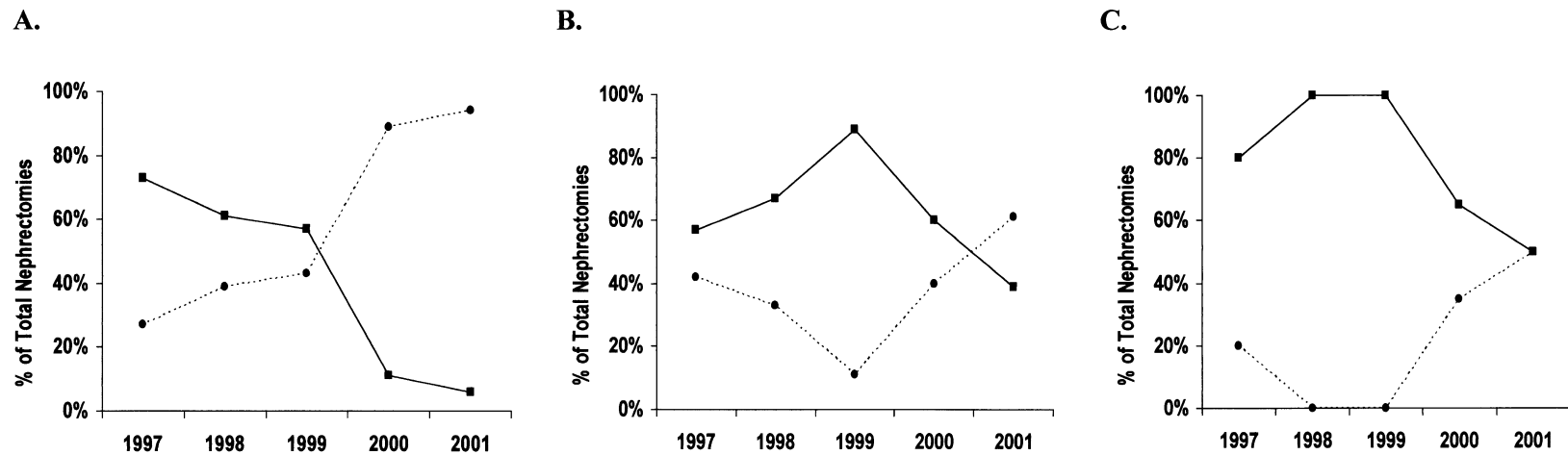
Table II shows the number of T1 lesions 4 cm or less treated with each modality by year. The percentage of patients who underwent radical nephrectomy remained relatively unchanged between 1997 (46%) and 2001 (38%). However, although almost all cases were performed by an open approach in 1997, radical nephrectomy was performed laparoscopically in nearly all the cases by 2001. NSS was used in 56% of small T1 lesions in 1997, always performed using an open approach. By 2001, NSS was used in 63% of these lesions, with laparoscopic and open approaches similarly represented. Conversions were excluded, and benign entities 4 cm or less were included in Table II.

Table III shows the treatment of T1 lesions greater than 4 cm (excluding conversions, and including benign entities 4 to 7 cm). In 1997, radical nephrectomy was used in 73% of these lesions, with the open approach used in 16 of 22 cases. By 2001, radical nephrectomy was used in 94% of these cases, with the laparoscopic approach used in

**TABLE I. Overview of surgical procedures performed for renal neoplasia at Washington University from 1997 to 2001**

Year	Total Surgeries for Renal Masses (n)	Open Radical Nephrectomy (n)	Open Partial Nephrectomy (n)	Open Partial Converted to Open Radical Nephrectomy (n)	Laparoscopic Transperitoneal Radical Nephrectomy (n)	Laparoscopic Retroperitoneal Radical Nephrectomy (n)	Hand-Assisted Laparoscopic Radical Nephrectomy (n)	Laparoscopic Converted to Open Radical Nephrectomy (n)	Laparoscopic Partial Nephrectomy (n)	Laparoscopic Cryoablation of Renal Mass (n)
1997	99	47 (47)	36 (36)	0 (0)	15 (15)	1 (1)	0 (0)	0 (0)	0 (0)	0 (0)
1998	83	41 (49)	24 (29)	0 (0)	16 (23)	0 (0)	0 (0)	0 (0)	2 (2)	0 (0)
1999	94	39 (41)	37 (39)	1 (1)	13 (14)	0 (0)	1 (1)	2 (2)	1 (1)	0 (0)
2000	128	31 (24)	35 (27)	10 (8)	34 (27)	3 (2)	4 (3)	2 (2)	5 (4)	4 (3)
2001	133	24 (18)	21 (16)	0 (0)	43 (32)	6 (5)	18 (14)	1 (1)	12 (10)	8 (6)

Numbers in parentheses are percentages.



**FIGURE 1. Evolution in treatment of renal masses by radical nephrectomy by stage. (A) T1 lesions treated with radical nephrectomy. (B) T2 lesions treated with radical nephrectomy. (C) T3a lesions treated with radical nephrectomy. Solid line indicates open approach; dotted line indicates laparoscopic approach.**

**TABLE II. Evaluation of T1 lesions  $\leq 4$  cm, by surgical approach\***

Year	Total Masses T1 $\leq 4$ cm (n)	Open Radical Nephrectomy (n)	Open Partial Nephrectomy (n)	Laparoscopic Radical Nephrectomy (n)	Laparoscopic Nephron-Sparing Surgery (n)
1997	41	14 (34)	22 (54)	5 (12)	0 (0)
1998	40	12 (30)	20 (50)	6 (15)	2 (5)
1999	48	9 (19)	29 (60)	9 (19)	1 (2)
2000	49	1 (2)	25 (51)	14 (29)	9 (18)
2001	57	1 (2)	16 (29)	20 (36)	20 (35)

Numbers in parentheses are percentages.

\* From 1997 to 2001, laparoscopic radical and partial nephrectomy were used with increasing frequency; percentage of patients who underwent nephron-sparing surgery was similar from 1997 to 2001.

**TABLE III. Surgical approach of T1 lesions  $>4$  cm\***

Year	Total Masses T1 4–7 cm (n)	Open Radical Nephrectomy (n)	Open Partial Nephrectomy (n)	Laparoscopic Radical Nephrectomy (n)	Laparoscopic Nephron-Sparing Surgery
1997	30	16 (53)	8 (27)	6 (20)	0 (0)
1998	23	13 (57)	2 (8)	8 (35)	0 (0)
1999	16	7 (44)	6 (38)	3 (19)	0 (0)
2000	29	3 (10)	9 (31)	17 (59)	0 (0)
2001	33	2 (6)	2 (6)	29 (88)	0 (0)

Numbers in parentheses are percentages.

\* These lesions were almost exclusively treated with laparoscopic radical nephrectomy in 2001.

88% of cases. Laparoscopic NSS has not yet been used to treat these lesions.

#### NEPHRON-SPARING SURGERY

NSS, either open or laparoscopic, was attempted in a relatively constant percentage of patients from 1997 to 2001 (Fig. 2). The type of NSS, however, has evolved. In 1997, all NSS was performed using an open approach, but by 2001, the cases were performed open or laparoscopically, with similar frequencies.

#### TRAINING OF SURGEONS

In 1997, all laparoscopic procedures were performed by two endourologists. By 2001, eight faculty members routinely performed laparoscopic radical nephrectomy, including two urologic oncologists, three general urologists, and three endourologists. Although the endourologists had extensive training in laparoscopic surgery, the urologic oncologists and general urologists were not fellowship trained in laparoscopy.

#### COMMENT

The major goal of this study was to assess the integration and impact of laparoscopic renal surgery on an academic practice. During the period studied (1997 to 2001), the treatment of renal tumors drastically changed, with laparoscopic ap-

proaches to renal neoplasia exceeding that of open approaches. If radical nephrectomy is currently desired for a T1 or T2 lesion, the laparoscopic approach is now the standard of care at our institution. The rare use of the open technique in selected cases reflects the technical hurdles to the use of laparoscopy in those cases.

Despite the large increase in laparoscopic radical nephrectomies at our institution, we believe that nephron-sparing approaches have not been compromised. For T1 lesions 4 cm or less, a near constant percentage of patients were treated with radical nephrectomy (~40%), but now it is performed almost exclusively laparoscopically. Therefore, the large increase in laparoscopic radical nephrectomy does not appear to be at the expense of partial nephrectomy for these small renal tumors. A valid concern is that some of these small tumors should have been managed with partial nephrectomy. However, in practice, size is not the only criteria for deciding on the surgical approach. Tumor location and patient preferences influence the choice of therapy. That the percentage of patients undergoing NSS remained constant is an indication that kidneys are not being removed inappropriately.

Improvements and experience in laparoscopic technique have made nephron-sparing approaches easier and as a result there has been a recent increase in the percentage of laparoscopic NSS per-

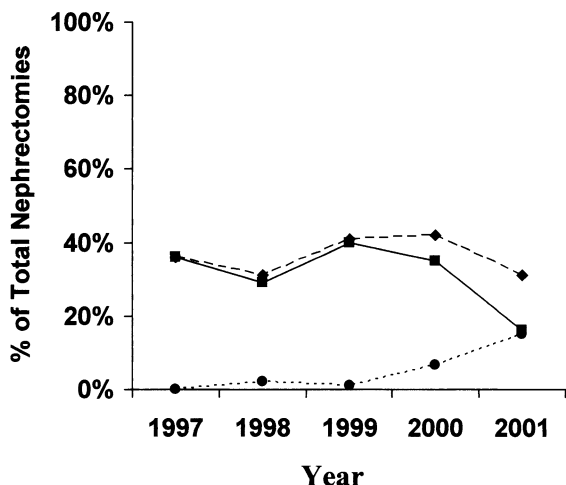


FIGURE 2. Evaluation of NSS attempts by year. NSS used in between 31% and 42% of cases at Washington University, but frequency of laparoscopic and open NSS changed markedly from 1997 to 2001, with laparoscopic approaches gradually replacing open. Dashed line indicates total NSS; solid line indicates open approach; dotted line indicates laparoscopic approach.

formed. By 2001, one half of the nephron-sparing approaches were performed laparoscopically. We suspect that this number will continue to increase as our staff becomes more comfortable with laparoscopic partial nephrectomy. Additionally, although no laparoscopic nephron-sparing approaches were used in tumors greater than 4 cm at our institution, other groups have performed these procedures successfully.<sup>10</sup> Other minimally invasive treatment options also exist for the small renal lesion. Laparoscopic cryoablation is being used in highly selected patients at many institutions, and the initial data have been promising.<sup>18</sup> Open partial nephrectomy continues to be used for relatively large masses, central tumors, or in cases in which cold ischemia is paramount. In these situations, the laparoscopic approach remains technically challenging.

Larger renal lesions are also being treated with laparoscopic radical nephrectomy. We have performed laparoscopic radical nephrectomy on tumors as large as 15 cm, and we have performed a subhepatic vena cava tumor thrombectomy.<sup>19</sup> Although we do not believe that large tumors are a contraindication to the laparoscopic approach, in practice, many of the larger tumors are still being approached through open incisions. In part, this is not just because of the size of the tumor, but also because of concerns of vascular involvement and growth into contiguous organs.

The accelerated popularity of laparoscopy has been associated with a major paradigm shift with regard to who is performing laparoscopic nephrectomy at our institution. From 1990 to 1998, the

procedure was limited to the surgical repertoire of the endourologists. However, after numerous published reports outlining the efficacy of the technique and the obvious decreased morbidity of laparoscopy,<sup>2-4,7,14,16</sup> general urologists and urologic oncologists began to accept, learn, and then routinely perform the procedure at our institution. In our opinion, this paradigm shift is particularly significant, because laparoscopy should be viewed as a technique rather than a discipline. As such, it can and should be learned by all urologists so that urologic oncologists, pediatric urologists, general urologists, and urologists treating voiding dysfunction may offer laparoscopic versions of their standard urologic procedures to their patients.

## CONCLUSIONS

Laparoscopic approaches to renal malignancies are gradually replacing open procedures for the treatment of low-stage renal tumors. Appropriate tumors continue to be treated with open NSS; however, laparoscopic NSS is increasing in frequency. If radical nephrectomy is desired, laparoscopic radical nephrectomy is now the standard of care for the treatment of low-stage renal neoplasia at our institution. As such, all urologists managing RCC at our institution now perform it. We anticipate similar changes in practice patterns will occur throughout the United States.

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