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Prospective, Nonrandomized Comparison Between Right- and Left-Sided Hand-Assisted Laparoscopic Donor Nephrectomy

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ABSTRACT

Background. Despite technical improvements, laparoscopic living donor right nephrectomy can be associated with difficulties to obtain a sufficient lengths of right renal vessels. We report our experience with right-sided, hand-assisted, laparoscopic donor nephrectomy (HALDN).

Patients and methods. During a 7-year period (2003–2010), right HALDN was performed on 51 and left HALDN on 40 living kidney donors. We prospectively collected perioperative outcome data in donors and recipients including graft function and calculated 1-year graft survival according to the Kaplan-Meier-method.

Results. There were no conversions. The mean procedure time was 123 minutes versus 135 minutes for left HALDN ($P = .09$). Mean blood loss was 92 mL versus 101 mL in left HALDN ($P = .09$). There was no renal artery or vein thrombosis. The mean warm ischemia time was 47 seconds versus 41 seconds in left HALDN ($P = .21$). Hospital discharge was on an average at 3.4 days postoperatively. Delayed graft function occurred in two recipients: one in the left group and the other in the right group. Further, no significant difference in serum creatinine values was seen between the groups at 1 year after the transplantation. One-year graft survival rate was 97.5% in the left versus 98.1% in the right group.

Conclusion. Right HALDN is as safe and feasible as left HALDN. Hand-assistance results in a convenient length of right renal vessels without an increased incidence of vascular thrombosis.

LAPAROSCOPIC DONOR NEPHRECTOMY is increasingly the preferred method for living kidney donation in many centers. It is a minimally invasive laparoscopic technique.[1] The surgical procedure can be performed using the conventional laparoscopic or the hand-assisted technique. Hand-assisted laparoscopic donor nephrectomy (HALDN) was introduced in 1998.[2] The hand-assisted approach permits the surgical team to use the necessary extraction incision to their advantage, resulting in some technical benefits, including the ability to manually assist in the dissection, prevention of torsion of the kidney after the lateral attachments have been dissected, and ease to obtain hemostasis by manual compression of bleeding vessels.[3]

Because of its greater renal vessel lengths, the left kidney has remained the preferred organ for laparoscopic donor nephrectomy.[4] In contrast, some surgeons prefer the right kidney because it is easier to recover than the left and the decreased risk of splenic laceration.[5] However, regardless of the difficulty due to a short right renal vein with the herder graft implantation, the evaluation process for the kidney extraction must follow the principle that the best kidney should always remain with the donor. In our transplantation centre, regardless of the side HALDN is the method of choice for donor nephrectomy since December 2003. Herein, we have reported our nonrandomized experience with right-sided HALDN, including our approach to

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provide exposure of the right aortorenal junction during the procedure.

PATIENTS AND METHODS

This nonrandomized comparative study over a period of 7 years (2003–2010) includes 91 HALDN: 51 right-sided HALDN and 40 left-sided HALDN. Pre-, intra-, and postoperative data were collected prospectively from all consecutive donors and recipients. Our preoperative donor workup was standardized: thorough screening by medical history, physical examination, an array of laboratory tests (hematology, coagulation, blood chemistry, urinanalysis), kidney and chest imaging, infectious disease (including viral) studies, immunologic evaluation of donor-recipient match, and electrocardiogram. All donors were required to undergo an evaluation by a clinical psychologist.

Description of Surgical Technique

After extensive explanation of the operative risks and preparation and after inquiries to Eurotransplant regarding potential kidneys for the recipient, both donor and recipient were taken to the operating theatre. For right HALDN, the donor was placed in the right flank position supported by adequate padding. The abdominal cavity was explored using a five-port transperitoneal approach: an 11-mm umbilical port for the laparoscope, one 5-mm port for liver retraction, and two 5-mm and one 10-mm trocars as working ports. After creation of the pneumoperitoneum by insertion of a Veress needle through an incision above the umbilicus, a 10-mm trocar was placed for camera insertion. Thereafter, four additional working trocars were introduced. The insufflation pressure was maximally 12 mm Hg. After superior retraction of the liver, the peritoneum was opened laterocolically and the colon mobilized medially. This maneuver was followed by inspection and subsequent depiction of the psoas muscle and the ureter. Preparation followed along the ureter and the adnexal vessels to the renal hilum, where the vessels were identified. After complete exposure of the kidney and vessels with ligation of the side branches of the renal vein, we isolated the vena cava and the abdominal aorta. The kidney was dissected until it was only fixed by the hilar vessels.

At this stage, full mobilization of the right renal pedicle and inferior vena cava (IVC) was possible. The right renal vein was dissected down to its root from the IVC and the renal artery, mobilized just to the lateral border of IVC, to obtain a sufficient length for an anastomosis. Thereafter, the left hand of the surgeon was placed intra-abdominally via a lower abdominal midline vertical incision. For this purpose, a hand port (Omniport, Advanced Surgical Concepts Ltd, Dublin, Ireland) was used in the first 16 patients. In the remaining 75 patients, the surgeon's hand was placed directly through the incision without using the hand port. The vessels were further prepared under digital control until the anterior surface of the IVC was exposed and the full length of the right renal vein demonstrated. Thereafter, using the index und middle fingers, the IVC was mobilized and pushed aside. This exposure allowed identification and dissection of right renal artery down to its aortic origin. The residual nervous and connective tissue between the renal artery and the renal vein were then dissected carefully, allowing now a full exposure of the renal artery at the level of the aortorenal junction.

After intravenous administration of heparin, the ureter was cut between two clips at the transition to the pelvis minor. The renal vein was accordingly held between two fingers (index and thumb) and closed by a triple-row Endo-TA stapler (Multifire Endo TA 30, Covidien, USA). Thereafter, the renal artery was closed and cut by a triple-row Endo-TA stapler. This simple maneuver resulted in recovery of the entire length of right renal artery in all cases, making a safe and simple anastomosis possible. We used this technique also for the left-sided HALDN. Immediately after extirpation of the kidney, we perfused the organ with histidine-tryptophan-ketoglutarate (Custodiol, Koehler, Alsbach-Haenlein, Germany) solution. The recipient was prepared simultaneously in the neighboring operating theatre, resulting in a reduction of cold ischemia time to less than 30 minutes.

Transplantation and Postoperative Management

Renal transplantation was performed using preperitoneal placement in the iliac fossa. The immunosuppressive protocol was standardized in all recipients consisting of tacrolimus, methylprednisolone, and mycophenolate mofetil. Patients with a particular immunologic risk received additional therapy with antithymocyte globulin or the IL-2R inhibitor basiliximab for induction therapy. Delayed graft function was defined as the need for dialysis within the first postoperative week.

Statistical Analysis

Statistical analyses were performed with SPSS 12.0 (SPSS Inc, Chicago, Ill, USA). Student *t* test and chi-square test were used for comparisons. The rate of 1-year graft survival was calculated by Kaplan-Meier analysis. The level of significance was set at $P < .05$.

RESULTS

Characteristics as well as surgical and postoperative donor and recipient outcomes are shown in Tables 1 and 2. The procedures were all performed as planned without the need for conversion to open donor nephrectomy. The clinical results of 51 right-sided HALDN donors were non ran-

Table 1. Characteristics of Donors (Right-Sided Versus Left-Sided HALDN)

	HALDN Right	HALDN Left	*P* value
Number of patients	51	40	NA
Age (y)	43.1 (11.9)	43.4 (12.9)	.25
Ratio male:female	1:6	1:8	.21
Body mass index (kg/m^2)	26.2	25.6	.12
Operative time (min)			
Median	123	135	.09
Range	97–184	109–191	
Warm ischemia time (s)			
Mean	44	41	.21
Range	25–110	21–103	
Artery length (cm)	3.3	3.1	.76
Vein length (cm)	2.3	3.8	.05
Open conversions	0	0	NA
Hospitalization period (mean)	3.4 d	3.4 d	
Operative blood loss (mL)			
Mean	92	101	.09
Range	42–280	48–420	
Intraoperative complications	0	2 (5%)	.05
Graft loss	0	0	NA

Data are presented as mean with or without standard deviation in parentheses. HALDN, hand-assisted laparoscopic donor nephrectomy; NS, not significant; NA, not available.

Table 2. Characteristics of Recipients of Right-Sided Versus Left-Sided HALDN

	HALDN Right	HALDN Left	*P* Value
Number of patients	51	40	NA
Recipient diuresis (mL)			
POD 1	4883	4955	.10
POD 3	4021	4413	.09
POD 7	3432	3723	.10
Delayed graft function	1/51 (1.96%)	1/40 (2.5%)	.05
One-year posttransplant graft survival	50/51 (98.1%)	39/40 (97.5%)	.12
Mean Δ creatinine at POD 1 (mg/dL)	−4.1	−4.3	.12
Creatinine (mg/dL) 1 year posttransplant	1.34 (0.22)	1.37 (0.31)	.08
Cystatine C (mg/L) 1 year posttransplant	1.92 (0.69)	1.52 (0.43)	.07

Data are presented as mean with or without standard deviation in parentheses. HALDN, hand-assisted laparoscopic donor nephrectomy; POD, postoperative day.

domly compared to those of 40 left-sided HALDN. Blood transfusion was not required for any patient who donated a right kidney. One patient required transfusion at 2 days after donating the left kidney. The mean operative time was 123 minutes (range, 97–184 minutes) in the right and 135 minutes (range, 109–191 minutes) in left HALDN group ($P = .09$). The warm ischemia time was not significantly different between the right HALDN (44 seconds; range, 25–110 seconds) and for the left kidney (41 seconds; range, 21–103 seconds; $P = .21$). Also, the average estimated blood loss for the right HALDN (92 mL; range, 42–280 mL) was not significantly different from that for the left HALDN (101 mL; range, 48–420 mL; $P = .09$). The mean time to discharge from the hospital was equal for patients in both groups (3.4 days). Intraoperative complications occurred in two patients during left-sided laparoscopic hand-assisted nephrectomy: bleeding in one case (total blood loss 420 mL), and a small capsular tear of the spleen in the other. The lesions were recognized immediately and treated without conversion. Reinterventions were not indicated. In all cases, the vascular anastomoses were easily performed; no vascular thrombosis occurred. No kidney graft was lost for technical reasons.

Further, data on recipients of 51 right-sided, hand-assisted, laparoscopically recovered kidneys were compared with 40 left-sided kidneys (Table 2): namely 53 transplanted to the right and 38, to the left iliac fossa. No significant difference was observed between the recipients in both groups regarding the rate of early function (Table 2). Delayed graft function occurred in two patients: one in the left and the other in the right group. One-year graft survival rates were 97.5% in the left versus 98.1% in the right group ($P = .13$). Further, parameters of glomerular filtration rate, serum creatinine and cystatin C, showed no significant difference between the groups at 1 year after transplantation (Table 2).

DISCUSSION

Laparoscopic living donor nephrectomy (LDN) has proven to be safe and reproducible in many studies.[6] However, when reviewing the cumulative experience of LDN, it is clear that the left kidney is preferred because of the longer renal vein.[4] In the meantime, some data on the advantages of right-sided LDN have become available. For instance, Dols et al demonstrated that right-sided LDN is associated with a significantly shorter operative time (median = 30 minutes) compared with left-sided LDN.[7] Further, while Husted et al showed no difference in operative time between the groups, the same kind of data were reported by Lind et al.[5,8] Nevertheless, major drawbacks to the use of the right kidney are the retrocaval position of the renal artery and the shorter length of the renal vein. In addition, transection of the renal vessels with laparoscopic vascular staplers may lead to additional loss of available length necessary for implantation.

To overcome the problem of short right renal vessels, several techniques have been reported for this laparoscopic donor nephrectomy.[9] Buell et al reported a large series of right-sided LDN with 4% rate of renal vein thrombosis (3/85) among the pure laparoscopic group, but no vascular complications among the hand-assisted group ($n = 40$).[10] They further observed that hand-assisted devices provided better exposure and resulted in faster surgery, with acceptable outcomes when compared with a pure laparoscopic approach. Mandal et al reported three venous thromboses among eight right renal allografts recovered by right-sided LDN.[11] As they noted these results to be unacceptable, they used several modifications both for right donor nephrectomy and for implantations in recipients. After these changes in technique they reported no vascular complication among their next nine recipients. Further, Lind et al cited their experience of pure right-sided LDN in 73 patients; they performed recipient iliac vein mobilization to overcome the difficulty to anastomose the right renal vein.[5] Kay et al reported 66 left and 18 right donor nephrectomies performed by laparoscopic techniques.[12] Among right donors, the IVC was controlled through an open incision to introduce a Satinsky clamp in six patients. Turk et al reported laparoscopic right donor nephrectomy using a laparoscopic Satinsky clamp that was inserted through a separate incision in the abdominal wall and applied to the IVC, excising the renal vein with a cuff of IVC.[13]

In the present work, we sought to evaluate whether utilizing hand-assistance during right-sided HALDN resulted in gaining a convenient length of the right renal vessels. The basic idea behind this technique was that during HALDN, digital palpation offers a valuable tool to give the surgeon a tactile sensation to manually trace the vascular structures, especially the aorta and the renal artery. This exposure allows identification and dissection of right renal artery to the origin of the aorta, thereby providing a maximal length of the right renal artery. This approach also enables the surgeon to have safe control of the IVC during

excision of the right renal vein. In this study, we did not detect any significant differences in donor hospital stay, donor intra- and postoperative complication rate, or renal graft survival between left- vs right-sided, hand-assisted donor nephrectomy. There were no conversions and no major complications in our study. Nevertheless, regardless of the difficulty due to a short right renal vein plus the difficulty in performing the graft implantation, the evaluation process for kidney extraction must follow the principle wherein the best kidney always remains with the donor.

In conclusion, right HALDN is as safe and feasible as left HALDN. The appropriate use of digital assistance during right-sided HALDN helps to overcome technical problems associated with the short right renal vessels that may jeopardize the results of living donor renal transplantation.

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