

Endourology

Obesity Is an Adverse Factor on Laparoscopic Radical Nephrectomy for T2 but Not T1 Renal Cell Carcinoma

Se Yun Kwon, Jae Jun Bae, Jung Gon Lee, Seock Hwan Choi, Bum Soo Kim, Eun Sang Yoo, Tae Gyun Kwon, Tae-Hwan Kim

Department of Urology, School of Medicine, Kyungpook National University, Daegu, Korea

Purpose: Laparoscopic radical nephrectomy (LRN) is more challenging with increases in body mass index (BMI). Several recent studies have shown, however, that LRN can be safely performed even in obese patients. The influence of obesity on the perioperative outcomes of LRN has not been well elucidated for large renal tumors (> 7 cm), however. We estimated the impact of obesity on LRN for stage T1 and T2 renal cell carcinoma (RCC).

Materials and Methods: From January 2004 to March 2011, 266 patients underwent LRN (T1: 195, T2: 71). These patients were subdivided into the following two groups according to BMI: the nonobese group (BMI less than 25 kg/m²) and the obese group (BMI greater than 25 kg/m²). Perioperative outcomes were retrospectively compared between these two groups in T1 and T2 RCC patients.

Results: There were no significant differences in perioperative outcomes between the obese and nonobese groups of T1 RCC patients. However, in T2 RCC patients, operative time and complication rate were significantly increased in the obese group.

Conclusions: Our results suggest that LRN can be safely performed in Korean patients with T1 RCC regardless of obesity. In T2 RCC patients, however, LRN may become more difficult with increasing BMI considering a longer operation time as well as a higher complication rate. We suggest that LRN for obese patients with T2 RCC be carefully considered.

Key Words: Laparoscop; Obesity; Renal cell carcinoma

This is an Open Access article distributed under the terms of the Creative Commons Attribution Non-Commercial License (<http://creativecommons.org/licenses/by-nc/3.0>) which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

Article History:

received 31 May, 2011

accepted 8 July, 2011

Corresponding Author:

Tae-Hwan Kim
Department of Urology, Kyungpook National University Medical Center, 474, Hakjeong-dong, Buk-gu, Daegu 702-210, Korea
TEL: +82-53-200-3012
FAX: +82-53-200-2027
E-mail: doctork@knu.ac.kr

This research was supported by Kyungpook National University Research Fund, 2010.

INTRODUCTION

Since 1991, when Clayman et al first reported laparoscopic nephrectomy [1], many investigations have shown the various advantages of the laparoscopic technique, such as decreased blood loss, rapid recovery, shorter hospital stay, less postoperative pain, and better cosmesis than with open nephrectomy [2,3]. Building on these gains, laparoscopic radical nephrectomy (LRN) is increasingly being performed at many centers and has become the standard technique for radical nephrectomies for T1 renal tumors (7 cm or less), except in favorable cases of nephron-sparing surgery [4,5]. Recently, laparoscopic surgery has also tended to be performed for larger renal masses (> 7 cm) [6,7].

The Korean National Health and Nutrition Surveys reported an increase in the prevalence of obesity from 1995 to 2001, and the prevalence of obesity was 31.8% in 2005 [8]. As a result of this trend, laparoscopic surgery has been increasingly performed in obese patients. However, several previous studies reported that obesity is a potential risk factor for poor outcomes after laparoscopic surgery. Therefore, obesity was regarded to be a relative contraindication to laparoscopy [9,10]. Despite these suggestions, the use of laparoscopic surgery for surgical procedures has been rapidly growing and most of the literature now agrees that the laparoscopic approach is feasible and safe in obese patients.

Several recent studies have concerned the effect of obe-

sity on the perioperative outcomes of LRN [9-15]. However, most studies were limited to T1 renal cell carcinoma (RCC). In the present study, we estimated the impact of obesity on LRN in T2 RCC as well as T1 RCC.

MATERIALS AND METHODS

From January 2004 to March 2011, we retrospectively analyzed 266 patients who underwent LRN for T1 and T2 RCC. All LRN procedures were performed by a single experienced laparoscopic surgeon. All patients were divided into T1 and T2 groups. These two groups were then subdivided into obese and nonobese groups according to body mass index (BMI) on the basis of the Asia-Pacific criteria in the World Health Organization classification. Patients with a BMI of 25 kg/m² or greater were defined as the obese group and those with a BMI of less than 25 kg/m² were defined as the nonobese group. Patients' demographic parameters and perioperative surgical outcomes were compared between the obese and nonobese groups in the same stage group. The demographic parameters included age, BMI, gender, tumor size, and tumor laterality. To evaluate the operative outcomes, we compared operative time, actual blood loss (ABL) [16], transfusion rate, time to oral intake, hospital stay, and complication rate.

LRN was performed by the transperitoneal approach in all cases. Pneumoperitoneum was achieved by using a Veress needle, and 3 or 4 ports were placed depending on the case. After laterocolic incision and mobilization of the colon, the renal hilum was dissected in the standard fashion with adequate visualization of the renal vein and artery. We used 3 or 4, 10 or 15 mm Hem-o-Lok clips to control the renal artery. The renal vein was controlled by 3 or 4, 15 mm clips. Para-aortic or paracaval and hilar lymph node dissection (LND) were performed when an enlarged lymph node was found radiologically before surgery or grossly during the operation. We removed the kidney, which was surrounded by the perinephric fat and enveloped by Gerota's fascia, with or without a concomitant adrenalectomy. All of the specimens were removed intact without morcellation or fragmentation in an Endo Catch retrieval bag through a lower abdominal incision. An indwelling Jackson-Pratt drain was placed in the retroperitoneal space through a 5 mm port site in all of the patients.

Continuous variables were compared with an independent Student's t-test and categorical variables were assessed with the chi-square test. All p values were 2-sided, and $p < 0.05$ was considered significant. Analyses were conducted by using SPSS ver. 12.0 (SPSS Inc., Chicago, IL, USA).

RESULTS

The non-obese T1 group and the obese T1 group included 135 and 60 patients, and the non-obese T2 group and the obese T2 group included 49 and 22 patients, respectively.

TABLE 1. Comparison of patients' demographic data and perioperative surgical outcomes in the T1 group

	Non obese (n=135)	Obese (n=60)	p-value
Age (yr)	57.7±11.6	55.8±11.5	0.298
Sex (M/F)	87/48	42/18	0.449
BMI (kg/m ²)	22.0±1.92	27.0±1.84	<0.001
Tumor size (cm)	3.51±1.20	3.50±1.14	0.908
Tumor laterality (Rt/Lt)	66/68	36/24	0.305
Operation time (min)	167.2±40.8	170.5±44.2	0.610
ABL (ml)	186.4±15.4	233.4±29.8	0.125
Transfusion rate (%)	5/135 (3.7)	5/60 (8.3)	0.176
Time to oral intake (days)	2.05±1.19	1.88±0.78	0.316
Hospital stay (days)	5.57±2.28	5.52±2.74	0.887
Complication rate (%)	12/135 (8.9)	5/60 (8.3)	0.899
Open conversion (%)	1 (0.7)	1 (1.6)	0.554

Data are presented as the mean±standard deviation. BMI: body mass index, ABL: actual blood loss

There were no significant differences in age, sex, mean tumor size, or tumor laterality between the nonobese T1 and obese T1 groups or between the nonobese T2 and obese T2 groups.

The mean operative time was similar between the non-obese T1 and obese T1 groups (167.2 minutes vs. 170.5 minutes, $p=0.610$). Although blood loss and the transfusion rate were higher in the obese T1 group than in the non-obese T1 group, these differences were not significant (186.4 ml vs. 233.4 ml, $p=0.125$; 3.7% vs. 8.3%, $p=0.176$). Time to oral intake, hospital stay, and complication rate were also not significantly different between the obese T1 and nonobese T1 groups (Table 1).

The mean operative time was significantly different between the non-obese T2 and the obese T2 groups (200.7 minutes vs. 253.6 minutes, $p < 0.001$). Blood loss and the transfusion rate were also higher in the obese T2 group than in the non-obese T2 group (220.5 ml vs. 313.5 ml, $p=0.193$; 20.4% vs. 27.3%, $p=0.522$); however, these differences were not significant. The complication rate was significantly higher in the obese T2 group than in the non-obese T2 group (10.2% vs. 31.8%, $p=0.025$). Time to oral intake and hospital stay were not significantly different between the obese T2 and the non-obese T2 groups (Table 2).

In a total of 266 patients, 29 complications (10.9%) occurred in our series. There was 1 case of open conversion in each group. Of 135 patients, 12 complications (8.9%; 1 pulmonary edema, 2 ileus, 9 chylous ascites) occurred in the non-obese T1 group, and of 60 patients, 5 complications (8.3%; 1 wound dehiscence, 1 pneumonia, 3 chylous ascites) occurred in the obese T1 group ($p=0.899$). Of 49 patients, 5 complications (10.2%; 1 ileus and 3 chylous ascites, 1 pneumothorax) occurred in the nonobese T2 group, and of 22 patients, 7 complications (31.8%, 1 pulmonary edema, 1 wound dehiscence, 2 ileus, and 3 chylous ascites) occurred in the obese T2 group ($p=0.025$). According to the complication classification system suggested by Clavien et al [17],

TABLE 2. Comparison of patients' demographic data and perioperative surgical outcomes in the T2 group

	Non obese (n=135)	Obese (n=60)	p-value
Age (yr)	55.1±11.4	55.9±13.5	0.790
Sex (M/F)	32/17	13/9	0.615
BMI (kg/m ²)	22.5±1.56	27.2±1.81	<0.001
Tumor size (cm)	7.41±1.65	7.00±9.52	0.287
Tumor laterality (Rt/Lt)	26/23	14/8	0.406
Operation time (min)	200.7±52.0	253.6±49.0	<0.001
ABL (ml)	220.5±41.1	313.5±52.0	0.193
Transfusion rate (%)	10/49 (20.4)	6/22 (27.3)	0.522
Time to oral intake (days)	2.14±0.98	2.40±1.00	0.297
Hospital stay (days)	6.29±2.97	6.27±2.85	0.986
Complication rate (%)	5/49 (10.2)	7/22 (31.8)	0.025
Open conversion (%)	1 (2.0)	1 (4.5)	0.555

Data are presented as the mean±standard deviation. BMI: body mass index, ABL: actual blood loss

21 cases were grade I and 8 cases were grade II. There were no grade III or worse complications (Table 3).

DISCUSSION

Obesity is a major public health issue that affects more than 30% of Korean adults [8]. Many diseases, including diabetes, coronary artery disease, hypertension, breast cancer, colon cancer, and osteoarthritis, are associated with obesity [18]. Theoretically, obese patients with these comorbid conditions have an increased risk of poorer outcomes after surgical treatment. At the beginning of laparoscopic surgery, obesity was considered to result in much technical challenge owing to the difficulty of trocar insertion, inadequate insufflations, limited movement of the trocars, and a narrow working space [12]. Laparoscopic surgery in obese patients is also a challenge for anesthesiologists, and obesity may complicate respiratory and hemodynamic management [19]. To minimize pulmonary complications including atelectasis and pneumonia, preoxygenation and rapid sequence induction should be performed and spirometry should be initiated in the immediate postoperative period. We must carefully discuss with anesthesiologists the perioperative management of obese patients undergoing LRN. Therefore, in the mid 1990s, there was much controversy regarding whether the benefits of laparoscopy existed for obese patients. Mendoza et al reported that obese patients were more prone to complications (57% vs. 16%) and Gill et al noted that obese patients underwent more conversions to open surgery (35% vs. 6%) [10,20]. However, in the current era, most of the literature now agrees that the laparoscopic approach is feasible and safe in obese patients. Futiga et al reported no statistically significant difference in operation time, blood loss, conversion rate, complications, length of hospitalization, or time to ambulation in a study of 32 obese and 69 normal-weight patients undergoing LRN [12]. Doublet and

TABLE 3. Complications of obese and nonobese patients with T1 or T2 renal cell carcinoma

	T1		T2	
	Non obese	Obese	Non obese	Obese
Pneumonia	0	1	0	0
Pulmonary edema	1	0	0	1
Ileus	2	0	1	2
Chylous ascites	9	3	3	3
Pneumothorax	0	0	1	0
Wound dehiscence	0	1	0	1

Belair also found no significant difference in operative time or complications between obese and nonobese patients [21]. Miyake et al reported no significant differences in operative time, estimated blood loss during LRN, and the incidences of open conversion and postoperative complications between these two groups [22]. In an analysis of 26 open radical nephrectomies and 30 LRNs, Lee et al reported that LRN is effective for both obese and nonobese patients [15]. Moreover, several studies reported better outcomes of laparoscopic surgery in obese patients. Fazeli-Matin et al reported that laparoscopic renal and adrenal surgery in obese patients showed lower blood loss, quicker return of bowel function, less analgesic requirement, shorter convalescence, and reduced hospital stay [11]. Klingler et al suggested that obese patients benefit more from laparoscopy than do nonobese patients with respect to postoperative pain and morbidity but do not experience more complications [23]. However, most of those reports were mainly intended for small-sized RCC, and there have been few studies about the impact of obesity for larger tumors.

With the development of laparoscopic technique, the indications for LRN are expanding to encompass increasingly larger tumors. However, large tumors often result in several problems for LRN, including decreased working space, difficulty with maintenance of operator orientation, incidence of significant parasitic vessels, and difficult specimen removal, and are often combined with enlarged lymph nodes. Therefore, large tumors entail technical concerns even in the hands of experienced laparoscopic surgeons. Obesity also adds technical challenge to laparoscopic surgery. These challenges include inadequate insufflation of the peritoneal cavity, difficulty of trocar insertion, maintenance of pneumoperitoneum, and restrictive visualization due to limited exposure. Moreover, obese patients usually have a thicker abdominal wall that may result in limited movement of the trocars and decreased sensitivity felt by the surgeon. Obesity also induces more visceral fat, which has more parasitic vessels and consequently has more potential for bleeding in the operation field with impairment of the visual field. On the other hand, laparoscopic surgery in obese patients has several potential advantages. Compared with open surgery, laparoscopic surgery can minimize skin incision, and this minimal incision can prevent the risk of wound complications.

In addition, laparoscopic surgery can reduce abdominal wall incision and closing time and may decrease the entire operative time. Reduction of operative time may reduce complications related to the patient's general condition caused by prolonged anesthesia.

In our study, we found that obesity had no significant effect on operative outcomes if the tumor size was smaller than 7 cm. Blood loss, the transfusion rate, operation time, time to oral intake, hospital stay, and the complication rate were not significantly different. However, in cases of larger tumors (> 7 cm), we found that the operation time and complication rate were significantly increased in the obese group. This may have been because of the narrower working space and increased visceral fat. In the case of small tumors, although the working space may be decreased in obese patients, if we approach transperitoneally, enough working space can usually be secured. However, in the case of larger tumors, because of the volume effect of the tumor, more time can be taken for the dissection of the perirenal space as well as hilar dissection. Moreover, larger tumors may have a greater chance of being accompanied by enlarged lymph nodes irrespective of lymph node invasion. Therefore, when we undertake LRN in T2 obese patients, the lymphatic channels can be easily injured during hilar, paraaortic, or paracaval dissection owing to the increased visceral fat tissue.

For other consideration of our results, we suggest that the surgeon's skill plays a major role in the perioperative outcomes of LRN in obese patients. The experienced laparoscopic surgeon may overcome the difficulties of surgery in obese patients if the tumor size is small. However, the obese T2 RCC patients in our study showed a significant increase in operation times (200.7 vs. 253.6 minutes, respectively, $p < 0.001$) and complication rates (10.2% vs. 31.8%, $p = 0.025$) compared with nonobese T2 RCC patients. In T2 RCC patients, who have larger tumors than T1 RCC patients, even experienced laparoscopic surgeons can be affected by obesity in the patient. Therefore, we suggest that obesity may be an important factor that negatively influences operative outcomes of LRN for T2 RCC patients. As a result, we should pay more attention if we are planning to perform LRN on T2 RCC in obese patients.

The limitations of our study were that it had a retrospective design and did not involve comparisons with open surgery. We need to compare laparoscopic and open surgery in obese T2 RCC patients. However, our data were enough to evaluate the surgical outcomes of LRN related to obesity, and the surgical techniques were standardized. Moreover, it is significant that this report is the first about the impact of obesity on LRN of large RCC in Korea.

CONCLUSIONS

Our results suggest that LRN can be safely performed in Korean patients with T1 RCC regardless of obesity. However, in T2 RCC patients, LRN may become more difficult with increasing BMI considering the longer operation

time as well as the higher complication rate. In conclusion, we suggest that LRN in obese patients with T2 RCC must be considered carefully.

Conflicts of Interest

The authors have nothing to disclose.

REFERENCES

1. Clayman RV, Kavoussi LR, Soper NJ, Dierks SM, Meretyk S, Darcy MD, et al. Laparoscopic nephrectomy: initial case report. *J Urol* 1991;146:278-82.
2. Saranchuk JW, Savage SJ. Laparoscopic radical nephrectomy: current status. *BJU Int* 2005;95(Suppl 2):21-6.
3. Dunn MD, Portis AJ, Shalhav AL, Elbahnasy AM, Heidorn C, McDougall EM, et al. Laparoscopic versus open radical nephrectomy: a 9-year experience. *J Urol* 2000;164:1153-9.
4. Ono Y, Kinukawa T, Hattori R, Gotoh M, Kamihira O, Ohshima S. The long-term outcome of laparoscopic radical nephrectomy for small renal cell carcinoma. *J Urol* 2001;165:1867-70.
5. Gill IS, Meraney AM, Schweizer DK, Savage SS, Hobart MG, Sung GT, et al. Laparoscopic radical nephrectomy in 100 patients: a single center experience from the United States. *Cancer* 2001;92:1843-55.
6. Kim JS, Kwon TG, Kim BW. Laparoscopic radical nephrectomy for T2 renal cell carcinomas. *Korean J Urol* 2006;47:1139-43.
7. Steinberg AP, Finelli A, Desai MM, Abreu SC, Ramani AP, Spaliviero M, et al. Laparoscopic radical nephrectomy for large (greater than 7cm, T2) renal tumors. *J Urol* 2004;172:2172-6.
8. Kim DM, Ahn CW, Nam SY. Prevalence of obesity in Korea. *Obes Rev* 2005;6:117-21.
9. Kapoor A, Nassir A, Chew B, Gills A, Luke P, Whelan P. Comparison of laparoscopic radical renal surgery in morbidly obese and non-obese patients. *J Endourol* 2004;18:657-60.
10. Mendoza D, Newman RC, Albala D, Cohen MS, Tewari A, Lingeman J, et al. Laparoscopic complications in markedly obese urologic patients (a multi-institutional review). *Urology* 1996;48:562-7.
11. Fazeli-Matin S, Gill IS, Hsu TH, Sung GT, Novick AC. Laparoscopic renal and adrenal surgery in obese patients: comparison to open surgery. *J Urol* 1999;162:665-9.
12. Futiga OE, Chan DY, Roberts WW, Kavoussi LR, Jarrett TW. Laparoscopic radical nephrectomy in obese patients: outcomes and technical considerations. *Urology* 2004;63:247-52.
13. Han DY, Oh SJ, Seo IY, Rim JS. Influence of obesity on laparoscopic radical nephrectomy. *Korean J Urol* 2007;48:771-4.
14. Lee JH, Kim KH, Cho DS, Kim SI, Kim SJ. Impact of body mass index on the prognosis of patients undergoing radical nephrectomy for non-metastatic renal cell carcinoma. *Korean J Urol* 2008;49:579-84.
15. Lee JG, Yoo KH, Min GE, Chang SG, Jeon SH. Laparoscopic radical nephrectomy in obese and non-obese patients: Comparison with open surgery. *Korean J Urol* 2009;50:1003-8.
16. McCullough TC, Roth JV, Ginsberg PC, Harkaway RC. Estimated blood loss underestimates calculated blood loss during radical retropubic prostatectomy. *Urol Int* 2004;72:13-6.
17. Clavien PA, Sanabria JR, Strasberg SM. Proposed classification of complications of surgery with examples of utility in cholecystectomy. *Surgery* 1992;111:518-26.
18. Bray GA. Obesity. In: Fauci AS, Braunwald E, Isselbacher KJ, Wilson JD, Martin JB, Kasper DL, editors. *Harrison's principle*

- or internal medicine. 14th ed. New York: McGraw-Hill; 1998; 454-62.
19. Midgley S, Tolley DA. Anaesthesia for laparoscopic surgery in urology. *EAU-EBU* 2006;4:241-5.
 20. Gill IS, Kavoussi LR, Clayman RV, Ehrlich R, Evans R, Fuchs G, et al. Complications of laparoscopic nephrectomy in 185 patients: a multi-institutional review. *J Urol* 1995;154:479-83.
 21. Doublet J, Belair G. Retroperitoneal laparoscopic nephrectomy is safe and effective in obese patients: a comparative study of 55 procedures. *Urology* 2000;56:63-6.
 22. 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;17:522-6.
 23. Klingler HC, Remzi M, Janeschek G, Marberger M. Benefits of laparoscopic renal surgery are more pronounced in patients with a high body mass index. *Eur Urol* 2003;43:522-7.