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DIFFERENCES IN COMPLICATIONS AND OUTCOMES FOR OBESE PATIENTS UNDERGOING LAPAROSCOPIC RADICAL, PARTIAL OR SIMPLE NEPHRECTOMY

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ABSTRACT

Purpose: Obesity has increased dramatically in American society during the last 2 decades. While the laparoscopic approach is common for patients requiring radical and partial nephrectomy, it is unclear if this procedure leads to worse outcomes and complications in obese patients. We determined if obese patients undergoing laparoscopic radical (RN), partial (PN) and simple (SN) nephrectomy are at risk for worse surgical outcomes or increased complications.

Materials and Methods: We retrospectively identified patients treated with nontransplant transperitoneal laparoscopic nephrectomies from 1998 to 2003. Patients with missing body mass index (BMI), operative, postoperative or pathological information were excluded from study. Obese patients (BMI 30 or greater) were compared to nonobese patients (BMI less than 30).

Results: A total of 189 patients undergoing 117 RN, 44 PN and 30 SNs met study criteria, and 29.0% of patients were obese. Overall obese patients had longer operative times (280 versus 241 minutes, $p = 0.003$), greater estimated surgical blood loss (230 versus 109 ml, $p = 0.0001$) and higher transfusion rates (6.8% versus 0.8%, $p = 0.032$) than nonobese patients. In subgroup analyses obese patients receiving RN and PN had longer operative times and increased blood loss. Obese and nonobese patients have similar open conversion rates, analgesic requirements, hospital stay, time to oral intake, and major and minor complication rates regardless of nephrectomy type.

Conclusions: Laparoscopic nephrectomy is associated with slightly greater operative time, estimated blood loss and transfusion rates in obese patients. Laparoscopic RN, PN and SN are safe and well tolerated in obese patients. Obesity is not a contraindication to laparoscopic renal surgery.

KEY WORDS: laparoscopy, nephrectomy, obesity, complications, outcome assessment

The introduction of laparoscopic nephrectomy to the urological community in 1991 heralded a new era in urology.[1] The laparoscopic approach is now commonly used for radical, partial and simple nephrectomy. Laparoscopic radical nephrectomy for T1 and select T2 renal cell carcinoma (RCC) yields equivalent cancer control and lower morbidity compared to open surgery.[2]

The rate of obesity has increased dramatically in American society during the last 2 decades, from approximately 15% in 1980 to 30% in 2000.[3] Obese patients have higher rates of postoperative complications including nosocomial infections,[4] wound infections and wound dehiscence.[5] While conventional wisdom initially suggested obesity was a relative contraindication to undergoing laparoscopy,[6] some groups have begun to question the necessity of withholding general elective and laparoscopic urological procedures in cases of obesity.[7] However, it is still unclear if obese patients undergoing transperitoneal laparoscopic renal surgery are at increased risk for adverse perioperative and postoperative incidents and complications. It is our experience that transperitoneal laparoscopy can be more challenging in obese patients due to increased abdominal wall fat. In this study we determined if patients undergoing laparoscopic radical, partial and simple nephrectomy at our institution experienced worse surgical outcome or increased complications.

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Nothing to disclose.
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Editor's Note: **This article is the second of 5 published in this issue for which category 1 CME credits can be earned. Instructions for obtaining credits are given with the questions on pages 2512 and 2513.**

MATERIALS AND METHODS

The institutional review board approved the retrospective collection and analysis of data in this study. Analysis of our laparoscopic database identified 211 patients treated with 213 nontransplant nephrectomies from 1998 to 2003. Patients were excluded from study if they had missing body mass index (BMI), operative, postoperative or pathological information.

The transperitoneal approach was used in all cases. All surgeries were performed by 4 staff urologists, with the majority of cases evenly split among 3 surgeons and with residents involved in every case. There was no association between surgeon and proportion of obesity cases. Laparoscopic partial nephrectomy (PN), radical nephrectomy (RN) and simple nephrectomy (SN) were performed as previously described.[8,9] Patients underwent RN or PN for suspected ma-

lignancies seen on radiological examination and SN for removal of nonfunctioning kidneys. For all procedures the patient was placed in the lateral decubitus position on a flexed table. We typically used 4 ports placed in an L-shaped (left side) or reverse L-shaped (right side) configuration with a 12 mm port at the apex. Specimen retrieval was via intact removal in all PN cases, in 39% of RN cases and 15% of SN cases, with tissue retrieval via specimen morcellation (SM) in the remainder. Postoperative serum creatinine (Cr) levels were obtained in the outpatient setting, typically 4 weeks after the procedure.

Obese patients were defined as having a BMI of 30 kg/m^2 or more and were compared to nonobese patients with BMI less than 30 kg/m^2. Obese patients were compared to nonobese patients in the parameters of demographics (sex, race and BMI), preoperative complications (American Society of Anesthesiologists [ASA] Score, serum Cr, comorbidities, computerized tomography [CT] tumor size), operative complications (operative time, estimated operative blood loss [EBL], complications), postoperative complications (postoperative analgesic [PA] use in morphine sulfate equivalents, hospital stay [HS] and days till oral intake [OI]), and major and minor complications. The indications for transfusion were similar for both body mass groups. Statistical analyses were performed using the Wilcoxon rank sum test, ANOVA, logistic regression, the chi-square test and Fisher's exact test (StatView statistical package, SAS Institute, Cary, North Carolina).

RESULTS

A total of 189 patients undergoing 117 laparoscopic RNs, 44 laparoscopic PNs and 30 SNs were identified who met study criteria. Two patients with bilateral masses were treated with 2 procedures and 29.0% of all patients were obese. There was no difference in age between the nonobese and obese groups (59.1 versus 57.1 years, p = 0.62). Likewise male/female distribution, racial distribution, ASA score and history of previous abdominal surgery were not significantly different between nonobese and obese groups (table 1). Obese patients were more likely to have diabetes mellitus (DM, 20.6% versus 3.9%, p = 0.0002) and hypertension (HTN, 52.4% versus 36.4%, p = 0.034), but had similar rates of renal insufficiency, coronary artery disease and pulmonary disease.

Overall obese patients had longer operative times (280 versus 241 minutes, p = 0.003), more estimated surgical blood loss (230 versus 109 ml, p = 0.0001) and higher transfusion rates (6.8% versus 0.8%, p = 0.032) compared to nono-

TABLE 1. *General demographics for obese and nonobese patients receiving radical, partial and simple nephrectomy*

	Nonobese	Obese	p Value
No. pts	132	59	
Mean age ± SD	57.8 ± 16.4	58.1 ± 13.6	0.90
Male/female ratio	1.19	1.56	0.43
% Race:			0.93
White	66.9	69.6	
Black	5.4	3.6	
Asian	8.5	7.1	
Hispanic	8.5	8.9	
Other/unknown	9.8	10.7	
Mean kg/m^2 BMI ± SD	24.3 ± 3.3	36.1 ± 6.1	<0.0001*
Mean ASA score ± SD	2.3 ± 0.6	2.5 ± 0.7	0.089
% Comorbidities:			
DM	3.9	20.6	0.0002*
HTN	36.4	52.4	0.034*
Chronic renal insufficiency	7.8	11.1	0.44
Coronary artery disease	15.0	9.5	0.38
Congestive-obstructive pulmonary disease	5.1	6.3	0.75
Previous abdominal surgery	44.6	36.4	0.33

* Values significantly different at p <0.05.

TABLE 2. *Operative and postoperative comparison of obese and nonobese patients receiving radical, partial and simple nephrectomy*

	All Nephrectomies			RN			PN			SN		
	Nonobese	Obese	p Value	Nonobese	Obese	p Value	Nonobese	Obese	p Value	Nonobese	Obese	p Value
No. pts	132	59		77	40		32	12		24	7	
Mean OR mins ± SD	241 ± 84	280 ± 95	0.003*	240 ± 80	282 ± 97	0.020*	233 ± 78	260 ± 51	0.036*	255 ± 104	306 ± 142	0.46
Mean ml EBL ± SD	109 ± 122	230 ± 364	0.0001*	90 ± 82	195 ± 266	0.0003*	189 ± 189	427 ± 637	0.047*	67 ± 45	116 ± 130	0.73
% Transfusion	0.8	6.8	0.032*	1.3	7.5	0.23	0.0	8.3	0.27	0.0	0.0	0.99
Mean MSO_4 mg equivalents PA ± SD	52 ± 59	54 ± 63	0.81	50 ± 68	37 ± 25	0.97	58 ± 50	87 ± 104	0.41	49 ± 37	79 ± 85	0.79
% Rt side tumor	48	48	0.89	44	38	0.56	66	64	0.99	38	86	0.17
Mean mg/dl serum Cr ± SD	+0.29 ± 0.38	+0.50 ± 0.64	0.15	+0.47 ± 0.36	+0.62 ± 0.62	0.75	+0.11 ± 0.16	+0.22 ± 0.67	0.67	−0.04 ± 0.31	−0.15 ± 0.21	0.38
% SM	50.0	42.6	0.36	60.9	51.2	0.34	0.0	0.0	—	76.9	71.4	0.76
Mean days HS ± SD	2.5 ± 1.8	3.0 ± 2.3	0.21	2.5 ± 1.4	2.7 ± 1.6	0.59	3.1 ± 2.8	4.5 ± 3.7	0.22	2.2 ± 1.2	2.2 ± 0.8	0.72
Mean days OI ± SD	1.0 ± 0.7	1.2 ± 1.1	0.082	1.0 ± 0.7	1.1 ± 0.5	0.084	0.9 ± 0.4	2.0 ± 2.0	0.083	1.0 ± 1.0	1.1 ± 0.6	0.23
% OC	2.3	3.3	0.65	2.6	0.0	0.54	3.0	18.2	0.15	0.0	0.0	0.99

* Values significantly different at p <0.05.

TABLE 3. *Major and minor complications in obese and nonobese patients*

	BMI Less Than 30	BMI Greater Than 30	p Value
Major complications:			
Urine leak	3	1	
Myocardial infarction	2	0	
Pneumothorax	1	1	
Acute renal failure	0	2	
Retroperitoneal bleed in anticoagulated pt, death	0	1	
Pulmonary embolism	1	0	
Perforated colon, sepsis	1	0	
Pericarditis	1	0	
Total major complications (%)	9 (6.8)	5 (8.5)	0.99
% Major complications:			
RN	5.2	7.5	0.69
PN	9.4	16.7	0.99
SN	8.3	0.0	0.99
Minor complications:			
Shoulder pain	5	1	
Fever	2	2	
Ileus	3	0	
Urinary retention	2	0	
Incisional pain	1	1	
Abdominal wall hematoma	1	1	
Port site leak	1	0	
Incisional hernia	0	1	
Bladder injury	0	1	
Diaphragm injury	1	0	
Renal collecting system injury	0	1	
Total minor complications (%)	16 (12.1)	8 (13.6)	0.99
% Minor complications:			
RN	11.7	15.0	0.77
PN	15.6	8.3	0.60
SN	12.5	14.3	0.99

bese patients (table 2). In the subgroup analyses obese patients undergoing RN and PN had longer operating room (OR) times (282 versus 240 minutes, p = 0.020 and 260 versus 233 minutes, p = 0.036, respectively) and greater estimated surgical blood loss than nonobese patients (195 versus 90 ml, p = 0.0003, 427 versus 189 ml, p = 0.047, respectively). There were no observed differences in OR time, estimated blood loss or transfusion rates for SN cases. For all surgical types studied obese and nonobese patients had similar open conversion (OC) rates, PA requirements, HS, time to OI, change in serum creatinine after surgery, and major and minor complication rates. SM rates were similar between groups and did not affect differences in OR time, EBL or complications for any type of nephrectomy (tables 2 and 3).

For the RN and PN groups there was no difference between obese and nonobese patients regarding CT tumor size, pathological tumor size, tumor stage, Fuhrman grade or presence of multiple renal vessels. After pooling patients undergoing RN and PN, obese and nonobese patients had similar rates of malignancy for similar size radiological lesions (table 4).

DISCUSSION

Obesity is an epidemic in American society with approximately 40% and 30% of adults now considered overweight and obese, respectively.[3] Obese patients have higher rates of many medical conditions including cardiovascular disease, DM, HTN, abdominal hernia and several malignancies including RCC.[10] Theoretically patients with these comorbid conditions have an increased risk of poorer outcomes after surgical treatment.[4,5] Given the increased challenge of the laparoscopic approach for any given procedure, surgeons have historically avoided treating obese patients with procedures involving laparoscopic techniques.[6] In a series of 670 laparoscopic prostatectomies reported by Bhayani et al, higher BMI was associated with conversion to open surgery, and the authors suggested that this procedure be initially contraindicated in obese patients.[11] Likewise in a study of 162 patients undergoing laparoscopic colorectal surgery, obese patients were more likely to have postoperative complications (78% versus 24%) and OC rates (39% versus 13%).[12] A report of 670 women undergoing laparoscopic hysterectomy demonstrated that obese patients are more likely to undergo OC (21% versus 10%).[13] In a study of 864 patients undergoing laparoscopic cholecystectomy, compared to normal weight patients, obese and morbidly obese patients had higher OC rates (4.3% and 5.9% versus 2.3%), greater postoperative morbidity (5.9% and 11.8% versus 4.7%) and longer operative times (85 and 107 versus 80 minutes).[14] Laparoscopic abdominal and pelvic procedures are arguably more challenging and potentially more morbid in obese patients.

Previous studies exploring the impact of obesity on laparoscopic nephrectomy have reported mixed results (table 5). Mendoza et al[6] compared 14 obese patients to normal weight patients from a study by Gill et al,[15] and concluded that obese patients have more complications (57% versus 16%) and open conversion rates (35% versus 6%). Fazeli-Matin et al[16] compared 11 obese patients undergoing laparoscopic RN and nephroureterectomy (NU) with 17 normal weight patients undergoing open radical nephrectomy or NU, and found longer operative times (210 versus 180 minutes) and less estimated blood loss (100 versus 375 ml) but no difference in

TABLE 4. *Radiological and pathological characteristics of masses treated with radical and partial nephrectomy*

	Nonobese	Obese	p Value
Mean cm CT tumor ± SD	4.5 ± 2.9	5.2 ± 3.0	0.20
Mean cm pathological tumor ± SD	3.8 ± 2.7	4.9 ± 1.6	0.075
Mean Fuhrman grade ± SD	2.0 ± 0.8	2.0 ± 0.7	0.60
% RCC tumor stage:			
1	49.5	55.7	0.72
2	11.2	11.5	
3	9.3	13.5	
% Multiple renal vessels	30.2	30.9	0.99
% Malignant tumor	70.1	80.8	0.25
% Malignant tumor by CT cm:			
3.0 or Less	66.7	52.9	0.51
3.1–4.0	83.3	83.3	0.99
Greater than 4.0	82.9	91.3	0.47

Tumor stages are based on the American Joint Committee on Cancer 1997 criteria.

All malignant lesions were renal cell carcinoma.

TABLE 5. *Literature review of obese patients treated with laparoscopic nephrectomy*

References	Obese/Nonobese Pts	Laparoscopic Approach	Associated With Obesity	Not Associated With Obesity
Mendoza et al[6]	14/0 RN	Not available	Complications†, OC rate†	None
Fazeli-Matin et al[16]	8/15 RN* 3/2 NU*	Retroperitoneal	Longer OR time, less EBL, faster OI, shorter LHS, less analgesics, quicker convalescence	Transfusions, complications, ASA score, age, prior abdominal surgeries
Kuo et al[17]	12/28 Donor RN	Transperitoneal	None	OR time, EBL, complications, time out of work, HS
Doublet and Belair[18]	8/47 RN	Retroperitoneal	None	OR time, perioperative complications, postop complications, HS
Matin et al[19]	Not available/389 RN, PN, NU + adrenalectomy	Transperitoneal, retroperitoneal	Preop comorbidities	Intraoperative, postop + late operative complications
Fugita et al[7]	32/69 RN	Transperitoneal	ASA score, MP	OR time, EBL, conversion rate, major complications, OI time, time to ambulation, analgesics, HS
Current study	40/77 RN 12/32 PN 7/23 SN	Transperitoneal	Longer OR time (RN and PN), greater EBL (RN and RN), higher transfusion rate (overall only)	OC rate, minor complications, major complications, analgesics, OI time, HS, MP, ASA score

* Comparison groups of patients receiving open procedures.
† Results compared to rates reported by Gill et al.[15]

complication or transfusion rates in the obese group. Among patients undergoing laparoscopic donor nephrectomy, Kuo et al found no difference in operating room time, estimated blood loss, length of stay, time out of work, or complications for obese patients.[17] In a similar study Doublet and Belair also found no difference in operative time or complications.[18] In a study exploring comorbid variables associated with complications, Matin et al did not find an association between BMI and surgical or postoperative complications.[19] Recently in a study of 32 obese and 69 normal weight patients undergoing laparoscopic RN, Fugita et al did not find a correlation between obesity and operative time, estimated surgical blood loss, conversion rate, complications, length of hospitalization, time to ambulation or analgesic requirements.[7]

Since the establishment of laparoscopic urology at our institution, obesity has not been a contraindication to treatment. With few modifications our procedure and approach are similar for obese and nonobese patients. Clinically we have observed that obese patients store most of their excess fat in subcutaneous tissue and do not have significantly more retroperitoneal or intra-abdominal fat than nonobese patients and, thus, our procedural modifications focus on patient position and port placement. We usually use less bend in the operative table with obese patients. We do not use the kidney rest in any laparoscopic renal surgery since we have not observed improvement in operative exposure with this modification. In patients with large abdominal girth, we insert our ports more laterally and above the medially rotated pannus, thus allowing us to use standard sized trocars and instruments in all obese patients. We use extra care in positioning obese patients and increase padding under the lower hip. This approach has resulted in no cases of extremity neuropraxia in our series of obese patients.

In our study we found obesity to be associated with longer operative time for all nephrectomies and the RN and PN subsets. Estimated surgical blood loss was also significantly greater for obese patients overall and the RN and PN groups. SN operative times were longer than RN or PN due to the increased technical difficulty from inflammation or prior surgeries. While the trend in longer operative times and greater estimated blood loss was similar for obese patients undergoing SN compared to RN and PN, no statistical difference was seen between SN groups likely because of the small sample size. Our study suggests that obese patients undergoing transperitoneal laparoscopic nephrectomy are likely to have greater blood loss than normal weight patients. Blood loss during laparoscopy has a much greater impact on obscuring vital structures and tissue planes than during similar open procedures due to the magnification effect of the laparoscopic camera, the dependence on visual rather than tactile identification of structures and the loss of insufflation that accompanies suction removal of blood from the laparoscopic field. In our experience more than a few hundred milliliters of blood loss during a laparoscopic procedure can be a challenging situation. Obese patients in our study also had slightly higher transfusion rates. For the RN and PN groups, transfusion rates for obese patients approached but did not reach statistical significance. This may represent a true difference that is masked by the small group sizes in these subsets.

A previous study reported that obese patients undergoing laparoscopic RN are more likely to have malignant pathology (MP) than nonobese patients.[7] However, obese patients in that study were also more likely to have larger masses, a factor correlated with the likelihood of malignancy.[20] In our study obese patients who underwent RN also had a greater chance of having a malignant mass (92.5% vs 74.7%, $p = 0.03$). However, after pooling the RN and PN groups, obese patients had similar size radiological masses (5.2 vs 4.5 cm, $p = 0.20$) and similar malignancy rates (80.8% vs 70.1%, $p = 0.25$) compared to nonobese patients. After pooling there was also no difference between similar size mass and malignancy rate between obese and nonobese groups (table 4). These results suggest that obese patients in our study were no more likely to harbor malignant renal masses before and after controlling for mass size.

Despite the differences in perioperative outcomes for obese and nonobese patients in our study, obese patients did not have more major or minor complications, open conversions, analgesic requirements, longer hospital stays or longer time to oral intake. These results suggest that in general, laparoscopic nephrectomy is no more morbid for obese patients than for nonobese patients. The subgroup analyses of patients undergoing RN, PN and SN suggest that these procedures are safe for obese patients. Since these procedures lead to shorter hospital stays and quicker return to normal activity, laparoscopic nephrectomy is theoretically more beneficial in obese patients, in whom wound infections and hospital related complications after surgery are more likely to develop.[5]

CONCLUSIONS

In our series laparoscopic nephrectomy was associated with slightly longer operative time and greater estimated blood loss in obese compared to nonobese patients. Transperitoneal laparoscopic renal surgery is a well tolerated and safe procedure for obese patients with no more morbidity than for nonobese patients. Obesity is not a contraindication to undergoing laparoscopic transperitoneal radical, partial or simple nephrectomy.

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