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Factors Associated with Prolonged Retroperitoneal Laparoscopic Radical Nephrectomy Performed by Non-expert Surgeons

Masato Yanagi[1], Go Kimura[1], Tetsuro Sekine[2],
Hayato Takeda[1], Jun Akatsuka[1], Yuki Endo[1],
Tatsuro Hayashi[1], Tsutomu Hamasaki[3] and Yukihiro Kondo[1]

[1]Department of Urology, Nippon Medical School Hospital, Tokyo, Japan
[2]Department of Radiology, Nippon Medical School Hospital, Tokyo, Japan
[3]Department of Urology, Nippon Medical School Musashi Kosugi Hospital, Kanagawa, Japan

Background: High body mass index (BMI) and visceral obesity were reported to be associated with prolonged transperitoneal laparoscopic radical nephrectomy (LRN); however, factors that prolong retroperitoneal LRN remain unknown. We therefore investigated factors associated with prolonged retroperitoneal LRN performed by non-expert surgeons.

Methods: We defined non-experts surgeons as surgeons not certified to perform laparoscopic surgery by the Japanese Society of Endourology. We retrospectively reviewed the medical records of 59 consecutive patients with renal cell carcinoma treated with retroperitoneal LRN performed by non-experts at our hospital between 2014 and 2019. Associations of surgical duration with age, sex, BMI, visceral fat area (VFA), subcutaneous fat area (SFA), laterality and location of the tumor, length of the major tumor axis (tumor length), clinical T stage, ipsilateral adrenalectomy and specimen weight were analyzed using Spearman rank correlation coefficients.

Results: Surgical duration positively correlated with ipsilateral adrenalectomy ($rs = 0.3162$, $p = 0.0147$) and specimen weight ($rs = 0.3103$, $p = 0.0168$) but not with BMI ($rs = 0.2016$, $p = 0.1257$) or VFA ($rs = 0.0185$, $p = 0.8894$).

Conclusions: Ipsilateral adrenalectomy and specimen weight were associated with prolonged retroperitoneal LRN, when performed by non-expert surgeons. (J Nippon Med Sch 2021; 88: 109−112)

Key words: laparoscopic radical nephrectomy, retroperitoneal approach, non-expert

Introduction

Laparoscopic nephrectomy, for treatment of benign disease, was first described in 1991 by Clayman et al[1]. Since then, laparoscopic radical nephrectomy (LRN) has become the standard surgical treatment in many countries for T1 and selected T2 and T3 renal cell carcinoma(s) (RCC)[2,3]. Therefore, educating non-expert surgeons, including urology residents, to become independent surgeons is important. Japanese university hospitals, including ours, are educational institutions where residents are provided opportunities to conduct as many surgical procedures as possible to improve their skills, reduce the risk of complications, and pass board examinations. Prolonged surgery increases the risk of perioperative complications, surgical team fatigue, and technical errors[4,5]. Therefore, appropriate case selection is important for non-expert surgeons, so that they can complete operations safely and in a timely manner. However, factors associated with prolonged LRN conducted by non-expert surgeons have not been reported in detail[6].

High body mass index (BMI) was reported to prolong the duration of transperitoneal LRN[7,8]. Another study found that visceral obesity rather than high BMI prolonged surgical duration for non-expert, but not expert,
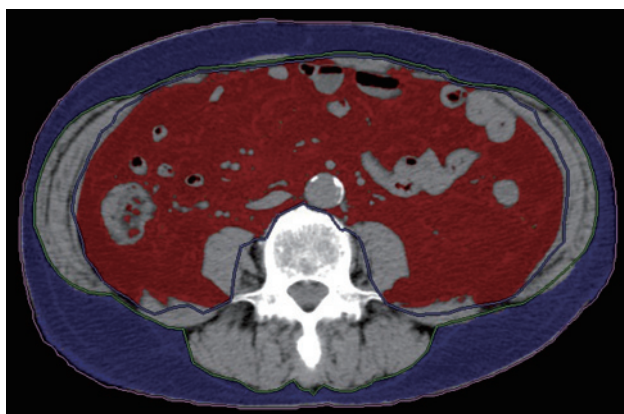
Fig. 1 Findings from computed tomography imaging
Red and blue areas indicate VFA and SFA, respectively.

surgeons[6]. In contrast, factors that prolong retroperitoneal LRN are not well understood[9] and have never been assessed in non-expert surgeons. Therefore, we retrospectively investigated factors that prolonged surgery conducted by non-expert surgeons, to identify the types of patients who would be most suitable for surgeons to acquire experience in retroperitoneal LRN.

Materials and Methods

We retrospectively reviewed the medical records of consecutive patients with RCC that was treated by non-expert surgeons using retroperitoneal LRN at our institution between 2014 and 2019. We collected data on patient characteristics and perioperative outcomes, age, sex, BMI, visceral fat area (VFA), subcutaneous fat area (SFA), tumor laterality and location, the length of the major axis of the tumor (tumor length), clinical T stage, ipsilateral adrenalectomy, surgical duration, and specimen weight. We excluded amount of intraoperative bleeding from the analysis because volume of intraoperative bleeding is correlated with operation time.

One radiologist measured VFA and SFA at the level of the umbilicus on preoperative images acquired using Synapse Vincent three-dimensional computed tomography (Fujifilm Co. Ltd., Tokyo, Japan) (**Fig. 1**). We defined non-experts in LRN as surgeons with ≥4 years of urological oncology experience who were not certified by the Japanese Society of Endourology (JSE). Non-experts operated on patients under the guidance of one or more expert surgeons, who also participated in procedures, if necessary. Patients at our institution underwent ipsilateral adrenalectomy when the upper pole of the tumor was located near the adrenal gland. Surgeries proceeded with patients in the kidney position, and four ports were placed in the retroperitoneal space.

Associations of clinical variables with LRN duration were analyzed by using Spearman rank correlations. Data were statistically analyzed with JMP® 13 (SAS Institute Inc., Cary, NC, USA). A P value of <0.05 was considered significant.

The Ethics Committee of Nippon Medical School Hospital approved this study (approval number 29-11-861).

Results

Seven non-expert surgeons treated 59 patients (39 men, 20 women; mean age, 63 years; range, 31-87 years) by retroperitoneal LRN. Mean BMI, VFA, and SFA were 24.0 (range, 16.3-37.8), 128.3 (range, 14.1-344.5), and 142.2 (range, 32.6-529.9) m^2, respectively. Among the patients, 27 and 32 had RCC on the left and right side, respectively. Tumors were located anteriorly and posteriorly in 30 and 29 patients, respectively. Mean tumor length was 55 (range, 18-100) mm. Tumors were clinically diagnosed as cT1a, 1b, 2a, and 3a in 11 (18.6%), 21 (35.6%), 7 (11.9%), and 20 (33.9%) cases, respectively, and seven required ipsilateral adrenalectomy (**Table 1**). Mean specimen weight was 448 (range, 169-949) g, and the pathological diagnosis was clear cell and non-clear cell carcinoma in 51 and 8 tumors, respectively. The pathological T stage was pT1a, 1b, 2a, and 3a in 10 (16.9%), 17 (28.8%), 4 (6.8%), and 28 (47.5%) patients, respectively (**Table 2**). Mean surgical duration and the amount of intraoperative bleeding were 271 (range, 148-458) minutes and 94 (range, 3-661) mL, respectively. None of the patients required transfusion or developed intraoperative complications. One patient developed postoperative Clavien-Dindo grade II rhabdomyolysis, but no complications were worse than Clavien-Dindo grade II. Surgical duration significantly positively correlated with ipsilateral adrenalectomy (rs = 0.3162, p = 0.0147) and specimen weight (rs = 0.3103, p = 0.0168) but not with BMI (rs = 0.2016, p = 0.1257), VFA (rs = 0.0185, p = 0.8894), or SFA (rs = 0.1723, p = 0.1920) (**Table 3**).

Discussion

The JSE was established in 2004 and conducts annual examinations to certify surgeons in laparoscopic nephrectomy, nephroureterectomy, and adrenalectomy. Expert surgeons evaluate videos of procedures conducted by non-expert surgeons, and the pass rate of the examination is about 50%. Therefore, almost all LRN are conducted by non-expert surgeons at our hospital, because they need to acquire sufficient experience to attempt the

Table 1　Preoperative data from patients treated by laparoscopic radical nephrectomy

	Number of patients (%)	Means ± SD
Age (years)		63±14
Sex		
Male	39 (66.1)	
Female	20 (33.9)	
BMI (kg/m²)		24.0±4.2
VFA (cm²)		128.3±67.8
SFA (cm²)		142.2±81.5
Laterality		
Left	27 (45.8)	
Right	32 (54.2)	
Location of tumor		
Anterior	30 (50.8)	
Posterior	29 (49.2)	
Tumor length (mm)		55±17
Clinical T stage		
1a	11 (18.6)	
1b	21 (35.6)	
2a	7 (11.9)	
2b	0 (0)	
3a	20 (33.9)	
Ipsilateral adrenalectomy		
No	53 (89.8)	
Yes	6 (10.2)	

SD: standard deviation, BMI: body mass index, VFA: visceral fat area, SFA: subcutaneous fat area

Table 2　Postoperative data from patients treated by laparoscopic radical nephrectomy

	Number of patients (%)	Means ± SD
Pathological tumor type		
CCC	51 (86.4)	
Non-CCC	8 (13.6)	
Pathological T stage		
1a	10 (16.9)	
1b	17 (28.8)	
2a	4 (6.8)	
2b	0 (0)	
3a	28 (47.5)	
Surgical duration (min)		271±59
Intraoperative bleeding (mL)		94±148
Specimen weight (g)		448±170

SD: standard deviation, CCC: clear cell carcinoma

examination and become certified by the JSE to work in other hospitals in the future.

The maximum duration of insufflation for LRN during the examination is limited to 210 minutes. Thus, surgical duration is important for passing the examination and

becoming certified. We found that factors associated with prolonged retroperitoneal LRN when conducted by non-expert surgeons were ipsilateral adrenalectomy and specimen weight. Because the retroperitoneal space is narrower than the peritoneal space, retroperitoneal LRN

Table 3 Spearman rank correlations of factors with duration of laparoscopic radical nephrectomy

	Correlation coefficient	p
Age	–0.1329	0.3157
Male	0.0736	0.5795
BMI	0.2016	0.1257
VFA	0.0185	0.8894
SFA	0.1723	0.1920
Left tumor	0.2009	0.1272
Anterior tumor	0.2161	0.1002
Tumor length	0.2212	0.0923
Clinical T3a	0.2114	0.1080
Ipsilateral adrenalectomy	0.3162	0.0147
Specimen weight	0.3103	0.0168

BMI: body mass index, VFA: visceral fat area, SFA: subcutaneous fat area

proceeds in a constricted working area, which becomes even more constricted when specimens are larger[10]. Therefore, less experienced non-expert surgeons will require more time to complete a retroperitoneal radical nephrectomy. A previous study found that significantly more time was needed to complete retroperitoneal LRN in obese patients (BMI ≥25.0) than in non-obese patients (BMI <25.0)[9]. However, renal specimens from the obese group were significantly heavier than those from the non-obese group in that study, suggesting that kidney weight, rather than BMI, affected surgical duration. Conversely, patients with small kidneys and no indication for ipsilateral adrenalectomy are considered suitable candidates for LRN by non-expert surgeons seeking experience in retroperitoneal LRN. In the present study, the amount of intraoperative bleeding was not correlated with ipsilateral adrenalectomy or specimen weight.

The present study was limited by its retrospective design and the inclusion of a small patient cohort from a single center. Another limitation is that the amount of help provided by expert surgeons to non-experts during each procedure was not quantified. In addition, specimen weight was not a preoperative factor. Therefore, prospective studies of more patients at several centers are needed to determine the amount of expert support provided per procedure and as a means to preoperatively predict specimen weight.

In conclusion, the present study showed that ipsilateral adrenalectomy and specimen weight, but not BMI, VFA, or SFA, predicted prolonged retroperitoneal LRN when conducted by non-expert surgeons. Patients with small kidneys who do not require ipsilateral adrenalectomy are optimal candidates for non-expert surgeons seeking experience in retroperitoneal LRN.

References
1. Clayman RV, Kavoussi LR, Soper NJ, et al. Laparoscopic nephrectomy: initial case report. J Urol. 1991 Aug;146(2): 278−82.
2. Wille AH, Roigas J, Deger S, Tüllmann M, Türk I, Loening SA. Laparoscopic radical nephrectomy: techniques, results and oncological outcome in 125 consecutive cases. Eur Urol. 2004 Apr;45(4):483−8.
3. Eskicorapci SY, Teber D, Schulze M, Ates M, Stock C, Rassweiler JJ. Laparoscopic radical nephrectomy: the new gold standard surgical treatment for localized renal cell carcinoma. Scientific World Journal. 2007 Apr 9;7:825−36.
4. Cheng H, Chen BP, Soleas IM, Ferko NC, Cameron CG, Hinoul P. Prolonged operative duration increases risk of surgical site infections: a systematic review. Surg Infect (Larchmt). 2017 Aug/Sep;18(6):722−35.
5. Glassman DT, Merriam WG, Trabulsi EJ, Byrne D, Gomella L. Rhabdomyolysis after laparoscopic nephrectomy. JSLS. 2007 Oct-Dec;11(4):432−7.
6. Yuge K, Miyajima A, Jinzaki M, et al. How does visceral obesity affect surgical performance in laparoscopic radical nephrectomy? Jpn J Clin Oncol. 2015 Apr;45(4):373−7.
7. Hagiwara M, Miyajima A, Matsumoto K, Kikuchi E, Nakagawa K, Oya M. Benefit of laparoscopic radical nephrectomy in patients with a high BMI. Jpn J Clin Oncol. 2011 Mar;41(3):400−4.
8. Miyake H, Muramaki M, Tanaka K, Takenaka A, Fujisawa M. Impact of body mass index on perioperative outcomes of laparoscopic radical nephrectomy in Japanese patients with clinically localized renal cell carcinoma. Int J Urol. 2010 Jun;17(6):522−6.
9. Inoue S, Mita K, Shigeta M, et al. Retroperitoneoscopic radical nephrectomy in obese patients: outcomes and considerations. Urol Int. 2006;76(3):252−5.
10. Wszolek MF, Wotkowicz C, Libertino JA. Surgical management of large renal tumors. Nat Clin Pract Urol. 2008 Jan;5(1):35−46.