

## HAND-ASSISTED RIGHT LAPAROSCOPIC LIVE DONOR NEPHRECTOMY

ANIBAL W. BRANCO, ALCIDES J. BRANCO FILHO, WILLIAM KONDO, MARCO A.  
GEORGE, RAFAEL F. MACIEL, MARIANA J. GARCIA

*Department of Urology and General Surgery, Cruz Vermelha Hospital, Curitiba, Parana, and Department of Urology, Sao Jose Municipal Hospital, Joinville, Santa Catarina, Brazil*

### ABSTRACT

**Purpose:** Laparoscopic live donor nephrectomy has acquired an important role in the era of minimally invasive surgery. Laparoscopic harvesting of the right kidney is technically more challenging than that of the left kidney because of the short right renal vein and the need to retract the liver away from the right kidney. The aim of this article is to report our experience with right laparoscopic live donor nephrectomies.

**Materials and Methods:** We performed a retrospective review of 28 patients who underwent right laparoscopic donor nephrectomies at our service. Operative data and postoperative outcomes were collected, including surgical time, estimated blood loss, warm ischemia time, length of hospital stay, conversion to laparotomy and complications.

**Results:** The procedure was performed successfully in all 28 patients. The mean operative time was 83.8 minutes (range 45 to 180 minutes), with an estimated blood loss of 111.4 mL (range 40 to 350 mL) and warm ischemia time of 3 minutes (range 1.5 to 8 minutes). No donor needed conversion to open surgery and all kidneys showed immediate function after implantation. The average time to initial fluid intake was 12 hours (range 8 to 24 hours). Two cases of postoperative ileus and a case of hematoma on the hand-port site were observed. The mean postoperative hospital stay was 3 days (range 1 to 7 days).

**Conclusions:** Our data confirm the safety and feasibility of right laparoscopic donor nephrectomy and we believe that the right kidney should not be avoided for laparoscopic donor nephrectomy when indicated.

**Key words:** laparoscopy; living donors; nephrectomy; transplantation

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### INTRODUCTION

The advent of laparoscopic donor nephrectomy has resulted in decreased donor morbidity with less pain, shorter hospital stays, earlier return to work and regular activity, and improved cosmetics compared with the conventional open donor nephrectomy approach (1,2). These benefits of the minimally in-

vasive approach to kidney donation are reflected by studies that demonstrate an increased willingness to donate when the laparoscopic technique is available (3-5).

As in open live donor nephrectomy, the left kidney is preferred for laparoscopic donor nephrectomy because of its longer renal vein, which facilitates the implantation process (6,7), and because the

liver does not need to be retracted when left nephrectomy is performed (8). However, because the “better” kidney should always remain with the donor (9), occasionally the right kidney must be transplanted.

Early experience with right laparoscopic donor nephrectomy was marked by a high incidence of venous thrombosis and graft loss (8), which has since improved with experience and with technical modifications of the procedure (8,10). Recently, many articles have been published demonstrating the safety and feasibility of right donor nephrectomies (6,7,11-14), which has allowed transplant centers to maintain the benefits of the laparoscopic era while adhering to the fundamental principles of patient selection established during the open surgery era (12). The purpose of this study is to report our initial experience with right laparoscopic live donor nephrectomy.

## MATERIALS AND METHODS

All potential living kidney donors presented to our department from May 2002 to August 2004 were considered for laparoscopic nephrectomy. Each potential donor underwent a standard preoperative immunologic and medical evaluation to confirm his/her suitability. The exams requested to delineate renal vascular anatomy preoperatively were those usually performed for conventional renal donors, including digital angiography and intravenous pyelogram.

The rationale for donor kidney selection for laparoscopic donor nephrectomy was identical to the standard principles used for open donor nephrectomy. In the setting of “all things being equal,” the left kidney was selected because of the longer left renal vein. However, if the left renal vascular anatomy was unfavorable compared with that of the right or if a right renal condition was identified, the right kidney was selected (12). We have always preserved the basic tenet that “the better kidney should remain in situ for the donor” when we have chosen which kidney would be removed (9).

Operative data and postoperative courses were reviewed. Information on donor age, sex, and previous medical history were collected. Surgical demographics included operative time, warm ischemia time, estimated blood loss, and intraopera-

tive complications. Operative time was defined as the time from the initial skin incision to closure of the external oblique fascia of the HandPort incision (7). Warm ischemia time was defined as time elapsed from the application of haemostatic clips to the renal artery until the kidney was perfused with cold preservation fluid (7). The measured postoperative parameters included the time to first oral intake and hospital stay.

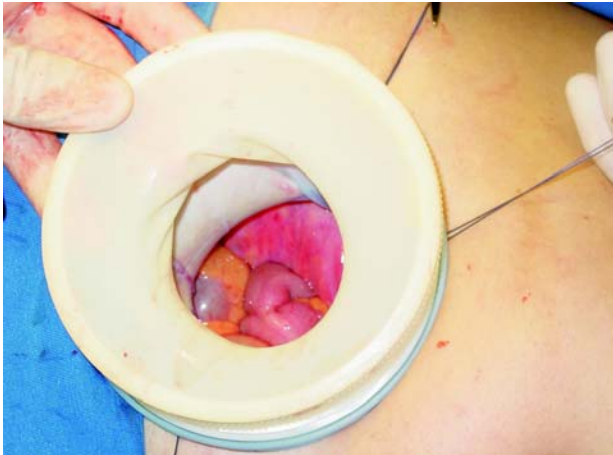
## Surgical Technique

The donor is positioned in a traditional left lateral decubitus position on the operating room table with the kidney rest fully elevated and the bed in a flexed position. An axillary roll is placed beneath the donor’s arm and the right arm is maintained on an armrest in a flexed functional position (Figure-1).

A 6 to 8-centimeter skin incision is performed in the right iliac fossa. The abdominal cavity is carefully inspected and a wet surgical towel is placed to mobilize the colon and to assist with any bleeding. After reflecting the colon medially by incising the lateral peritoneal reflection, the ureter is identified and isolated with a Penrose drain. The HandPort (Lap Disc® - Ethicon Endo-Surgery, Cincinnati, Ohio, USA) is placed through the incision (Figure-2) and the abdomen is inflated with carbon dioxide to an intra-abdominal pressure of 12 to 14 mmHg.



*Figure 1 – The patient is placed in the 45-degree left lateral decubitus position with slight flexion of the operating table to extend the ipsilateral flank gently.*



*Figure 2 – Placement of the HandPort in the right iliac fossa.*

Subsequently, a 10 mm trocar is placed in the periumbilical area for the 30-degree laparoscope; 2 additional 10 mm trocars are placed, one approximately halfway between the xiphoid and the umbilicus, and the other in the right middle axillary line at the umbilical level. A 5 mm trocar is then placed in the right side to retract the liver (Figure-3).

Dissection continues at the lower renal pole, posterior renal portion and superior renal pole. This can be conducted easier since the intra-abdominal hand facilitates control of the kidney and prevents rotation and potential damage to the renal hilum. The ureter isolated by the Penrose drain is dissected in a

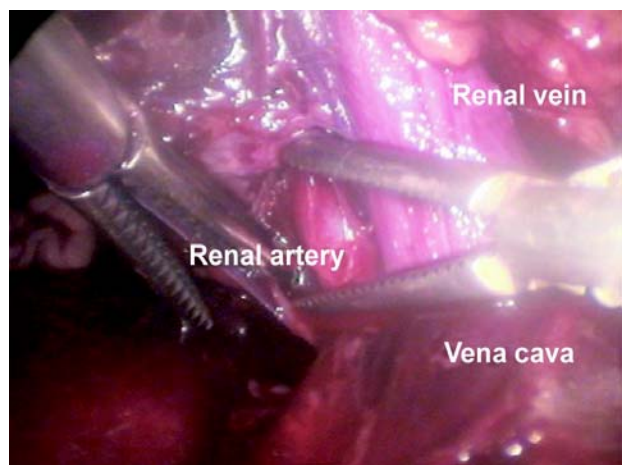


*Figure 3 – Position of the trocars.*

superior and inferior direction up to the crossing of the iliac vessels, taking care with the periureteral tissue (between the lower pole and ureter), which must be left intact to prevent devascularization of the ureter. The renal vessels are dissected and freed of surrounding tissues (Figure-4). All side branches are clipped using LT-300 titanium clips (Ethicon EndoSurgery) and divided. It is imperative to clear the adipose/lymphatic tissues off the artery and vein completely so that the hemostatic clips may hold the vessel walls securely without risk of dislodgement. The renal artery and vein are dissected free to the level of the aorta and inferior vena cava, respectively. Throughout the operation, urine output is monitored and maintained with fluids and mannitol.

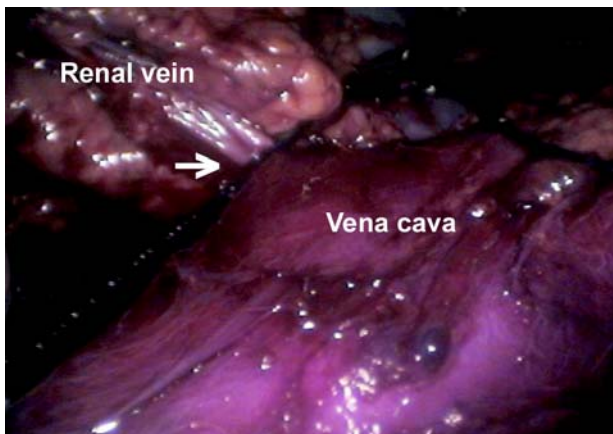
Several methods have been introduced to ligate the renal vessels. In our series, renal artery ligation was performed using LT-300 titanium clips or Hem-o-lok clips (Weck Closure Systems, Research Triangle Park, North Carolina, USA) and, in most cases, the technique of venous control with cotton suture and LT-300 titanium clips was used. We also tried the Hem-o-lok clips to right renal vein ligation and the caval suture after division of the renal vein with a cuff of the vena cava.

After completely isolating the renal artery and vein, the kidney was retracted laterally with the assistant hand. A number “0” cotton suture was passed laparoscopically around the vein before the renal ar-

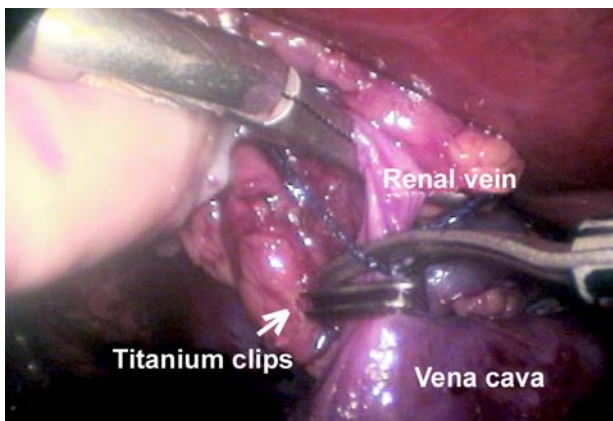


*Figure 4 – Identification of the renal vessels.*

tery ligature, leaving the loose knot to be tightened just after sectioning the artery. The artery was ligated on the aorta side with 2 titanium clips (or Hem-o-lok clips when available) and divided sharply distal to the 2 clips. The renal vein ligature was performed by tightening the knot and placing 2 titanium clips next to it on the lateral edge of the vena cava (Figure-5). (When we perform this ligature using Hem-o-lok clips, the cotton suture is not necessary because the Hem-o-lok clip is longer than the LT-300 titanium clip, and this allows the ligature of the whole renal vein circumference). The vein was cut distal with laparoscopic scissors (Figure-6). As with the renal artery, no clips or staples were left on the vein of the graft.



**Figure 5** – Reducing the caliber of the renal vein and tightening the knot (arrow).

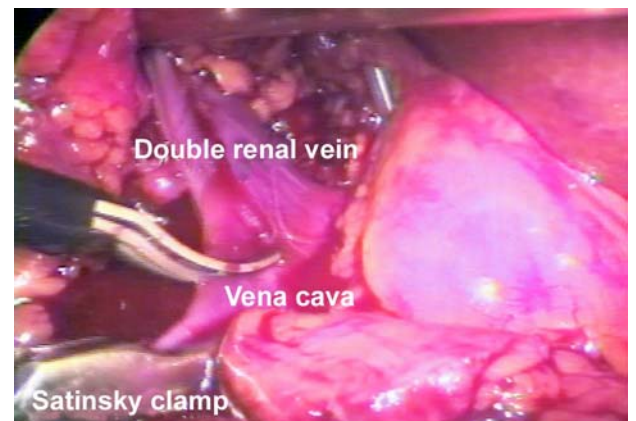


**Figure 6** – Two titanium clips are placed and the renal vein is sectioned close to the vena cava.

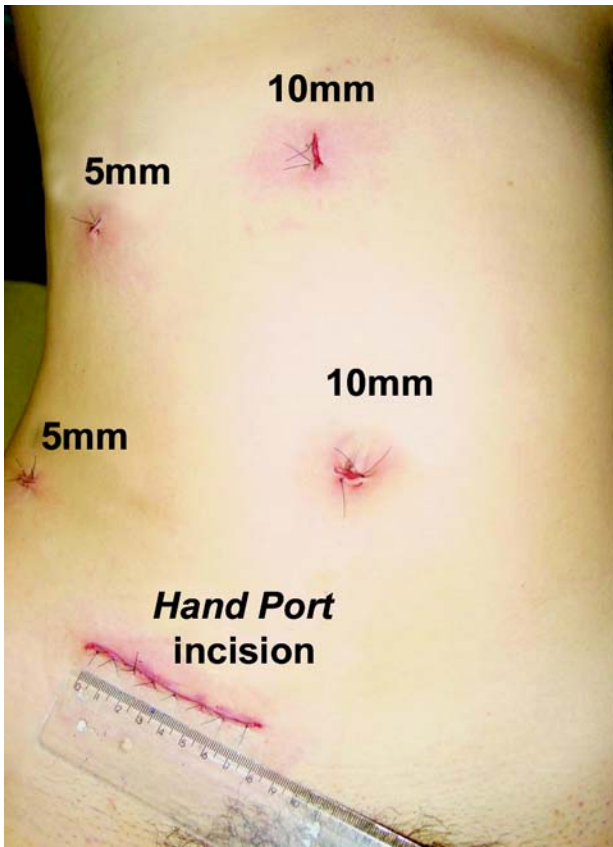
When a caval suture is performed, a Satinsky clamp is introduced into the abdominal cavity through the HandPort incision after the renal artery ligature, and the clamp is placed on the inferior vena cava. Renal vessels are divided, thereby allowing the division of the renal vein with a cuff of the vena cava (Figure-7) and maximizing the renal vein length. The cavotomy is sutured laparoscopically with 4-0 Prolene and afterwards the Satinsky clamp is released from the vena cava (15).

The kidney is removed through the hand-assisted device and the ureter is sectioned under direct vision. The kidney is then placed in an iced preservative and delivered to the recipient team for grafting. After the abdomen is checked for bleeding, the trocar sites are closed under direct vision and the pneumoperitoneum is evacuated (Figure-8).

Some cases were performed by retroperitoneoscopic approach with four ports. This procedure starts with a skin incision of 1 to 2 cm just below the tip of the twelfth rib. The flank muscle fibers are separated by blunt dissection. After sharp incision of the anterior thoracolumbar fascia, an initial retroperitoneal space is created by index finger dissection. A 10 mm trocar is placed through the incision for the 30-degree laparoscope, and the retroperitoneal working space is created using the laparoscope and gas insufflation. Two additional 10 mm trocars and one 5 mm trocar (for upper renal pole exposure) are inserted in a typical diamond arrange-



**Figure 7** – The Satinsky clamp is placed on the vena cava and the renal vein is divided with a cuff of the vena cava.



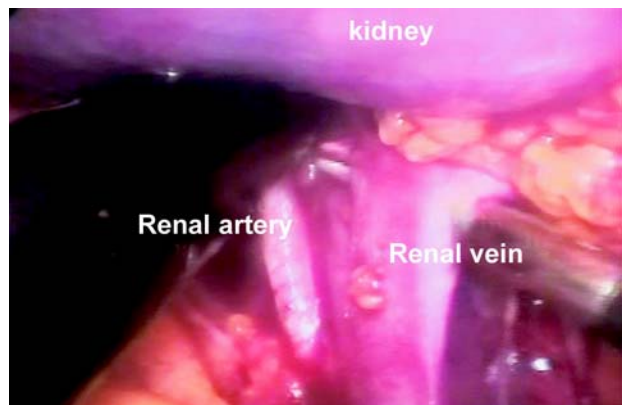
**Figure 8** – Final aspect of the surgery.

ment. After identification of the psoas muscle, the Gerota's fascia is incised laterally and the ureter as well as the renal vessels are dissected (Figure-9). The kidney is then completely freed of covering fatty tissue. A 6-centimeter skin incision is performed over the iliac crest for the assistant's hand. The ureter is divided under direct vision and the pneumoperitoneum is again insufflated. The renal vessels ligation is performed as previously mentioned – the vein with LT-300 titanium clips and cotton suture (Figure-10), and the artery with LT-300 titanium clips. The kidney is then removed from the retroperitoneal cavity through the iliac crest incision.

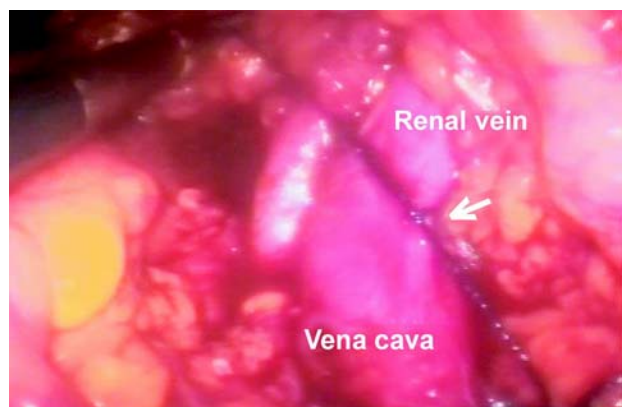
**RESULTS**

Between May 2002 and September 2004, a total of 70 healthy donors underwent laparoscopic nephrectomy for kidney transplantation in our unit,

of which 28 (40%) were on the right side. Indications for selecting the right side were multiple left renal vessels (n = 18), right renal artery fibromuscular dysplasia (n = 2), right renal cyst (n = 2), early branching of the left renal artery (n = 2), right ureterocele (n = 1), right renal ptosis (n = 1), right renal artery aneurysm (n = 1) and left ureteral duplication (n = 1). The procedure was performed successfully in all cases, and no patients required conversion to laparotomy. There were 13 male and 15 female patients, and the mean age was  $34.8 \pm 8$  years (range 21 to 52 years). The surgery was performed by hand-assisted transperitoneal approach in 24 patients (85.7%) and by pure retroperitoneoscopic approach in the remaining 4 cases (14.3%).



**Figure 9** – Dissection of the renal vessels by retroperitoneoscopy.



**Figure 10** – Retroperitoneoscopic right renal vein ligation with cotton 2-0 suture (arrow).

Anatomically, 24 patients had single right renal artery (85.7%), 3 patients had double right renal arteries (10.7%) and another one had triple right renal arteries (3.6%). Twenty-six patients had single right renal vein (92.9%), and 2 donors had double right renal veins (7.1%).

We used LT-300 titanium clips and cotton suture for venous control in 24 patients (85.8%), Hem-o-lok clip in 2 patients (7.1%) and caval sutures in 2 patients (7.1%). The right renal artery was ligated using LT-300 titanium clip in 26 patients (92.9%) and Hem-o-lok clip in 2 patients (7.1%).

The mean operative time in our series was  $83.8 \pm 37.2$  minutes (range 45 to 180 minutes). Estimated blood loss was  $111.4 \pm 61.9$  mL (range 40 to 350 mL) per patient and none required transfusion. Warm ischemia time was  $3.0 \pm 1.4$  minutes (range 1.5 to 8 minutes). We had no intraoperative complications and all kidneys showed immediate function after implantation.

All patients were allowed a liquid diet as soon as they were fully awake. The average time to initial fluid intake was  $12.0 \pm 3.9$  hours (range 8 to 24 hours). The 3 postoperative donor complications in our series consisted of 2 cases of postoperative ileus (7.1%), which resolved spontaneously in 7 days, as well as a case of hematoma (3.6%) at the HandPort site, which was opened and drained. The mean postoperative hospital stay was  $3.0 \pm 1.5$  days (range 1 to 7 days).

## COMMENTS

Since the first successful case of laparoscopic live-donor nephrectomy reported by Ratner et al. in 1995 (16), laparoscopy has emerged as an alternative to open surgery in donor nephrectomy for transplantation (1,17-21), and recently it has become the standard of care at increasing numbers of renal transplant programs worldwide (22).

Advantages to the laparoscopic approach are self-evident and well described, and include a reduction in postoperative discomfort, narcotic requirements and hospital stays, shortened recoveries, improved cosmetic results and a more rapid return to regular activities and work (1-4,21-27). All these benefits are obtained using laparoscopic technique with

an equivalent renal graft outcome compared with open surgery (1,28). Moreover, some centers have documented an increase in the number of donations and have attributed this increase to a less invasive surgical procedure that is more acceptable to the donor (5,21,25).

Several reports have confirmed some advantages of the hand-assisted technique described in 1998 by Wolf et al. (29). By using the hand, the surgeon can facilitate complete mobilization of the colon, easily exposing the kidney and the aorta. In addition, tissue planes are more easily defined using the intraperitoneal hand for retraction (26). Surgical time is comparable to open nephrectomy and tends to decrease with the learning curve. It can be performed with safety and without harm to the donor and the graft function (30). Comparisons of hand-assisted laparoscopic with standard laparoscopic donor nephrectomies have not demonstrated any statistically significant differences in analgesic requirements, hospital stays, or allograft function. Significantly shorter operative and warm ischemia times have been demonstrated in the hand-assisted laparoscopic groups compared with the standard laparoscopic groups (1,11,24,27).

To date, most laparoscopic live donor nephrectomies have been performed on the left side because the shorter length of the right renal vein poses technical challenges for the transplant surgeon in implanting the kidney into the recipient (8,31). Yet several indications should prompt consideration of the right rather than the left kidney, including multiple renal arteries, a smaller right kidney or undiagnosed lesions within the right donor kidney (6,13,14,31). Some authors have questioned whether surgical technique rather than appropriate selection criteria is driving the side of kidney selected for the laparoscopic operation (32). The ability to perform right laparoscopic donor nephrectomy allows the inclusion of those donors with only right kidneys suitable for donation (13).

Mandal et al. (8) reported a significant rate (37.5%) of graft loss in their early experience with 8 right kidneys. These losses were attributable to thromboses postulated to be from the short, thin-walled renal vein. Subsequently, certain technical modifications were proposed in an attempt to overcome the short length of the right renal vein. The Johns Hopkins

group (8) shifted the Endo-GIA stapler port to the right lower quadrant. In this manner, the stapler was placed across the renal vein in a plane parallel to the vena cava in an effort to maximize the vein length. In the presence of a right renal vein shorter than 3 cm, this group also suggested a subcostal incision for open placement of a Satinsky clamp on the inferior vena cava and for graft extraction. This allowed division of the renal vein with a cuff of the vena cava and closure of the cavotomy through the incision. Recently, Turk et al. (11) described the use of a laparoscopic Satinsky clamp for side clamping of the vena cava to obtain a caval cuff at right renal vein transection, followed by laparoscopic suturing of the vena cava in 4 patients. The largest single-center experience is from Rotterdam where the right kidney is preferred (33). They reported an unusually high rate of 73% of right laparoscopic donor nephrectomies with no differences in thrombosis, graft loss or complications compared to the left kidney.

Several groups currently advocate the retroperitoneal approach, especially for right donor nephrectomies (11,34,35). This approach allows direct visualization of the aortocaval junction ensuring the maximal renal vein length possible. However, the retroperitoneal working space is smaller (13), and prior expertise with this approach is necessary before attempting retroperitoneal laparoscopic donor nephrectomy (12). We performed more than 40 laparoscopic transperitoneal donor nephrectomies before using the retroperitoneal approach. The choice of laparoscopic approach (whether trans- or retro-peritoneal) was at the discretion of the surgeon. The advantages of retroperitoneoscopic surgery over transperitoneal access are that bowel mobilization is not required, retraction of the solid viscera is not needed, the risk of inadvertent gut injury and ileus is minimized, contamination of the peritoneal cavity is avoided, previous abdominal surgery does not preclude this approach and there is a lower incidence of long-term complications, such as port site hernia and bowel obstruction.

In many respects, the right kidney is easier to remove, with less extensive colonic dissection and absence of splenic/pancreatic attachments. The typical absence of gonadal, adrenal and lumbar branches makes control of the renal vein more straightforward (13).

When evaluating our results and comparing them with those of the major university transplant centers, we found that our data compare favorably with the results of their reports. Overall, mean operative time from skin incision to closure was 83.8 minutes and this was shorter than reported in almost all other studies (115 to 218 minutes) (6,7,11-14,33,36). Our average estimated blood loss of 111.4 mL compares well with the reported average blood loss of 71 and 302 mL (6,7,11,12,14,33,36). Mean warm ischemia time was 3 minutes, which is comparable with other reported studies (6,14,33,36), and superior to the experiences of Ng et al. (12) and Boorjian et al. (7), which reported 1.7 and 1.9 minutes, respectively.

Considering the complications in donors, we had 2 cases of postoperative ileus (7.1%) with spontaneous resolution in seven days. Actually, the major postoperative problem in laparoscopic donors is bowel function. Ileus prolongs hospitalization and causes readmissions. Donors report that bowel function is not really normal for 7 to 10 days. Some prolonged bowel recovery may be due to unrecognized pancreatitis (36). The two cases of prolonged ileus occurred at the beginning of our series and we observed that by placing the HandPort again after kidney removal and aspirating blood and blood clots, we did not have any other case of postoperative bowel functioning disorder. Another complication observed in our series was a case of hematoma (3.6%) at the HandPort site, which was opened and drained.

Up to 1.6% of patients undergoing right laparoscopic nephrectomies need conversion to an open method (36). Fortunately, as seen in other series (7,12,13), we had no conversions.

Our mean hospital stay of 3 days is a little longer than that reported recently by other major centers, which have an average hospital stay of between 1.8 and 2.6 days (6,7,12,13,36). With the increasing experience in laparoscopic nephrectomies, we started discharging our patients sooner (24 to 48 hours after surgery) in the last nine cases.

## CONCLUSIONS

Our data confirm the safety and feasibility of right laparoscopic donor nephrectomy and, based on

these findings, we state that the right kidney should not be avoided for laparoscopic donor nephrectomy when indicated.

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**Correspondence address:**

Dr. Anibal Wood Branco  
 Rua das Palmeiras, 170 / 201  
 Curitiba, PR, 80620-210, Brazil  
 Phone: + 55 41 242-6543  
 E-mail: anibal@awbranco.com.br

**EDITORIAL COMMENT**

Laparoscopic nephrectomy has gained increasing popularity since the early experimental works by Gill et al. in 1994 (1) at Washington University, and the first surgery performed in humans by Ratner et al. (2) at Johns Hopkins University. Currently, the leading institutions in USA and Europe have been preferentially using the laparoscopic

approach rather than the conventional open technique due to shorter hospitalization times, less post-operative pain and shorter convalescence times, even if there are few differences in terms of surgical time, bleeding, complications and warm ischemia time, as observed in 2 recently published prospective works (3,4).

In most case of live donors for kidney transplantation, the performance of laparoscopic nephrectomy has led to improved technique, allowing some contraindications to be abandoned and turning the minimally invasive technique into the preferential approach.

In this issue of the *Int Braz J Urol*, the authors report a significant series of 28 cases of laparoscopic nephrectomy in kidney donors in most cases performed with the “hand-assisted” technique for removal of the right kidney. In many institutions, right nephrectomy is considered to be a contraindication for laparoscopy due to the usually shorter length of the renal vein on this side. The authors reported good results with minor complication (7% of ileus, and one case of hematoma on the incision), thus corroborating the safe indication for laparoscopic nephrectomy on the right side as well.

On the other hand, some conventional surgeons have tested the surgery with “mini-incision” in order to minimize the effects and sequelae of the classic incision so that conventional surgery could be superposed to the laparoscopic technique. In 2003, Perry et al. (5) published a prospective analysis of patients undergoing laparoscopic nephrectomy with another group undergoing nephrectomy with “mini-incision” and still found statistically significant advantages for the laparoscopic surgery in terms of postoperative pain throughout the first month, introduction of oral diet, return to usual activities, esthetic satisfaction and a better emotional role as verified by validated quality of life questionnaires. Such evidence could be due to the fact that, despite incisions performed for removal of the kidney in both groups, the abdominal incision in the lower quadrant is more benign, thus providing a better postoperative period.

Despite much recent scientific evidence, increasingly more surgeons performing surgery world-

wide, continuous technological advancements, the decrease in limitations and the increase in donations at institutions that offer laparoscopy, many institutions still don't offer this technique, for reasons that are unclear. For example, at Washington University where it all started, the transplantation team does not yet perform laparoscopic nephrectomy, in spite of the early contribution and constant advancements in the field provided by their neighbors, who are trying more and more to explore the maze of scientific advances and progress. I often prefer to think and act like Spencer Johnson, M.D. (6) in his book, “Who moved my cheese?”: it is safer to search in the maze than remain without the cheese.

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**Dr. Cassio Andreoni**

*Section of Endourology and Laparoscopy  
Federal University of Sao Paulo, UNIFESP*

*Sao Paulo, SP, Brazil*

*E-mail: c.andreoni@attglobal.net*