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Renal Disease

Determinants of Laparoscopic Donor Nephrectomy Outcomes

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Abstract

Background: Pure laparoscopic donor nephrectomy (LDN) is a unique intervention because it carries known risks and complications, yet carries no direct benefit to the donor. Therefore, it is critical to continually examine and improve quality of care.
Objective: To identify factors affecting LDN outcomes and complications.
Design, setting, and participants: A retrospective analysis of prospectively collected data for 1204 consecutive LDNs performed from March 2000 through August 2012.
Intervention: LDN performed at an academic training center.
Outcome measurements and statistical analysis: Using multivariable regression, we assessed the effect of age, sex, body mass index (BMI), laterality, and vascular variation on operative time, estimated blood loss (EBL), complications, and length of stay.
Results and limitations: The following variables were associated with longer operative time (data given as parameter estimate plus or minus the standard error): female sex (9.09 ± 2.43; $p < 0.001$), higher BMI (1.03 ± 0.32; $p = 0.001$), two (7.87 ± 2.70; $p = 0.004$) and three or more (22.45 ± 7.13; $p = 0.002$) versus one renal artery, and early renal arterial branching (5.67 ± 2.82; $p = 0.045$), while early renal arterial branching (7.81 ± 3.85; $p = 0.043$) was associated with higher EBL. Overall, 8.2% of LDNs experienced complications, and by modified Clavien classification, 74 (5.9%) were grade 1, 13 (1.1%) were grade 2a, 10 (0.8%) were grade 2b, and 2 (0.2%) were grade 2c. There were no grade 3 or 4 complications. Three or more renal arteries (odds ratio [OR]: 2.74; 95% CI, 1.05–7.16; $p = 0.04$) and late renal vein confluence (OR: 2.42; 95% CI, 1.50–3.91; $p = 0.0003$) were associated with more complications. Finally, we did not find an association of the independent variables with length of stay. A limitation is that warm ischemia time was not assessed.
Conclusions: In our series, renal vascular variation prolonged operative time and was associated with more complications. While complicated donor anatomy is not a contraindication of LDN, surgical decision-making should take into consideration these results.

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1. Introduction

Living donor versus deceased donor kidney transplantation is associated with better outcomes [1]. Improved graft survival at 1 yr and 10 yr has been achieved with living donor transplantation. This improvement is thought to arise from decreased ischemia times, selection of healthy donors, and shortened waiting times for transplantation with living donor approaches [2–4]. Furthermore, with new matching strategies such as donor chains and paired exchanges,

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improved outcomes may be seen from enhanced donor–recipient matching [5].

The laparoscopic approach has become the optimal approach for living donor nephrectomy, due to less postoperative pain, quicker convalescence, decreased morbidity, and improved cosmetic appearance compared to the traditional open approach [6]. Several distinct surgical approaches to living donor nephrectomy have developed in the laparoscopic era, including, pure laparoscopic donor nephrectomy (LDN), hand-assisted LDN, minilaparoscopy, retroperitoneal and transperitoneal approaches, and more recently, laparoendoscopic single-site, and robotic donor nephrectomy. Currently, LDN, hand-assisted LDN, and open donor nephrectomy make up the majority of procedures performed [7,8].

LDN is a unique operation in that it is an elective operation performed on healthy individuals; therefore, every effort must be made to attenuate perioperative morbidity and ensure a rapid return to baseline. This study aims to investigate donor characteristics effects on donor outcomes (operative time, estimated blood loss [EBL], complications, and length of stay [LOS]) to identify potential areas for improvement.

2. Methods

2.1. Enrollment and selection criteria

From March 2000 through August 2012, 1204 consecutive LDNs were performed at an academic training center, and patient characteristics and outcomes were prospectively entered into a University of California Los Angeles (UCLA) institutional review board-approved Access database (Microsoft, Redmond, WA, USA). Selection of potential donors to undergo surgery was made after a rigorous evaluation by a nephrologist, a surgeon, a psychiatrist, and an independent donor advocate. Routine evaluation included the following laboratory tests: urine analysis and culture, 24-h urine collection to measure protein and creatinine levels to estimate glomerular filtration rate, complete blood count, chemistry panel, pregnancy testing, and appropriate serologies for donation (hepatitis, human immunodeficiency virus, cytomegalovirus, Epstein-Barr virus, and herpes simplex virus) and cross matching. Every candidate received a multidetector, triple phase, contrast computed tomography (CT) scan with urogram. Of the 1162 subjects with complete record of CT findings, the intraoperative findings of 1139 (98%) subjects were consistent with that of the CT imaging. No nuclear studies were performed. Voiding cystourethrogram or other studies were seldom done and only as indicated by patient history or findings on routine labs and CT imaging. Donor selection was finalized by a multidisciplinary donor-selection committee. The donors were healthy donors with Charlson Comorbidity Index score of 0 in all cases, and the left kidney was preferentially selected to provide longer vein length during transplantation. Additionally, longer left renal vein length was preferred even in the presence of up to two left renal arteries.

2.2. Surgical technique

Our technique for LDN has been previously described [9,10]. Four different surgeons fellowship trained in laparoscopy (PGS, JCH, AE) or transplantation (HAG) performed the surgery in our series. Briefly, patients are placed in the lateral decubitus position and LDN is performed via a transperitoneal approach. A Veress needle is used for insufflation and three 5-mm trocars are placed along the rectus margin beneath the costal margin. Another 5-mm port is placed in the anterior axillary line under the costal margin to aid lateral hilar retraction. A Pfannestiel incision allows the insertion of a 15-mm trocar to accommodate: (1) the endovascular stapler (Multifire Endo GIA 30; Covidien, Dublin, Ireland) for renal hilar ligation and division; (2) a Hem-o-Loc (Weck Closure Systems, Research Triangle Park, NC, USA) clip applier for ligation of the ureter at the level of common iliac artery; and (3) a laparoscopic bag for specimen retrieval. Mannitol (7.5 mg) is administered at the time of Veress needle insertion and again just prior to specimen retrieval. Subcutaneous bupivacaine and intravenous ketorolac are used for postoperative analgesia, in addition to narcotics on an as-needed basis.

2.3. Statistical analysis

2.3.1. Independent variables

Patient characteristics included age, sex, body mass index (BMI), laterality, and vascular anatomic variation. Vascular anatomic variation included multiple renal arteries and veins, early renal artery branching (within 2 cm of the aorta for left-side donors and proximal to the right wall of the inferior vena cava for right-side donors), and late renal vein confluence (left renal vein branch convergence within 1.5 cm of the aorta and right renal vein branch convergence within 1.5 cm of the inferior vena cava).

2.3.2. Dependent variables

Operative time was defined as the interim between Veress needle insertion and completion of skin closure. Other dependent variables included EBL, LOS, and complications as defined by the modified Clavien classification [11].

For univariable analysis, we used the Wilcoxon rank-sum test for nonparametric variable comparison, t test for continuous variable comparison, and chi-square test for categorical variable comparison. For multivariable analyses, we selected covariables a priori in our linear (continuous outcomes: operative time, EBL, and LOS) and logistic regression (complications) that may have influenced our outcomes of interest. Additionally, we performed additional multivariable regression analyses for clinical interpretability to examine factors associated with EBL $\geq$50 ml versus $<$50 ml and complications that were self limited (Clavien 1 and 2a) versus those requiring intervention (Clavien 2b, 2c) versus no complication.

3. Results

3.1. Study population characteristics

The demographic and clinical characteristics of the study cohort are reported in Table 1. The mean age and BMI were 41.2 yr (range: 18–70 yr) and 25.8 kg/m^2(range: 14–37 kg/m^2), respectively. Among 1204 LDNs, the left kidney was removed in 1187 (98.6%) of the cases. Male patients accounted for 481 (40%) of the cases. Renal vascular variation occurred in 674 (55.98%) of donors and 278 (23.9%) donors had two renal arteries. Early renal arterial branching occurred in 249 (20.8%) donors. Late renal vein confluence was found in 230 (19.3%) cases. Overall, there were 99 (8.2%) complications, including 3 (0.3%) open conversions, 55 (4.6%) postoperative emergency room visits, and 16 (1.4%) hospital readmissions (Table 2). One (0.08%) patient required a blood transfusion. Open conversions were for an iliac injury with Veress needle, stapler misfire, and the last was for failure to progress.