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ORIGINAL ARTICLE

Laparoscopic donor nephrectomy in obese donors: easier to implement in overweight women?

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Summary

Laparoscopic donor nephrectomy (LDN) has been proven feasible in overweight individuals, but remains technically challenging. As the perirenal fat distribution and consistency significantly differ between men and women, we investigated possible differences between the genders. Prospectively collected data of 37 female and 39 male donors with a body mass index (BMI) over 27 who underwent total LDN were compared. Ninety-one donors with a BMI <25 served as controls. Clinically relevant differences were not observed between men and women of normal weight. In overweight donors, two (5%) procedures were converted to open in females and five (13%) in males. None of these conversions in females, but four conversions in males, appeared to be related to the donor's perirenal fat ($P = 0.05$). Operation time (median 210 vs. 241 min, $P = 0.01$) and blood loss (median 100 vs. 200 ml, $P = 0.04$) were favorable in female donors. The number of complications did not significantly differ. Total LDN in overweight female donors does not lead to increased operation times, morbidity or technical complications. In contrast, the outcome in obese males seems to be less advantageous, indicating that total LDN in overweight women can be advocated as a routine procedure but in obese men reluctance seems justified.

Introduction

Currently, live kidney transplantation is the preferred treatment for end-stage renal disease [1]. However, this implies a certain risk of morbidity and mortality for a healthy donor. Laparoscopic donor nephrectomy (LDN) has been promoted to minimize the discomfort to the donor and to facilitate the postoperative recovery [2]. The success of this procedure and the persistent organ shortage have contributed to the worldwide expansion of live kidney donation. As the donor pool expands and the inclusion criteria for living kidney donation are broadening, there is an increasing number of overweight and obese donors. These donors might enlarge the donor pool substantially, assuming that the procedure of donation is as safe as in nonobese donors and thus justified from the donor's perspective. In general, a body mass index (BMI) below 35 is deemed acceptable to undergo donor nephrectomy physically without unacceptably high risks [3]. The question has arisen which operative procedure should be performed in these donors. LDN has been demonstrated feasible in this category of donors and can lead to equivalent results in obese as in normal weight individuals [4–6]. In specialized centers in the USA, hand-assisted LDN in overweight and obese donors has become a common practice [6]. Nevertheless, total LDN in overweight and obese donors is definitely more challenging and experience is required to render acceptable results. On the other hand, total LDN may avoid postoperative complications that typically occur in obese individuals such as wound infections and incisional hernias, because there is no hand within the abdominal cavity

and the extraction incision is smaller because a hand-port is not required.

As opposed to many American centers, many European centers are still reluctant towards LDN in general and LDN in donors with more difficult anatomy in particular. It was recently suggested to limit LDN according to BMI [7]. Moreover, the current guidelines for the Dutch cross-over program [8] state that donors with a BMI higher than 30 are not accepted. However, fat distribution may differ between overweight individuals. As there is a marked difference regarding build between men and women, we investigated the influence of the donor's gender on the outcome of total LDN in overweight donors.

Patients and methods

Patients

From January 1998 to July 2005, 76 donors with a BMI over 27 underwent LDN at the authors' institute. A BMI higher than 27 indicates more than 20% over ideal body weight [4]. Ninety-one normal-weight donors (BMI <25) were operated in the same period and served as controls. Although the World Health Organization has defined overweight as a BMI between 25 and 30 kg/m^2, we decided not to include donors with mild overweight in our analysis, because most Western citizens actually have mild overweight. In the donors, either right- or left-sided LDN was performed. A nephrologist and an anesthesiologist and, if indicated, a medical psychologist or a cardiologist screened all donors. The kidneys were imaged by using subtraction angiography or magnetic resonance imaging. Selection of the right or left kidney was based on renovascular anatomy and size. If no differences in anatomy were present, the right kidney was removed.

Surgical procedures

The surgical procedure of total LDN has been described previously [9]. Briefly, with the donor in a lateral decubitus position, the video-endoscope was introduced under vision. With three to four additional trocars, the right or left hemi-colon was mobilized. Thereafter, the kidney, ureter and vascular structures were carefully dissected. A pfannenstiel incision was made as extraction site while maintaining pneumoperitoneum. After division of the ureter with scissors and the vascular structures with a vascular endostapler (Endogia, US surgical, Norwalk, CT, USA), the kidney was removed with an endobag (Endocatch, US surgical). After extraction, the kidney was flushed with 4 °C Eurocollins (Fresenius, Bad Homburg, Germany) and stored on ice. The pfannenstiel incision was closed in two layers. Again, the abdomen was insufflated. Hemostasis was ensured and the trocars were removed. The hemi-colon was replaced. The fascia of keyholes measuring 10 mm was closed. Skin incisions were sutured intracutaneously. The same operation team that performed the donor nephrectomy transplanted the kidney into the iliac fossa of the recipient.

Data collection and definitions

Data of all procedures were collected prospectively. Warm ischemia time was defined as the time elapsing between stapling of the artery and flushing the kidney after extraction. Time until kidney removal was defined as the time elapsing from the incision of the skin until extraction of the kidney. As the same operation team performed the nephrectomy and the transplantation, this time included cold perfusion of the kidney by the senior surgeon. Operation time was defined as skin-to-skin time. Blood loss was precisely calculated taking into account the volume of fluids used to rinse the abdomen during the operation and the kidney during cold perfusion. Intraoperative complications were defined as technical failure or unintended (potential) damage to the donor or the graft. Postoperative complications were defined as adverse effects of the operation causing the damage to the patient requiring an intervention or prolonged hospital stay.

Statistical considerations

Variables were compared between female and male donors, respectively, of the study group and control group. In this study, we did not go into detail on possible long-term complications, which overweight donors may encounter after unilateral nephrectomy, because in the majority of donors, long-term follow-up was not yet available. Categorical and continuous variables were compared with the chi-squared test and the Mann–Whitney *U*-test, respectively, using SPSS (version 11.5, SPSS Inc., Chicago, IL, USA). A P-value < 0.05 (two-sided) was considered statistically significant.

Results

Patients

The control group consisted of 48 female donors and 43 male donors with a BMI lower than 25. Most of these donor nephrectomies occurred relatively early in our series. Baseline characteristics were comparable (Table 1). Thirty-seven overweight female donors and 39 overweight male donors underwent LDN during the study period. Thirty-three donors (43%; 19 female donors and 14 male donors) had a BMI higher than 30. Except for previous abdominal surgery, baseline characteristics (Table 1) did not differ between the groups.

Table 1. Baseline characteristics of normal weight female donors versus normal weight male donors and baseline characteristics of overweight female donors versus overweight male donors. Categorical data are given as number (percent) and continuous variables as median (range).

	Normal weight donors			Overweight donors		
	Female ($n = 48$)	Male ($n = 43$)	*P*-value	Female ($n = 37$)	Male ($n = 39$)	*P*-value
Age (years)	48 (28–70)	45 (20–76)	0.28	52 (20–77)	50 (22–70)	0.39
Kidney (left)	21 (44%)	18 (42%)	1.00	13 (35%)	19 (49%)	0.23
ASA classification (>1)	7 (15%)	5 (12%)	0.76	13 (35%)	10 (26%)	0.37
Body mass index (kg/m^2)	22.8 (16.5–24.9)	23.0 (18.1–24.9)	0.80	30.1 (27.0–36.6)	29.2 (27.2–34.7)	0.59
Renal arteries (>1)	11 (23%)	10 (33%)	1.00	7 (19%)	10 (26%)	0.48
Renal veins (>1)	5 (10%)	4 (9%)	1.00	4 (11%)	4 (10%)	0.94
Previous abdominal operations	15 (31%)	6 (14%)	0.08	17 (46%)	4 (10%)	0.001
Relation (living related)	30 (63%)	31 (72%)	0.38	22 (60%)	29 (74%)	0.17

Intra-operative outcomes

Intra-operative outcomes of donors are demonstrated in Table 2. In one female donor, the procedure was converted to open because of a splenic injury that required splenectomy. In three male donors, the procedure was converted because of bleeding from the renal vein (maximum blood loss 2700 ml). Four other bleeds in the female group (total blood loss 400, 550, 600 and 800 ml) and two bleeds in the male group (360 and 400 ml) were controlled laparoscopically. Both bowel lesions were superficial lesions of the serosa occurring during mobilization of the hemi-colon. Warm ischemia time, blood loss and operation time did not differ between normal weight female and male donors. The majority of donor nephrectomies with long warm ischemia times occurred in the early stages of our laparoscopic donation program (data not shown).

Two overweight female donors (5%) required elective conversions to open surgery using a muscle-splitting approach because of bleeding that impeded overview (maximum total blood loss 1000 ml). Five conversions (13%) occurred in male donors including one procedure immediately after introduction of the video-endoscope because of severe adhesions, three procedures because of the abundant amount of fatty tissue surrounding the kidney and its hilar structures impeding overview, and one procedure because of placement of a titanium clip on a structure which turned out to be an accessory artery to the lower kidney pole. A muscle-splitting approach was performed in these donors. In one donor, arterial bleeding occurred after extraction of the kidney because of a tear in the origin of the renal artery and because of the limited exposure, up to 3500 ml blood was lost. After emergent enlarging of the incision, the bleeding could be controlled. In female donors, operation time was significantly shorter and blood loss was significantly less. In donors with a BMI higher than 30, these trends were also encountered, but numbers were too small to reach statistical significance (data not shown). The number of

Table 2. Intra-operative outcomes of laparoscopic donor nephrectomy in normal weight female donors versus normal weight male donors and intra-operative outcomes of laparoscopic donor nephrectomy in overweight female donors versus overweight male donors. Categorical data are given as number (%) and continuous variables as median (range).

	Normal weight donors			Overweight donors		
	Female ($n = 48$)	Male ($n = 43$)	*P*-value	Female ($n = 37$)	Male ($n = 39$)	*P*-value
Conversion to open	1 (2%)	3 (7%)	0.34	2 (5%)	5 (12%)	0.32
Conversion because of abundant fat	–	–	–	–	4 (10%)	0.05
Warm ischemia time (min)	7 (3–17)	6 (2–14)	0.10	7 (2–15)	7 (2–14)	0.56
Time until kidney removal (min)	197 (82–325)	189 (109–400)	0.84	175 (91–271)	196 (109–336)	0.009
Operative time (min)	241 (112–349)	221 (135–420)	0.93	210 (110–320)	241 (141–374)	0.01
Blood loss (ml)	150 (20–1450)	115 (10–2700)	0.49	110 (20–1000)	200 (20–4500)	0.05
Complications	9 (19%)	7 (16%)	0.79	2 (5%)	6 (15%)	0.16
Bleeding	4	5		2	3	
Splenic lesion	2	–		–	–	
Endocatch failure	1	1		–	–	
Bowel lesion	1	1		–	3	
Subcapsular hematoma kidney	1	–		–	–	

complications did not significantly differ between overweight female and male donors. However, complications in the male group included potentially severe complications, i.e. three bowel perforations. One remained undiscovered during the operation. Within group analysis showed significantly shorter operation times for right-sided donor nephrectomy in overweight males (right 229 vs. left 263 min, $P = 0.03$) but not in overweight females (right 210 vs. left 232 min, $P = 0.24$). Complication rates and conversion rates did not significantly differ between left- and right-sided LDN.

With regard to blood loss and operation time, outcomes did not differ between normal weight and overweight female donors. Overweight male donors suffered significantly more blood loss ($P = 0.04$) compared with normal weight controls.

Postoperative outcomes

Postoperatively, six and five complications occurred in normal weight female and male donors, respectively (Table 3). Complications in female donors included one-time blood transfusions in two donors, two pulmonary infiltrates and a wound infection requiring antibiotics, and temporary sensibility loss of the skin of the lateral thigh in one donor. In the male group, one donor was re-admitted and re-operated because of continued bleeding from a splenic injury requiring open splenectomy. Length of stay was just shorter in male donors. In the overweight group, one wound infection occurred in either group. The aforementioned undiscovered bowel perforation in a male donor resulted in a re-laparotomy and primary closure of the bowel. One female donor was shortly re-admitted because a urinary tract infection was suspected. However, this complication was never confirmed by urine culture. Incisional hernias did not occur with a minimal follow-up of 1 year. Median length of stay was 3 days in either group.

Discussion

The benefits of laparoscopic renal surgery have been reported previously [10]. As suggested by others, we speculated that the technique may offer even more advantages in overweight patients [11,12]. Although feasibility and good results of LDN in overweight donors have been reported [4–6], restriction of overweight individuals from LDN remains common because of the association with more complications, conversions to open and longer operation times [7,12]. As donors are healthy individuals, selection of candidates for LDN is possible, in particular, for total LDN. It is questionable whether overweight donors should be exposed to a higher risk of conversion [13] and minor complications [6] associated with LDN in obese donors.

In the USA, an important number of transplant surgeons is trained in open donor nephrectomy only [14]. Outside the USA, most surgeons still favor open donor nephrectomy. We recently polled a substantial number of European transplant centers [15]. Obesity as such was not often explicitly deemed a criterion not to perform a laparoscopic technique. However, difficult anatomy and low caseload appeared important reasons to maintain an open approach in addition to lack of evidence that laparoscopic approaches were superior to open methods. Moreover, the true number of obese donors (i.e. with a BMI >30), as indicated by our series, may be limited in European series. Therefore, we chose a cut-off point with regard to BMI of 27, which indicates significant overweight [4].

We believe that, by now, LDN has become the standard of care for removal of a kidney of a live donor [10,16–18]. We personally favor a complete laparoscopic approach to minimize the surgical damage to the donor. It is comprehensible that surgeons with a low number of live donors yearly or without sufficient experience in other laparoscopic operations have been reluctant toward laparoscopic live

Table 3. Postoperative outcomes following laparoscopic donor nephrectomy (LDN) in normal weight female donors versus normal weight male donors and postoperative outcomes following LDN in overweight female donors versus overweight male donors. Categorical data are given as number (%) and continuous variables as median (range).

	Normal weight donors			Overweight donors		
	Female ($n = 48$)	Male ($n = 43$)	*P*-value	Female ($n = 37$)	Male ($n = 39$)	*P*-value
Complications	6 (13%)	5 (12%)	1.00	2 (5%)	2 (5%)	0.96
Bleeding	2	1		–	–	
Pulmonary complications	2	–		–	–	
Bowel perforation	–	–		–	1	
Urinary tract infections	–	–		1	–	
Wound infection	1	2		1	1	
Sensibility loss skin lateral thigh	1	1		–	–	
Incisional hernia	–	1		–	–	
Postoperative hospital stay (days)	3 (2–9)	3 (2–7)	0.02	3 (2–7)	3 (1–9)	0.04

kidney donation in general and in obese donors in particular, fearing complications and conversions.

According to current evidence, we assume that an important number of centers will switch from open to laparoscopic techniques. In addition, the increasing number of donors in Western countries will force centers currently excluding those individuals from LDN to consider expansion of their laparoscopic program with these donors. Therefore, it is important to explore ways that lead to a safe introduction of LDN in obese donors without having the potential difficulties that a sudden change in criteria of acceptance for LDN or changing techniques from open to laparoscopic could cause.

While investigating ways to offer LDN to more donors, we found overweight women easier to operate on than overweight men. This gender difference is clearly absent in normal weight controls. This finding was not biased by a considerably higher percentage of right-sided LDN in the female donor group [19]. The significant less blood loss, the significant shorter operation time, the absent number of potentially dangerous injuries to adjacent organs such as the bowel and absent number of conversions because of abundant fatty tissue emphasize that total LDN is technically easier in overweight women than in men. The differences between normal weight and overweight male donors may appear minor because of a potential bias on account of the fact that relatively more normal weight male donors were operated early in our series. However, the number of conversions because of abundant fatty tissue and the magnitude of the intra-operative complications clearly differ.

We believe that both the distribution of fatty tissue and the consistency contributed to these findings [20]. Overweight men often have a relatively large waist circumference, which enlarges the distance between the trocars and the kidney. Furthermore, overweight men have more visceral adipose tissue [20], which is in our experience more difficult to divide than the fatty tissue in women. Although overweight women frequently have abundant adipose tissue in the region where the pfannenstiel incision is made, it is often surprising how easy the division of intra-abdominal fatty tissue can be achieved.

We realize that a total laparoscopic approach may be more difficult to realize than a hand-assisted approach. This technique has a higher level of difficulty compared with hand-assisted LDN and therefore requires more experience, in particular in donors with more difficult anatomy (i.e. obesity and multiple arteries). Current data suggest that approximately 50% of all centers with a laparoscopic live kidney donation program use hand-assistance and 50% do not [15], without proven benefits for the one or the other.

As in normal weight individuals, expansion of laparoscopic kidney donation programs may stimulate the number of potential obese donors. Knowledge of gender differences could help surgeons stretch the criteria gradually on LDN in overweight donors. We realize that the chance to develop metabolic changes remains a hot item in overweight and obese donors. Although short-term data on glomerular filtration rate and protein excretion were not alarming [6], long-term results should cautiously be monitored.

In conclusion, total LDN appeared to be easier in overweight female donors compared to overweight male donors. We recommend surgeons planning introduction of laparoscopic live kidney donation or expansion of already existing LDN programs with overweight donors, to apply a different policy for LDN in overweight female and male donors to gain experience. This could aid the safe introduction of (total) LDN in obese living donors.

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Authorship

NFMK designed the study, collected data, performed the statistical analyses and wrote the article. JNMI collected data and wrote the article. OS performed the statistical analysis and wrote the article. KTCT designed the study and collected data. WW included all donors and drafted the article. IPJA designed the study, collected the data and supervised the process.

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