

LAPAROSCOPIC LIVING DONOR NEPHRECTOMY: FEASIBILITY AND FIRST EXPERIENCE IN INDONESIA

¹Chaidir A. Mochtar, ¹Irfan Wahyudi, ¹Nur Rasyid, ¹Arry Rodjani, ¹Ponco Birowo, ¹Widi Atmoko, ¹Yopie Tjandradiguna Satyawan, ¹Hery Tiera.

¹Department of Urology, Faculty of Medicine/Indonesia University, Cipto Mangunkusumo Hospital, Jakarta.

ABSTRACT

Objective: To report our first experience laparoscopic living donor nephrectomy (LLDN). **Material & Method:** A 37 year-old man was planned for the living-donor transplantation. The recipient was a 63 year-old man suffering from end stage renal disease, and hypertensive heart disease. The donor and recipient were allowed for positive qualification evaluated preoperatively. We applied a transperitoneal approach for the left kidney. **Results:** The operation time was 300 minutes and the estimated blood loss was 600 mL. The first warm ischemia time was 15 minutes and 24 seconds. There were no major intraoperative and postoperative complications. The donor began oral intake and mobilization within 10 hours and was hospitalized for 4 days. The recipient's serum creatinine levels reached near baseline levels (1,5 mg/dL) at day 6. **Conclusion:** LLDN is technically feasible in Indonesia and may increase the rate of kidney donation in Indonesia due to the minimally invasive nature of the procedure.

Keywords: Renal transplantation, laparoscopic living donor nephrectomy, Indonesia.

ABSTRAK

Tujuan Penelitian: Melaporkan pengalaman nefrektomi donor hidup secara laparoskopik. **Bahan & Cara:** Laki-laki 37 tahun direncanakan untuk donor transplantasi ginjal. Resipien adalah laki-laki 63 tahun dengan gagal ginjal stadium akhir dan penyakit jantung hipertensif. Donor dan resipien menjalani evaluasi preoperatif. Pendekatan transperitoneal dilakukan pada ginjal kiri. **Hasil Penelitian:** Waktu operasi sepanjang 300 menit dan estimasi perdarahan sebesar 600 mL. Waktu iskemia hangat pertama selama 15 menit 24 detik. Tidak didapat komplikasi mayor intraoperatif dan pasca operasi. Donor memulai asupan oral dan mobilisasi setelah 10 jam dan lama perawatan rumah sakit 4 hari. Kadar kreatinin serum mencapai 1,5 mg/dL pada hari ke-6. **Simpulan:** Nefrektomi donor hidup laparoskopik secara teknis dapat dilakukan di Indonesia dan dapat meningkatkan angka donasi ginjal di Indonesia karena tindakan yang invasif minimal.

Kata kunci: Transplantasi ginjal, nefrektomi donor hidup laparoskopik, Indonesia.

Correspondence: Chaidir A. Mochtar, c/o: Department of Urology, Faculty of Medicine/Universitas Indonesia, Cipto Mangunkusumo Hospital, Jl. Diponegoro No. 71, Jakarta 10430. Phone: 021-3152892, 3923631, 3923632. Mobile phone: 081 317981748. Email: camochtar@yahoo.com.

INTRODUCTION

Living donor kidney transplantation is better than deceased donor kidney transplantation because of better patient and graft survival rates, better cost-effectiveness and improved quality of life of the recipient.¹ In living kidney donation there are several surgical techniques for taking a renal allograft from a living donor. The classical method to procure a kidney from a living donor is the open

donor nephrectomy performed through a flank lumbotomy incision. In 1995, Ratner et al. described the laparoscopic technique to perform a living donor nephrectomy.² Laparoscopic living donor nephrectomy (LLDN) techniques has become a very attractive method of procuring kidneys from live donors, compared to the traditional standard open surgical approach.³ In the past years, several modifications to these two techniques of living donor nephrectomy have been described (table 1).

Table 1. Surgical techniques for living kidney transplantation (modified from Minnee RC et al).⁴

Open donor nephrectomy techniques	<ul style="list-style-type: none"> - Flank lumbotomy incision - Muscle-sparing mini-incision donor nephrectomy
Laparoscopic transperitoneal techniques	<ul style="list-style-type: none"> - Laparoscopic donor nephrectomy - Hand-assisted laparoscopic donor nephrectomy
Endoscopic retroperitoneal techniques	<ul style="list-style-type: none"> - Retroperitoneoscopic donor nephrectomy - Hand-assisted retroperitoneoscopic donor nephrectomy

Compared to the open approach, LLDN has advantages of decreased postoperative pain with less analgesic requirement, less surgical trauma, shorter hospitalization, decreased donor recovery time and better cosmetic results.⁵⁻⁷ No significant differences exist between the two approaches in terms of complication rates, cost-effectiveness and graft function.³⁻⁷ Simforoosh et al, reported the first randomized controlled trial between open and laparoscopic donor nephrectomy. They included 100 donors and reported no differences in complications and graft survival.¹ One-year graft survival after laparoscopic donor nephrectomy ranges from 93-100% and after open donor nephrectomy from 91-100%.^{7,8} Donors of the laparoscopic group were more satisfied and resumed their normal activities earlier.¹ Conversion rate from laparoscopic to open surgery is 1,8% (range 0 to 13,3%). Approximately half of the conversions to open are for bleeding or vascular injury.⁸ The longer operating time and warm ischaemia time during laparoscopic donor nephrectomy showed no significant deleterious effect on graft survival. The open donor nephrectomy compared with the laparoscopic donor nephrectomy has a shorter operative time by 52 minutes (95% CI 39,73 to 64,12; $p = 0,001$). Compared with laparoscopic donor nephrectomy, open donor nephrectomy has a shorter warm ischaemia time by 102 seconds (95% CI 102,01 to 155,15; $p < 0,001$).⁸ There is no clinically demonstrated negative effect on kidney function if the warm ischaemia is less than 10 minutes, which is the case in almost all laparoscopic series.⁹

There is an ongoing discussion whether right or left donor nephrectomy is to be preferred. Most centers prefer to use the left kidney for living kidney donation because the renal vein is longer,

which is advantageous during implantation.¹⁰ However, some surgeons prefer the right kidney because it is easier to recover than the left kidney and the risk of splenic laceration is decreased. A single-centre randomized controlled trial revealed no differences between left- and right-sided donor nephrectomy in donor hospital stay, donor quality of life, donor and acceptor complication rates, or graft survival.¹¹

In earlier studies the implantation of kidneys with multiple arteries has been associated with an increased incidence of vascular and urological complications, such as thrombosis and ureteral ischaemia, and was considered a relative contraindication by some. However, more recent reports state that renal transplantation can be performed safely in case of multiple arteries. Special care has to be taken with the lower kidney pole accessory renal arteries as they often provide substantial blood supply to the renal pelvis and ureter in a transplanted kidney and otherwise giving urological complications.¹²⁻¹³

Nowadays, the surgical technique of living donor nephrectomy varies greatly between transplant centres in European countries. An audit held in 2005 revealed that 40% of the living donor nephrectomies in Western Europe are performed laparoscopically.¹⁴ In 2003, the percentage of laparoscopies in the United States was approximately 67%.¹⁵ In Japan, 125 Japanese kidney transplantation centers investigated the outcomes of LLDN in 2005. Among the 695 nephrectomies, 441 donors had undergone LLDN and 254 had open nephrectomies. Then, there was an increase in the number of LLDN.¹⁶ In 2007, these centers performed 840 living donor nephrectomies, including 623 LLDN and 217 open nephrectomies.¹⁷ Laparoscopic

donor nephrectomy has become the standard method for procuring kidney grafts of living donors in many centers.

OBJECTIVE

In Indonesia, this is the first experience of laparoscopic living donor nephrectomy. In this article, we aim to present our experience with LLDN which was performed on November 8, 2011.

MATERIAL & METHOD

A 37 years-old man was planned as the living donor. The recipient was a 63 year-old man suffering from end stage renal disease and hypertensive heart disease, and was on chronic haemodialysis. The donor was evaluated pre-operatively. The evaluation included medical, surgical, and psychosocial suitability for live donation. Absolute contraindications to laparoscopic donor nephrectomy included absence of two functional kidneys, ABO incompatibility, certain infectious diseases (hepatitis B or C, human immunodeficiency virus), significant renal arterial occlusive disease, renal parenchymal diseases such as malignancy or polycystic kidney disease, uncorrectable coagulopathy, and horseshoe kidney. Relative contraindications to laparoscopic donor nephrectomy include underlying medical conditions (extremes of age, hypertension, diabetes mellitus, nephrolithiasis), inability to tolerate general anesthesia or pneumoperitoneum, prior left colonic or splenic surgery, retroperitoneal inflammatory processes (diverticulitis, retroperitoneal fibrosis), morbid obesity, and ascites. Informed consent was obtained together with detailed explanations provided by both the surgeon and the renal physician, and a patient information sheet was given preoperatively. His renal and other organs function was excellent and allowed for positive qualification. Intravenous urography showed normal function of kidneys and no abnormalities, such as stones or obstructions. Ultrasonography and chest X-ray also showed no abnormalities. Renal angiography showed one left main renal artery with one small branch just off its aortic origin. Renal scintigraphy showed normal and even function in both kidneys (left kidney's GFR: 47 ml/mnt, right kidney's GFR: 50 ml/mnt). The donor signed the informed consent for laparoscopic donor nephrectomy.

General anaesthesia was given to the patient and Foley catheter for diuresis control was introduced. Laparoscopic donor nephrectomy was pre-planned to be performed on the left kidney to maximize the length of renal vein available to the transplant surgeon. The patient is placed in lateral decubitus position, 4 trocars (in diamond-shaped fashion) are introduced. The colon is mobilized and displaced medially. The line of Toldt is opened and the kidney is exposed (Figure 1). The ureter and spermatic vein are dissected free from its surrounding tissue with leaving a sufficient amount of periureteric tissue/fat (Figure 2). The left spermatic vein is followed up to the left renal vein. The spermatic vein is clipped and cut 2 cm from the renal vein (Figure 3). A lumbar vein was identified and also clipped and cut (Figure 4). The left renal artery is dissected free at its aortic origin. The adrenal vein is identified, clipped and cut (Figure 5). Near the adrenal gland, Gerota's fascia is opened. Then, the upper pole of the kidney is freed (Figure 6). The ureter is identified and cut (Figure 7), and the kidney released from all surrounding attachments except for the hilum (Figure 8). A low transverse suprapubic (Pfannenstiel) incision is made, creating a gate for extraction of the kidney. After clipping and cutting the small arterial branch close to the aorta, the renal artery is clipped with hem-o-lok (Weck Closure system, Research Triangle Park NC, USA) clips applied as close as possible to the aorta, and cut distal to the clips (Figure 9). The renal vein is clipped with hem-o-lok clips and cut distally from the clips (Figure 10).



Figure 1. The line of Toldt is opened and the kidney is exposed.

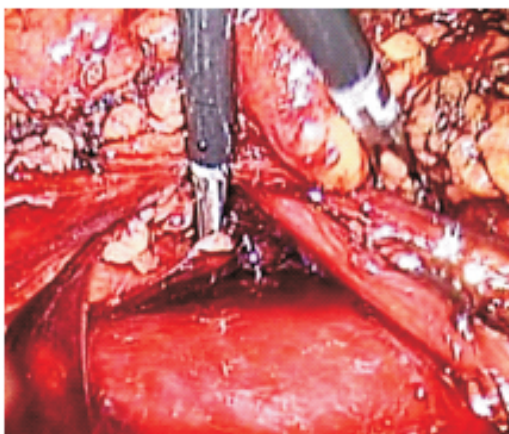


Figure 2. Ureter and spermatic blood vessels drawn into anterolateral away from psoas muscle. Periureter fat preserved as much as possible.

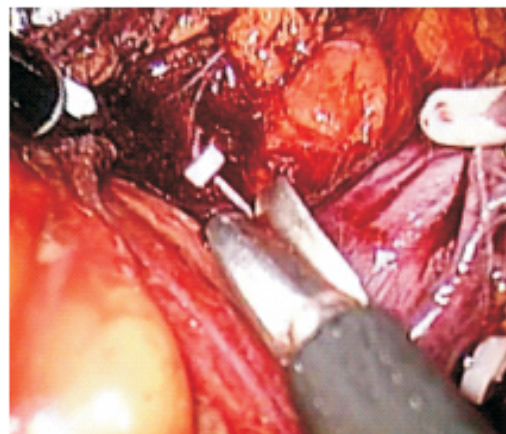


Figure 5. The adrenal vein is identified, clipped, and cut.

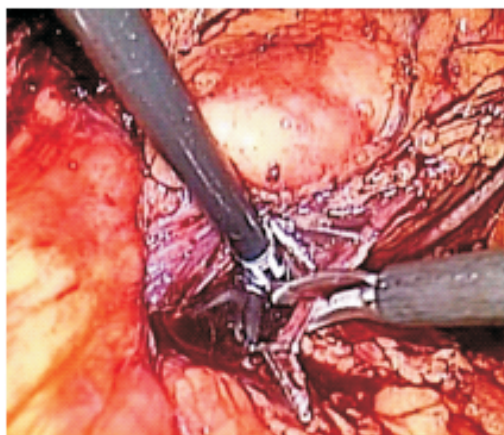


Figure 3. The spermatic vein is clipped and cut 2 cm from the renal vein.

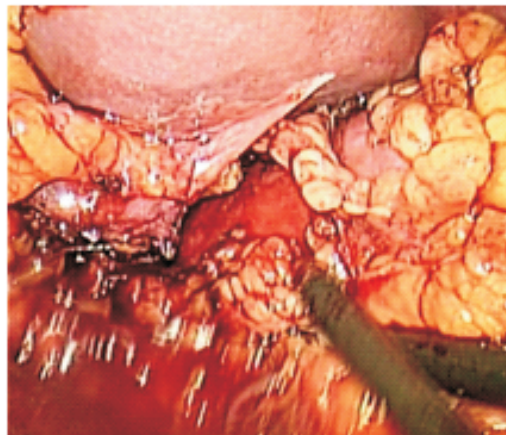


Figure 6. Near the adrenal gland, Gerota's fascia is opened and the upper pole of the kidney freed.

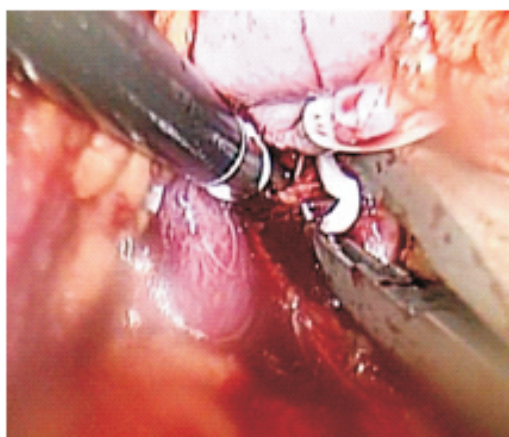


Figure 4. A left lumbar vein, lying behind the renal vein is clipped with hem-o-lok (Weck Closure system, Research Triangle Park NC, USA) clips and cut.



Figure 7. The ureter is identified and cut.

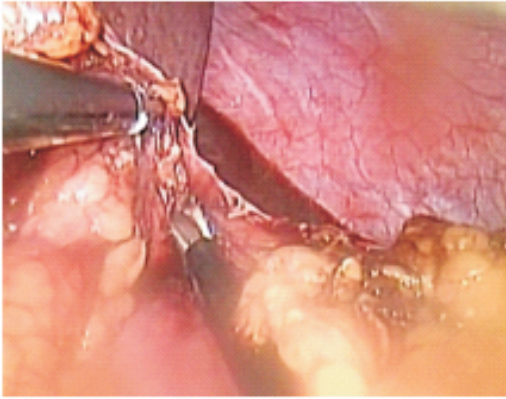


Figure 8. The kidney is released from all remaining attachments.

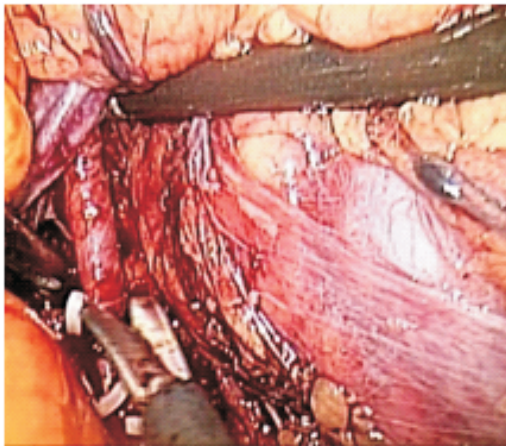


Figure 9. The renal artery is cut distal to the clips.

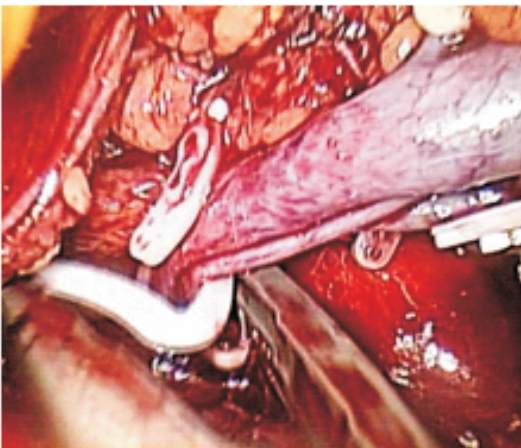


Figure 10. The renal vein is clipped with hem-o-lok clips (XL) and cut distally from the clips.

The kidney is then immediately retrieved with the operator's right hand introduced through the extraction incision and placed in the icy solution for perfusion.

After control of hemostasis and inspection of peritoneum was performed, a drain tube is inserted and the abdominal wounds are closed at the fascia and skin levels, and the procedure is concluded. The kidney, immediately after having been retrieved from the donor, is flushed and immersed in histidine-tryptophan ketoglutarate (Custodiol) solution of 0°C.¹⁸ After that, the kidney is transported to the recipient operating room. The implantation procedure began immediately afterwards. For preparation of the recipient, a Gibson incision was used. The muscle was opened and peritoneum was set aside to mediocranial. The external iliac vessels were identified. Perivascular sheath was released and bladder was identified. Ureteroneocystostomy was prepared. The graft came up and two vascular anastomoses are performed between the renal and external iliac vessels in an "end-to-side" manner. Reperfusion proceeded immediately, and shortly after that the urine output from the ureter was observed. Ureteroneocystostomy (Lich-Gregoir technique) was conducted. Patency of the anastomosis was secured by an indwelling double-J ureteral stent.

RESULTS

The total operating time was 300 minutes (skin-to-skin). The estimated blood loss was 600 mL. The warm ischaemia I time, cold ischaemia time, and warm ischaemia II time were 15 minutes and 24 seconds, 37 minutes, and 63 minutes respectively. The time to first initial urine output was 87 minutes. Postoperatively, the donor resumed oral diet 10 hours after operation. The patient started ambulating after 10 hours and was discharged 4 days after surgery. There were no significant intra-operative complications. At postoperative day-1 urinary catheter was pulled out, but the patient suffered from an acute urinary retention. Catheter was inserted for another two days, and at day-3 underwent a successful trial without catheter (TWOC). There were no other postoperative complications. Postoperative pain was mild if none at all (the patient was put on epidural analgesia since operation day, hence the probable cause of AUR). The recipient had immediate graft function post-transplantation and the serum creatinine levels

reached near baseline levels (1,5 mg/dL) at day 6. There was no incidence of vascular or ureteral complications in the recipient.

DISCUSSION

Donor nephrectomy is unique among major surgical procedures, because it exposes an otherwise healthy patient to the risks of major surgery entirely for the benefit of another person. For LLDN to become a viable option for procuring kidneys for renal transplantation, several conditions must be met. Most important, the laparoscopic donor should suffer no additional or unique morbidity when compared to the open donor. In addition, kidneys harvested using laparoscopic techniques must have graft survival and function rates equivalent to those obtained by the “gold standard” of open nephrectomy. Finally, the laparoscopic approach should convey some advantage to the patient such as less pain, shorter hospital stay, and earlier return to normal activity. The results of laparoscopic and open living donor nephrectomies between this case and the other studies are described in table 2.

Laparoscopic donor nephrectomy resulted in impressive improvements in patient outcome when compared to open donor nephrectomy. Resumption of diet and starting ambulating averaged < 50% of the times for the open procedure. Length of stay after open donor nephrectomy ranges from 5 to 17,6 days in recent series, with the most typical stay being 5,6 to 7,9 days.²¹ While in the laparoscopic series the length of stay were between 2,1 to 4,0 days.¹⁹⁻²²

In terms of warm ischaemia time, this case demonstrated that the warm ischaemia time on LLDN operation longer than open nephrectomy. Multiple studies including the comparison of

laparoscopic versus open donor nephrectomy showed that this situation did not affect the long-term graft outcome.³⁻⁸ However, the effect of warm ischaemia time on delayed graft function is controversial according to the literature. Delayed graft function is defined as hemodialysis requirement within one week of transplantation. In a Cochrane Database Systematic Review article, Wilson et al.⁵ mentioned that the extracted kidney was exposed to longer warm ischaemia periods (2 to 17 minutes) on LLDN with no associated short-term consequences. Jacobs et al.,²³ compared warm ischaemia time ≤ 3 minutes vs. ≤ 3 minutes and warm ischaemia time ≤ 5 minutes, 5-10 minutes, and ≥ 10 minutes, and showed that prolonged warm ischaemia time did not affect graft function. In contrast, in a series reported by Sasaki et al.²⁴ a warm ischaemia time of > 10 minutes was associated with acute tubular necrosis and an elevated serum creatinine concentration at 7 days post-transplantation. In this case, the recipient had immediate graft function post-transplantation and the serum creatinine levels reached near baseline levels (1,5 mg/dL) at day 6.

The lack of LLDN experience in our institution contributed to the longer operating time and higher estimated blood loss. This technique has become the preferred method of allograft procurement for many transplantation centers worldwide but still remains technically challenging with a steep learning curve.²⁵

CONCLUSION

Although this is the first experience of LLDN in Indonesia, laparoscopic live donor nephrectomy is technically feasible and can be performed with low morbidity and mortality rates

Table 2. Results of laparoscopic and open living donor nephrectomies.

Parameters	This case	Ratner et al ¹⁹		Koffron et al ²⁰		Flower et al ²¹		Mitre et al ²²	
		Open	Laparoscopic	Open	Laparoscopic	Open	Laparoscopic	Open	Laparoscopic
Patients (n)	1	241	323	65	70	65	69	37	38
Operating room time (min)	300	183 ± 47	230 ± 29	186	276	212,8	226,3	150,9 ± 32,2	168,7 ± 27,0
Estimated blood loss (mL)	600	393 ± 335	266 ± 174	174	165	408,0	122,3	ND	ND
Warm ischaemia I time (min)	15	ND	ND	ND	ND	3,0 (1,9-6,9)	ND	1,0 ± 0,4	3,3 ± 4,1
Cold ischaemia time (min)	37	ND	ND	ND	ND	ND	ND	ND	ND
Warm ischaemia II time (min)	63	ND	ND	ND	ND	ND	ND	ND	ND
Return to oral diet (hr)	10	62,4 ± 24	19,2 ± 12	20,9	8,1	77,7	40,0	ND	ND
Starting ambulating (hr)	10	28	14	ND	ND	ND	ND	ND	ND
Length of stay (days)	4	5,7 ± 1,7	3,0 ± 0,9	3,2	2,1	4,5	2,2	3,7 ± 0,6	3,1 ± 0,9

ND = No Data

comparable to those of open donor nephrectomy, with substantial improvements in patient recovery after the laparoscopic approach.

REFERENCES

1. Simforoosh N, Basiri A, Tabibi A, Shakhssalim N, Hosseini Moghaddam SM. Comparison of laparoscopic and open donor nephrectomy: A randomized controlled trial. *BJU Int.* 2005; 95(6): 851-5.
2. Ratner LE, Ciseck LJ, Moore RG, Cigarroa FG, Kaufman HS, Kavoussi LR. Laparoscopic live donor nephrectomy. *Transplantation.* 1995; 60(9): 1047-9.
3. Velidedeoglu E, Williams N, Brayman KL, Desai NM, Campos L, Palanjian M, et al. Comparison of open, laparoscopic, and hand-assisted approaches to live-donor nephrectomy. *Transplantation.* 2002; 74: 169-72.
4. Minnee RC, Idu MM. A review of laparoscopic donor nephrectomy. *Neth J Med.* 2010; 68(5): 199-206.
5. Wilson CH, Sanni A, Rix DA, Soomro NA. Laparoscopic versus open nephrectomy for live kidney donors. *Cochrane Database Syst Rev.* 2011; 11: CD006124.
6. Shokeir AA. Open versus laparoscopic live donor nephrectomy: A focus on the safety of donors and the need for a donor registry. *J Urol.* 2007; 178(5): 1860-6.
7. 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(3): 404-14.
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(1): 58-70.
9. Simforoosh N, Basiri A, Shakhssalim N, Ziaee SA, Tabibi A, Moghaddam SM. Effect of warm ischaemia on graft outcome in laparoscopic donor nephrectomy. *J Endourol.* 2006; 20(11): 895-8.
10. Lind MY, Hazebroek EJ, Hop WC, Weimar W, Jaap BH, Ijzermans JN. Right-sided laparoscopic live-donor nephrectomy: is reluctance still justified? *Transplantation.* 2002; 75(7): 1045-8.
11. Minnee RC, Bernelman WA, Maartense S, Bernelman FJ, Gouma DJ, Idu MM. Left or right kidney in hand-assisted donor nephrectomy? A randomized controlled trial. *Transplantation.* 2008; 85(2): 203-8.
12. Kok NF, Dols LF, Hunink MG, Alwayn IP, Tran KT, Weimar W. Complex vascular anatomy in live kidney donation: Imaging and consequences for clinical outcome. *Transplantation.* 2008; 85(12): 1760-5.
13. Minnee RC, Surachno S, Bemelman F, ten Berge IJ, Kox C, Legemate DA, et al. Impact of additional vascular reconstructions on survival of kidney transplants. *Int Surg.* 2008; 93(2): 111-5.
14. Kok NF, Weimar W, Alwayn IP, Ijzermans JN. The current practice of live donor nephrectomy in Europe. *Transplantation.* 2006; 82(7): 830-4.
15. Matas AJ, Bartlett ST, Leichtman AB, Delmonico FL. Morbidity and mortality after living kidney donation, 1999-2001: Survey of United States transplant centers. *Am J Transplant.* 2003; 3(7): 830-4.
16. Yuzawa K, Shinoda M, Fukao K. Outcome of laparoscopic live donor nephrectomy in 2005: National Survey of Japanese Transplantation Centers. *Transplant Proc.* 2006; 38(10): 3409-11.
17. Yuzawa K, Shinoda M, Fukao K. Outcome of laparoscopic live donor nephrectomy in 2007: National Survey of Japanese Transplantation Centers. *Transplant Proc.* 2009; 41(1): 85-7.
18. Agarwal A, Murdock P, Fridell JA. Comparison of histidine tryptophan ketoglutarate solution and University of Wisconsin solution in prolonged cold preservation of kidney allografts. *Transplantation.* 2006; 81(3): 480-2.
19. Ratner LE, Kavoussi LR, Schulam PG, Bender JS, Magnuson TH, Montgomery R. Comparison of laparoscopic live donor nephrectomy versus the standard open approach. *Transplant Proc.* 1997; 29: 138-9.
20. Koffron A, Herman C, Gross D, Ferrario M, Kaufman D, Abecassis M, et al. Laparoscopic donor nephrectomy: Analysis of donor and recipient outcomes. *Transplant Proc.* 2001; 33: 1111.
21. Flowers JL, Jacobs S, Cho F, Morton A, Rosenberger WF, Evans D, et al. Comparison of open and laparoscopic live donor nephrectomy. *Ann Surg.* 1997; 226: 483-90.
22. Mitre AI, Denes FT, Nahas WC, Simoes FA, Colombo JR, Piovesan AC, et al. Comparative and prospective analysis of three different approaches for live-donor nephrectomy. *Clinics.* 2009; 64(1): 23-8.
23. Jacobs SC, Cho E, Foster C, Liao P, Bartlett ST. Laparoscopic donor nephrectomy: The University of Maryland 6-year experience. *J Urol.* 2004; 171: 47-51.
24. Sasaki TM, Finelli F, Bugarin E, Fowlkes D, Trollinger J, Barhyte DY, et al. Is laparoscopic donor nephrectomy the new criterion standard? *Arch Surg.* 2000; 135: 943-7.
25. Su LM, Ratner LE, Montgomery RA, Jarrett TW, Trock BJ, Sinkov V, et al. Laparoscopic live donor nephrectomy: Trends in donor and recipient morbidity following 381 consecutive cases. *Ann Surg.* 2004; 240(2): 358-63.