

Safe transition from open to pure laparoscopic donor nephrectomy: Approach and results

Yusuf Saifee, C. S. Chamania, Sushil Bhatia, Pradeep Salgia, Jai Kriplani, Achal Sepaha

Department of Urology, Choithram Hospital and Research Centre, Indore, Madhya Pradesh, India

Abstract

Introduction: Laparoscopic living donor nephrectomy (LLDN) offers many advantages compared to open living donor nephrectomy. However, the perceived difficulty in learning LLDN has slowed its wider implementation. Herein, we describe the evolution of LLDN at a single center, emphasizing the approach and technical modifications and its impact on outcome.

Methods: The series included a 2½-year period and three different surgeons. We started with two-stage plan for establishing LLDN at the institute (introduction and consolidation). Data of laparoscopic donor nephrectomy performed at the institution were prospectively evaluated regarding donor and recipient outcome.

Results: From December 2016 to April 2019, 221 donors underwent LLDN. Three donors required conversion to open surgery. The mean operation time was 96.4 (62–158) min and the mean warm ischemia time was 186 (149–423) s. The complications were observed in 11.6% of donors from LLDN group and all complications were Class I and Class II only (Clavien–Dindo classification). No Class III and Class IV complications occurred. In the present study, there was some learning curve effect observed only in operative time (OT) with longer OT in initial cases. However, the overall operative complications were minimal, showing that this learning curve had no deleterious effects on donor safety.

Conclusion: The present study demonstrates that with proper planning, team approach, and a few technical modifications, the transition from open to LLDN could be safe and effective.

Keywords: Laparoscopic donor nephrectomy, learning curve, open donor nephrectomy

Address for correspondence: Dr. Yusuf Saifee, Department of Urology, Choithram Hospital and Research Centre, Manik Bagh Road, Indore - 452 014, Madhya Pradesh, India.

E-mail: yusuf.saifee@gmail.com

Submitted: 14.04.2020, **Revised:** 16.08.2020, **Accepted:** 27.11.2020, **Published:** 23.06.2021

INTRODUCTION

Laparoscopic live donor nephrectomy has been well received among donors and recipients and may have the potential to expand the donor pool. However, the perceived difficulty in learning laparoscopic living donor nephrectomy (LLDN) has slowed its wider implementation. Large series of LLDN have come from relatively few institutions.^[1–4] Early series were

troubled with complications in up to 20% of donors. Indeed, many of the procedure's greatest proponents have expressed concern about safety during early learning. In an editorial that voiced general support of the laparoscopic approach, Fabrizio *et al.* cautioned that “this has the potential to expose a large number of patients to the learning curve of each physician offering this technique.”^[1,5,6] The aim of this study

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

For reprints contact: WKHLRPMedknow_reprints@wolterskluwer.com

How to cite this article: Saifee Y, Chamania CS, Bhatia S, Salgia P, Kriplani J, Sepaha A. Safe transition from open to pure laparoscopic donor nephrectomy: Approach and results. *Urol Ann* 2021;13:384-90.

Access this article online	
Quick Response Code:	Website: www.urologyannals.com
	DOI: 10.4103/UA.UA_56_20

was to describe the evolution of LLDN at a single center, emphasizing the approach and technical modifications and their impact on the outcome.

METHODS

The present study was conducted at the Department of Urology, Choithram Hospital & Research Centre (CHRC) Hospital, from December 2016 to April 2019. The study was undertaken after obtaining approval from our institutional ethical committee. Donor suitability was confirmed by medical, surgical, immunological, and psychological assessment; and a complete detailed informed consent, including consent for open conversion, was obtained.

After a complete history and physical examination, the required laboratory investigations, and a basic radiological workup in the form of sonography of the abdomen and Kidney, Ureter, Bladder (KUB), donors were subjected to diethylenetriaminepentaacetic acid renal scan for the functional assessment and computed tomography renal angiography for the anatomical assessment of the vasculature and the draining system.

The laterality of the surgery was decided based on the presumption that the better kidney remains with the donor. If both kidneys had an equal function, the kidney with simpler vascular anatomy was procured. Initially, we selected donors with an average build having a single artery and vein. After 15 successful living donor nephrectomies (LDNs), we included all obese donors and donors with multiple vessels for laparoscopic donor nephrectomy. Finally, after 50 left LDNs, we did right-side laparoscopic donor nephrectomy.

Surgical approach

Donor nephrectomy was performed by a pure laparoscopic, nonhand-assisted procedure. The operative team had two senior surgeons, one laparoscopic urologist, and general surgery residents. The senior general surgeon and senior urologist had been part of the transplant program for >25 years. They had extensive experience in Open Live Donor Nephrectomy (OLDN) and some experience in basic laparoscopic surgery (laparoscopic cholecystectomy, laparoscopic varicocele ligation, etc.). The laparoscopic urologist had training and experience in laparoscopic kidney surgery (experience of 100+ simple and radical laparoscopic nephrectomies and 20 laparoscopic donor nephrectomies).

We established a staged plan for establishing LDN at the institute, with two stages – introduction and consolidation.

The introduction stage lasted for 100 cases done in about 1 year, during which LLDNs were performed by two senior surgeons alternately. The laparoscopic urologist provided assistance in all cases. The procedures were stratified into three groups. Group A consisted of LDN cases performed by senior transplant surgeon and laparoscopic urologist as the first assistant, Group B consisted of cases performed by senior urologist and the same laparoscopic urologist as the first assistant. In the consolidation stage, the senior surgeons and the laparoscopic urologist operated turn wise independently. Hence, there were three groups – Group A with transplant surgeons, Group B with senior urologists, and Group C with laparoscopic urologists. All were assisted by a general surgery resident as the first assistant.

Surgical procedure

After general anesthesia, a Foley's catheter is inserted. The donor is placed in a modified lateral decubitus position. Pneumoperitoneum is created by insufflation of carbon dioxide using a Veress needle. Few technical modifications were done in the standard surgical technique of transperitoneal LDN. The first important modification was the use of additional ports. Besides the three standard ports, the present study used two additional ports (one 5 mm subumbilical port and another 5 mm lateral port above the anterior superior iliac spine) [Figure 1]. With the instruments introduced through additional ports, the experienced laparoscopic urologist helped in the various steps, such as retracting the bowel or giving a gentle traction on the upper or lower pole of the kidney at the time of hilar dissection, clipping, and cutting.

The second modification involved sequence of hilar dissection. Our modification involved dissection on both poles of the kidney before we approached the actual hilum.

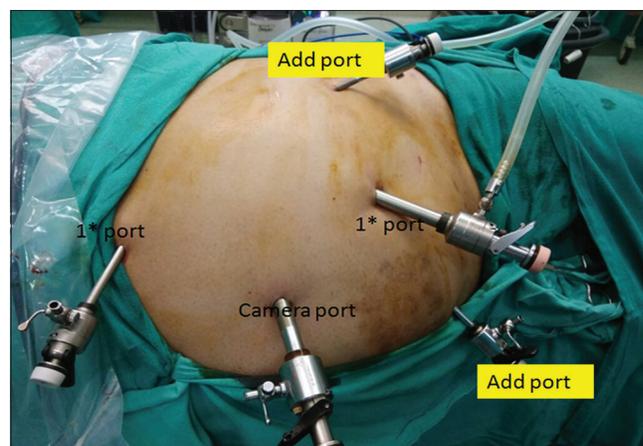


Figure 1: Port configuration. Besides three standard port, two additional ports used one 5 mm subumbilical port and other 5 mm lateral port above the anterior superior iliac spine

The rationale for this approach was to reduce the level of our apprehension in the initial learning curve. The most demanding part of this surgery is the hilar dissection. In our opinion, if there is a hilar injury in the initial learning curve requiring open conversion, the potential complications because of excessive bleeding or undue compression and vasospasm of graft kidney would be minimized as both the poles of the kidney had already been dissected.

The detailed procedure was as follows. After the medial reflection of the colon, splenic flexure with its attachments was released by dividing the splenocolic and splenorenal ligaments.

The lateral and posterior attachments of the kidney are not divided at this time to prevent the kidney falling medially. The dissection was started from the caudal side by delineating the ureter, lifting up the ureterogonadal complex, and mobilizing the lower pole. At this stage, we did not proceed cephalad with lumbar vein and hilar dissection. Instead, we shifted to upper pole dissection inside Gerota's fascia, adrenal gland was released off from the upper pole of the kidney using a harmonic scalpel, carrying the dissection until the point when the upper portion of the psoas muscle was seen. The adrenal vein was also divided during this step [Figure 2a and b]. Then, we tackled the lumbar veins. The lumbar vein is a gateway to the renal artery. The lumbar vein usually passes near the origin of the renal artery and drains into the renal vein posteriorly. Lumbar vein dissection remains the most difficult part of vascular dissection and requires utmost care and precision to avoid injury that can lead to significant bleeding. When the hilum is kept at a gentle stretch by traction on either of the poles, some length is gained for safe clipping and cutting of lumbar veins [Figure 3a and b]. After this, we proceed to hilar dissection. Hilum becomes prominent with subtle superolateral traction on the kidney. This makes intrahilar dissection easier. The renal artery is dissected up to its origin toward the aorta using the combination of harmonic and low intermittent suction [Figure 3c and d].

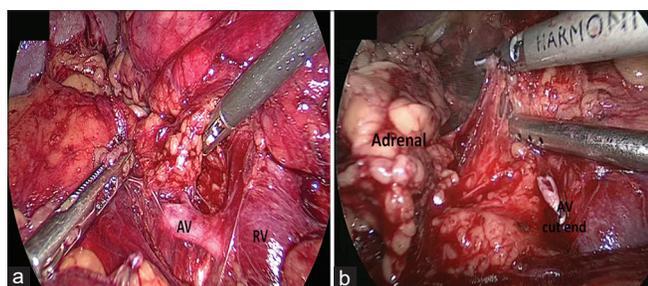


Figure 2: Upper polar dissection (a) Dissection of the upper pole to expose adrenal vein draining into the renal vein. (b) Dissection carried till the point when the upper portion of the psoas muscle was seen

The lateral and posterior attachments of the kidney are finally divided. The ureter was clipped distally over the bifurcation of the common iliac artery and cut. An oblique paramedian 7–8 cm was made for graft retrieval; the peritoneum is left intact. The renal artery and vein were cut after applying two Hem-o-lok® clips (Weck Closure Systems, Research Triangle Park, NC, USA) on them. Dislodgment of the clips were avoided by ensuring proper application and locking of the Weck clips, with application of one titanium clip under the Weck clip to dampen the pressure. The lubricated palm of the hand was introduced through the retrieval incision and the kidney was glided over psoas and brought out.

Right-sided donor nephrectomy approach

We have done only four right-side LDNs. The remaining all right-sided donors were managed by a traditional open approach. In this study, a vascular stapler was not used because of cost constraints in the study setup. Instead, a hybrid technique was used where the hilum was dissected laparoscopically. The dissection of the renal arteries and veins is completed to their origin at the aorta and to their entrance at the cava, respectively. Division of the ureter is done laparoscopically. At this time, 10–15 cm subcostal incision is made followed by a complete exposure of the right renal vessels using retractors. The renal artery is clamped and cut. After this, a Satinsky clamp was placed around the insertion of the renal vein into the vena cava. The renal vein was then cut with inferior vena cava (IVC) cuff and the kidney was extracted from the abdomen. The incision in the vena cava was then closed with a 5/0 running Prolene suture.

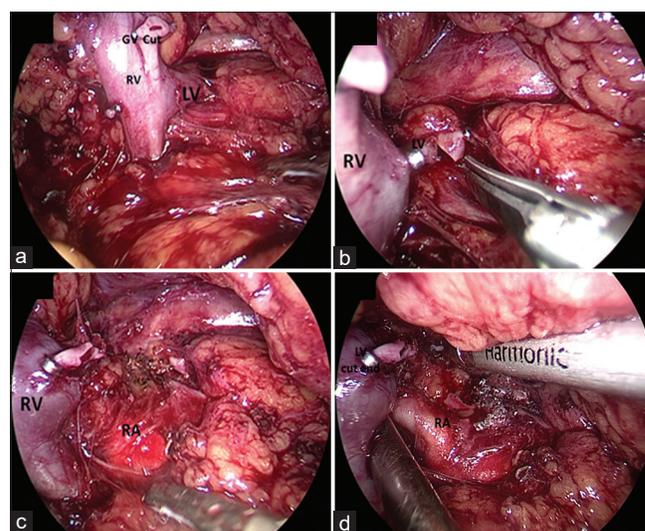


Figure 3: Hilar dissection (a) lumbar vein seen in front of the renal artery. (b) Two renal arteries dissected up to their origin from the aorta. (c) The lumbar vein being clipped. (d) Dissection of circumaortic renal vein with two renal arteries

The clinical data were obtained for each group. Preoperative parameters like age, sex, body mass index, vascular anomalies were recorded. Intraoperative parameters were recorded including total operative time (OT) (defined as the time from the skin incision to the skin closure), warm ischemia time (WIT) (defined as the time from clamping the renal artery to the starting of the cold perfusion), blood loss and any complications. Data were analyzed using IBM SPSS statistics version 21.0 software (IBM Co., Armonk, NY, USA). An independent *t*-test was used to calculate statistical significance represented by *P* value.

RESULTS

The first laparoscopic left donor nephrectomy at our institute was performed in December 2016, and until April 2019, 221 LLDNs were performed. The donor characteristics of the LLDN group are shown in Table 1.

On analyzing the 221 LLDN cases in the whole study, the mean (range) operation time was found to be 96.4 (62–158) min and the mean (range) WIT was 186 (149–423) s. Twenty-five donors (11.6%) experienced 28 postoperative complications that were identified as either Class 1 or Class 2 (Clavien–Dindo classification). Three donors

required conversion to open surgery. In one donor (58th case), tear of the lumbar vein led to significant bleeding. In another donor (124th case), the aortic wall was injured by the tip of a scissor at the time cutting renal vein. The third donor (163rd case) had an accidental injury to the renal artery during its dissection. All the three donors required blood transfusion; however, the rest of the postoperative course was uneventful.

All these three donors required blood transfusion; however, the rest of the postoperative course was uneventful. One patient developed chylous ascites that required readmission, percutaneous drainage, and supportive care. Two donors sustained minor splenic capsular tear. These were managed with pressure and absorbable gelatin sponge (Gelfoam) with adequate hemostasis. No donor who sustained splenic injury required transfusion. One recipient was re-explored few hours after transplant for repair of an intimal flap of the native external iliac artery causing thrombosis of the external iliac artery [Table 2].

In the present study, there was some learning curve effect observed in OT with longer OT in initial cases in the introduction phase and consolidation phase. A drop in later part of the introduction phase was followed by a transient rise in the consolidation phase, as all three surgeons perform the procedure with surgery residents as the first assistant trainees [Graph 1]. On comparing the initial 25 cases of surgeons with their next series of cases, we verify a statistically significant reduction in OT ($P < 0.001$) [Table 3].

The present study also compared 221 LLDNs with the last 100 OLDNs performed before the start of laparoscopic donor program. The mean estimated blood loss, mean OT, and mean WIT for LLDN were 40.3 mL, 96.4 min, and 186 s, respectively. The mean estimated blood loss, mean OTs, and the average WIT for OLDN were 42 mL, 87 min, and 123 s, respectively. The average hospital stay was 2.8 days for patients undergoing LLDN and 5.2 days for patients undergoing OLDN. The graft function was comparable between the laparoscopic and open groups. The recipient renal function between the LLDN and OLDN groups was comparable at 1 week (LLDN: 1.62 mg/dL vs. OLDN: 1.53 mg/dL) and at 6 months (LLDN: 1.38 mg/dL vs. OLDN: 1.49 mg/dL).

DISCUSSION

The merits of LDN and its benefits when compared with open donor nephrectomy have been well argued, and we do not seek to continue this debate. Instead, we undertook our

Table 1: Characteristics across the study population

Characteristics	LLDN (n=221)
Age (years), mean (range)	42.4 (25-66)
Sex	
Male	58 (26.24)
Female	163 (73.76)
BMI (kg/m ²), mean (range)	22.1 (16-33)
Arterial anatomy	
Number of arteries	
1	203 (91.8)
2	15 (6.8)
3	3 (1.3)
Early bifurcation	11 (4.9)
Venous anatomy	
Number of veins	
1	209 (94.8)
2	9 (4.1)
3	3 (1.3)
Circumaortic	5 (2.3)
Retroaortic	2 (0.9)
Double IVC	2 (0.9)
Late confluence	12 (5.4)
Ureteral duplication	1 (0.6)
Open conversions	3 (1.35)
WIT (s), mean	186
EBL (mL), mean	40.3
Operative time (min), mean	96.4
Hospital stay (days), mean	2.8
Recipient renal function (mg/dL)	
At 1 week	1.62
At 6 months	1.38

LLDN: Laparoscopic living donor nephrectomy, BMI: Body mass index, IVC: Inferior vena cava, WIT: Warm ischemia time, EBL: Estimated blood loss

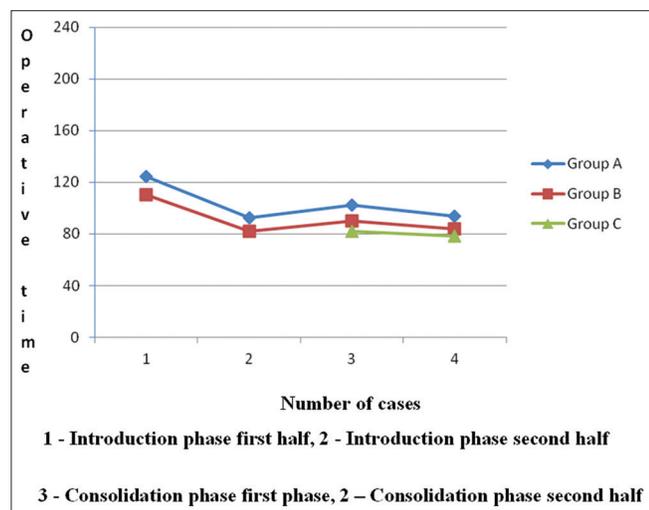
renal transplant program considering LDN as the emerging standard for live renal procurement. In addition, we realized the power of minimal invasiveness in motivating live kidney donors. The present study aimed to start a laparoscopic donor program with proper plan and team approach. The study institute was one of the oldest tertiary care institutes in central India, having a kidney transplant program that started in 1978, with collaboration between the departments of general surgery/transplantation and urology. From the onset, donor nephrectomies were performed by open approach. A clean transition from the open donor nephrectomy (ODN) technique to the LLDN occurred in December 2016, with the recruitment of a new urologist trained in minimally invasive kidney surgery.

We started with the staged plan for establishing LDN at the institute. In the introduction stage, donor operations were performed by two senior surgeons alternately. The laparoscopic urologist provided assistance in all cases. This collaborative approach had several advantages. First, the assistant in laparoscopic surgery is vital. The laparoscopic urologist used additional ports to assist in various steps – traction, counter traction, suction, and controlling small bleeders, etc. This helped in keeping both the hands of surgeons free for comfortable and safe dissection. There is no need for the regular interchange of right-hand instruments of a senior surgeon with suction or scissor, as this can be done by the laparoscopic urologist. This resulted in fast dissection, smooth progression, and OT reduction. Furthermore, this approach provided good moral support at various steps of surgery, such as where to dissect, how to continue, or when to covert, thus reducing fatigue and subsequent impaired performance. Standardization of surgical steps and familiarity of technique by the whole team allowed the program to

go in the consolidated stage where senior surgeons and laparoscopic urologist operated turn wise independently and were assisted by a general surgery resident as the first assistant.

In the present study, the incidence and severity of donor complications were low and resolved without sequelae after conservative treatment. We were unable to detect any adverse effect of laparoscopic procurement on graft function. Complex renal vascular anatomy did not affect safety. Similarly, no ureteral complications were recorded. The complications that did occur were evenly spaced throughout the series, suggesting no significant effect of the learning curve.

In the present study, the mean OT for transperitoneal LDN was higher (96.4 min) as compared to OLDN (87 min) ($P < 0.05$). Similarly, in the present study, the mean (range) WIT was 186 (149–423) s in the LLDN group, which was comparatively higher than the OLDN group (123 s) ($P < 0.001$). WIT presents a major concern as it has always



Graph 1: Operative time progression in whole series

Table 2: Complications during laparoscopic living donor nephrectomy according to the Clavien–Dindo classification

Complications	LLDN (introduction) (n=100)	LLDN (consolidation) (n=121)
Class 1		
Shoulder tip pain	3	4
Hematoma	2	1
Wound infection	1	0
Orchalgia	1	0
Scrotal swelling	0	1
Fever	1	2
Class 2a		
Bleeding (required transfusion)	1	2
Paralytic ileus	2	3
Readmission	0	1
Class 2b		
Wound dehiscence	1	0
Splenic capsular tear	1	1
Chylous ascites	0	1

LLDN: Laparoscopic living donor nephrectomy

Table 3: Operative time comparison

Introduction phase		
	n	Operative time(mints)
Group A	25	124.5
	19	92.6
Group B	25	110.5
	31	82.1
Consolidation Phase		
	n	Operative time(mints)
Group A	25	102.4
	14	93.7
Group B	25	90.3
	23	83.6
Group C	23	82.3
	14	78.6

been slightly longer in the LLDN group when compared with the OLDN group due to the longer extraction time. It has been thought that any increase in this would translate into poor graft function. This notion has been disproved by various studies suggesting no bearing of this small difference on the recipient outcome.^[7,8]

To determine the efficacy of LLDN, recipient renal function is an important measure, and therefore, it was analyzed in the present study. The recipient renal function between LLDN and OLDN groups were comparable at 1 week and at 6 months. The 1-year follow-up results of the present study groups were comparable. In addition, the amount of parenteral analgesia, the hospital stay, and the time to return home have been found to be significantly favorable in the LDN group ($P < 0.0001$).

Therefore, equivalent graft outcomes and reduced donor morbidity have made LDN a new standard of care for live kidney procurement at the study location. There are multiple reasons that might have been responsible for the successful evolution of LDN in the study location. First, a new urologist, who was trained in minimally invasive kidney surgery, joined the team of two senior surgeons who have been part of the transplant program for more than two decades. This collaborative approach optimized familiarity with technique and local anatomy and allowed the mastery of a new procedure in a safe manner. Second, a small modification in the standard surgical technique proved vital. The additional ports for use by assistant to lift the poles of the kidney or retract the bowel gave good hilar exposure, facilitating its dissection. Finally, the sequence of hilar dissection, after dissection of both poles of the kidney, also proved to be beneficial. The classical approach of LDN entails dissection from caudal to cephalad side, and it is similar to working in a narrow hole rather than exposing the field completely. However, our technique of hilar dissection after dissection of both poles of the kidney made circumferential mobilization of renal vessels easier and safer, as we could clear the lymphatics and fibrofatty tissue around vessels from both the poles. Furthermore, due to the widely exposed field, vascular injuries are minimized.

One limitation of our study is that we have mostly performed left-side LDN and only four right-side LDNs. The remaining all right-sided donors were managed by a traditional open approach. In this study, a vascular stapler was not used because of cost constraints in the study setup. Instead, a hybrid technique was used where the kidney was dissected laparoscopically and the vein was managed via an open approach using an 10–15 cm subcostal incision

to obtain maximal renal vein with IVC cuff. As per the published reports, most LLDNs performed worldwide have also been performed on the left side.^[8,9] Laparoscopic right donor nephrectomy is technically more difficult because of the lack of proper laparoscopic vascular stapler to get few millimeters of IVC cuff attached to a short renal vein. Without an IVC cuff, a shorter right renal vein makes the implant procedure more difficult and may be associated with a higher rate of renal vein thrombosis.^[10,11] Currently, endovascular gastrointestinal anastomosis/vascular stapler is used at some centers, but it is not without risks. It fires three rows of staple lines on the renal vein and IVC side, so there is some shortening of the renal vein after cutting of the staple line. Furthermore, the malfunction of the stapler has been reported leading to IVC and renal vein tear.^[11,12] Finally, the high cost of the stapler makes it more difficult to use in all centers in developing countries.^[13,14]

CONCLUSION

The observations and experience from the present study suggest that proper planning, team approach, and a few technical modifications allow LLDN program development in a safe and efficient manner.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. Kim FJ, Ratner LE, Kavoussi LR. Renal transplantation: Laparoscopic live donor nephrectomy. *Urol Clin North Am* 2000;27:777-85.
2. Wright AD, Will TA, Holt DR, Turk TM, Perry KT. Laparoscopic living donor nephrectomy: A look at current trends and practice patterns at major transplant centers across the United States. *J Urol* 2008;179:1488-92.
3. Øyen O, Andersen M, Mathisen L, Kvarstein G, Edwin B, Line PD, *et al.* Laparoscopic versus open living-donor nephrectomy: Experiences from a prospective, randomized, single-center study focusing on donor safety. *Transplantation* 2005;79:1236-40.
4. Chung E, Grant AB, Hibberd AD, Spratt P. Why potential live renal donors prefer laparoscopic nephrectomy: A survey of live donor attitudes. *BJU Int* 2007;100:1344-6.
5. Simforoosh N, Bassiri A, Ziaee SA, Tabibi A, Salim NS, Pourrezaghali F, *et al.* Laparoscopic versus open live donor nephrectomy: The first randomized clinical trial. *Transplant Proc* 2003;35:2553-4.
6. Fabrizio MD, Ratner LE, Montgomery RA, Kavoussi LR. Laparoscopic live donor nephrectomy. *Urol Clin North Am* 1999;26:247-56.
7. Soulsby RE, Evans LJ, Rigg KM, Shehata M. Warm ischemic time during laparoscopic live donor nephrectomy: Effects on graft function. *Transplant Proc* 2005;37:620-2.
8. Nanidis TG, Antcliffe D, Kokkinos C, Borysiewicz CA, Darzi AW, Tekkis PP, *et al.* Laparoscopic versus open live donor nephrectomy in renal transplantation: A meta-analysis. *Ann Surg* 2008;247:58-70.
9. Tooher RL, Rao MM, Scott DF, Wall DR, Francis DM, Bridgewater FH,

- et al.* A systematic review of laparoscopic live-donor nephrectomy. *Transplantation* 2004;78:404-14.
10. Breda A, Veale J, Liao J, Schulam PG. Complications of laparoscopic living donor nephrectomy and their management: The UCLA experience. *Urology Int* 2007;69:49-52.
 11. Bollens R, Mikhaski D, Espinoza BP, Rosenblatt A, Hoang AD, Abramowicz D, *et al.* Laparoscopic live donor right nephrectomy: A new technique to maximize the length of the renal vein using a modified Endo GIA stapler. *Eur Urol* 2007;51:1326-31.
 12. Hsi RS, Ojogho ON, Baldwin DD. Analysis of techniques to secure the renal hilum during laparoscopic donor nephrectomy: Review of the FDA database. *Urology* 2009;74:142-7.
 13. Kumar A, Chaudhary H, Srivastava A, Raghavendran M. Laparoscopic live-donor nephrectomy: Modifications for developing nations. *BJU Int* 2004;93:1291-5.
 14. Simforoosh N, Sarhangnejad R, Basiri A, Ziaee SA, Sharifiaghdas F, Tabibi A, *et al.* Vascular clips are safe and a great cost-effective technique for arterial and venous control in laparoscopic nephrectomy: Single-center experience with 1834 laparoscopic nephrectomies. *J Endourol* 2012;26:1009-12.