BRIEF COMMUNICATION

TECHNICAL CONSIDERATIONS IN HAND-ASSISTED LAPAROSCOPIC LIVE DONOR NEPHRECTOMY: INITIAL TAIWAN EXPERIENCE FROM NATIONAL TAIWAN UNIVERSITY HOSPITAL

Shih-Chieh Chueh, Ming-Kuen Lai, Po-Huang Lee, and Jun Chen

Abstract: This report describes the initial experience of laparoscopic live donor nephrectomy (lap-LDN) in Taiwan and discusses the technical considerations and modifications of our technique. From September to November 2000, three (one right and two left) lap-LDNs were performed at our institute. The right kidney was retrieved in one donor because of an early branching of the left renal artery. The details of our technique are described for both left and right LDN. The perioperative parameters were compared to those of the 10 immediately preceding cases of LDNs using the traditional open approach.

All lap-LDNs and open LDNs were successful, and all 13 recipients had smooth recovery of renal function. The donors recuperated better in the lap-LDN group with resumption of oral intake on postoperative day (POD) 1 and discharge on POD 5 (vs POD 3.4 and 8.5, respectively, in the open group). The mean blood loss was lower and narcotic use was less in the lap-LDN group (75 vs 164 mL, 25 vs 47 mg morphine sulfate equivalent, respectively). The extraction wound was much shorter in the lap-LDN group (6.5–8 vs 23 cm). The warm ischemia time was slightly but not significantly shorter in the open group (4 vs 2.75 min), and the average operative time was shorter in the open group. The results of our initial experience suggest that for surgeons with laparoscopic surgery experience, lap-LDN is a feasible procedure that decreases donor discomfort, while improving the quality of graft kidneys and the safety of the donor.

Patients and Methods

Live donor nephrectomy is a challenging operation for the transplant surgeon because it allows almost no morbidity in the donor and requires the harvest of a best-conditioned kidney for engrafting in the recipient [1]. The donor benefits from the smaller incision, shorter hospitalization, and more rapid recuperation, allowing faster resumption of normal life [2]. Laparoscopic live donor nephrectomy, as first reported by Ratner et al in 1995 [3], can provide these benefits if performed by experienced surgeons. Here, we report the first series of laparoscopic live donor nephrectomy in Taiwan, and discuss our technical considerations and modifications.

From September to November 2000, three laparoscopic live donor nephrectomies were performed in National Taiwan University Hospital by the same surgeon. Two left kidneys and one right kidney were harvested for implantation.

The technique was a combination of those reported by Jacobs et al [4], Ratner [3], Kavoussi [2], Wolf et al [5], and Slakey et al [6], with some modifications.
**Left donor nephrectomy**

The donor was placed in a full flank position (left side up; Figure, A) with the table flexed after general anesthesia. A 6.5- to 7-cm periumbilical midline incision was made to open the peritoneal cavity. The base retractor of the Hand-Port (Smith and Nephew, Andover, MA, USA [7]) was set up in the wound. The left hand of the surgeon was used to tent the abdominal wall for inserting a 5- to 12-mm Versaport (US Surgical Corp., Norwalk, CT, USA) in the left lower quadrant at the mid-clavicle line, mainly for the telescope. The assistant’s hand, equipped with the sleeve of the Hand-Port, was introduced into the wound, and the ring on the sleeve was attached to the inflated external rim of the base retractor to create an airtight seal. The abdominal cavity was then insufflated to 12 mmHg and two more working ports were introduced, one 2-mm Miniport (US Surgical Corp.) at the left upper quadrant lateral to the rectus muscle and another 5- to 12-mm Versaport at the anterior axillary line halfway between the iliac crest and the lower costal margin (Figure, A). The order of the operation was not much altered from previous descriptions [2–6]. The intraabdominal hand was used freely for retracting the colon, spleen, and pancreas away from the operative field, and for some blunt dissection between the kidney and the surrounding soft tissues. The descending colon was taken down to expose the anterior surface of the kidney. The phrenicocolic and splenophrenic ligaments were divided to detach the spleen from the operative field. The gonadal, adrenal, and lumbar veins were clipped and divided. The adrenal gland was dissected from the upper pole of the kidney. The assistant’s right hand in the abdomen and a mini-grasper kept adequate traction and created clear tissue planes for dissection. The left renal vein was dissected medially beyond its crossing of the aorta. The renal artery was dissected without any grasping or compression of the artery to avoid arterial spasm. The lateral, posterior, and superior surfaces of the kidney were then dissected from their surrounding attachments, while leaving some soft tissue at the superior pole of the kidney for further traction. The posterior surface of the renal artery was further freed when the kidney was flipped forward. The ureter was dissected medial to the gonadal vein to leave abundant tissue around it down to its crossing at the iliac vessels, and it was transected immediately before transecting the renal pedicle to avoiding torsion of the kidney. The kidney was held gently with the intraabdominal hand, and the renal artery was ligated at its origin from the aorta with three endoscopic clips. The renal vein was transected using an EndoGIA vascular stapler (US Surgical Corp.) at the point of its crossing of the aorta. The kidney was immediately removed via the Hand-Port device and perfused ex vivo in ice slush.

**Right donor nephrectomy**

Only the differences in the procedure from left donor nephrectomy are described below. The donor was placed similarly but with the right side up (Figure, B). An open Hasson method (1.5-cm incision) ensured safe placement of the first port at the umbilicus. After CO₂ insufflation to create a pneumoperitoneum, an 8-cm subcostal oblique line at the level of the right renal pedicle was marked on the skin. Three working ports were inserted, two at the ends of the marked line and one at the anterior axillary line between the iliac bone and the lower costal margin (Figure, B). The ascending colon and the second portion of the duodenum were taken down to expose the kidney and the inferior vena cava (IVC). After division of the right gonadal vein near its insertion into the IVC, and primitive dissection of the renal pedicle and right ureter, the incision between the two working ports was connected to set up the Hand-Port and the surgeon’s left hand was inserted intraabdominally. The dissection of the right renal artery was done mainly when the right kidney was flipped medially to expose its posterior surface. After the dissection was complete, the ureter was transected laparoscopically. The hand was removed from the Hand-Port, the sleeve disconnected, and pneumoperitoneum desufflated, while leaving the base retractor of the Hand-Port unchanged. This created a window large enough for division of the vessels with traditional instruments to yield a full-length right renal vein with an IVC cuff under combined direct vision and laparoscopic assistance.

![Figure](https://example.com/fig.png)

**Figure.** Position of the patient and port configuration for A) left laparoscopic live donor nephrectomy and B) right laparoscopic live donor nephrectomy (detailed in text). Open circle = 5–12 mm port; solid circle = 2-mm port; heavy solid line = Hand-Port.
The perioperative parameters of the donors and recipients in the laparoscopic group were retrospectively compared to those of our 10 immediately preceding live donor nephrectomies performed using the traditional open (midline transperitoneal) approach.

Table 1. Perioperative parameters of donors undergoing laparoscopic nephrectomy

<table>
<thead>
<tr>
<th>Recipient No.</th>
<th>LDN side</th>
<th>Operative time (min)</th>
<th>Warm ischemia time (min)</th>
<th>Estimated blood loss (mL)</th>
<th>MS equivalent (mg)</th>
<th>Wound length (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>L</td>
<td>244</td>
<td>5</td>
<td>&lt;50</td>
<td>20</td>
<td>6.5</td>
</tr>
<tr>
<td>2</td>
<td>R</td>
<td>287</td>
<td>4</td>
<td>100</td>
<td>25</td>
<td>8</td>
</tr>
<tr>
<td>3</td>
<td>L</td>
<td>232</td>
<td>3</td>
<td>75</td>
<td>30</td>
<td>7</td>
</tr>
</tbody>
</table>

LDN = live donor nephrectomy; MS = morphine sulfate; L = left; R = right.

Table 2. Pre- and postoperative (postop.) serum creatinine (Cr) in kidney recipients in the laparoscopic group

<table>
<thead>
<tr>
<th>Recipient No.</th>
<th>Cr at admission (mg/ dL)</th>
<th>Cr 7 days postop. (mg/ dL)</th>
<th>Days to baseline Cr</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>11.5</td>
<td>1.4</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>12.7</td>
<td>1.2</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>7.6</td>
<td>0.7</td>
<td>3</td>
</tr>
</tbody>
</table>

Discussion

Although laparoscopic live donor nephrectomy was suggested to be feasible in an animal study by Gill et al in 1994 [8], and first successfully performed in a human by Ratner et al in 1995 [3], it was not until recently that larger-scale studies have shown that the risk of this operation is comparable to traditional open surgery and that the success rates for both the donors and recipients are high [2–7, 9–11]. Since the priorities of live donor nephrectomy are to harvest a good and functioning kidney for the recipient and to have a safe and uncomplicated procedure for the donor [1], and the number of live kidney donations in Taiwan was limited, we did not start our laparoscopic live donor nephrectomy program until we felt confident after gathering enough experience in retroperitoneoscopic simple nephrectomy [12], retroperitoneoscopic ureterolithotomy [13], laparoscopic adrenalectomy [14], laparoscopic radical nephrectomy for renal tumors, and laparoscopic nephroureterectomy for upper tract transitional cell carcinoma [15]. Our initial series of three cases, although small in number when compared with our historical cohort of open live donor nephrectomy, has clearly confirmed the benefits of this operation reported by other studies; ie, better cosmesis, less pain, and more rapid convalescence [2–7].

Since one of the aims of this operation is to lessen the trauma to the donor, for left side laparoscopic live donor nephrectomy, we substituted a 5- or 12-mm port used in other series [2, 4, 6] with a 2-mm Miniport at the left upper quadrant. This port is usually used for dissecting or grasping instruments with the surgeon’s left hand. We found that a 2-mm mini-grasper had very nice and delicate holding capacity of the tissue, which made the dissection easy. Postoperatively, the tiny 2-mm wound caused significantly less discomfort as compared with a 5-mm port. Wolf et al did not use a third port for dissection, but the use of a bare hand might have decreased handling and traction ability, especially during delicate dissection around the renal vessels [5].
Because the kidney needs to be taken out intact for implantation and unnecessary morbidity in the donor must be avoided [1], we started very cautiously with the open technique for the placement of the first port to ensure avoidance of any unexpected complication during initial port placement. We also used the hand-assisting device, which helped provide good intraoperative traction of the surrounding organs during dissection and good tactile perception of the major vessels and ureter. The design of our wound for the Hand-Port device (periumbilical midline for the left kidney and oblique subcostal for the right kidney) was suitable for open conversion if necessary. For surgeons who are not very experienced in laparoscopic surgery, the use of a hand-assisting device will certainly facilitate their initial cases of laparoscopic live donor nephrectomy [5–7]. Although an Endocatch device (USCC, Norwalk, CT, USA) is often used to harvest the kidney [2–4, 14, 16], the cost of the Endocatch (single use, disposable, US$ 250 per use) was much higher than the Hand-Port (limited use, US$ 150 per use) in Taiwan. This cost issue also prompted us to use the Hand-Port because special disposable instruments are not reimbursed by National Health Insurance at present in Taiwan.

Traditionally, when there are multiple left renal arteries in the donor, the surgeon might choose the right kidney for donation. With the advent of laparoscopic live donor nephrectomy, the selection criteria for kidney donation were modified [2, 4, 14]. Kuo et al. reported a technique of bench reconstruction of multiple donor renal arteries before connecting the donor arteries to the recipient’s artery for use in cases with multiple left renal arteries after laparoscopic live donor nephrectomy [14]. If there are only two donor arteries, in situ anastomosis of the donor arteries onto the branches of the recipient’s iliac arteries can also be performed. Thus, the left kidney remains the choice for donation, and the right kidney is harvested only when the function of the right renal unit is significantly worse than that of the left one, or when there are more than four renal arteries on the left side. This is mainly due to the shorter and thinner right renal veins after EndoGIA stapling in the laparoscopic approach, and increased incidence of renal vein thrombosis and graft loss when using right kidneys [2, 4]. In our donor who underwent laparoscopic right nephrectomy, we adopted and modified the technique described by Kavoussi [2]. We completed the whole dissection, including the hilum, and transected the ureter laparoscopically with hand-assistance. Then, through the window retracted wide open by the base element of the Hand-Port (without any other external retraction device), the vessels were ligated and divided under direct vision. The length of the renal vein harvested along with a cuff of IVC was 3.1 cm, which was long enough for easy anastomosis in the recipient without much tension or difficulty. As a consequence, we do not consider it necessary to change the traditional principles of side-selection for donor kidneys, because there could be potential hazards in compromising the blood flow to the graft kidneys due to technical complexity in connecting multiple branches of the left renal arteries. Our technique for right live donor nephrectomy is also novel in that we used a purely laparoscopic approach initially, and connected the incisions of the two subcostal laparoscopic ports for the Hand-Port device in the middle of the operation for both the initial delicate dissection and for further sale manipulation of the renal vessels.

Although laparoscopic live donor nephrectomy is relatively safe in the hands of experienced laparoscopists, complications and morbidities, which occur more often at the beginning of each operator’s initial series, have been reported [2, 4, 9, 17, 18]. Thus, surgeons using this technique should always remember not to jeopardize the donor’s safety or the recipient’s graft function during the learning curve for the technique, and keep a low threshold for open conversion.

ACKNOWLEDGMENTS: Dr. SC Chueh would like to thank Drs. Stephen Bartlett, Stephen Jacobs, Louis Kavoussi, and Lloyd Ratner for the opportunity to observe their surgeries. We would also like to thank Fong-Cheng Teng for drawing figures. This study was sponsored in part by a non-profit grant from the Chu’s Medical Foundation.

References