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Laparoscopic Nephrectomy Is Cost Effective Compared With Open Nephrectomy in a Large County Hospital

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ABSTRACT

Background and Objectives: To evaluate the experience with laparoscopic nephrectomy in a large county hospital and perform a cost comparison between uncomplicated open and laparoscopic nephrectomy.

Methods: Eleven consecutive patients who underwent an uncomplicated laparoscopic nephrectomy in a large county hospital were compared with 8 patients who underwent uncomplicated open nephrectomy during the same period. Patient charts and corresponding billing records were reviewed to determine overall hospitalization cost and individual cost components.

Results: No perioperative complications occurred in either the laparoscopic or open group, and no statistically significant differences existed between groups with regard to patient demographics or operative parameters. The overall operating room costs favored the open nephrectomy group by $1070 ($P$=0.003). However, the overall cost of hospitalization, surgeon professional fees, duration of hospitalization, room and board costs, laboratory, and radiology costs, pharmacy costs, intravenous solution and infusion pump costs all significantly favored the laparoscopic patient group. The mean difference in overall hospital cost between laparoscopic and open nephrectomy was $1211 in favor of laparoscopy (P=0.037).

Conclusions: Our experience with laparoscopic nephrectomy in a large county hospital demonstrates a clear economic advantage in favor of the laparoscopic approach. Given limited funding for public hospitals and a clear patient benefit, laparoscopic nephrectomy should constitute first-line therapy when nephrectomy is indicated.

Key Words: Laparoscopic nephrectomy, Cost comparison.

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INTRODUCTION

Since 1990 when Clayman and colleagues first performed a laparoscopic nephrectomy for a 3-cm oncocytoma,[1] published series have confirmed the feasibility and safety of performing the procedure for benign and malignant lesions.[2-11] The laparoscopic approach has been associated with a shorter length of hospital stay, decreased requirements for pain medication and quicker recovery in the postoperative period.[2,3,6,8,9] Despite these advantages, however, most centers have reported higher costs for the laparoscopic approach due to longer operative times and use of nonreusable equipment.[2,9,10]

Fiscal responsibility is mandatory in today's health-care environment, particularly at publicly funded institutions. We performed a cost comparison between consecutive cases of uncomplicated open and laparoscopic nephrectomy at a large metropolitan county hospital and assessed the individual cost centers to identify areas in which we could increase the cost efficiency of the laparoscopic approach.

MATERIALS AND METHODS

Eleven consecutive patients who underwent an uncomplicated laparoscopic nephrectomy in a large county hospital were compared with 8 patients who underwent uncomplicated open nephrectomy during the same period. None of these patients had a perioperative complication. Patient characteristics and intraoperative parameters were obtained including age, American Society of Anesthesiologists (ASA) class, specimen dimensions, tumor size, surgery duration (time of first incision to surgery end time), estimated blood loss (EBL), and complications. Patient charts and billing records were then reviewed to determine the total hospitalization cost for the procedure, taking into account individual cost centers, hospital stay, and professional fees. Cost centers included operating room, surgical supplies, room and board, pharmacy, intravenous fluids, laboratory, radiology, and infusion pump fees. The information obtained for each case was based on hospital cost and not charge data.

Statistical analyses were performed with the Student t test and the Mann-Whitney test when applicable. Statistical

significance was assumed for $P<0.05$.

All laparoscopic procedures were supervised by 1 surgeon (J.A.C) with urology residents as the primary surgeons. Regardless of presumed pathology (benign vs malignant), all patients underwent a radical nephrectomy dissection. A transperitoneal laparoscopic approach was used exclusively. Patients with a solid renal lesion underwent intact specimen removal, whereas patients with presumed benign renal disease underwent specimen morcellation.

The technique of transperitoneal laparoscopic nephrectomy has been previously described.[12] Typically, a 3- or 4-port approach was used: one 12-mm trocar was placed at the umbilicus, one 12-mm port 2 fingerbreadths above and medial to the anterior superior iliac spine, and one 5-mm port in the midline between the xiphoid process and the umbilicus. Occasionally, a 5-mm upper midline port was placed to facilitate liver retraction. Surgical specimens were removed with a laparoscopic sack. For intact specimen removal, the umbilical port incision was extended. For specimen morcellation, a ringed-forceps or Kelly clamp was used to extract the specimen piecemeal through the umbilical port.

The laparoscopic procedure included the use of disposable instruments including 12-mm trocars, Veress needle, 5-mm clip appliers, suction-irrigator, endo GIA, and laparoscopic sack. All other instruments were reusable.

Open nephrectomy was performed with a variety of incisions (flank incision=6, subcostal incision=2). These operations were similarly supervised by staff urologists with urology residents as the primary surgeon.

RESULTS

The laparoscopic and open nephrectomy groups were comparable with regard to patient characteristics and operative parameters **(Tables 1 and 2)**. No intraoperative or postoperative complications occurred in either group. For patients with malignant disease, surgical margins were negative in both groups.

Table 3 compares the overall cost and individual cost centers for the 2 groups. The overall cost, surgeon professional fees, length of stay, room and board costs, laboratory and radiology costs, pharmacy and intravenous solution and infusion pump fees all favored the laparoscopic group ($P<0.05$). However, operating room cost favored the open nephrectomy group over the laparoscopic group ($2487 vs $3557, respectively, ($P=0.003$).

The mean difference in overall hospital cost between laparoscopic and open nephrectomy was $1211 in favor of laparoscopy ($P=0.037$). The higher operating room cost was more than offset by earlier discharge, faster return to a regular diet, and less use of oral pain medication in the laparoscopic compared with the open group, which translated into cost savings with regard to intravenous fluids, medication, and infusion pumps.

No statistically significant differences in total cost, operative time, or length of hospitalization were demonstrated between patients undergoing a laparoscopic nephrectomy for benign and malignant disease. Similarly, no significant differences in total cost or any cost center were demonstrated between surgical approaches for open nephrectomy.

Table 1.
Patient Demographics

	Laparoscopic Nephrectomy	Open Nephrectomy	*P* Value*
Male	2	3	N/A
Female	9	5	N/A
Left side	7	4	N/A
Right side	4	4	N/A
Age	46.6 (26-63)	49.3 (30-62)	0.657
American Society of Anesthesiologists (ASA) class	2.4 (2-3)	2.9 (2-3)	0.067†

*Student *t* test used for evaluation of *P* values unless otherwise specified.
†Mann-Whitney test.

Table 2.
Operative Parameters

	Laparoscopic Nephrectomy Mean (range)	Open Nephrectomy Mean (range)	*P* Value*
Malignant	6	6	N/A
Benign	5	2	N/A
Surgery duration (min)†	185 (110-303)	174 (127-210)	0.582
Est. blood loss (cc)	382 (100-1100)	271 (100-650)	0.297‡
Specimen weight (g)§	399 (149-553)	656 (260-1240)	0.151
Specimen dimensions:§			
Length (cm)	15.4 (13-18)	14.3 (10-19)	0.427
Width (cm)	9.6 (7.5-12)	9.6 (7-15)	0.988
A-P (cm)	4.6 (4-5.5)	6.3 (3-9.5)	0.135
Tumor max diameter (cm)	4.7 (1.5-7.5)	8.3 (2-12)	0.083

*Student *t* test used for evaluation of *P* values unless otherwise specified.
†Surgery duration was from initial incision to surgery finish time.
‡Mann-Whitney test.
§ Specimen dimensions and weight did not include morcellated specimens.

Table 3.
Cost Analysis

	Laparoscopic Nephrectomy Mean ± SD	Open Nephrectomy Mean ± SD	*P* Value*
Overall cost (hospital costs+professional fees)	7468 ± 1036	8679 ± 1195	0.037
Hospital costs (all inclusive)	5968 ± 977	6870 ± 1182	0.097
Anesthesiologist fees†	348 ± 64	335 ± 36	0.625
Surgeon's fees‡	1152	1474	<0.001§
Total OR (OR costs+supplies)	3557 ± 759	2487 ± 271	0.003§
OR costs	2435 ± 496	2332 ± 283	0.625
Surgical supplies	1122 ± 361	155 ± 65	<0.001§
Anesthesia costs (hospital)	229 ± 34	260 ± 37	0.075
Duration of hospitalization (days)	3.3 ± .91	6.1 ± 1.73	<0.001
Room and Board	1293 ± 357	2419 ± 682	<0.001
Studies (laboratory/radiology)	136 ± 31	255 ± 63	<0.001
Pharmacy (medications+supplies)	232 ± 110	484 ± 154	<0.001
Intravenous solutions	112 ± 66	315 ± 152	<0.001
Infusion pump	36 ± 24	93 ± 68	0.02

*Student *t* test used for evaluation of *P* values unless otherwise specified.
†Anesthesiologist fees based on Medicare reimbursement rates of $18/unit.
‡Surgeon's fees based on Medicare reimbursement for year 2000.
§Mann-Whitney test.

DISCUSSION

In the current cost-conscious medical environment, the importance of fiscal responsibility rests heavily on physicians. Although the feasibility, safety and advantage of performing laparoscopic nephrectomy for benign and malignant disease[2-11] has been well established, the laparoscopic approach has consistently been associated with higher costs due to longer operative times and the use of nonreusable equipment.[2,9,20] Thus far, few cost comparisons have been made between open and laparoscopic nephrectomy. Dunn and colleagues[2] compared 5 uncomplicated laparoscopic and 5 open nephrectomies and found that the laparoscopic approach was $2000 more costly because of longer operating room time and higher equipment costs.[2] Wolf and associates[9] compared the cost of laparoscopic and open live donor nephrectomy and noted that the mean operative cost was 73% higher and the mean overall hospital cost was 23% higher in the laparoscopic group compared with that in the open group ($P<0.001$ and $P<0.005$, respectively). The shorter hospital stay and fewer interventions required in the laparoscopic group partly compensated for the increased operating room expenses. In contrast, Kou and colleagues[13] recently reported a cost advantage for laparoscopic donor nephrectomy when the hospital stay was less than 23 hours. When the hospital stay exceeded 23 hours, a cost advantage no longer existed for laparoscopic nephrectomy.

In the present study, the decrease in hospital stay, earlier return to oral intake, and more rapid progression to oral pain medication significantly reduced the overall cost in favor of laparoscopy by offsetting the increased cost of laparoscopic equipment. In addition, our comparable open and laparoscopic operating room surgical times eliminated the cost advantage for open nephrectomy seen in other series. At our institution, the cost of one 30-minute increment of operating room time is $280, and Medicare reimbursement for anesthesiologist professional fees is $18 per 15-minute increment. Thus, each additional hour of operating time would translate into an additional $632 incremental cost.

Our outcomes for laparoscopy are comparable to those reported in the literature. Gill and coworkers[3] compared their extensive laparoscopic nephrectomy experience with a contemporary open nephrectomy group and noted a length of stay advantage similar to ours (1.4 vs 5.8 days for the laparoscopic and open patients, respectively). Likewise, our mean operative time was consistent with many reported in the literature for retroperitoneal (145-211 minutes[3,4,8]) and transperitoneal laparoscopic nephrectomy (207 minutes).[8] In 2 recent series, however, operative times of 354 minutes[2] and 312 minutes[6] were reported. These longer operating times reflect the extensive 5-[6] and 9-year[2] experiences of the authors, including the initial learning curves.

Although the specimen weight in our study was greater for the open compared with the laparoscopic group, the difference did not reach statistical significance. However, specimen weights were limited to the intact specimens and the sample size for the laparoscopic group was small. The specimen dimension and maximum tumor diameter were not statistically different between the 2 groups. Both Gill et al[3] and Abbou et al[4] reported larger tumor sizes in their open nephrectomy groups compared with the laparoscopic nephrectomy groups, but the differences were not statistically significant. Currently, we remove potential neoplasms through an extension of the umbilical port site and have not been significantly limited by the size of specimens.

We acknowledge several limitations to our study. First, institutional costs differ, and this outcome could be institution-dependent. Although the various cost parameters may differ among institutions, the contribution of earlier discharge, earlier return to oral intake, and less pain medication should be universal. The cost of complications was not considered in our evaluation. Cadeddu and coworkers[5] reported a 9.6% rate of perioperative complications in a multicenter retrospective study of 157 patients. Other studies that compared the complication rates between open and laparoscopic nephrectomy found either no significant difference[9,10] or fewer complications in the laparoscopic group.[2-4] These results suggest that adding complication costs would not significantly alter the outcome of our cost comparison or would further favor laparoscopy. This study also included a relatively small number of patients. However, the overall costs varied by a similar standard deviation of approximately $1000, and no patients were significant outliers. This study primarily addressed a comparison of patients with uncomplicated hospital courses so it is unlikely that any given patient would significantly deviate from the mean.

The results of this study demonstrate that in this era of cost containment, laparoscopic nephrectomy offers both

direct and indirect cost advantages over open nephrectomy. In addition to a lower overall cost for hospitalization for laparoscopic nephrectomy, Dunn et al[2] noted that patients undergoing laparoscopy return to work sooner, an economic advantage that is difficult to quantify but nonetheless has a significant impact on the economy and community as a whole. The economic as well as clinical advantages of laparoscopic nephrectomy should serve as a strong impetus to expand the availability and utilization of laparoscopy as a surgical option for patients at other institutions with fixed funding.

CONCLUSIONS

In reviewing a county hospital experience with laparoscopic and open nephrectomy, a clear economic advantage was demonstrated for laparoscopic nephrectomy. Adding this to the already established advantages of more rapid convalescence, quicker return to oral intake, less pain medication, and less postoperative pain, laparoscopic nephrectomy should be offered to all eligible patients, regardless of whether the institution is private or public.

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