

Laparoscopic Nephrectomy: Initial Experience in Israel with 110 Cases

Andrei Nadu MD, Yoram Mor MD, Juza Chen MD, Mario Sofer MD, Jacob Golomb MD and Jacob Ramon MD

Department of Urology, Sheba Medical Center, Tel Hashomer, Israel
Affiliated to Sackler Faculty of Medicine, Tel Aviv University, Ramat Aviv, Israel

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Abstract

Background: Data during the last decade show that laparoscopic nephrectomy is becoming an accepted and advantageous minimally invasive alternative to the open procedure.

Objective: To evaluate the efficacy, safety and reproducibility of laparoscopic nephrectomy in a series of 110 consecutive procedures.

Methods: A total of 110 patients underwent laparoscopic nephrectomy in our institution during the last 3 years. Their data were entered into a database and analyzed, including age, gender, indications for surgery, operative time, blood loss, intraoperative complications, conversion rates, and postoperative complications (defined as complications occurring up to 1 month after surgery). Histologic results and outpatient follow-up were also recorded.

Results: Mean age at surgery was 63 years (range 21–89 years). The indications for surgery included solid renal masses in 64 cases, non-functioning kidneys in 35, and collecting system or ureteral tumors in 11; and the procedures performed were radical nephrectomy, simple nephrectomy, or nephroureterectomy, respectively. The mean operative time was 125 minutes (range 70–310 minutes). Intraoperative complications were recorded in eight cases (7.3%), including vascular injuries of the renal artery in two, and of the renal vein, inferior vena cava and right adrenal vein in one case each. Injury of the large bowel and splenic hylus was recorded in one case and malfunction of the vascular endoGIA stapler leading to severe bleeding in one case. Nine cases were converted to open surgery (8.2%), four of them urgently due to intraoperative complications, while in another five cases conversions were elective following poor progression of the laparoscopic procedure. Comparison of the complication rate at follow-up between the initial 50 and the last 60 patients revealed no change. The conversion rate dropped significantly along the learning curve with 7 cases converted among the initial 50 patients, versus 2 in the last 60. There was no perioperative mortality. In two cases we recorded major postoperative complications, including pneumothorax treated by insertion of a thoracic drain and incarcerated inguinal hernia treated by surgery, while minor complications were seen in five patients. Histologic examination showed renal cell carcinoma pT1-T3a in 62 patients, oncocytoma in 5, transitional cell carcinoma T1G2-T3G3N1 in 10, renal sarcoma in 1, metastasis from lung tumor in 1, and end-stage kidney in the remainder. Negative margins were obtained in all cases.

Conclusions: Laparoscopic nephrectomy may be currently considered a routine, safe and effective procedure associated with minimal morbidity. The conversion rate seemed to drop significantly after 50 cases. In view of the inherent benefits for patients, in terms of reduced pain level, faster recovery and improved cosmetic results, the laparoscopic approach has become the standard approach for nephrectomy in our institution.

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proach to kidney surgery, and in the past few years the laparoscopic approach to nephrectomy has gained widespread acceptance in the urologic and surgical community. The indications have been extended from simple nephrectomy due to benign disease to radical nephrectomy and nephroureterectomy due to malignancy. The main benefits of the laparoscopic approach to renal surgery compared to open procedures are decreased patient discomfort, reduced pain level, reduced blood loss, faster return to normal activity, and excellent cosmetic results [2–5].

We present our experience with 110 cases of laparoscopic nephrectomy performed by two surgeons during the past 3 years. To our knowledge this is the first series of laparoscopic nephrectomy from Israel.

Patients and Methods

Laparoscopic nephrectomy was performed in 110 patients during the past 3 years by two surgeons (J.R. and A.N.). All patients with an indication for nephrectomy were considered eligible for laparoscopy with the following exceptions: tumors larger than 10–12 cm, suspicion of local spread of the tumor, or suspicion of severe perinephric inflammation. Patients eligible for partial nephrectomy (those with solid tumors smaller than 4 cm and peripherally located, and patients with bilateral tumors or non-functioning contralateral kidney) were not considered candidates for laparoscopic radical nephrectomy and underwent open or laparoscopic partial nephrectomy.

Data were recorded in real time and entered into a database; they included age, gender, indication for surgery, body mass index, operative time, blood loss, intraoperative complications, conversion rates, and postoperative complications (defined as complications occurring up to 1 month after surgery). Histologic results and outpatient follow-up were also recorded.

All the procedures were performed under general anesthesia without regional anesthesia. Postoperative pain was managed by patient-controlled analgesia for 24–48 hours and oral analgesia subsequently.

Retroperitoneal or transperitoneal laparoscopy was performed according to the surgeon's preference. We used a three- or four-port technique as described elsewhere [6,7]. When malignancy was suspected, the specimen was removed intact and entrapped in a non-permeable bag, through a 5–8 cm incision in the right or left lower abdominal quadrant. When nephrectomy was performed for non-functioning kidneys, the specimen was manually

The first laparoscopic nephrectomy in a human, performed by Clayman in 1990 [1], raised tremendous interest in this ap-

morcellated, avoiding the need to enlarge the incision of the laparoscopic ports.

Results

The number of laparoscopic cases increased steadily during the study period, with 14 cases performed during 2001, 38 during 2002 and 58 during 2003. The indications for surgery included renal tumors in 64 cases, non-functioning kidneys in 35 and collecting system or ureteral tumors in 11. The procedures carried out were radical nephrectomy, simple nephrectomy and nephroureterectomy, respectively. The indications for surgery changed during the study period, with a shift from simple nephrectomy for benign lesions to radical and nephroureterectomy for malignant tumors.

The mean age at surgery was 63 years (range 21–89 years). Thirty-six patients were considered obese with a BMI above 40, and 14 patients had previously undergone either transperitoneal (n=12) or retroperitoneal (n=2) surgery. The mean operative time was 125 minutes (range 70–310 minutes).

Intraoperative complications were recorded in eight cases and were mostly related to injuries of large blood vessels, including the renal artery in two, the renal vein in one, the inferior vena cava in one, and tear of the right adrenal vein in one. In one patient a trocar injury of the large bowel required suturing repair of the bowel wall without further postoperative complications. In the same patient, bleeding from the splenic hilum necessitated open conversion and splenectomy. The patient had sarcoma of the kidney involving the splenic hilar vessels. Another complication encountered was malfunctioning of the vascular stapler with missing staples on the proximal side of the renal artery; this patient was managed by open conversion.

Nine cases were converted to open surgery (8.2%), four of them emergency conversions due to intraoperative complications and the other five following poor progression of the laparoscopic procedure. There was no perioperative mortality. There were two cases of major postoperative complications, including pneumothorax treated by insertion of a thoracic drain and incarcerated inguinal hernia treated by surgery. Minor complications were encountered in five patients: two presented with urinary retention, two with self-limiting bleeding from a port site (n=2), and one with wound infection. Histologic examination revealed either renal cell carcinoma pT1-T3a in 62 patients, oncocytoma (n=5), transitional cell carcinoma T1G2-T3G3N1 (n=10), renal sarcoma (n=1), metastasis from lung cancer (n=1), and end-stage kidney in the remaining cases.

Negative surgical margins were demonstrated in all cases in which tumors were found. Patients were followed as outpatients with a first visit at 2 weeks after discharge from the hospital. No wound-related complications were recorded in any patient. At mean follow-up of 14 months, one patient died from metastatic TCC and another had recurrence of TCC in the bladder.

The remaining patients who were operated for cancer showed no evidence of disease.

Discussion

The approach to kidney surgery has undergone significant changes over the past decade. The management of small solid tumors with nephron-sparing surgery is increasingly replacing radical nephrectomy, and the laparoscopic approach is gradually becoming the new standard of care. Renal surgery – including simple nephrectomy, radical nephrectomy, donor nephrectomy, partial nephrectomy and nephroureterectomy – has become the most frequent laparoscopic procedure performed by urologists.

In the early 1990s, urology lagged behind general surgery and gynecology in introducing laparoscopy into routine clinical practice. This might be due, in part, to the fact that urologic surgery deals with retroperitoneal and pelvic organs that are more difficult to access and expose by laparoscopy. Most general surgeons acquired their skills in laparoscopy by performing cholecystectomies, a rather straightforward procedure, and eventually progressed to advanced laparoscopy. Urology lacks a significant caseload of basic procedures, like cholecystectomy, and the novice in laparoscopic urology is confronted with major procedures from the very beginning of his or her learning curve.

The first laparoscopic nephrectomy in a human, performed by Clayman in 1990, was an uneventful procedure that lasted 8 hours and the patient was found to have a 4 cm oncocytoma [1]. Since this seminal breakthrough, urologists worldwide have revealed tremendous interest in developing, practicing and standardizing laparoscopic procedures, and have turned laparoscopic urology into one of the prominent fields of ablative and reconstructive laparoscopic surgery.

Laparoscopic simple nephrectomy for benign lesions has proved to be a safe procedure with considerable advantages over the open approach. A reduced pain level, faster convalescence and excellent cosmetic results have turned the laparoscopic approach into the new standard of care for simple nephrectomy [8,9]. These benefits have been reproduced for radical laparoscopic nephrectomy performed for renal cancer, and in selected centers the laparoscopic approach is consequently gradually replacing open surgery [10,11]. In accordance, Gill et al. [12] reported that laparoscopic radical nephrectomy decreases morbidity and expedites recovery without compromising the oncologic efficacy. In their series, a comparison of the laparoscopic and open approach showed that patients treated by laparoscopy had fewer complications, less blood loss, lower analgesic requirements, shorter hospitalization and a faster convalescence. The quality of life after surgery, defined as a combination of several variables (postoperative pain, hospitalization, convalescence period, time to full recovery) was shown to be significantly improved after laparoscopic nephrectomy compared to open nephrectomy. Similarly, Portis and Clayman [13] reported, following their comparative study, that patients

BMI = body mass index

TCC = transitional cell carcinoma

undergoing laparoscopic radical nephrectomy benefited from decreased pain, reduced hospitalization, less blood loss and more rapid convalescence. Additionally, at 5 years follow-up, their data show that cancer control was identical to that obtained by the open procedure. Several authors reported that mean analgesic requirements were less than half in laparoscopic cases compared to open nephrectomy. The mean time to normal activity was 3.6 weeks in the laparoscopic group versus 8.1 weeks in the open group and the mean time to full recovery was 8.2 weeks versus 29.3, respectively.

In the present study, we evaluated the outcome of 110 cases of laparoscopic nephrectomy. The study extended over 3 years but the distribution of the cases was uneven, with few cases during the first year and a gradual, steady growth in the number of cases in the subsequent 2 years. In our opinion, this fact reflects the progression on the learning curve with increasingly more difficult cases performed by laparoscopy instead of open surgery, but it might also reflect increasing patient and referring physician satisfaction with the outcome of this procedure. Accordingly, the overall number of nephrectomies has increased by 30% in the last year as laparoscopy has become the standard approach in our department.

The indications for laparoscopic nephrectomy are essentially the same as for open nephrectomy, except in some special and relatively rare situations including renal tumors larger than 10–12 cm, suspicion of renal vein involvement, and suspicion of severe perirenal inflammatory process such as encountered in xantogranulomatous pyelonephritis. Currently, the laparoscopic approach for nephrectomy is routinely discussed with all patients, apart from the above-mentioned exceptions.

Intraoperative complications were recorded in eight cases (7%), mostly injuries of large blood vessels. These complications were promptly managed mainly by laparoscopy; they rarely warranted open conversion and had no long-term sequelae. Nine cases in the current series were converted to open surgery (8%), four due to intraoperative complications and five following poor progression of the surgery. It is noteworthy that the highest complication and conversion rates were observed in the group of patients undergoing simple nephrectomy for non-functioning kidneys due to stone disease. Owing to perirenal inflammation, scarring and loss of anatomic landmarks, it is especially difficult to perform the laparoscopic procedure in these cases. Correspondingly, several authors have emphasized the higher conversion rate in such cases of non-functioning kidneys with underlying stone and/or infectious pathologies [14]. Comparison of the complication and conversion rates between the first 50 and the last 60 patients in our series revealed that the conversion rate dropped significantly along the learning curve while the complication rate remained unchanged. Seven of the nine open conversions occurred in the first 50 patients. This significant drop in the conversion rate was due to our increased ability to deal laparoscopically with major vascular injuries. We currently are able to control bleeding from hilar vessels with laparoscopic maneuvers and avoid conversions in most cases. The fact that the complication rate did not drop significantly

along the learning curve is probably due to the inclusion of increasingly more difficult cases and to the growing participation of residents and other surgeons with no laparoscopic experience.

At the beginning of our series we performed a thorough patient selection for laparoscopic nephrectomy, whereas today we discuss this option with almost every patient before nephrectomy, regardless of the indication for surgery, obesity and previous abdominal or renal operations. In addition, laparoscopic nephrectomy procedures were initially entirely performed by one of two surgeons with laparoscopic training (A.N. and J.R.), whereas in our later experience, residents and other urologists with no laparoscopic proficiency performed various steps of the procedure under our tutorial as a part of a teaching program.

From the technical point of view there are two approaches to laparoscopic nephrectomy – the retroperitoneal and the transperitoneal approach. With no comparative prospective randomized study available to demonstrate the superiority of one approach over the other, the choice of the approach remains a matter of preference and habit of the surgeon. With transperitoneal laparoscopy the working space is larger and orientation easier, but the approach to the kidney and especially the renal hilum is more difficult. In retroperitoneal laparoscopy, the kidney and its blood vessels are relatively easier to reach but the working space is smaller, the orientation difficult and, overall, the ergonomics of the procedure less than optimal (Due to the smaller working space and limitations by bony structures such as the ribs and iliac crest, working instruments interfere with each other inside and outside the patient). We also believe that transperitoneal laparoscopy is easier to teach and that residents can be more confidently trained and tutored with this approach compared to the retroperitoneal approach. We routinely perform transperitoneal laparoscopy except in selected cases when severe intraabdominal adhesions are anticipated.

There were two cases of major postoperative complications and five minor complications. Considering that as many as half the patients undergoing open nephrectomy by a subcostal or flank approach develop late complications related to these incisions [15] (paresthesias, hernia in scar, bulging related to abdominal wall weakness), we believe that avoiding these complications could be one of the main advantages of the laparoscopic approach. Additionally, the safety of laparoscopic nephrectomy is consistently supported by data in the literature. Several authors have reported complication rates similar to that in our series. Simon and associates [16] recently reviewed the complications of laparoscopic nephrectomy in their series of 285 laparoscopic renal procedures performed at the Mayo Clinic. Their analysis reveals that 5.6% had major complications (bleeding, splenic injury, pneumothorax and pulmonary embolus) and 7.6% had minor complications. The authors conclude that laparoscopic nephrectomy is becoming a routine and safe procedure. Complications that are unique to laparoscopy exist and their incidence should decrease with growing experience. Sequeira and colleagues [15] reported a 7.3% rate of major complications and a conversion rate of 6.1% in a series

of 213 laparoscopic nephrectomies. The authors conclude that their series provides additional evidence to support the evolution of laparoscopic nephrectomy into a standard of care. Gill et al. [17] reported a single surgeon experience with 100 cases of laparoscopic radical nephrectomy. Their complication rate was 14% with 3% major and 11% minor complications, and a very low conversion rate (2%). In their opinion, this procedure is safe, routine and should be considered as a standard of care for low-stage kidney cancer.

The mean operative time in our series was 126 minutes (range 70–310). The operative time has constantly decreased over the learning curve and is currently similar to the operating time required for open nephrectomy. When comparing the mean operative time in the first 50 cases to that in the last 60 cases we noted a significant shortening (120 min versus 190 min). This is probably due to progression on the learning curve and to the standardization of the procedure.

The oncologic effectiveness of laparoscopic radical nephrectomy has been demonstrated by several authors. Long-term follow-up at 5 years shows that this approach confers long-term oncologic effectiveness equivalent to that of traditional open radical nephrectomy [17,18]. In our series, 69 patients underwent laparoscopic radical nephrectomy. No recurrence or port site metastasis has been noted to date.

In conclusion, considering the existing data in the literature and our personal experience, we believe that laparoscopic nephrectomy can be considered a routine, safe and effective procedure associated with minimal morbidity and significant advantages for the patient. The oncologic outcome seems to be equivalent to that obtained with the open approach but longer follow-up is still needed. Acknowledging the inherent advantages of laparoscopic surgery, this approach has become the standard approach for nephrectomy in our institution

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Correspondence: Dr. A. Nadu, Dept. of Urology, Sheba Medical Center, Tel Hashomer 52621, Israel.
Phone: (972-3) 530-2231
Fax: (972-3) 535-1892
email: andrein2002@yahoo.com