Evolution of Laparoscopic Donor Nephrectomy Technique and Outcomes: A Single-center Experience With More Than 1300 Cases

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OBJECTIVE To describe and illustrate the evolution of surgical technique, emphasizing technical modifications of laparoscopic donor nephrectomy (LDN) and the impact on complication outcome.

METHODS This is a retrospective observational study of prospectively collected data on all consecutive purely LDN surgeries performed at a tertiary academic medical center (n = 1325), performed between March 2000 and October 2013.

RESULTS Over time, LDN was performed on older patients, changing from a mean of 35.7 years in 2000 to 41.2 years in 2013 (P <.001). Additionally, mean blood loss decreased from 75 mL in 2000 to 21.6 mL in 2013 (P <.001). However, body mass index, operative time, and length of stay remained similar. Overall, there were 105 (7.9%) complications: Clavien grade 1 (n = 81, 6.1%) and grade 2 or higher (n = 23, 1.8%). Procedure duration, blood loss, surgeon, year of procedure, laterality, body mass index, age, and gender did not significantly predict complications. There was no significant difference for Clavien complication rates between the early learning period (first 150 cases) and the rest of the series.

CONCLUSION With continual refinement with LDN techniques based on intraoperative observations and technological advances, complication rates remain consistently low, despite increasing donor age. UROLOGY 85: 107–112, 2015. © 2015 Elsevier Inc.

Laparoscopic techniques improve morbidity and shorten convalescence for donor nephrectomy.[1] However, in contrast to kidney surgeries eliminating cancer, infection, or obstruction, laparoscopic donor nephrectomy (LDN) risks donor health without improving it. Thus, the challenge for LDN is to relentlessly pursue the refinement of surgical technique to reduce risk to the donor. Continuous quality improvement should accompany advances in surgical technology and technique. Although population-based studies demonstrate better donor nephrectomy outcomes over time, these may not include subtle details that incrementally improve the donor experience.[2] Herein, we aim to describe the evolution of surgical technique, emphasizing technical modifications and the impact on complication outcome with a single institution's LDN experience.

METHODS

Patient Selection

This is a retrospective observational study of prospectively collected data on all consecutive purely LDN surgeries performed at a tertiary academic medical center (University of California, Los Angeles, CA) since March 2000 through October 2013. LDN patient selection and workup has been described previously.[3] In 98% of cases, the patient's kidneys were equivalent by imaging; therefore, based on surgeon preference for longer vein length, the left kidney was routinely removed. For brevity, this surgical description will focus on the left-sided procedure. Of note, the right kidney was taken typically in instances of minor nephrolithiasis or small renal defects.

Surgical Technique

The supplementary video depicts a typical left LDN to accompany this description (Video).

Patient Positioning. After anesthesia induction, an oral gastric tube is placed to decompress the stomach. Additionally, the Pfannenstiel incision is premarked in the supine position (lower transverse approximately 8 cm in length, 3 cm above the

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symphysis pubis) to prevent an asymmetric skin incision resulting from gravity's effect on the pannus in flank position. The patient is positioned into a modified flank or right lateral decubitus position (Supplementary Fig. 1). Early in our experience, the left arm was extended and abducted, supported by an airplane armrest over the right arm. However, since 2012, we place the arm in a neutral position along the left lateral torso in an adducted anatomic position because we observed that this position was associated with less limitations of instrument range during robotic-assisted transperitoneal partial nephrectomy. Before this modification, the laparoscope range of motion was limited by the ipsilateral arm position on the airplane. Moreover, this positioning eliminates the need for an airplane, and there is adequate space for open conversion through a subcostal incision. Once positioned, a 10-cm cloth tape is used to secure the patient at the chest, hips, and ipsilateral arm, and the first 12.5-gm intravenous mannitol dose is administered.

Trocar Placement. Pneumoperitoneum is obtained using a Veress needle placed 0.5 cm cephalad to the umbilicus. Before 2006, the Veress needle was placed in the left lower quadrant; however, we adjusted placement after an injury to the left common iliac artery. After achieving 15 mm Hg of insufflation, three 5-mm trocars are placed along the left rectus margin in a linear configuration.[4] Before 2005, before the advent of high-definition cameras, we used 12-mm trocars, but the switch obviates trocar fascial closure with endoclose devices that often snare the rectus muscle and contribute to postoperative discomfort. Next, an optical obturator 5-mm trocar with a 0° scope is advanced under direct vision at the junction of the rectus border and costal margin (approximately 1 cm inferior to rib). We switch to the 30° laparoscope and place the next two 5-mm trocars under direct vision, spaced approximately 7 cm apart, respectively.

Reflection of Descending Colon. The assistant operates the camera through the most cephalad trocar. We routinely used a fourth 5-mm trocar under the costal margin at the anterior axillary line and a second assistant to facilitate lateral traction on the kidney during the medial upper pole and hilar dissections; however, this was eliminated in 2012 in favor of a 3-trocar technique. The white line of Toldt is incised approximately 1 cm lateral to the descending colon into the pelvis. Over the kidney, care is taken only to incise the peritoneal layer to preserve an anatomic approach, and not enter the Gerota fascia. Moreover, entry into the Gerota fascia over the kidney obscures the hilar dissection, as the Gerota fascia (and perinephric fat) falls medially over the hilum. Caudad to the kidney, a combination of sharp or blunt dissection is used to sweep the peritoneum medially. Spinning a laparoscopic Kittner medially while maintaining lateral counter traction with a blunt tip grasper is very effective to avoid an inadvertent peritoneal window. With more medial reflection of the peritoneum, the gonadal vein is identified coursing just under the mildly transparent Gerota fascia.

This dissection plane of the peritoneal reflection medially and inferiorly away from the Gerota fascia is carried lateral to the tail of the pancreas and approximately 1 cm lateral to the spleen. The incision of the peritoneum needs to be carried up superiorly well above the spleen to ensure adequate exposure for the medial upper pole dissection (Supplementary Fig. 2A).

Gonadal Vein, Ureteral, and Posterior Dissection. We dissect around the gondal vein, just below the lower pole where it crosses over the ureter (Supplementary Fig. 2B). Next, we divide the somewhat opaque Gerota fascia overlying the gonadal vein in a cephalad direction, facilitating the identification of the renal vein. Extending this dissection of the Gerota fascia more cephalad across the renal vein often reveals the confluence of the adrenal and renal vein more medial to the takeoff of the gonadal vein. The vessel sealer and divider (VSAD; LigaSure; Covidien, Norwalk, CT) is then used to ligate and divide the gonadal vein. We used the harmonic scalpel exclusively until 2006; however, we switched to the VSAD due to the consistent ligation of the gonadal, adrenal, and lumbar veins thus avoiding clips near the hilum that may increase the subsequent risk of stapler misfire. In our initial experience, we did not routinely ligate and divide the adrenal vein due to the inability of the harmonic scalpel to easily seal the adrenal vein. Therefore, we stapled the vein distal to the adrenal vein takeoff early in our experience. Additionally, the VSAD facilitates blunt dissection without the concern of thermal injury, whereas the harmonic scalpel has a sharper, hotter tip.

After gonadal vein division, we bluntly dissect onto the psoas muscle fascia, establishing the medial border of the ureteral dissection. Initially, we ligated and divided the gonadal vein just proximal to where the ureter crosses the common iliac artery with the intent of maximal preservation of ureteral vasculature; however, since 2007, we routinely ligate the gonadal vein just below the level of the lower pole because others have shown that this provides less postoperative ipsilateral scrotal discomfort in male donors with higher ligation.[5] The plane between the ureter and gonadal vein is established with sharp and blunt downward sweeping motions. The ureteral dissection ceases at the common iliac artery, but the ureter is not divided until after hilar vessels are divided to provide a point of fixation during hilar division and to prevent the ureter from flopping into areas of subsequent dissection, such as the hilum, and so forth.

Next, dissection is carried medial to the proximal gonadal vein stump toward the renal vein; however, this dissection ceases before lumbar veins are encountered typically inserting into the renal vein at the same level as the gonadal vein. The 30° scope is angled to visualize behind the kidney toward the upper pole, whereas blunt dissection is used to elevate the kidney off the psoas and quadratus muscle fascia. This release ensures renal vessel length through by enabling maximal stretch of the hilar vessels.

Upper Pole and Adrenal Gland Dissection. After reflecting the tail of the pancreas away from the medial upper pole, we enter the Gerota fascia, dissecting into the perinephric fat. First, the lateral edge of the adrenal gland is identified, and the dissection plane is carried as medial and as close to the adrenal gland as possible, to prevent potential injury to hilar branches to the upper pole (Supplementary Fig. 2C). This is carried down to the posterior body wall musculature, and extended superolaterally resulting in complete release of the upper pole of the kidney from the spleen. With the harmonic scalpel, we frequently encountered small vessel bleeding during dissection into the perinephric fat. However, this ceased with conversion to the VSAD, which also allows more 1-handed dissection due to secure hemostasis and led to the elimination of the fourth 5-mm port. Next, the adrenal vein is divided, and the upper edge of the renal vein proximal to the adrenal vein stump is released with blunt dissection to prepare the exit site of the endovascular stapler.