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LAPAROSCOPY
Original Article

Retroperitoneoscopic nephrectomy has better perioperative outcomes than transperitoneal laparoscopic nephrectomy in obese patients

Retroperitoneoskopik nefrektomi obez hastalarda transperitoneal laparoskopik nefrektomiden daha iyi perioperatif sonuçlara sahiptir

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ABSTRACT

Objective: This retrospective, case-controlled study compares the operative outcomes of retroperitoneoscopic nephrectomy (RN) and transperitoneal laparoscopic nephrectomy (TLN) in obese patients.

Materials and Methods: A total of 202 operations, including 114 radical and 88 simple nephrectomies were identified from our prospectively collected institutional laparoscopic nephrectomy database. Patients were stratified into 3 groups according to the World Health Organization's body mass index (BMI) classification: normal (Group 1-BMI <25 kg/m^2, n=68), overweight (Group 2-25 kg/m^2 ≤ BMI <30 kg/m^2, n=88) and obese (Group 3-BMI ≥30 kg/m^2, n=46). Furthermore, each group was divided into two subgroups according to the operation performed (RN or TLN). Perioperative parameters were compared statistically between the RN and TLN subgroups in all of the BMI-stratified categories.

Results: The results for mean operative time (p<0.001, p=0.034 and p=0.005), estimated blood loss (p<0.001, p<0.001 and p=0.002) and length of hospital stay (p=0.005, p<0.001 and p<0.001) were all significantly in favor of RN in Groups 1, 2 and 3, respectively. The complication rate did not significantly differ between RN and TLN in the BMI-stratified groups. Conversely, the open conversion rate was significantly higher for TLN in Group 1 (p=0.024); this rate was similar for RN and TLN in Group 2 (p=0.22) and Group 3 (p=0.658).

Conclusion: Retroperitoneoscopic nephrectomy has better perioperative outcomes in obese patients; these outcomes are similar to those seen in non-obese patients. However, both retroperitoneoscopic and transperitoneal laparoscopic operations can be safely performed, with the same complication and open conversion rates, in obese patients.

Key words: Nephrectomy; obesity; retroperitoneoscopic; transperitoneal laparoscopic.

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ÖZET

Amaç: Bu retrospektif vaka-kontrol çalışmasında, obez hastalarda retroperitoneoskopik nefrektomi (RN) ve transperitoneal laparoskopik nefrektomi (TLN) operatif sonuçlar açısından karşılaştırıldı.

Gereç ve Yöntem: Kurumsal laparoskopik nefrektomi veritabanından, 114'ü radikal ve 88'i basit toplam 202 operasyon belirlendi. Hastalar, Dünya Sağlık Örgütü'nün vücut kitle indeksi (VKİ) sınıflamasına göre 3 gruba ayrıldı; normal (Grup 1 - VKİ <25 kg/m^2, n=68), aşırı kilolu (Grup 2-25 kg/m^2 ≤ VKİ <30 kg/m^2, n=88) ve obez (Grup 3-VKİ ≥ 30 kg/m^2, n=46). Her grup, RN ve TLN operasyonlarına göre ileri iki altgruba ayrıldı. Perioperatif parametreler VKİ'ye göre sınıflandırılmış gruplarda, RN ve TLN arasında istatistiksel olarak karşılaştırıldı.

Bulgular: Operasyon süresi (p<0.001, p=0.034 and p=0.005), tahmini kan kaybı (p<0.001, p<0.001 and p=0.002) ve hastane yatış süresi (p=0.005, p<0.001 and p<0.001) sırasıyla Grup 1, 2 ve 3 için RN lehine anlamlı bulundu. Komplikasyonlar VKİ'ye göre sınıflandırılmış gruplarda, RN ve TLN arasında anlamlı olarak farklı değildi. Buna karşın; açık operasyona geçiş oranları Grup 1'de TLN için anlamlı olarak artmış (p=0.024) bulunurken Grup 2 (p=0.22) ve Grup 3'te (p=0.685) RN ve TLN arasında fark gözlenmedi.

Sonuç: Obez hastalarda, retroperitoneoskopik nefrektomi obez olmayan hastalarda olduğu gibi daha iyi perioperatif bulgulara sahiptir. Bununla birlikte, benzer komplikasyon ve açık operasyona geçiş oranları ile hem retroperitoneoskopik hem de transperitoneal laparoskopik yaklaşım obez hastalarda güvenle uygulanabilmektedir.

Anahtar sözcükler: Nefrektomi; obesite; retroperitoneskopik; transperitoneal laparoskopik.

Introduction

Obesity, defined as a body mass index (BMI) greater than 30 kg/m^2, is an increasingly common social health problem around the world, especially in Western societies and industrialized countries. The prevalence of obesity has been found to be approximately 3% in Japan and 30% in the United States.[1,2] Meanwhile, the prevalence of obesity was reported to be 16% in Turkey, and this rate tends to increase each year.[3] The same study reported that the proportion of the population that is overweight, which can be used to predict future obesity, is 40%. Many studies have shown that obesity is associated with general co-morbidity, depending on simultaneously occurring diabetes mellitus (DM) and hypertension. In addition, obesity is associated with an increased risk of perioperative complications, such as respiratory and cardiovascular problems, deep vein thrombosis (DVT), incisional hernias, wound infections and dehiscence.[4-8] Thus, obese patients are considered to be special, challenging cases when surgical interventions are considered.

Since it was first described in 1991, transperitoneal laparoscopic nephrectomy (TLN) has been widely accepted as a standard surgical method for the simple nephrectomy of non-functioning kidneys and the radical nephrectomy of clinically localized T1 and T2 tumors that are not amenable to partial nephrectomy.[9,10] Two years after the introduction of the transperitoneal technique, retroperitoneoscopic nephrectomy (RN) was described as an alternative to this approach.[11] Currently, long-term data indicate that transperitoneal laparoscopic and retroperitoneoscopic radical nephrectomy have cancer-free survival rates that are equivalent to that of open radical nephrectomy.[10, 12-14]

An increased incidence of renal cell carcinoma (RCC) in obese patients, as well as an increased rate of perioperative complications, has directed the attention of urologists to the surgical treatment of renal tumors in obese patients and has prompted them to use laparoscopic approaches in this special patient group.[15-17] However, to our knowledge, only a limited number of studies using the World Health Organization body mass index (WHO-BMI) classification have undertaken "head-to-head" comparisons of these two approaches in obese patients. The aim of the present study is to directly compare RN and TLN in terms of perioperative parameters, complications and open conversions.[18]

Materials and methods

In this study, radical and simple LNs were retrospectively analyzed from our prospectively collected institutional LN database. The database was adopted from the University of Michigan Laparoscopy Database Chart Abstraction form and includes demographic, operative, and follow-up information from more than 400 patients treated at our institution. Patients were excluded from the study if data related to demographics, BMI, peri-operative parameters or pathological findings were missing. Of those operations conducted between September 2005 and February 2011, 202 LNs (114 radical and 88 simple) were included in this study. The patients were stratified into 3 groups according to the WHO-BMI classification system: normal (Group 1-BMI <25 kg/m^2, n=68), overweight (Group 2-25 kg/m^2 ≤ BMI <30 kg/m^2, n=88) and obese (Group 3-BMI ≥30 kg/m^2, n=46). Each group was divided into retroperitoneoscopic (A) and transperitoneal (B) subgroups. The demographic data (age, sex, laterality, co-existence of DM or hypertension, and operation type), peri-operative outcomes (operative time, estimated blood loss, transfusion, length of hospital stay, complications, and open conversions) and pathological results of the patients in each group were compared.

Surgical technique: Briefly, in the RN procedures, the patient was placed in a standard full-flank position, a 2-cm incision was made at the Petit triangle, and a dissector was inserted into the retroperitoneal space through the thoracolumbar fascia. The retroperitoneal space was dilated with a balloon dilator; in left-sided cases, a 12-mm trocar was inserted at the tip of the 12th rib and a 5-mm trocar was inserted 3 cm above the anterior superior iliac spine. In right-sided cases, the 12-mm and 5-mm ports were reversed. Following the placement of a 10-mm trocar at the Petit incision for the camera, the operation continued with blunt dissection and the identification of the ureter, renal hilus and vessels. After the application of 3 Hem-o-lok® clips on each artery and vein, the vessels were transected. The specimen was released from the surrounding adhesions and was removed.

In the TLN procedures, the patient was placed in a 45°-60° modified flank position. A Veress needle was used to create a 15 mmHg pneumoperitoneum. A 10-mm trocar was placed lateral to the umbilicus, and the camera was introduced into the abdominal cavity. In right-sided cases, a 12-mm second port was placed at the midclavicular line 2 cm below the costal margin, while the 5-mm third port was inserted between the anterosuperior iliac spine and the umbilicus. In left-sided cases, a 12-mm port was placed between the anterosuperior iliac spine and the umbilicus, while a 5-mm port was placed at the midclavicular line 2 cm below the costal margin. Dissection started with the incision of the white line of Toldt, and the ascending or descending colon was reflected, medially exposing the retroperitoneum. The ureter was identified and dissected, and the hilar vessels were observed. Following the application of 3 Hem-o-lok® clips on each artery and vein, the vessels were transected. The specimen was released from the surrounding adhesions and was removed. All operations were performed or supervised by a single attending surgeon (OS).

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Statistical analysis: Parametric continuous variables are reported as the mean and standard deviation, whereas ordinals or variables not fitting normal distributions are reported as the median and range. The Student's t test, the Mann-Whitney U test, Pearson's χ^2 test, and Fisher's exact test were used when appropriate to compare continuous and categorical variables. For all statistical analyses, a two-sided $p<0.05$ was considered statistically significant.

Results

Two major demographic differences (distribution of sex and operation type) were identified between Groups A and B (Table 1). TLN was used more often in male patients (p=0.006) and in those undergoing radical nephrectomies (p<0.001). Other demographic variables were comparable between the groups.

Among the perioperative parameters, operative time (OT), estimated blood loss (EBL), need for transfusion, length of hospital stay (LHS) and complication rates all favored the retroperitoneoscopic groups (p<0.001, p<0.001, p=0.019, p<0.001 and p=0.022, respectively). Rates of conversion to open surgery were similar in the RN and TLN subgroups (p=0.063) (Table 1).

Outcomes comparing RN and TLN among the BMI-stratified groups are listed in Table 2. The distribution of operation types was significantly different in all groups. More radical nephrectomies were performed transperitoneally in each BMI-stratified group (p=0.019, p=0.002 and p=0.054, respectively) and in the entire study cohort. Only in the overweight group was the distribution of sex different, with a larger male population undergoing TLN. In all of the BMI-stratified groups, perioperative parameters indicated that RN had statistically significant improved outcomes over TLN in terms of OT (p<0.001, p=0.034 and p=0.005, respectively for Group 1, 2 and 3), EBL (p<0.001, p<0.001 and p=0.002, respectively) and LHS (p=0.005, p<0.001 and p<0.001, respectively). Other parameters, including the need for transfusions, complications and conversion rates, were similar for the RN and TLN procedures in all groups (Table 2). Intraoperative and postoperative complications for both the retroperitoneoscopic and transperitoneal laparoscopic subgroups in all of the BMI-stratified groups are cited in Table 3.

Table 4 lists the numbers of and reasons for open conversions. In patients with a normal BMI (Group 1), no open conversions occurred with RN and four occurred with TLN (p=0.021). In overweight patients (Group 2), one open conversion occurred with RN and four occurred with TLN (p=0.147). In obese patients (Group 3), two open conversions occurred with RN and one occurred with TLN (p= 0.548).

Table 1. Comparison of retroperitoneoscopic (A) and transperitoneal (B) laparoscopic nephrectomies

	Retroperitoneoscopic (A)	Transperitoneal (B)	p
Number	103	99	
Male/Female	49/54	66/33	0.006
Female (%)	52.4	33.3	0.006
Age	51±16.20	53.02±13.23	0.334
Body Mass Index (kg/m^2)	27.27±5.51	26.83±4.38	0.536
ASA score	1 (1-4)	1 (1-3)	0.135
Diabetes Mellitus (n; %)	11; 10.7	12; 12.1	0.747
Hypertension (n; %)	32; 31.1	42; 42.4	0.094
Radical/Simple (n)	43/60	71/28	<0.001
Radical nephrectomy (%)	41.7	71.7	<0.001
Right/Left (n)	46/57	44/55	0.975
Right side (%)	44.66	44.44	0.975
Operation time (min.)	116.16±31.66	148.19±52.009	<0.001
Estimated blood loss (cc)	50 (0-500)	150 (0-2000)	<0.001
Transfusion (unit)	0 (0-2)	0(0-4)	0.019
Hospital stay (day)	2 (1-11)	3 (2-21)	<0.001
Complications (n; %)	18; 17.5	31; 31.3	0.022
Conversions to open surgery (n; %)	3; 2.9	9; 9.1	0.063

The pathological findings are listed in Table 5 and are separated according to retroperitoneoscopic and transperitoneal laparoscopic approaches in each group. Renal cell carcinoma and pyelonephritis were the most commonly reported pathologies.

The mean tumor diameter was 6.46 cm for the patients undergoing laparoscopic radical nephrectomy. The mean tumor size was 5.80 cm and 6.86 cm in the retroperitoneoscopic and transperitoneal procedures, respectively, but the difference in size was not statistically significant. Pathological analyses revealed renal cell carcinoma in 72% and 89% of the radical nephrectomies in the RN and TLN groups, respectively, without surgically positive margins in all cases.

Discussion

Initial studies in urology suggested that obesity is a contraindicative factor for laparoscopic operations.[19,20] However, the development of new technologies and increasing surgical experience have enabled laparoscopists to overcome the obstacles to LN presented by obese patients. Thus, published evidence indicates

Table 2. Comparison of retroperitoneoscopic (A) and transperitoneal (B) laparoscopic nephrectomies in each BMI-stratified group

	Group 1 - Normal (BMI < 25 kg/m²)			Group 2 - Overweight (25 kg/m² ≤ BMI < 30 kg/m²)			Group 3 - Obese (BMI ≥ 30 kg/m²)		
	Retroperitoneoscopic (A)	Transperitoneal (B)	p	Retroperitoneoscopic (A)	Transperitoneal (B)	p	Retroperitoneoscopic (A)	Transperitoneal (B)	p
Number	37	31		41	47		25	21	
Male/Female	22/15	24/7	0.115	21/20	34/13	0.041	6/19	8/13	0.301
Female (%)	40.5	22.6	0.115	48.8	27.7	0.041	76	61.9	0.301
Age	45.97±19.32	51.32±16.05	0.224	52.63±13.17	53.91±11.93	0.634	55.76±14.13	53.52±11.74	0.567
Body Mass Index (kg/m²)	22.24±2.56	22.31±2.04	0.895	27.52±1.45	27.01±1.23	0.079	34.30±5.04	33.11±3.37	0.359
ASA score	1 (1-3)	1 (1-3)	0.329	1 (1-2)	1 (1-3)	0.071	2 (1-4)	2 (1-3)	0.689
Diabetes Mellitus (n; %)	2; 5.4	3; 9.7	0.501	4; 9.8	7; 14.9	0.467	5; 20	2; 9.5	0.324
Hypertension (n; %)	7; 18.9	12; 38.7	0.07	12; 29.3	18; 38.3	0.373	13; 52	12; 57.1	0.727
Radical/Simple (n)	11/26	18/13	0.019	17/24	35/12	0.002	15/10	18/3	0.054
Radical (%)	29.7	58.1	0.019	41.5	74.5	0.002	60	85.7	0.054
Right/Left (n)	17/20	15/16	0.841	20/21	23/24	0.988	9/16	6/15	0.592
Right (%)	45.94	48.38	0.841	48.78	48.93	0.988	36	28.57	0.592
Operation time (min.)	112.43±32.02	152.26±37.83	<0.001	121.17±26.57	142.57±58.37	0.034	113.44±38.39	154.76±55.89	0.005
Estimated blood loss (cc)	50 (20-500)	150 (20-2000)	<0.001	50 (0-300)	150 (0-2000)	<0.001	80 (10-500)	200 (30-1000)	0.002
Transfusion (unit)	0 (0-2)	0 (0-2)	0.056	0 (0-2)	0 (0-4)	0.227	0 (0-1)	0 (0-2)	0.242
Hospital stay (day)	3 (1-11)	3 (2-10)	0.005	2 (1-4)	3 (2-21)	<0.001	2 (2-5)	4 (2-11)	<0.001
Complications (n; %)	9; 24.3	14; 45.2	0.07	4; 9.8	10; 21.3	0.141	5; 20	7; 33.3	0.305
Open Conversion (n; %)	0; 0	4; 12.9	0.024	1; 2.4	4; 8.5	0.22	2; 8	1; 4.8	0.658

that open and laparoscopic procedures in obese patients have similar results in terms of perioperative outcomes and complications. These studies suggest that laparoscopy can be performed safely and as feasibly as open surgery in obese patients.[21,22] Other comparative studies have highlighted similar complication and open conversion rates between obese and non-obese patients who have undergone laparoscopic nephrectomy despite the increased operative times and greater estimated blood loss seen in obese patients.[23-25]

In general, the present study aimed to examine another issue related to LN in obese patients and to determine whether the retroperitoneoscopic or transperitoneal laparoscopic approach is better. The general comparison of all RN and TLN procedures, listed in Table 1, revealed that retroperitoneoscopic surgery had significantly better outcomes in terms of OT, EBL, transfusion rate and LHS, regardless of BMI. Meanwhile, complication rates were significantly higher with TLN. In their prospective, randomized comparison, Desai et al.[26] obtained statistically significant results indicating shorter renal hilar control and total operative time for RN, whereas EBL, LHS and complication rates were similar between RN and TLN. In the present study, better perioperative outcomes and a reduction in the complication rate in RN may have been associated with the well-known advantages of retroperitoneoscopy over the transperitoneal approach, such as direct hilar control and less surgical dissection for mobilizing the kidney.

When our data were analyzed according to the WHO-BMI classification system, both normal and overweight patients were found to have significantly better outcomes (in OT, EBL and LHS) with the retroperitoneoscopic approach. Furthermore, complication rates were similar between the two techniques in both groups. Similar advantages are also observed with retroperitoneoscopic approaches in obese patients. A comparison of RN and TLN obtained from the literature is detailed in Table 6.[26-32] Generally, there were no significant differences between the two techniques with respect to perioperative parameters (including OT, EBL and LHS). However, a tendency toward increased complications and higher open conversion

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Table 3. List of intraoperative and postoperative complications in retroperitoneoscopic (A) and transperitoneal (B) laparoscopic groups of BMI-stratified patients

	Group 1 - Normal (BMI < 25 kg/m²)		Group 2 - Overweight (25 kg/m² ≤ BMI < 30 kg/m²)		Group 3 - Obese (BMI ≥ 30 kg/m²)	
Complications	**Retro-peritoneoscopic (A)**	**Trans-peritoneal (B)**	**Retro-peritoneoscopic (A)**	**Trans-peritoneal (B)**	**Retro-peritoneoscopic (A)**	**Trans-peritoneal (B)**
Intraoperative						
Hemorrhage	-	-	-	2	-	1
Peritoneal injury	1	-	-	1	-	-
Pancreatic injury	-	-	-	-	1	-
Splenic injury	-	2	-	1	-	1
Renal Artery injury	-	1	-	-	-	-
Renal Vein injury	-	1	-	-	-	-
Renal Artery and Vein injury	-	1	-	-	-	-
Colonic injury	-	-	-	1	-	-
Inferior Caval Vein injury	-	-	1	-	1	-
Postoperative						
Fever	3	3	2	2	1	3
Transfusion	4	5	1	5	1	-
Elongated drainage	-	-	-	1	-	-
Ileus	-	1	-	-	-	2
Pneumonia	-	-	-	-	-	1
Pulmonary embolism	-	-	-	1	-	-
Death	1	-	-	-	1	-
Total	9	14	4	14 (in 10 patients)	5	8 (in 7 patients)

Table 4. Open conversions in retroperitoneoscopic (A) and transperitoneal (B) groups of BMI-stratified patients

	Group 1 - Normal (BMI < 25 kg/m²)	Group 2 - Overweight (25 kg/m² ≤ BMI < 30 kg/m²)	Group 3 - Obese (BMI ≥ 30 kg/m²)
Retroperitoneoscopic (A)			
Insufficient laparoscopic exploration of kidney	-	1	-
Vena Cava injury	-	-	1
Bleeding from tumor vessels	-	-	1
Transperitoneal (B)			
Adhesions causing difficult manipulation	-	3	-
Renal artery injury	1	1	-
Renal vein injury	1	-	-
Splenic injury	1	-	-
To extract caval tumor thrombus	1	-	-
Bleeding from tumor vessels	-	-	1

Table 5. Pathological reports in each group

	Group 1 - Normal (BMI < 25 kg/m²)		Group 2 - Overweight (25 kg/m² ≤ BMI < 30 kg/m²)		Group 3 - Obese (BMI ≥ 30 kg/m²)	
	Retro-peritoneoscopic (A)	Trans-peritoneal (B)	Retro-peritoneoscopic (A)	Trans-peritoneal (B)	Retro-peritoneoscopic (A)	Trans-peritoneal (B)
Renal Cell Carcinoma	9	16	12	33	10	14
Transitional Cell Carcinoma	-	-	1	1	1	-
Oncocytoma	1	-	3	2	-	1
Angiomyolipoma	-	-	1	-	1	2
Fusiform Cell Carinoma	-	2	-	-	-	-
Squamous Cell Carcinoma	1	-	-	-	-	-
Pyelonephritis	16	12	15	8	9	2
Nephrolithiasis	4	1	5	3	3	1
Hydatid Cyst	-	-	-	-	-	1
Chronic Renal Failure	6	-	3	-	1	-
Arterio-Venular Fistula	-	-	1	-	-	-

Table 6. Studies comparing retroperitoneoscopic and transperitoneal laparoscopic nephrectomy

Authors	Approaches (RN / TLN)	Mean Operative M Time (min.)	Estimated Blood Loss (ml.)	Length of Hospital Stay (day)	Complications (%)	Conversions to Open Surgery (%)
Nambirajan et al.[28], 2004	20/20	213/181	208/179	7.6/7.2	5/10	0/0
Desai et al.[26] 2005	52/50	150/206#	242/180	1.87/1.80	19/30	0/0
Berdjis et al.[29], 2006	29/34	183/190	ND	ND	7/15	0/0
Nadler et al.[30]∞, 2006	11/11	185/196	107/127	3.6/2.1	9/9	0/9
Berglund et al.[31]*, 2007	40/13	180/190	100/150	1.58/2.25	5/0	0/15
Okegawa et al.[32], 2008	53/47	267/292	202/223	12.3/13	9/13	0/2
Taue et al.[27], 2009	67/33	280/258	50/50	12/11	6/24	0/9
Present Study (Overall)	103/99	116/148#	50/150#	2/3#	17.5/31.3#	2.9/9.1
Present Study (Obese)	25/21	113/154#	80/200#	2/4#	20/33	8/4.8

ND Not defined in the literature
#Statistically significant outcomes
∞Comparing retroperitoneoscopic, transperitoneal and hand-assisted techniques
*Comprising only extremely obese (BMI ≥40 kg/m²) patients

rates has been reported with TLN. Only Desai et al.[26] obtained statistically significant results in terms of OT favoring the RN group. Thus, it is reasonable to conclude that the techniques could be performed with equivalent safety in obese patients.

In obese patients, retroperitoneoscopy in a 90º flank position offers important advantages, including the avoidance of intraabdominal fatty tissues and pannus. This benefit allows the surgeon to have additional intraoperative maneuverability and to more easily achieve hilar control. Moreover, the retroperitoneoscopic approach allows for an operational field far from adjacent abdominal organs, which decreases the complication rates associated with these organs. However, limited working space is the most emphasized disadvantage of RN. Conversely, TLN offers a large working space and anatomic landmarks (liver, spleen, colon) that facilitate orientation during the operation. At the same time, the proximity of these anatomic landmarks in TLN may cause more complications related to these organs. The most important problem in obese patients regarding TLN is increased abdominal wall fat, which decreases the maneuverability of the

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surgeon. Increased subcutaneous fatty tissue affects the ability to fix trocars to the skin, causing inadequate flexibility and preventing the surgeon from successfully reaching the operational field. Modifications to address this problem in obese patients have been suggested in the past; these include using a modified 45° flank position, shifting trocars lateral to the umbilicus, inserting a fourth trocar, and using greater insufflation pressures, extra-long instruments and bariatric trocars for TLN.[33] Another concern, regardless of BMI, in TLN is an increased risk of postoperative ileus secondary to colon mobilization; this complication is especially challenging to the surgeon in patients who have undergone previous abdominal surgeries.[34]

The present study has some limitations that should be mentioned. First, this study included two different operations, simple and radical nephrectomies, that were evaluated in the same study cohort. Although the inclusion criteria could be regarded as a drawback of the current study, the high number of pyelonephritic kidneys undergoing simple RN may justify this selection bias. Although this methodological approach may have complicated the comparison of perioperative data for both groups, we believe that the perioperative outcomes of these operations were not significantly different, except for the large tumors treated with TLN. Although simple nephrectomies are generally thought to be easier than radical nephrectomies, adhesions secondary to previous pyelonephritis and larger nonfunctioning kidneys can be challenging in simple nephrectomy cases. It is a matter of debate whether T2 radical nephrectomy or simple nephrectomy with adhesions secondary to pyelonephritis is a more technically demanding procedure. In the current study, due to the high number of pyelonephritic kidneys in simple nephrectomy patients (n=62), we evaluated both radical and simple nephrectomies in the same cohort.

Nevertheless, to our knowledge, the present study is the first that uses the World Health Organization BMI cut-off values to directly compare retroperitoneoscopic and transperitoneal laparoscopic approaches. We believe that future studies examining BMI should not only include normal and obese groups but should use the WHO-BMI criteria to separate patients into normal, overweight and obese groups.

Conclusion

The current study suggests that retroperitoneoscopic nephrectomy has better perioperative outcomes, specifically in terms of operative time, estimated blood loss and length of hospital stay, than transperitoneal laparoscopic nephrectomy in obese patients. These outcomes are similar to those seen in normal and overweight patients. Both approaches can be safely performed in obese patients with similar complication and open conversion rates.

Conflict of interest
No conflict of interest was declared by the authors.

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