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Implications of excess weight on kidney donation: Long-term consequences of donor nephrectomy in obese donors ☆

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ABSTRACT

Background: An elevated body mass index (>30 kg/m^2) has been a relative contraindication for living kidney donation; however, such donors have become more common. Given the association between obesity and development of diabetes, hypertension, and end-stage renal disease, there is concern about the long-term health of obese donors.

Methods: Donor and recipient demographics, intraoperative parameters, complications, and short- and long-term outcomes were compared between contemporaneous donors—obese donors (body mass index ≥30 kg/m^2) versus nonobese donors (body mass index <30 kg/m^2).

Results: Between the years 1975 and 2014, we performed 3,752 donor nephrectomies; 656 (17.5%) were obese donors. On univariate analysis, obese donors were more likely to be older ($P < .01$) and African American ($P < .01$) and were less likely to be a smoker at the time of donation ($P = .01$). Estimated glomerular filtration rate at donation was higher in obese donors (115 ± 36 mL/min/1.73m^2) versus nonobese donors (97 ± 22 mL/min/1.73m^2; $P < .001$). There was no difference between groups in intraoperative and postoperative complications; but intraoperative time was longer for obese donors (adjusted $P < .001$). Adjusted postoperative length of stay (LOS) was longer (adjusted $P = .01$), but after adjustment for donation year, incision type, age, sex, and race, there were no differences in short-term (<30 days) and long-term (>30 days) readmissions. Estimated glomerular filtration rate and rates of end-stage renal disease were not significantly different between donor groups >20 years after donation ($P = .71$). However, long-term development of diabetes mellitus (adjusted hazard ratio (HR) 3.14; $P < .001$) and hypertension (adjusted hazard ratio (HR) 1.75; $P < .001$) was greater among obese donors and both occurred earlier (diabetes mellitus: 12 vs 18 years postnephrectomy; hypertension: 11 vs 15 years).

Conclusion: Obese donors develop diabetes mellitus and hypertension more frequently and earlier than nonobese donors after donation, raising concerns about increased rates of end-stage renal disease.

Introduction

For a kidney transplant candidate, a living donor transplant is the best option. In an effort to minimize short-and long-term risks to the donor, transplant centers adhere to candidate exclusion criteria. Obesity (body mass index [BMI] ≥30 kg/m^2) has long been a relative contraindication to living kidney donation (LKD). Concerns about obese donors (ODs) have included intraoperative risks and the short- and long-term effects of kidney donation on a population of patients who are already susceptible to hypertension (HTN), diabetes mellitus (DM), and kidney disease as a consequence of their obesity.[1–3] However, with increased comfort with the operation, acceptance of ODs has become more common in the United States,[4–5] accentuating the importance of studying the interplay between obesity and outcomes after LKD.

Although some studies demonstrate equivalent intraoperative outcomes with ODs,[6–8] others report longer operative time, greater estimated blood loss (EBL), the need for additional laparoscopic ports, and a greater rate of conversion to open surgery.[9–13]

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Moreover, although short-term outcomes for ODs seem to be equivalent to nonobese donors[11,14] little data exist on the relationship between obesity and kidney donation long term.[1,15] Because ODs are susceptible to obesity-related morbidity, the study of long-term impact of kidney donation in this population is critical. Some groups have even advocated for the stipulation that potential donors lose weight before approving their candidacy.[16] However, this does not address the long-term health benefits of lifestyle modifications needed to maintain a healthy weight and its challenges. In fact, our group recently presented on the outcomes of living kidney donors who lost weight to become donors and reported that the vast majority of donors gained weight over time, including those who lost weight just for the purposes of meeting suitability to donate.[17]

At the University of Minnesota, the LDK transplant program began in 1963. Similar to global trends, as our experience with LDK expanded, we began approving ODs with increasing frequency. Herein, we present our experience with ODs, the perioperative morbidity of donor nephrectomy, and the long-term (>20 years) consequences of donation.

Methods

Study cohort

From June 1975 through December 2014, we performed 3,752 donor nephrectomies at the University of Minnesota. All living donor and recipient information is prospectively maintained in a database approved by the University of Minnesota Institutional Review Board. Living donors are routinely followed postoperatively at 2 weeks, 6 months, 12 months, and every 3 years thereafter.

Data collected on living donors included demographic and clinical information at donation, intraoperative details (EBL, cold ischemia time, etc), complications, length of stay, any postoperative short-term (≤30 days) and long-term (>30 days) complications (defined as untoward events within the perioperative period that affected recovery, prolonged hospital stay, or required technical deviations during the surgical procedure), and readmission. For follow-up, donors are contacted every 3 years (one-third of the cohort each year) and asked to provide an updated medical and psychosocial history, including development of new conditions, and to send us any intervening laboratory results. Donors not having recent laboratory results are asked to undergo a routine health checkup, including laboratory tests. Glomerular filtration rate was estimated using the Modification of Diet in Renal Disease Study equation.

Our living donor evaluation criteria have previously been described.[18–20] Exclusion criteria for donation include any proteinuria (urinary protein >150 mg/day or urinary albumin/creatinine >30 mg/g), BMI >30 kg/m^2 unless physical examination results warranted acceptance, and DM. We do not exclude donors with a family history of type 2 DM (T2DM). Potential donors who have multiple direct family members with T2DM, or more than one immediate family member with diabetic kidney disease, are strongly discouraged from donating, especially if they are African American or Hispanic. Before 2002, all potential donors wishing to donate to a family member with T2DM were required to have a normal glucose tolerance test result. After 2002, only potential donors with more than one immediate family member with T2DM, women with history of gestational DM, and those with fasting blood glucose 99 to 110 mg/dL underwent a glucose tolerance test. HTN had historically been a contraindication to donation. More recently, we have accepted Caucasian donors >55 years of age and non-Caucasian donors >60 years of age whose HTN is well controlled with a single drug and had no evidence of end-organ damage (ie, hypertensive retinal changes).

To verify the presence of 2 functional kidneys and assess vascular anatomy, we used angiography, high-resolution computed tomographic angiography, or magnetic resonance angiography. If we found a large size discrepancy between the two kidneys, we obtained a split-function renogram to individually assess the functional status of each kidney. For all donor nephrectomies (DNs) (whether open or laparoscopic), if there was a single artery, our practice has been to remove the left kidney. If there were >2 renal arteries on the left kidney and a single artery on the right kidney, we removed the right kidney. If there were multiple arteries bilaterally, we removed the left kidney. If there was an incidental minor abnormality (eg, a simple cyst), we removed the kidney with the abnormality, leaving the living donor with the normal kidney.

Donor nephrectomy surgical technique

The details of open and laparoscopic donor nephrectomy (LDN) by our group have been published previously.[21,22] For standard open donor nephrectomy, we perform a 6-inch muscle-splitting flank incision. For left hand–assisted laparoscopic donor nephrectomy (HA-LDN), we perform a vertical midline 2.5-inch incision and two laparoscopic ports: one at the midclavicular line in the left upper quadrant (2 finger breadths below the costal margin) and the other at the level of the umbilicus to the left of the midline. For right hand–assisted laparoscopic donor nephrectomy, we also insert two laparoscopic ports: one at the midclavicular line in the right upper quadrant (2 finger breadths below the costal margin) and the other in the subxiphoid midline. In addition, we place a liver retractor in the right subcostal anterior axillary line. In the subxiphoid midline, we use a GelPort pneumatic sleeve (Applied Medical, Rancho Santa Margarita, CA) to permit removal of the kidney. For left pure laparoscopic donor nephrectomy, we use three laparoscopic ports (two in the left upper quadrant and one in the subxiphoid midline). To remove the kidney at the end of the procedure, we employ a Pfannenstiel (suprapubic transverse) incision. For right pure laparoscopic donor nephrectomy, we use an additional liver retractor port.

Statistical analysis

Demographic and clinical data were summarized as frequency (percentage) for categorical data and mean (standard deviation) for continuous variables. For pairwise comparisons according to BMI groups, we used the Fisher exact test for categorical variables and the Wilcoxon rank sum test for continuous variables. Because ODs are more likely to have donated more recently, we fit logistic (binary outcomes) and linear (continuous outcomes) models, adjusting for donation year, incision type (laparoscopic versus open), age, race (black versus other), and sex. To compare biometric parameters (eg, BMI, systolic blood pressure, diastolic blood pressure, estimated glomerular filtration rate [eGFR], glucose) after donation, we summarized the last recorded measure on each subject by time since donation (<10 years, 10–20 years, 20–30 years, and >30 years) and BMI group. We compared time to postdonation disease (DM, HTN, proteinuria, hyperlipidemia, end-stage renal disease [ESRD]) onset among the BMI categories using proportional hazards models, adjusting for the same characteristics as discussed earlier in this report. For these analyses, only donors who were disease free at donation were included in the analysis. All hypothesis tests were two-sided, with statistical significance defined as $P < .05$. All analyses were conducted using SAS v 9.4 (SAS Institute, Cary, NC).

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