# An obese body habitus does not preclude a minimally invasive partial nephrectomy

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**Introduction:** Partial nephrectomy (PN) via open or minimally invasive (MI) techniques is the referent standard for managing renal cell carcinoma (RCC) whenever possible. Outcomes of MIPN in the obese patient population are incompletely defined. We investigate the feasibility of MIPN in obesity class I-III patients via comparison of surgical outcomes to those with a lower body mass index (BMI).

*Materials and methods:* The electronic medical records of 184 consecutive patients undergoing MIPN via laparoscopic (n = 109) or robotic (n = 75) techniques were reviewed. Patients were classified into the following patient cohorts stratified by BMI: 1) BMI < 30; 2) BMI 30-35 – obesity class I; 3) BMI 35-40 – obesity class II; 4) BMI > 40 – obesity class III. The association between obesity class and perioperative and pathologic outcomes was determined.

# Introduction

Obesity has increasingly become a public health concern. In 2009, its prevalence was reported at 35.7% in the United States with further studies implicating

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Results: Ninety-five men and 89 women with a median age of 55 years, BMI of 31, tumor size of 2.9 cm, and RENAL nephrometry score of 6 were included. Median operative time was 218 minutes, ischemia duration was 23.5 minutes, estimated blood loss (EBL) was 150 cc, and length of stay was 3.0 days. Of the 184 patients, 71 (39%) were non-obese, 58 (32%) had class I obesity, 33 (18%) patients had class II obesity, and 22 (12%) had class III obesity. Compared to patients with a BMI < 30, neither an obese body habitus nor the degree of obesity was associated with any adverse perioperative or pathologic outcomes. In a multivariate model querying variables associated with complications, only a RENAL nephrometry  $\geq 8$  (HR 5.1, 95% CI 2.4-7.9, p < 0.001) was significant. **Conclusion:** An increase in obesity classification was not associated with adverse outcomes following MIPN. Increasing nephrometry score was the sole variable

Increasing nephrometry score was the sole variable associated with perioperative complications. The presence of an obese body habitus alone should not preclude offering appropriate patients a MIPN.

**Key Words:** renal cell carcinoma, body mass index (BMI), complications, surgical approach

a continued rise.<sup>1</sup> Known associated risks of obesity include diabetes, hypertension, stroke and malignancy including renal cell carcinoma.<sup>2</sup> Compared to the non-obese patient, the obese utilize more healthcare resources with a resultant increase in imaging.<sup>3</sup> Such imaging (particularly abdominal axial imaging) has in turn contributed to the increased diagnosis of small renal masses (SRMs).<sup>4,5</sup>

The standard of care for management of SRMs includes partial nephrectomy (PN) via open (OPN) or minimally invasive (MI) techniques.<sup>6</sup> When

appropriately employed, minimally invasive partial nephrectomy (MIPN) has the potential advantage of improved convalescence and decreased morbidity than OPN. Previous work from our institution has suggested that at high volume surgical centers, body mass index (BMI) does not influence the selection of an open versus laparoscopic approach to partial nephrectomy.<sup>7</sup> Other small single institutions series have further implicated that MIPN is safe and feasible in the obese population.<sup>8-10</sup>

Our geographic referral base provides a large cohort of patients of varying degrees of obesity referred for minimally invasive partial nephrectomy. Here, we review our experience with such patients to determine outcomes of MIPN in the obese patient population. Furthermore, we explored whether further stratification into specific obesity classifications (Classes I-III) impacted MIPN perioperative or pathologic outcomes.

## Materials and methods

#### Patient population

Institutional review board (IRB) approval was obtained to retrospectively review medical charts and radiographic studies of patients undergoing MIPN via laparoscopic or robotic techniques between January 2003 and June 2012. All cases were performed by one of two surgeons evolving from a pure laparoscopic to robotic approach later in surgical experience. The two surgeons were relatively equally matched in surgical volume (surgeon 1 – 102 cases, surgeon 2 – 82 cases). Patients younger than 18 years of age, those with a functional or anatomic solitary kidney, patients undergoing bilateral synchronous nephron-sparing surgery, and those without BMI measurements or available cross-sectional imaging for review were excluded from analysis. With such criteria, 184 patients were identified for inclusion in our study cohort.

## Clinical variables

Clinical data points included patient age, gender, race, BMI, estimated glomerular filtration rate (eGFR), comorbid conditions, American Society of Anesthesiologists (ASA) score, Eastern Cooperative Oncology Group (ECOG) score, and year of surgery. The abbreviated Modification of Diet in Renal Disease Study (MDRD) formula, a function of serum creatinine and demographic variables, was used to assess preoperative eGFR. Comorbidities included coronary artery disease, hypertension, and diabetes.

# Defining BMI

Patients were stratified by BMI according to the World Health Organization criteria:<sup>11</sup> 1) BMI < 30 - non-obese; 2) BMI 30-35 - obesity class I; 3) BMI 35-40 - obesity class II; 4) BMI > 40 - obesity class III. No differences in clinical outcomes when substratifying patients into normal weight (BMI < 25, n = 42) versus overweight groups (BMI 25-30, n = 29) were observed. Therefore, we elected to combine these groups to generate a larger cohort more suitable for analysis. BMI was calculated using weight and height data from the pre-surgical record within 30 days of surgery.

## Radiographic data

All preoperative computed tomography (CT) or magnetic resonance imaging (MRI) was reviewed by two authors. Tumor characteristics were determined and RENAL nephrometry scores were calculated according to previously described technique.<sup>12</sup>

# Clinical and pathologic data

Operative data included OR duration, ischemia time, estimated blood loss, need for conversion to open surgery, and transfusion requirement. The modified Clavien-Dindo classification system was used to categorize perioperative complications occurring within 30 days of surgery.<sup>13</sup> All specimens were reviewed by institutional pathologists. Staging was according to the American Joint Committee on Cancer (AJCC) and tumors (of clear cell histology) were graded using Fuhrman criteria.

## Statistical analysis

The chi-squared or Fisher-exact test evaluated the association between categorical variables, and the Mann Whitney U-test assessed for differences in continuous variables. Cox proportional hazard regression models determined variables associated with perioperative complications. All reported p values are two-sided and statistical significance was set at  $\leq 0.05$ . Statistical analysis was performed with S-Plus Professional version 4.5 (MathSoft Inc., Seattle, WA, USA).

#### Results

Table 1 highlights clinical, operative, and pathologic data from our cohort. Overall, 184 patients including 95 men and 89 women underwent MIPN via laparoscopic (n = 109) or robotic (n = 75) techniques. The median age of patients was 55 years, BMI was 31, tumor size was 2.9 cm, and RENAL nephrometry score was 6. Of the 184 patients, 71 (39%) were non-

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TABLE 1. Clinical and perioperative characteristics of 184 patients undergoing minimally invasive partial nephrectomy

Variables	Number of patients (%)
Gender	
Male	95 (52)
Female	89 (48)
Age	
Median (range)	55 (20-83)
Body mass index	
Median (range)	31 (18-46)
Tumor size (cm)	
Median (range)	2.9 (0.7-10.2)
Nephrometry score	
Median (range)	6 (4-10)
OR duration (min)	
Median (range)	218 (98-396)
Ischemia duration (min)	
Median (range)	23 (0-60)
Estimated blood loss (mL)	
Median (range)	150 (75-1800)
Length of stay (days)	
Median (range)	3 (1-9)
0	

obese, 58 (32%) had class I obesity, 33 (18%) patients had class II obesity, and 22 (12%) had class III obesity. Median operative duration was 218 minutes, ischemia duration was 23.5 minutes, estimated blood loss (EBL) was 150 mL, and length of stay was 3.0 days. Eightythree percent of patients had pathologically confirmed renal cell carcinoma. Six patients (3.3%) had positive surgical margins. Patients undergoing robotic (versus laparoscopic) partial nephrectomy were more likely to be of larger diameter (3.2 cm versus 2.6 cm; p=0.01) and of greater complexity (median RENAL score 7 m versus 5 m p = 0.02).

Table 2 summarizes outcomes from our cohort stratified by obesity classification. When compared to non-obese patients, neither the presence of obesity nor the obesity classification was associated with any adverse perioperative or pathologic outcomes, (p for all > 0.05)

Overall, 53 patients (29%) experienced a postoperative complication. Ten patients (5.4%) had a major complication defined as Clavien III or greater including two urine leaks requiring additional drainage, four postoperative bleeds managed by selective angioembolization, and two episodes of gross hematuria and clot retention managed by clot evacuation under anesthesia. Four patients (2%) in our cohort received a blood transfusion. No differences in complications were seen between the robotic and laparoscopic approaches. In a multivariate model querying variables associated with complications, only a RENAL nephrometry  $\geq 8$  (HR 5.1, 95% CI 2.4-7.9, p < 0.001) was significant, Table 3.

#### Discussion

Obesity is associated with several different malignancies including renal cell carcinoma.<sup>2</sup> The finding of SRMs in the obese is not uncommon considering the increasing use of radiographic imaging in these patients. In this study, we evaluated the impact of BMI on clinical

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	BMI < 30	BMI 30-35 (Class I)	BMI 35-40 (Class II)	BMI > 40 (Class III)	p value		
Number of patients	71	58	33	22			
Median tumor size (cm)	2.5	2.7	3.0	2.7	0.84		
Median nephrometry score	5.5	7.0	6.0	6.0	0.63		
Median OR duration (min)	212	230	207	230	0.34		
Median ischemia time (min)	23.5	24.5	20	25	0.57		
Median EBL (mL)	150	175	150	100	0.43		
Median LOS (days)	3	3	3	3	0.95		
Complications (No., %)	21 (30)	16 (28)	11 (33)	5 (23)	0.66		
Positive margins (No., %)	4 (6)	0 (0)	1 (3)	1 (5)	0.21		
BMI = body mass index; EBL = estimated blood loss; LOS = length of stay							

Covariate	Hazard ratio (HR)	95% CI	p value	
Nephrometry score				
> 8 versus < 8	5.1	2.4-7.9	< 0.001	
Body mass index				
> 30 versus < 30	1.2	0.6-1.4	0.46	
> 40 versus < 40	1.25	0.8-1.7	0.28	
Age				
< 70 yrs versus > 70 yrs	1.5	0.9-1.9	0.17	
Ischemia duration				
< 30 versus > 30	1.03	0.55-1.15	0.88	
Surgical approach				
Robotic versus laparoscopic	1.8	0.8-2.3	0.08	

TABLE 3. Multivariable Cox regression model predicting variables associated with complications following minimally invasive partial nephrectomy

outcomes of minimally invasive partial nephrectomy. We found that there was no difference in intraoperative, postoperative, or pathologic outcomes between groups of patients stratified by BMI classification in our large population with a high prevalence of obesity. Furthermore, we demonstrated that only nephrometry score (and not BMI) was associated with perioperative 30 day complications following MIPN.

Several other groups have performed similar studies albeit with slightly different conclusions. Naeem et al reviewed outcomes in 49 obese patients and 48 nonobese patients undergoing robotic partial nephrectomy and determined that obese patients had a higher EBL but no other differences in other perioperative variables.<sup>9</sup> Recently, Isac and colleagues stratified 250 patients undergoing robotic partial nephrectomy by BMI.<sup>10</sup> These authors found no significant differences in operative time, warm ischemia time, transfusion rate and postoperative complication rates between groups. The morbidly obese (BMI > 40) did, however, have a significantly greater EBL (median 250). When considering a pure laparoscopic approach, Columbo et al studied 140 obese patients and 238 non-obese patients undergoing laparoscopic partial nephrectomy.<sup>8</sup> Operative time, EBL, warm ischemia time, and postoperative complication rates were similar.

In our study, we observed no difference in outcomes of patients with an increasing BMI. Other studies have implicated similar results albeit with the potential for greater operative blood loss. Compared to other published series, we believe our analysis was unique in that we were able to provide detailed comparison across different obesity classifications. Such considerations may be significant as obesity encompasses a wide range of BMI classifications which surgeons may intuitively view differently. Indeed, our data indicates that despite rigorously dividing patients into BMI classifications, no appreciable difference can be seen across the cohorts.

Our study had several limitations. First, it was retrospective in nature and could thus introduce the surgical experience and bias of the authors. Second, it was conducted at a single high volume center by two surgeons. Outcomes for obese patients undergoing surgery at lower volume centers or geographically distinct regions where surgeons are less experienced in operating on overweight patients could be different. Third, a high BMI does not necessarily select for the obese. Individuals with greater muscle mass have greater BMI. Fourth, our study design did not take into account distribution of adipose tissue. We hypothesize that there could be a difference in outcomes for patients with a greater distribution of visceral fat. Lastly, our study takes into account both laparoscopic and robotic approaches with growth of surgical experience. Earlier lesions tended to be less complex and were performed in patients with lower BMI. Growth of experience may have blunted the negative effects of increased BMI. Despite these limitations, we do believe that our series rigorously evaluates the issues of BMI and MIPN in a large cohort of patients and provides valuable data to urologists.

#### Conclusions

An increase in obesity classification was not associated with an adverse perioperative or pathologic outcomes related to MIPN. Increasing nephrometry score was the sole variable associated with perioperative complications. The presence of an obese body habitus alone should not preclude offering appropriate patients a MIPN.

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