Perioperative outcomes for laparoscopic radical nephrectomies performed on ≥ 10 cm tumors

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Introduction: *The role of laparoscopic radical nephrectomy (LRN) in the management of very large renal masses has yet to be determined. Moreover, no studies have considered the total size of the specimen removed. We report our experience managing renal masses ≥ 10 cm with transperitoneal LRN.*

Materials and methods: *We retrospectively reviewed cases of LRN performed in the context of renal masses from 2006 to 2012 at our institution. LRNs were divided into two groups; tumors 10 cm or larger (n = 24) and tumors smaller than 10 cm (n = 124). Patient demographics, tumor characteristics, operative and perioperative outcomes were compared. Complication rate was assessed in relation to tumor and specimen size.*

Results: *Mean pathologic tumor size was 11.8 cm (range 10.0 cm-17.0 cm) and 5.8 cm (range 2.1 cm-9.5 cm) for tumors ≥10 cm and < 10 cm, respectively. No difference was found in demographic characteristics, operative and perioperative outcomes (estimated blood loss, rate of conversion to open radical nephrectomy, length of postoperative stay and complication rate), between both groups, except higher surgical time in the ≥ 10 cm group (171 min versus 143 min, respectively, p = 0.005). There was no difference in tumor and total specimen size between patients with and without complications. Due to its retrospective nature, the major limitation of this study is missing data regarding specimen size.*

Conclusion: *LRN can be performed safely with acceptable operative and perioperative outcomes by experienced laparoscopists for very large renal masses (≥ 10 cm). Complication rates were unrelated to tumor and total specimen size.*

Key Words: laparoscopy, radical nephrectomy, renal cell carcinoma

Introduction

Since its initial description in 1991, laparoscopic radical nephrectomy (LRN) has gained wide acceptance in the surgical management of renal masses.[1,2] LRN yields equivalent oncologic results[3,4] and several benefits in terms of blood loss, analgesia requirement, hospital stay, recovery time and cosmesis when compared with open radical nephrectomy (ORN).[2,5-7] ORN remains the gold standard for renal masses larger than 7 cm.[8] However, some authors reports the safety and efficacy of LRN for tumors ranging from 7 cm to 10 cm when performed by an experienced laparoscopist.[5,9-17]

In contrast, it might be expected that larger masses be more difficult to manage by laparoscopy and have higher complication rate because of decreased working space, difficult access to the renal hilum and a higher probability of neovascularisation and nodal disease.[18,19] To date, few studies report on the safety and feasibility of LRN for very large (≥ 10 cm) tumor masses[20-22] and none have investigated whether the overall size of the removed specimen, including renal mass, kidney, adrenal and perirenal fat, has an effect on operative and perioperative outcomes. We report our experience regarding the safety of transperitoneal LRN according to tumor size and overall specimen size.

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Materials and methods

The internal review board approved the retrospective review of the medical charts of all adult patients who underwent LRN for renal masses at our institution from 2006 to 2012. We stratified the 148 patients into two groups according to tumor size: 1) renal mass of 10 cm or larger (hereafter referred to as LRN ≥ 10 cm) and 2) renal mass less than 10 cm (LRN < 10 cm). Twenty-four patients had renal lesions ≥ 10 cm and 124 had lesions < 10 cm. All LRN were performed by two surgeons. Patient characteristics considered included age, sex, American Society of Anesthesiologists (ASA) class, body mass index (BMI), cause for renal mass diagnostic, tumor localization and whether synchronous surgery or adrenalectomy was performed. Pathological features recorded included tumor and entire specimen size and volume, histological subtype, pathologic stage (2010 TNM classification), nuclear grade (Fuhrman grade), and margin status. Tumor and specimen size were calculated as the maximum diameter on the pathologic analysis. The equation for the volume of an ellipsoid (π / 6 (length x width x height)) was used to estimate the tumor and specimen volume by using the dimensions reported on the pathologic record. Radiologic size (based on CT scan findings 2 months or less prior to surgery) was calculated as the maximum diameter on the radiology report. Operative and perioperative data such as operative time, estimated blood loss (EBL), rate of conversion to ORN, length of hospital stay, and complications were recorded.

All procedures were performed by pure transperitoneal radical nephrectomy. All specimens were extracted without morcellation by either a subumbilical midline, Pfannenstiel incision or by the extension of a laparoscopic port incision. No technique modification was made for tumors larger than 10 cm except for a larger proportion of subumbilical midline incision as the extraction site. In few cases a fifth trocar was added for retraction purpose. Preoperative imaging and lymph node exploration during the surgery guided the decision to perform a lymph node dissection or not.

IBM SPSS® Statistics for Windows, Version 19.0 was used for statistical analysis (released 2010, Armonk, NY: IBM Corp.). Categorical variables were compared with

TABLE 1a. **Patient characteristics**

Patient characteristics	**LRN < 10 cm**	**LRN ≥ 10 cm**	**p value**
Patients (n)	124	24	
Age (y ± SD)	65.0 ± 13.1	62.8 ± 9.4	0.22
Sex, male	72 (58.1)	17 (70.8)	0.30
ASA score (n = 112/22)			0.94
1	9 (8.0)	2 (9.1)	
2	60 (53.6)	11 (50.0)	
3	43 (38.4)	9 (40.9)	
Body mass index (kg/m^2 ± SD)	28.1 ± 5.8	28.7 ± 4.9	0.61
Symptomatic presentation (n = 108/21)	39 (36.1)	10 (47.6)	0.26
Right-sided	63 (50.8)	10 (41.7)	0.32
Tumor localization (n = 122/21)			0.84
Inferior pole	40 (32.8)	6 (28.6)	
Middle pole	34 (27.9)	6 (28.6)	
Hilar	5 (4.1)	0 (0.0)	
Superior pole	43 (35.2)	9 (42.8)	
Synchronous surgery	9 (7.3)	2 (8.3)	0.68
Adrenalectomy	29 (23.4)	6 (25.0)	0.78

ASA = American Society of Anesthesiologists; LRN < 10 cm = renal mass less than 10 cm; LRN ≥ 10 cm = renal mass of 10 cm or larger; SD = standard deviation. Data presented as number (percentage), unless otherwise specified. When data was missing from patient charts, adjusted number of patients is indicated next to parameter as: (n = number of patients in LRN < 10 cm / number of patients LRN ≥ 10 cm).

chi-square or Fisher's exact tests. Continuous variables were analyzed with Student's t-tests and Mann-Whitney U tests. Statistical significance was set as $p < 0.05$.

Results

Table 1a lists the patient characteristics by group (LRN < 10 cm and LRN ≥ 10 cm). Age, sex, ASA score, BMI, tumor localization, rate of synchronous surgery and adrenalectomy did not differ significantly between groups. In most cases, renal masses were incidental findings ($p = 0.26$). Pathologic tumor characteristics are presented in Table 1b. Mean tumor pathologic and radiologic sizes (based on CT scan findings 2 months or less prior to surgery) were 6.8 cm ± 2.9 cm and 6.9 cm ± 2.7 cm, respectively (Pearson's correlation

TABLE 1b. **Pathologic tumor characteristics**

Pathologic data	**LRN < 10 cm**	**LRN ≥ 10 cm**	**p value**
Tumor maximum diameter			**< 0.001**
Mean (cm ± SD)	5.8 ± 1.9	11.8 ± 1.8	
Median (cm) (range)	6.0 (2.1-9.5)	11.8 (10.0-17.0)	
Tumor volume (n = 57/14)			**< 0.001**
Mean (cm^3± SD)	80 ± 69	499 ± 285	
Median (cm^3) (range)	58 (7-336)	285 (209-1056)	
Specimen size (mean ± SD)			
Maximum diameter (cm) (n = 68/18)	15.5 ± 3.8	18.1 ± 1.9	**0.003**
Volume (cm^3) (n = 67/17)	490 ± 294	1023 ± 357	**< 0.001**
Weight (g) (n = 82/18)	586 ± 333	1047 ± 605	**< 0.001**
Histologic type			0.61
Clear cell	95 (76.6)	18 (75.0)	
Papillary	13 (10.5)	2 (8.3)	
Chromophobe	4 (3.2)	1 (4.2)	
Other malignancy	2 (1.6)	1 (4.2)	
Oncocytoma	6 (4.8)	0 (0.0)	
Other benign	4 (3.2)	2 (8.3)	
Pathologic stage			**< 0.001***
pT1a	21 (18.9)	0 (0.0)	
pT1b	40 (36.0)	0 (0.0)	
pT2a	15 (13.5)	3 (14.3)	
pT2b	0 (0.0)	7 (33.3)	
pT3a	26 (23.4)	8 (38.1)	
pT3b	9 (8.1)	2 (9.5)	
pT4	0 (0.0)	1 (4.8)	
M1	8 (7.0)	1 (4.2)	0.98
Fuhrman grade (n = 107/20)			0.15
1	1 (0.9)	0 (0.0)	
2	45 (42.1)	4 (20.0)	
3	54 (50.5)	12 (60.0)	
4	7 (6.5)	4 (20.0)	
Margin status			
Positive	0 (0)	0 (0)	

LRN < 10 cm = renal mass less than 10 cm; LRN ≥ 10 cm = renal mass of 10 cm or larger; SD = standard deviation. Data presented as number (percentage), unless otherwise specified. When data was missing from patient charts, adjusted number of patients is indicated next to parameter as: (n = number of patients in LRN < 10 cm / number of patients LRN ≥ 10 cm). Bold characters indicate statistically significant comparisons.

* Comparison based on malignant tumors only.

TABLE 2a. **Operative and perioperative outcomes**

Perioperative outcomes	**LRN < 10 cm**	**LRN ≥ 10 cm**	**p value**
Patients (n)	124	24	
Operative time (min)			**0.005**
Mean ± SD	143 ± 61	171 ± 52	
Median (range)	130 (65-530)	167 (90-300)	
EBL (mL)			0.078
Mean ± SD	233 ± 684	260 ± 344	
Median (range)	100 (10-7000)	100 (25-1600)	
Length of stay (days)			0.15
Mean ± SD	4.8 ± 4.6	5.9 ± 4.3	
Median (range)	4 (1-48)	4 (2-18)	
Complications – Clavien grade			0.60
None	94 (75.8)	19 (79.2)	
I-II	25 (20.2)	3 (12.5)	
III-IV	5 (4.0)	2 (8.3)	
Extraction site			
Pfannenstiel incision	26 (21.0)	5 (20.8)	**< 0.001**
Subumbilical midline incision	47 (37.9)	17 (70.8)	
Extension of a laparoscopic port incision	48 (38.7)	1 (4.2)	
Conversion to open approach	3 (2.4)	1 (4.2)	0.051

EBL = estimated blood loss; LRN < 10 cm = renal mass less than 10 cm; LRN ≥ 10 cm = renal mass of 10 cm or larger; SD = standard deviation. Data presented as number (percentage), unless otherwise specified. Bold characters indicate statistically significant comparisons.

coefficient, 0.9). Mean tumor size and volume for LRN ≥ 10 cm were larger than for LRN < 10 cm (11.8 cm versus 5.8 cm, 499 cm^3 versus 80 cm^3, respectively, both p < 0.001). The LRN ≥ 10 cm group also presented significantly larger overall specimen size, volume and weight, than the LRN < 10 cm group (18.1 cm versus 15.5 cm, p = 0.003; 1023 cm^3 versus 490 cm^3, p < 0.001; 1047 g versus 586 g, p < 0.001). No significant differences between the two groups were detected in histologic type and Fuhrman grading, but LRN ≥ 10 cm had a

TABLE 2b. **Operative and perioperative outcomes**

Perioperative outcomes	**LRN < 7 cm**	**LRN ≥ 7 and < 10 cm**	**p value**
Patients (n)	87	37	
Operative time (min)	144 ± 68	141 ± 44	0.59
EBL (mL)	241 ± 800	214 ± 266	0.16
Length of stay (days)	4.8 ± 2.7	5.0 ± 2.5	**0.048**
Open conversions	3 (3.4)	0	
Complications – Clavien grade			**0.01**
None	62 (71.3)	33 (89.2)	
I-II	23 (26.4)	2 (5.4)	
III-IV	2 (2.3)	2 (5.4)	

EBL = estimated blood loss; LRN < 7 cm = renal mass less than 7 cm; LRN ≥ 7 and < 10 cm = renal mass of 7 cm or larger but smaller than 10 cm. Data presented as number (percentage) or mean ± standard deviation. Bold characters indicate statistically significant comparisons.

TABLE 3. **Clavien grade III and IV complications**

Clavien grade	LRN < 10 cm	LRN ≥ 10 cm
III	Wound dehiscence Hemorrhagic shock Drainage/reparation of colon laceration Pneumothorax requiring chest tube placement	Wound dehiscence Hemorrhagic shock
IV	Laceration of inferior vena cava	

LRN < 10 cm = renal mass less than 10 cm; LRN ≥ 10 cm = renal mass of 10 cm or larger.

higher pathologic stage on average than LRN < 10 cm ($p < 0.001$). There were one sarcoma and two collecting duct carcinoma in the LRN ≥ 10 cm and < 10 cm, respectively. All surgical margins were negative in both groups. A total of nine LRNs were performed in a cytoreductive intent, one in the ≥ 10 cm group and eight in the < 10 cm group ($p = 0.98$).

Operative and perioperative results, Table 2a, revealed significantly higher operative time for LRN ≥ 10 cm compared to LRN < 10 cm (171 min versus 143 min, $p = 0.005$), but no difference in the mean EBL (260 mL versus 233 mL, $p = 0.078$) or hospital stay (5.9 days versus 4.8 days, $p = 0.15$). Open conversion due to intraoperative bleeding occurred in one case (4.2 %) and in three cases (2.4 %) in LRN ≥ 10 cm and LRN < 10 cm, respectively ($p = 0.51$). Overall complicatio n rate was 23.6 % (35 patients) in both groups, with 20.8 % and 24.2 % in LRN ≥ 10 cm and LRN < 10 cm, respectively ($p = 0.60$). Two and four patients had Clavien grade III complications in the LRN ≥ 10 cm and LRN < 10 cm group, respectively. One patient in the LRN < 10 cm group experienced a severe Clavien grade IV complication. See Table 3 for a list of Clavien grade III and IV complications). No mortality occurred.

When we stratify the LRN < 10 cm group into two subgroups: LRN < 7 cm and LRN 7 cm-10 cm, Table 2b, and compare their operative and perioperative outcomes, there was a significantly longer hospital stay for the LRN 7 cm-10 cm compared to LRN < 7 cm (5.0 days ± 2.5 days versus 4.8 days ± 2.7 days, $p = 0.048$) but no difference in the mean EBL (214 mL ± 266 mL versus 241 mL ± 800 mL, $p = 0.16$) or operative time (141 min ± 44 min versus 144 min ± 68 min, $p = 0.59$). There were three cases of open conversion in the LRN < 7 cm subgroup and none in the LRN 7 cm-10 cm subgroup. There are two cases of Clavien grade III-IV in each subgroup.

TABLE 4. **Complication rate by tumor and specimen size**

Complications	Clavien grade I-IV	No complications	p value
Patients (n)	35 (23.6)	113 (76.4)	
BMI (kg/m^2) ± SD	29.4 ± 6.4	27.8 ± 5.4	0.28
Tumor size (mean ± SD)			0.18
Maximum diameter (cm)	6.5 ± 3.6	6.9 ± 2.7	
Volume (cm^3) (n = 15/56)	209 ± 331	150 ± 177	0.38
Specimen size (mean ± SD)			
Maximum diameter (cm) (n = 20/66)	16.3 ± 4.3	16.0 ± 3.4	0.54
Volume (cm^3) (n = 22/79)	681 ± 528	573 ± 311	0.79
Weight (g) (n = 27/73)	785 ± 661	626 ± 299	0.90

BMI = body mass index; SD = standard deviation. Data presented in parentheses are percentages, unless otherwise specified. When data was missing from patient charts, adjusted number of patients is indicated next to parameter as: (n = number of patients with Clavien grade I-IV / number of patients with no complications).

Only four cases involved tumors above 13 cm. We found similar EBL, operative time and length of stay between these cases and those with tumors of 10 cm-13 cm. None required conversion to open radical nephrectomy. However, three of them experienced two minor complications (bleeding requiring one transfusion and one repair of a small bowel serotomy intraoperatively) and one major complication (wound dehiscence requiring surgical closure).

A sub-analysis showed that patients with and without complications (Clavien grades I-IV) had similar tumor and specimen sizes, Table 4. Both groups had similar age, sex and BMI. Therefore, complication rate was unrelated to either tumor or specimen size in our study.

Discussion

While the use of LRN for tumors less than 7 cm is now widely accepted[8] and evidence suggesting the safety and feasibility of LRN for renal tumors between 7 cm and 10 cm is increasing in the literature[5,9-17] the role of LRN in the management of very large renal masses (≥ 10 cm) has yet to be determined. We report favorable safety outcomes of our experience managing very large renal masses (≥ 10 cm) with transperitoneal LRN when comparing results to those of a similar group of patients undergoing LRN for smaller tumors (< 10 cm). Except for operative time, there was no significant difference in operative and perioperative data between both groups. Furthermore, pathologic data show that all surgical margins were found to be negative. In addition, despite our hypothesis that larger overall specimen size may be associated with higher complication rates, no evidence to support this hypothesis was found in this series. In order to situate our results in the context of the available literature, an overview of published series involving LRN for large (≥ 7 cm) and very large (≥ 10 cm) tumors is provided in Table 5.

In our study, the only outcome that differed significantly between both groups was operative time; LRNs for tumors ≥ 10 cm was approximately 30 minutes longer than LRNs for tumors < 10 cm (171 min versus 143 min, p = 0.005). However, our operative time for tumors ≥ 10 cm is similar to what is reported in the literature (156 min to 192 min.).[20-22] As no myocardial infarction, pulmonary embolism or deep vein thrombosis occurred in either group, the increased operative time did not seem to be clinically significant.

Although postoperative stay is similar in the two groups compared in our study, it seems to be longer than what is reported in the literature: 5.9 days versus range of 2.0 days to 3.5 days, Table 5.[20-22] This may be partly attributed to internal discharge criteria and to the fact that our patients leave directly to their homes without transiting to a nearby motel or transition home. Dillenburg et al[11] also reported an average hospitalization time of 6 days for LRN involving renal tumors > 7 cm, but this was still significantly lower than the 11 days they observed for ORN (p < 0.001) and the other traditional benefits of LRN over ORN, such as short and mid-term decrease in pain and better quality of life, were still present.

EBL for the larger tumor group was not increased in our study nor in the studies mentioned previously.[20,21] Conversion to ORN, however, was found to be more frequent in LRNs for larger tumors in Pierorazio et al's series[20] (2.1% versus 13.8 %, p = 0.001), while we found no difference in our study. Although several studies report a complete lack of conversions,[21,22] the rate observed in our LRN ≥ 10 cm group (4.2%) was within the range of conversion rates reported for both tumors ≥ 10 cm and ≥ 7 cm summarized in Table 5.

We report an overall complication rate of 20.8 % for tumors ≥ 10 cm which is similar to data from earlier reports ranging from 18.2 % to 26.7%.[20-22] Moreover, the only Clavien grade IV and four of the six Clavien grade III complications occurred in the < 10 cm group, highlighting the fact that LRN carries inherent risks for all tumor sizes. While we found no evidence that tumor size was a predictor of complication rate, we wanted to verify whether overall specimen size was a predictor. We had hypothesized that restrictions such as decreased working space and difficult access to the renal hilum might be more closely linked to overall specimen size (diameter, volume and weight) than to one-dimension tumor size. A comparison between patients experiencing any complication (Clavien grade I to IV) and patients experiencing none revealed no significant difference in specimen diameter (16.3 cm versus 16.0 cm), volume (681 cm^3 versus 573 cm^3) and weight (785 g versus 626 g) (p = 0.54, 0.79 and 0.90, respectively). Given that some data on specimen size was missing in this series due to pathologists' lack of homogeneity in their reports, we consider that further investigation into this question is warranted.

In our opinion, LRN for tumors ≥ 10 cm remains very challenging and demanding. Due to the low number of cases involving extremely large tumors in our study (≥ 13 cm) (e.g. four) we suggest using laparoscopy with extreme caution and in highly selected patients in such cases. In technically challenging cases, some authors have opted for hand-assisted laparoscopic (HAL) nephrectomies while others have exclusively used HAL in their series, Table 5.[23,24] The potential advantages of

TABLE 5. **Overview of the series involving LRN for large and very large kidney tumors**

Series	n	Mean/ median tumor size cm (range)	Positive margins n (%)	Mean/ median EBL (mL)	Mean/ median operative time (min)	Mean length of stay (days)	Open conversion n (%)	Complications n (%)
Tumor 7 cm or larger								
*Patel and Leveillee[9]	10	9.2 (8-12)	–	105	185.1	2.3	0	0
**Stifelman et al[23]	32	8.9 (-)	1 (3.1)	167	198	3.7	2 (6.2)	US = 4 (12.5)
Steinberg et al[21]	35	8.0 (7.1-9.9)	0	150	180	1.6	0	IO = 3 (8.6) PO = 8 (22.9)
*Malaeb et al[18]	9	8.6 (4.5-14)	0	261	205	2.9	2 (22.2)	US = 1 (11.1)
Gong et al[10]	43	9.7 (7.1-18.0)	1 (2)	275	212	2.4	5 (12)	IO = 8 (19) PO = 9 (21)
Dillenburg et al[11]	23	8.9 (-)	0	227	171	6	0	IO = 12 (52) PO = 8 (35)
Hemal et al[5]	41	9.9 (-)	–	245.5	180.8	3.6	2 (4.87)	IO = 4 (9.75) PO = 5 (12.19)
*Berger et al[12]	40	9.2 (7-14)	1 (2.5)	275	209.5	3.79	1 (2.5)	-
*Rosoff et al[13]	30	8.8 (-)	1 (3)	275.5	175.7	2.4	0	US = 4 (13)
*Chertin et al[14]	35	10.1 (7-19)	–	388	150	4.36	1 (2.9)	IO = 3 (8.6) PO = 2 (5.7)
Bird et al[15]	23	9.28 (-)	0	169	-	3.5	0	IO = 3 (13.0) PO = 7 (30.4)
*Jeon et al[16]	88	9.2 (7.2-16)	–	439.8	241.5	–	4 (4.5)	IO = 9 (10.2) PO = 15 (17)
Pierorazio et al[20]	138	8.2 (7.1-10)	4 (2.9)	288	188	3.4	3 (2.1)	US = 32 (21.9)
*Luciani et al[17]	222	8.5 (7-18)	0	280	180	–	12 (5.4)	US = 64 (28.8)
Tumor 10 cm or larger								
Steinberg et al[21]	30	12.0 (10-16.0)	2 (6.9)	250	185	2	0	IO = 2 (6.7) PO = 6 (20.0)
**Venkatesh et al[24]	9	5.4 (3.5-9)	-	-	142	3.0	0	PO = 2 (22)
Venkatesh et al[24]	12	5.7 (2.5-9)	-	-	171	2.7	0	IO = 1(8.3) PO = 1 (8.3)
Conley et al[22]	11	12.4 (10-21)	0	154.5	155.8	3.1	0	US = 2 (18.2)
Pierorazio et al[20]	62	12.9 (10.2-30)	3 (4.8)	406	192	3.5	9 (13.8)	US = 15 (23.1)
Our series	24	11.8 (10.0-17.0)	0	260	171	5.9	1 (4.2)	IO = 2 (8.3) PO = 3 (12.5)

EBL = estimated blood loss; « - » = not reported; IO = intraoperative complication; PO = postoperative complication; US = unspecified
*series including patients undergoing hand assisted laparoscopic radical nephrectomy; **series using exclusively hand assisted laparoscopic radical nephrectomy.

HAL nephrectomy over pure laparoscopy is based on increased tactile sensation, blunt dissection, and retraction of surrounding structures. HAL could be used as an intermediate step between pure laparoscopy and open conversion in the setting non-life threatening challenging cases. We had no experience with HAL.

We found similar EBL, operative time and length of stay between patients with tumors > 13 cm and those with tumors ranging from 10 cm to 13 cm. None required conversion to open radical nephrectomy. However, three of them experienced complications (bleeding requiring one transfusion, one repair of a small bowel serotomy intraoperatively and one wound dehiscence requiring surgical closure). Open radical nephrectomy remains a very suitable approach for these patients. We also recommend an open approach for managing very large renal masses invading inferior vena cava or adjacent structure (e.g. spleen, liver, psoas). Moreover, any polycystic kidneys that extend below the iliac crest which require nephrectomies for either a renal mass or for pre-renal transplant are recommended by open surgery. However, based on our results, for large tumors ≥ 10 cm, we would not avoid laparoscopy for patients with comorbidities such as BMI > 30, moderate COPD, or prior abdominal surgeries.

Other than its retrospective nature, we recognize a number of inherent limitations in our study. For example, safety and efficacy of LRN compared with ORN for very large renal masses was not evaluated. Because the complication rate of LRN has already been demonstrated to be lower or similar to that of the open approach for small renal masses,[2] we believe a comparison between LRN management of < 10 and ≥ 10 cm lesions is clinically relevant. Furthermore, during the study period, only six ORNs were performed in our institution: three for patients with vena caval tumor thrombi, two for patients having concomitant surgeries that required open surgery (e.g. aortoiliac bypass graft surgery, abdominoperineal resection) and one for a patient with known liver invasion. All other radical nephrectomies were attempted using a laparoscopic approach regardless of tumor size. As for our surgeons' experience, he has a fellowship in advanced laparoscopy. As both surgeons were involved in all cases we could not assess whether there was a difference between their outcomes. Finally, neither cancer-specific nor recurrence-free survival rates were calculated due to the short follow up time, though this has been given some consideration in previous assessments of oncologic outcomes in stage T2 tumors (≥ 7 cm) managed through LRN with optimistic conclusions.[5,17,25]

Conclusions

In experienced hands, LRN can be performed safely with acceptable operative and perioperative outcomes for very large renal masses (≥ 10 cm). Despite prolonged operative time for larger tumors, tumor size does not impact blood loss, hospital stay, or rate of conversion to ORN. Furthermore, complication rate was unrelated to both tumor size and total specimen size in our study. □

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