

## Incidence of Ureteral Strictures After Laparoscopic Donor Nephrectomy

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**Purpose:** Previous reports of laparoscopic donor nephrectomy have suggested that preservation of the gonadal vein with the specimen is important for preventing ureteral strictures. To test this hypothesis we examined our series of patients for the incidence of ureteral strictures when the gonadal vein was not preserved with the specimen during laparoscopic donor nephrectomy.

**Materials and Methods:** We reviewed the records of 300 consecutive patients at our institution who underwent laparoscopic donor nephrectomy between 2000 and 2005. Mean donor age was 36.7 years (range 18 to 68) in the 167 female and 133 male donors. Mean recipient age was 38.4 years. Average followup was 2 years. During ureteral dissection the gonadal vein was transected just distal to the renal vein and left in situ. The ureter was dissected and transected at the level of the common iliac vessels. Indwelling ureteral stents were used for all recipient ureteral reimplantations and left in place for 1 month. In the postoperative period transplant recipients were followed biweekly for serum creatinine function during month 1 and monthly thereafter. All patients with increased creatinine (greater than 1.3 mg/dl) or an increasing trend were evaluated with transplant renal ultrasound. Clinically significant ureteral stricture was defined as persistent hydronephrosis resulting in impaired renal function and the need for percutaneous nephrostomy tube placement or ureteroscopic management.

**Results:** After laparoscopic living donor transplantation without gonadal vein preservation we found no incidence of clinically significant ureteral stricture.

**Conclusions:** Gonadal vein preservation with the specimen during laparoscopic donor nephrectomy is not necessary. Preservation of the periureteral blood supply is sufficient to prevent ureteral strictures.

*Key Words:* kidney, laparoscopy, nephrectomy, kidney transplantation, ureteral strictures

Laparoscopic live donor nephrectomy was first introduced in 1995 by Ratner et al as a less invasive alternative to the open procedure to increase the number of renal donors.<sup>1</sup> Six years later the United Network for Organ Sharing announced that the number of living donation procedures performed in the United States during 2001 exceeded the number of cadaveric donations for the first time.<sup>2</sup> The advantages of LLDN are decreased hospital stay and decreased convalescence, less pain and greater patient acceptance.<sup>3-6</sup> There is no increased risk to the donor, graft or recipient compared to that of the standard open procedure.<sup>7-9</sup> Despite the low complication rate<sup>10</sup> the incidence of ureteral stricture in the recipient is still reported to be 2% to 10.5 % (table 1).<sup>5,10-12</sup> To prevent this complication groups at some centers suggest that preserving the gonadal vein with the specimen is essential to prevent ureteral stricture in the recipient.<sup>11-14</sup> We retrospectively examined our database of 300 consecutive LLDNs between 2000 and 2005 as performed by a single surgeon (PGS) to determine the incidence of ureteral strictures when the gonadal vein was not preserved with the specimen during LLDN.

### MATERIALS AND METHODS

Between 2000 and 2005, 300 consecutive LLDNs were performed by a single surgeon (PGS). A separate recipient sur-

gical team performed renal transplantation in the adjacent operating room. Mean donor age was 36.7 years (range 18 to 68) and there were 167 female and 133 male donors (table 2). Mean recipient age was 38.4 years. All donors underwent extensive medical, psychological and surgical evaluation before surgery. Screening laboratory and imaging including urinalysis, urine culture, 24-hour urine collection, complete blood count, serum chemistry, blood urea nitrogen, creatinine, blood typing, viral serology, electrocardiogram, chest x-ray, and computerized tomography of the abdomen and pelvis with 3-dimensional reconstruction. All female patients underwent gynecological evaluation. Pregnancy test and screening mammogram were performed in women in the reproductive years and in those older than 39 years, respectively. Prostate specific antigen testing was done in male patients older than 39 years.

The transperitoneal LLDN technique was that described previously<sup>1,3</sup> with the modification that the gonadal vein was not taken en bloc with the specimen. The gonadal vein was isolated and transected just distal to the renal vein using clips and/or a Harmonic Scalpel® (fig. 2). The ureter was then dissected using the Harmonic Scalpel® with the gonadal vein left in situ and particular attention given not to devascularize the blood supply. The ureter was transected at the level of the common iliac vessels using a vascular Endo GIA™ stapler (fig. 3). Particular attention was given to avoiding dissection in the triangular area formed by the kidney, renal hilum and gonadal vein stump (fig. 2). The harvested kidney was then transplanted in the recipient by the transplant surgeon (HAG) and

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References	% Ureteral Strictures
Nogueira et al <sup>12</sup>	2
Waller et al <sup>5</sup>	5
Jacobs et al <sup>10</sup>	4.4
Su et al <sup>11</sup>	10.5 (first 95 pts), 5.4 (last 97)

Urine leakage was noted in 4.5% of the patients.<sup>12</sup>

the ureter was reimplemented using the standard Lich-Gregoire technique.<sup>15,16</sup>

Indwelling ureteral stents were used in all transplant recipients for approximately 1 month (range 3 to 6 weeks).<sup>17</sup> Stents were later removed by flexible cystoscopy. Renal function in the recipients after transplantation was monitored by daily serum creatinine while in the hospital, then biweekly during month 1 and monthly thereafter. All patients with creatinine greater than 1.3 mg/dl or with an increasing trend were investigated with ultrasound. All patients received followup care at our institution. Average followup was 24 months (range 3 to 48).

**RESULTS**

In our LLDN series 297 procedures were done on the left side and 3 were done on the right side. Table 2 lists the outcomes. Mean operative time ± SD was 180 ± 55 minutes with an estimated blood loss of 80 ± 50 ml. Warm ischemia time was 4 ± 2 minutes. Cold ischemia time was less than 60 minutes. Mean body mass index was 28.3 kg/m<sup>2</sup> (range 22.7 to 34). Multiple arteries (2 or greater) were found in 66 patients. Ureteral length was approximately 15 cm. All 300 kidneys were procured and transplanted successfully with adequate renal artery and renal vein length to perform the recipient operation using standard techniques.

Mean creatinine in all patients 1 month after ureteral stent removal was 1.04 mg/dl (range 0.4 to 2.6). There were 3 open conversions (1%) due to failure to progress, malfunctioning of the Endo GIA™ stapler during transection of an accessory renal artery and vascular injury during Veress needle entry, respectively. There were 5 postoperative complications (1.6 %), including 2 cases of chylous ascites that resolved with percutaneous drainage and a medium chain triglyceride diet. There was 1 subcutaneous hematoma

Mean age (range)	36.7 (18–68)
No. race:	
White	124
Black	7
Hispanic	156
Other	13
No. sex:	
M	133
F	167
No. kidney removed:	
Lt	297
Rt	3
Mean blood loss ± SD (cc)	80 ± 50
Mean operative time ± SD (mins)	180 ± 55
Mean kg/m <sup>2</sup> body mass index (range)	28.4 (22.7–34)
Multiple arteries (No. pts)	66
Mean warm ischemia time ± SE (mins)	4 ± 2
Mean cold ischemia time (mins)	Less than 60
Mean mg/dl creatinine/1 mo postop (range)	1.04 (0.4–2.6)

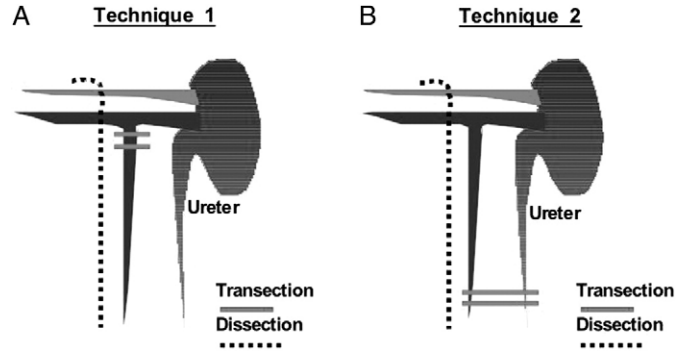


FIG. 1. Gonadal vein preservation

treated with open drainage and local wound care. There were 2 cases of epididymitis treated with antibiotics. There were no deaths. In recipients there were 11 allograft failures (3.6%) due to chronic rejection. There was 1 case of renal vein thrombosis (0.3%), which resulted in allograft nephrectomy.

We found no incidence of clinically significant ureteral obstruction in the recipient allograft using our technique of nonpreservation of the gonadal vein with the specimen. We observed patients with normal creatinine associated with transient mild hydronephrosis that resolved on serial ultrasound. No interventions were done and these patients were observed. None of our patients required percutaneous nephrostomy tube placement or ureteroscopic intervention.

**DISCUSSION**

LLDN is considered a comparable alternative to the open procedure with all of the advantages of a less invasive technique, including less postoperative discomfort, shorter hospital stay, better cosmetic results and decreased convalescence.<sup>4,18</sup> Despite these advantages there are still some well described complications that can occur in the donor as well as in the recipient.<sup>9,11</sup> One of the most debated points of interest in the literature is ureteral stenosis and/or necrosis in the recipient with a reported incidence of 2% to 10.5% (table 1). It is believed that ureteral stenosis or necrosis may occur within 6 months of transplantation,<sup>10</sup> due to impaired vascularity of the ureter from aggressive ureteral dissection, thereby compromising its delicate blood supply.<sup>11</sup>

For this reason some reports in the literature describe modifications to the standard laparoscopic technique to preserve the ureteral blood supply.<sup>11–14,19</sup> There are 2 major modifications described in the literature. Khauli et al proposed transecting the ureter en bloc with the gonadal vein at

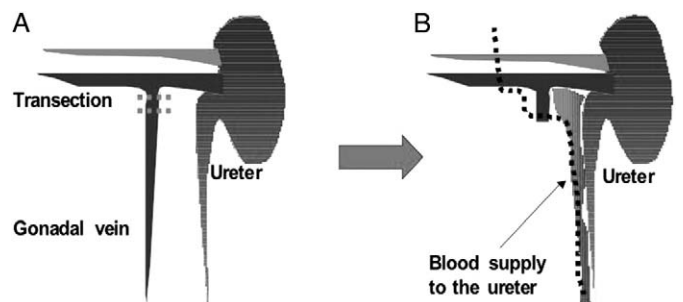


FIG. 2. Nonpreservation of gonadal vein

the level of the iliac vessels (fig. 1).<sup>14</sup> The rationale of this approach is to keep the gonadal vein in continuity with the renal vein and avoid dissection between the ureter and gonadal vein to preserve the ureteral blood supply. Su et al recommended blunt dissection with minimal electrocautery medial to the gonadal vein, keeping it and the mesoureter along the entire length of the ureter down to the pelvic inlet and transecting the gonadal vein at the level of the renal vein (fig. 1).<sup>11</sup> This approach avoids dissection between the proximal ureter and the lower pole of the kidney to maintain the ureteral blood supply from the renal artery. Su et al reported a statistically significant decrease in ureteral complications after the introduction of the gonadal sparing technique from 10.5% in the first 95 cases to 5.2% in the last 96 with a mean 6.3% ureteral complication rate overall (fig. 1).<sup>11</sup> Other reports describe similar results after introducing preservation of the gonadal vein with the specimen.<sup>13,19</sup>

In our series of 300 initial consecutive LLDNs we did not preserve the gonadal vein with the specimen (figs. 2 and 3). We found no incidence of clinically significant ureteral strictures. We transected the gonadal vein just distal to the renal vein and dissected with the Harmonic Scalpel™ between the ureter and gonadal vein. There are 3 crucial aspects to our approach that may contribute to the absence of postoperative ureteral complications. 1) Particular attention is given to avoiding dissection too close to the ureter and skeletonizing the periureteral blood supply. 2) Dissection between the ureter and gonadal vein is performed with a Harmonic Scalpel™. The Harmonic Scalpel™ may be safer than electrocautery since energy dispersion is less than 1 mm for the former. This is potentially an important factor to consider since we dissect close to the ureter. 3) Dissection between

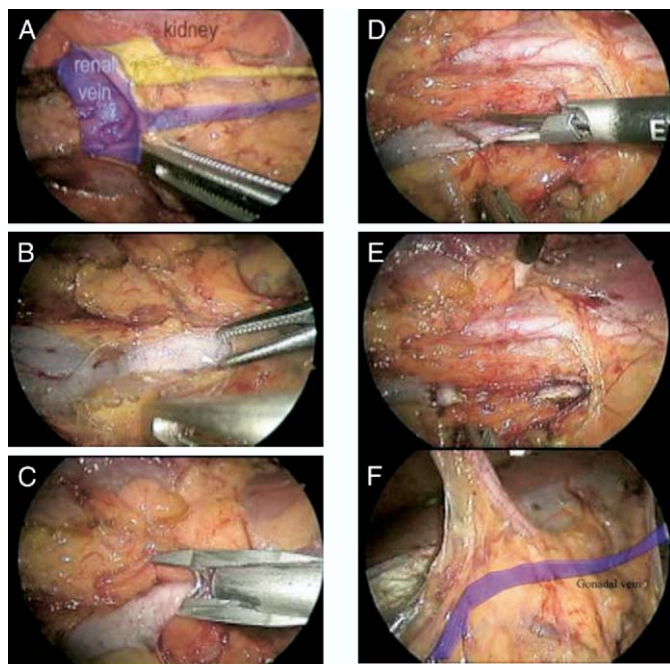


FIG. 3. Intraoperative view during nonpreservation of gonadal vein. A, gonadal vein is identified. B, gonadal vein is dissected. C, gonadal vein is clipped. D, gonadal vein is transected with harmonic scalpel. E, gonadal vein is transected at renal vein level. F, dissection is done between gonadal vein and ureter with preservation of proximal periureteral tissue.

the triangle defined by the gonadal vein stump, renal hilum and lower pole of the kidney is avoided. The superior blood supply of the ureter originating from the renal artery lies within this triangular area.<sup>20</sup> Furthermore, this approach offers additional advantages for simplifying the nephrectomy procedure. In particular transection of the gonadal vein at the level of the renal hilum provides better access to the lumbar vein and dissection of the ureter away from the gonadal vein allows easier elevation of the ureter.

After 300 LLDNs we found no incidence of clinically significant ureteral strictures. To our knowledge this result is unique and it confirms that the gonadal vein can be safely sacrificed to achieve a simplified procedure. Preventing ureteral stricture in the recipient requires preserving the periureteral blood supply and gently handling the distal ureter during reimplantation. Our transplant team uses the Lich-Gregoire technique for ureteral reimplantation.<sup>15,16</sup>

Groups at other centers that preserve the gonadal vein still report a low incidence of ureteral stricture, while our experience lacks this complication. A possible explanation is that our approach of nonpreservation of the gonadal vein provides cleaner dissection of the ureter, such that minimal manipulation or trimming is needed before reimplantation. In contrast, if the gonadal vein and associated tissue were taken en bloc with the ureter, there would be substantial bulk to the distal ureteral packet that would require extensive handling and trimming before ureteral reimplantation.

## CONCLUSIONS

LLDN has had a substantial impact on the donor operation with less morbidity in donor patients and high quality allografts for the recipient. One of the most concerning complications in kidney transplantation is the incidence of ureteral stricture in the recipient. In our 5 years of experience with 300 cases of LLDN we have attributed the lack of ureteral stenosis or urine leakage to meticulous attention to preserving the periureteral blood supply during ureteral dissection and providing a clean ureter that requires minimal manipulation or revision before reimplantation. Preserving the periureteral blood supply to the ureter does not require preservation of the gonadal vein with the specimen. It depends on preserving the tissue defined by the triangular area formed by the stump of the gonadal vein, renal hilum and lower pole of the kidney, where the superior blood supply from the renal artery lies.

### Abbreviations and Acronyms

LLDN = laparoscopic live donor nephrectomy

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