Kidney Laterality and the Safety of Hand-assisted Live Donor Nephrectomy: Review of 1000 Consecutive Cases at a Single Center

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OBJECTIVE To determine the feasibility of performing right-sided, hand-assisted, laparoscopic donor nephrectomy (HALDN) and compare with the results of left-sided surgeries in both donors and recipients.

METHODS Between September 2006 and September 2013, 1000 consecutive patients underwent HALDN at our institution. Patient characteristics and the intraoperative or postoperative parameters of the donors and recipients were retrospectively evaluated. Preoperative data, including relative renal function, vascular anatomy, and parenchymal abnormalities, were evaluated to determine the reasons for harvesting the right kidney. Intraoperative and postoperative data, including pneumoperitoneum time, warm ischemia time, complications, chronic kidney disease stage, and graft function, were compared between donors and recipients who underwent right- and left-sided procurement.

RESULTS Mean follow-up period was 21 months in donor and 42 months in recipient. Right-sided HALDN was performed on 421 patients (42.1%). The most common reasons for selecting the right kidney was reduced right kidney function (53.4%) followed by multiple left renal arteries (34.2%). None of 1000 patients required conversion to open surgery or developed major complications. Serum creatinine concentrations and chronic kidney disease stage at the last follow-up examinations were similar in donors. There were no significant differences in graft function and ureter-related complications between right- and left-sided kidneys at the last follow-up examination.

CONCLUSION Right-side HALDN is a safe procedure. The donor side can be freely selected using HALDN to benefit both donors and recipients. UROLOGY 85: 1360–1367, 2015. © 2015 Elsevier Inc.

Kidney transplantation is the treatment of choice for patients with end-stage renal disease.[1] Living donor renal transplantation is superior to cadaveric donor renal transplantation, demonstrating higher patient and graft survival rates.[2,3] Laparoscopic living donor nephrectomy (LDN) series reported graft outcomes and complication rates that are similar to those of open surgery.[4] However, the rate of removing the right-side kidney is very low according to a series on pure laparoscopic LDN.[4]

Hand-assisted laparoscopic surgery was initially used for nephrectomy and donor nephrectomy, enabling the operating surgeon to use tactile feedback.[5] This method offers particular advantages for precise dissection using the fingers, allowing the determination of graft consistency via palpation, control of potential bleeding during vascular stapling, and graft removal.[6] Donor and recipient safety and maintaining minimal operative invasiveness are paramount considerations during LDN.

Donor nephrectomy policy states that the better kidney must always remain in the donor. Most transplant centers in the world, however, more frequently remove the left donor kidney than the right because removing the right kidney may be associated with higher rates of complications, including renal vein thrombosis and graft loss and also because the left renal vein is longer. Other surgeons, however, prefer the right kidney because it is easier to remove.[7] Several recent studies have reported that the right donor

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kidney is not associated with an increased risk of complications.[8,9] Meanwhile, right donor nephrectomy is frequently performed using open surgery owing to the technical difficulties associated with laparoscopic nephrectomy.

This study was performed to determine the outcomes of right-sided hand-assisted LDN (HALDN) and compare results in both donors and recipients who undergo left-side surgeries.

METHODS

Patients and Data Collection

After approval from the hospital institutional review board, the records of 1000 consecutive HALDN procedures that were performed under the direction of 2 surgeons (B.S.H. and I.G.J.) between September 2006 and September 2013 were retrospectively reviewed to evaluate the reasons for removing the right kidney and retrieve relevant data.

Renal vascular anatomy was assessed using computed tomography angiography. Preoperative renal function measurement in donors include 24-hour creatinine (Cr) clearance (mL/min), estimated glomerular filtration rate (eGFR) calculated using the Chronic Kidney Disease Epidemiology Collaboration (CKD-EPI),[10] and the Modification of Diet in Renal Disease (MDRD) equation. The relative GFRs between right- and left-side HALDNs were determined by renal nuclear perfusion scans (99m-Technetium diethylenetriamine pentaacetic acid [DTPA] renal scans). The analyzed factors included patient demographics, such as donor age, sex, and body mass index. Operative parameters, such as pneumoperitoneum time, warm ischemia time, intraoperative complications, length of hospital stay, and postoperative complications were compared between right- and left-side HALDNs. Pneumoperitoneum time was measured from the introduction of gas to the withdrawal of trocars. Warm ischemia time was defined as the time between renal arterial divisions to graft perfusion with cold preservation solution. Major postoperative complications (Clavien grade ≥ 3)[11] were compared between donors who received between the right- and left-sided surgeries.

To compare renal function to the donor side, we used postoperative serum Cr concentrations and CKD-EPI eGFR obtained at the last follow-up examination and DTPA GFR (available for 517 of patients), which was postoperatively performed after a mean of 16.2 months. We also reviewed the medical records of the recipients to obtain data including preoperative patient characteristics, and intraoperative and postoperative outcomes. All parameters and Cr at the last follow-up examination were compared between the right- and left-sided grafts. High-grade complications related to the ureter were also reviewed. The hospital's ethics committee approved the study.

HALDN Surgical Technique

For left-side surgery, the donor was placed in the partial right lateral position (45° from horizontal). An 8-cm incision was made at the midline above the umbilicus, and a hand port device (Applied GelPort; Applied Medical, Rancho Santa Margarita, CA) was inserted. A 12-mm camera trocar was placed at the lateral aspect of the rectus muscle and around the medial one-third point from the umbilicus to the anterior superior iliac spine. Under direct vision and hand guidance, 2 additional working laparoscopic ports were inserted. The gonadal, adrenal, and lumbar veins were controlled using 3-0 black silk one-hand ties. Initial posterior and inferior dissection of the hilum was performed, and finally anterior and superior dissection was performed to completely free the hilum. After the ureter was transected, the renal artery was controlled using a single Hem-o-lok clip (Weck Closure System, Research Triangle Park, NC) and 2 metal clips, and the renal vein was controlled using the EndoGIA stapler (Endopath ETS articulating linear cutters; Ethicon, Irvine, CA).

For right-side HALDN, an 8-cm incision was made below the umbilicus at the lateral aspect of the rectus muscle to insert the hand-assistive device. A 12-mm camera trocar was placed at the umbilicus through the lunar incision, and a 12-mm laparoscopic working port was inserted at the upper abdomen along the anterior axillary line. An additional 5-mm port was preferred for liver retraction. In our attempt to gain the maximum length of the right renal vein, the kidney must be smoothly retracted laterally with the surgeon's left hand to extend the right renal vein, and the EndoGIA stapler (Endopath ETS articulating linear cutters; Ethicon) was placed at the confluence of the inferior vena cava and the right renal vein. The figure of port placement for the left- and right-sided HALDN is shown in Supplementary Figure.

Statistical Analysis

All statistical analyses were performed using the Statistical Package for the Social Sciences for Windows (version 21.0; SPSS, Inc, Chicago, IL). Categorical data were compared using the Fisher exact test; non—normally distributed continuous data were compared using the nonparametric Mann-Whitney U test for independent groups, and independent groups of normally distributed data were compared using the t test. In this study, $P < .05$ is considered statistically significant.

RESULTS

Donor Characteristics

The demographic characteristics of the donors who underwent right- and left-sided HALDN are shown in Table 1. Relative DTPA GFR in preserved kidney was significantly higher than relative DTPA GFR in removed kidney in right-side HALDN group. CKD-EPI eGFR was more approximate to 24-hour Cr clearance than MDRD eGFR. The number of arteries in the removed kidney was 1.14 (single: 358 [85%]) in right HALDN and 1.21 (single: 479 [83%]) in left HALDN. The remaining factors were not statistically different between the groups.

Policy in Donor-side Selection and Reasons for Selecting the Right Kidney

Right-sided HALDN was performed on 421 patients (42.1%) in this cohort. Right-sided HALDN was 32% in 2007 and 49.2% in 2013. The kidney with better function in terms of relative DTPA function remained in the donor; however, left nephrectomy was preferred when the difference in renal function was <6%. If multiple arteries were present, the side with the single artery was preferred. Left nephrectomy was performed if both kidneys had double arteries and renal function difference was <6%.

The 2 most common reasons for selecting the right side were lower relative renal function ($\geq$6%) on the right