Comparison of Transperitoneal and Retroperitoneal Laparoendoscopic Single-site Donor Nephrectomy

Chung-Yu Lin

Kaohsiung Medical University Chung-Ho Memorial Hospital

Ching-Chia Li

Kaohsiung Medical University Chung-Ho Memorial Hospital

Hung-Lung Ke

Kaohsiung Medical University Chung-Ho Memorial Hospital

Wen-Jeng Wu

Kaohsiung Medical University Chung-Ho Memorial Hospital

Yii-Her Chou

Kaohsiung Medical University Chung-Ho Memorial Hospital

Sheng-Chen Wen (✉ carl0815@gmail.com)

Department of Urology, Kaohsiung Medical University hospital, Kaohsiung Medical University, Kaohsiung, Taiwan

Research Article

Keywords: Donor nephrectomy, Transplantation, preoperative outcome, single-site laparoscopy

Posted Date: December 28th, 2020

DOI: <https://doi.org/10.21203/rs.3.rs-111078/v1>

License: © ⓘ This work is licensed under a Creative Commons Attribution 4.0 International License.

[Read Full License](#)

Abstract

Background: Laparoscopic living-donor nephrectomy is the standard technique at high-volume renal transplant centers. Laparoendoscopic single-site donor nephrectomy (LESS-DN) is a relatively novel minimally invasive surgery, which was differed to transperitoneal and retroperitoneal approaches. We present a retrospective analysis of our single-institution donor nephrectomy series comparing the transperitoneal to retroperitoneal LESS-DN with regards to operative outcomes.

Materials and Methods: Ten patients who underwent LESS-DN from 2017–2019 were enrolled at our center. The same surgeon performed all cases. The two approaches were compared retrospectively and evaluated for differences in perioperative outcomes, including operation time, console time, blood loss, graft warm ischemia time, postoperative pain, length of stay (LOS), wound size, postoperative pain, and renal function post LESS-DN at less than one year.

Results: Total operating time (315 ± 82.69 vs. 191 ± 24.9 min, $p = 0.016$), console time (224 ± 74.15 vs. 110 ± 19.84 min, $p = 0.016$), and LOS (8.4 ± 1.82 vs. 4.8 ± 1.10 days, $p = 0.013$) were significantly longer in the transperitoneal group. The wound size (44 ± 3.81 vs. 68.2 ± 13.5 mm, $p = 0.038$) was significantly smaller in the transperitoneal group. There was no significant difference in other parameters, including blood loss, warm ischemia time, and postoperative pain from day one to day three.

Conclusions: Retroperitoneal LESS-DN results in similar perioperative outcomes as transperitoneal LESS-DN without compromising donor safety, and while providing a faster operation time, console time, shorter LOS, and a trend toward a shorter warm ischemia time.

Introduction

End-stage renal disease (ESRD) has a high prevalence in Taiwan and is a robust economic burden on the national health insurance[1]. Kidney transplantation is one of the main therapies for ESRD, as it provides a better quality of life. It is now a routine medical practice worldwide, especially in high economic countries[2–4]. For ESRD patients, the cost of hemodialysis is higher than that for performing transplantation, post-operation care, and further maintenance[5].

Nowadays, the number of patients receiving kidneys from their spouses or family is increasing[6]. Living-donor kidney transplantation is associated with more advantages, such as a short waiting-list period, elective time of the surgery, and better graft function compared to cadaveric kidney donation[7–10].

According to the literature, the first donor nephrectomy surgery was done in 1954 via an open method. It was regarded as the gold standard surgery for almost 45 years[11]. Now, laparoscopic living-donor nephrectomy is the gold standard technique at high-volume renal transplant centers, and laparoendoscopic single-site donor nephrectomy (LESS-DN) is a relatively novel minimally invasive surgery. The procedure can be approached both transperitoneally and retroperitoneally. Retroperitoneoscopic living-donor nephrectomy provides direct access to the renal hilum without the need

to mobilize the colon, but there is a lack of anatomic landmarks to guide orientation, a smaller working space, and a steep learning curve[12].

There are few studies which compare the transperitoneal approach with the retroperitoneal approach regarding laparoscopic donor nephrectomy. In this study, we present a retrospective analysis of our single-institution donor nephrectomy series comparing the transperitoneal to retroperitoneal LESS-DN regarding operative outcomes.

Materials And Methods

Study Population

This retrospective study included patients who underwent LESS-DN performed by the same team (Dr. C.C. Li and Dr. S.C. Wen) that has significant experience in single-site laparoendoscopic surgeries. A total of 10 patients underwent LESS-DN: five underwent transperitoneal LESS-DN and five underwent retroperitoneal LESS-DN. Technetium 99 m diethylenetriaminepentaacetic acid (DTPA) scans were used to assess donors' split renal function for preoperative evaluation. The side of the kidney with the more inferior function was chosen, while the donor patient had asymmetry renal function (> 10% difference in glomerular filtration rate). If female patients were desirous of becoming pregnant in the future, the patient underwent right-sided donor nephrectomy to prevent pregnancy-related hydronephrosis[13]. Every living donor renal transplantation was approved by our hospital ethics committee. The present study was approved by the review board of our institution (KMUHIRB-E(l)-20200063). For this type of study informed consent was not required and approved by institutional research committee.

Surgical Technique - Retroperitoneal and Transperitoneal Approaches

Patients received a transperitoneal or retroperitoneal approach according to 'their preferences. LESS-DN was performed through a 5 cm single transumbilical incision for a transperitoneal approach, or a 5 cm incision at the midaxillary line with a muscle splitting technique for a retroperitoneal approach. Regarding a single-port device, we used two kinds of multi-glove ports, GlovePort (Nelis Medical, South Korea) and Lagis port (Lagis Endosurgical, Taiwan). For the transperitoneal approach, a pneumoperitoneum was created following placement of the transumbilical multichannel single-port device. Division of the Toldt line was the first step, followed by colonic mobilization. The ureter and gonadal vein could be found soon after dissection of the psoas muscle. Lifting the ureter from the psoas muscle facilitated dissection of the renal vein and artery from the surrounding alveolar tissue. We dissected the kidney to remove perirenal fat, spared the adrenal gland, and the ureter was divided. Finally, the kidney was extracted directly by hand-grasping from the wound retractor of the single-port device. For the retroperitoneal approach, the patient was in the 90° full flank position, and we created retroperitoneal space using a balloon dilator after skin incision and finger dissection. After mounting the single-port device, we identified the ureter anterior to the psoas muscle and further dissected the renal artery and vein by lifting the ureter. Once the

renal artery and vein were thoroughly free from the adjacent alveolar and lymphatic tissue, we unmounted the single-port device and used a hand-assisted technique for perirenal dissection and adrenal division. After dividing the renal pedicles by EndoTA (Medtronic, Minneapolis, MN, USA) and cutting with scissors, we extracted the donor kidney by hand directly after detaching the single-port device.

Postoperative Management

Every patient underwent patient-controlled analgesia and took oral NSAIDs every eight hours for postoperative pain control. The pain was evaluated every two hours on the operation day and every eight hours for the remaining days. Patients were discharged home when pain and oral intake were tolerable without acute complications.

Statistical Analysis

Variables collected from patients included age, sex, side of nephrectomy, body mass index (BMI), operation time, console time, estimated blood loss, warm ischemia time, length of hospital stay, and postoperative pain, which was evaluated via visual analog scale score from days 1–3, as well as the outcomes mentioned above. The size (cm) of the operative wound was measured one month after the operation. The renal function post LESS-DN was followed for one year, and serum creatinine level was checked at 1, 3, 6, and 12 months after surgery. The database with the variables were expressed as median (interquartile range [IQR]) values. To compare outcomes between two independent groups, Mann-Whitney U test (Wilcoxon rank-sum test) was used for non-normally distributed continuous variables, and Fisher's exact test was used for categorical variables. Statistical significance was defined as $p < 0.05$, and all reported p values were two-sided. Statistical analyses were conducted using IBM SPSS statistical software version 19 (IBM SPSS Statistics for Windows, Version 19.0; IBM Corp., Armonk, NY).

Results

Five patients underwent transperitoneal LESS-DN, and five underwent retroperitoneal LESS-DN. Table 1 summarizes patient characteristics. No significant differences were observed in age, gender, BMI, or laterality. Regarding the laterality of donor nephrectomy between the two groups, nine patients were left-sided, and only one patient was right-sided in the transperitoneal group. Table 2 summarizes the perioperative outcomes. Total operating time (315 ± 82.69 vs. 191 ± 24.9 min, $p = 0.016$), console time (224 ± 74.15 vs. 110 ± 19.84 min, $p = 0.016$), and LOS (8.4 ± 1.82 vs. 4.8 ± 1.10 days, $p = 0.013$) were significantly longer in the transperitoneal group. The postoperative wound size (44 ± 3.81 vs. 68.2 ± 13.5 mm, $p = 0.038$) was significantly smaller in the transperitoneal group. There were no significant differences in the other parameters, including blood loss (166 ± 167.42 vs. 190 ± 178.19 mL, $p = 0.945$), warm ischemia time (245 ± 201.80 vs. 149 ± 35.94 s, $p = 0.593$), and postoperative pain from day one to day three. Although there were no significant differences, we observed a trend toward shorter warm ischemia time in the retroperitoneal group. Renal function was followed for one year after LESS-DN and no significant differences were observed between the two groups.

Discussion

Living-donor nephrectomy is usually an altruistic act. The surgery is different from other destructive surgeries in that it involves a healthy individual being exposed to the risks of the procedure. The symptoms and discomfort that patients encounter should be minimized in clinical practice. Compared to open donor nephrectomy, laparoscopic donor nephrectomy showed superior donor postoperative recovery and convalescence[14, 15], and also equivalent safety and post-nephrectomy outcome in the donor[16].

LESS is a revolutionary laparoscopy because of the advantage of less bleeding, less wound pain, less risk of incisional hernia, and better cosmesis[17]. At our institution, our surgeons experience single-port laparoscopic surgery technique, such as LESS adrenalectomy, herniorrhaphy, partial nephrectomy, and robotic single-port radical prostatectomy in daily practice[18–20]. LESS-DN has become the standard procedure for living-donor kidney transplantation since December 2017 in our institution.

This article is a comparison of transperitoneal and retroperitoneal LESS-DN. Based on previous studies, although the transperitoneal approach of laparoscopy provides a broader view and clear anatomic landmarks to gain direct access without bowel manipulation, the retroperitoneal approach of laparoscopy can reduce the violation of abdominal organs and bypass the intraperitoneal adhesion[21, 22]. This may contribute to the reduced operation time and even the shortened recovery periods post-surgery in our analysis. In our study, the faster operation time in the retroperitoneal approach group did not lead to more blood loss or a longer warm ischemia time during the surgery compared to the transperitoneal group. The LOS was significantly shorter in the retroperitoneal group. Minimal interference of the abdominal organs during the retroperitoneal approach supposedly shortens the duration of bowel recovery and hospital stay. In our study, the wound of the transperitoneal approach was created on the umbilicus. During wound healing, the wound retracted to the inner-side of the umbilicus and the healing scar was less visible in the transperitoneal approach group, as mentioned in other literatures[23]. Thus, the wound size was smaller than in the retroperitoneal approach, although the original incision was the same size. Based on Choi et al.'s study, poor renal function recovery and chronic kidney disease were predicted by unstable renal function at one month postoperatively. Such patients should be followed for more than one year to confirm their final renal outcomes[24]. After donor nephrectomy, all patients were followed for one year to evaluate the postoperative renal function. There was no significant difference between the transperitoneal group and the retroperitoneal group, which indicates that the safety of LESS-DN was identical regardless of the approach method.

The present evidence demonstrates that the retroperitoneal LESS-DN may be a faster surgery without compromising safety under the expertise of an experienced surgeon. There are limitations to this study. First, there is a small number of patients in our study. Further studies should include more patients to provide more robust evidence. Second, all patients underwent surgeries under the same team. The bias about the surgeon's learning curve could therefore not be neglected in this study.

Conclusion

In our study, retroperitoneal LESS-DN resulted in similar perioperative outcomes as transperitoneal LESS-DN without compromising donor safety. It also provided a faster operation time, console time, shorter length of stay, and a trend toward a shorter warm ischemia time. Future investigations should include more studies and reports to strengthen this conclusion.

List Of Abbreviations

LESS-DN Laparoendoscopic single-site donor nephrectomy

LOS length of stay

ESRD End-stage renal disease

Declarations

Availability of data and material

All data will be available by contacting the corresponding author. All strains and reagents used in the studies are available upon request.

Code availability

Not applicable.

Authors' contributions

Chung-Yu Lin wrote the original draft. Wen-Jeng Wu, Ching-Chia Li, Hung-Lung Ke, Yii-Her Chou provides raw database and performed data curation. Sheng-Chen Wen reviewed, and revised the article and he also was responsible for project administration.

Compliance with Ethical Standards

Disclosure of potential conflicts of interest

The authors declare that they have no conflict of interest.

Disclosure of Funding

No external funding was received for this study.

Ethics approval and consent to participate

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional research committee (KMUHIRB-E(I)-20200063, Institutional Review Board of Kaohsiung Medical University Hospital, Kaohsiung Medical University, Republic of China) and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Every living donor renal transplantation was approved by our hospital ethics committee. The present study was approved by

the review board of our institution (KMUHIRB-E(I)-20200063). For this type of study, informed consent was not required and approved by institutional research committee.

Consent for publication

N/A (Not Applicable)

Informed consent

The present study was approved by the review board of our institution (KMUHIRB-E(I)-20200063). The informed consent was waived by Institutional Review Board (IRB) of the KMUH of ethics committee

Acknowledgments

The authors thank the help from the Division of Medical Statistics and Bioinformatics, Department of Medical Research, Kaohsiung Medical University Hospital, Kaohsiung Medical University

References

1. Hwang SJ, Tsai JC, Chen HC. Epidemiology, impact and preventive care of chronic kidney disease in Taiwan. *Nephrology (Carlton)*. 2010;15 Suppl 2:3-9.
2. Vollmer WM, Wahl PW, Blagg CR. Survival with dialysis and transplantation in patients with end-stage renal disease. *N Engl J Med*. 1983;308(26):1553-8.
3. Edwards EB, Bennett LE, Cecka JM. Effect of HLA matching on the relative risk of mortality for kidney recipients: a comparison of the mortality risk after transplant to the mortality risk of remaining on the waiting list. *Transplantation*. 1997;64(9):1274-7.
4. Garcia-Garcia G, Harden P, Chapman J. The global role of kidney transplantation. *Indian J Nephrol*. 2012;22(2):77-82.
5. Perović S, Janković S. Renal transplantation vs hemodialysis: cost-effectiveness analysis. *Vojnosanit Pregl*. 2009;66(8):639-44.
6. Terasaki PI, Cecka JM, Gjertson DW, Takemoto S. High survival rates of kidney transplants from spousal and living unrelated donors. *N Engl J Med*. 1995;333(6):333-6.
7. Cecka M. Clinical outcome of renal transplantation. Factors influencing patient and graft survival. *Surg Clin North Am*. 1998;78(1):133-48.
8. Koo DD, Welsh KI, McLaren AJ, Roake JA, Morris PJ, Fuggle SV. Cadaver versus living donor kidneys: impact of donor factors on antigen induction before transplantation. *Kidney Int*. 1999;56(4):1551-9.
9. Kuo PC, Johnson LB. Laparoscopic donor nephrectomy increases the supply of living donor kidneys: a center-specific microeconomic analysis. *Transplantation*. 2000;69(10):2211-3.
10. YaghoubiFard S, Goudarzi R, Etminan A, Baneshi M, Barouni M, Jafari Sirizi M. Cost-effectiveness analysis of dialysis and kidney transplant in patients with renal impairment using disability adjusted life years in Iran. *Med J Islam Repub Iran*. 2016;30:390.

11. Gill IS, Carbone JM, Clayman RV, Fadden PA, Stone MA, Lucas BA, et al. Laparoscopic live-donor nephrectomy. *J Endourol.* 1994;8(2):143-8.
12. Tay WK, Kesavan A, Goh YSB, Tiong HY. Right Living Donor Nephrectomies: Retroperitoneoscopic vs Laparoscopic Transperitoneal Approach. *Transplant Proc.* 2018;50(8):2333-7.
13. Rasmussen PE, Nielsen FR. Hydronephrosis during pregnancy: a literature survey. *European Journal of Obstetrics & Gynecology and Reproductive Biology.* 1988;27(3):249-59.
14. Leventhal JR, Paunescu S, Baker TB, Caciado JC, Skaro A, Kocak B, et al. A decade of minimally invasive donation: experience with more than 1200 laparoscopic donor nephrectomies at a single institution. *Clin Transplant.* 2010;24(2):169-74.
15. Fonouni H, Mehrabi A, Golriz M, Zeier M, Müller-Stich BP, Schemmer P, et al. Comparison of the laparoscopic versus open live donor nephrectomy: an overview of surgical complications and outcome. *Langenbecks Arch Surg.* 2014;399(5):543-51.
16. Taweemonkongsap T, Nualyong C, Amornvesukit T, Srinualnad S, Jitraphai S, Premasathian N, et al. Laparoscopic live-donor nephrectomy: a comparison with the open technique and how to reach quality standards: a single-center experience in Thailand. *Transplant Proc.* 2011;43(10):3593-8.
17. Autorino R, Brandao LF, Sankari B, Zargar H, Laydner H, Akça O, et al. Laparoendoscopic single-site (LESS) vs laparoscopic living-donor nephrectomy: a systematic review and meta-analysis. *BJU Int.* 2015;115(2):206-15.
18. Wen SC, Yeh HC, Wu WJ, Chou YH, Huang CH, Li CC. Laparoendoscopic single-site retroperitoneoscopic adrenalectomy versus conventional retroperitoneoscopic adrenalectomy: initial experience by the same laparoscopic surgeon. *Urol Int.* 2013;91(3):297-303.
19. Lo IS, Lee HY, Chou YH, Huang CN, Wu WJ, Yeh HC, et al. Robot-Assisted Extraperitoneal Radical Prostatectomy, Single Site Plus Two Model. *J Laparoendosc Adv Surg Tech A.* 2018;28(2):140-4.
20. Chen YC, Lee HY, Shih MP, Juan YS, Chen HW, Wu WJ, et al. Effect of preoperative computed tomography parameters and obesity on surgical outcomes of laparoendoscopic single-site adrenalectomy. *Surg Endosc.* 2019.
21. Özdemir-van Brunschot DM, Koning GG, van Laarhoven KC, Ergün M, van Horne SB, Rovers MM, et al. A comparison of technique modifications in laparoscopic donor nephrectomy: a systematic review and meta-analysis. *PLoS One.* 2015;10(3):e0121131.
22. Zhao L, Ma LL, Zhang HX, Hou XF, Liu L, Fu Y, et al. Technical improvement in retroperitoneal laparoscopic living donor nephrectomy: report of 193 cases. *Journal of Peking University Health sciences.* 2017;49(5):867-71.
23. Lee JS, Hong TH. Intraumbilical versus periumbilical incision in laparoscopic cholecystectomy: A randomized controlled trial. *Int J Surg.* 2016;33 Pt A:83-7.
24. Choi KH, Yang SC, Joo DJ, Kim MS, Kim YS, Kim SI, et al. Clinical assessment of renal function stabilization after living donor nephrectomy. *Transplant Proc.* 2012;44(10):2906-9.

Table.1 Characteristics of patients undergoing single site donor nephrectomy		
	All(n=10)	
	Trans	Retro
Number of patient(%)	5(50)	5(50)
Age($\pm$ IQR)	58(28-61)	57(54–58)
Gender		
Male(%)	3(60)	3(60)
Female(%)	2(40)	2(40)
BMI($\pm$ IQR)	24.3(24.2-28.4)	22.5(22.0-24.2)
Lateral(%)		
Left	4(80)	5(100)
Right	1(20)	0(0)
Values correspond to medians (interquartile range)		
IQR, interquartile range; trans, transperitoneum; retro, retroperitoneum.		

Table.2 Perioperative outcomes of single site donor nephrectomy			
	All(n=10)		
	Trans	Retro	p-value
Operation time, sec	345(245-385)	195(180-205)	*0.016
Console Time, sec	236(174-260)	112(107-116)	*0.016
Blood loss, cc	100(50-180)	150(100-150)	0.670
WIT, sec	185(120-200)	130(120-187)	0.590
VAS on Day1	2(1.5-2.16)	2.2(1-3)	0.602
VAS on Day2	1.5(1.5-2.33)	0(0-0.25)	0.112
VAS on Day3	1(0.33-1.33)	0(0-1.00)	0.240
LOS, day	9(7-10)	4(4-6)	0.013*
Wound Size, mm	45(40-47)	75(68-75)	0.035*
Creatinine at 1 month	1.02(0.95-1.12)	0.92(0.86-1.08)	0.754
Creatinine at 3 month	1.14(1.01-1.17)	1.01(0.89-1.32)	0.834
Creatinine at 6 month	1.17(1.02-1.20)	0.97(0.92-1.20)	0.530
Creatinine at 12 month	1.05(0.95-1.14)	1.01(0.91-1.21)	0.834
Values correspond to medians (interquartile range)			
WIT, warm ischemia time; LOS, length of stay; VAS, visual analogue scale; trans, transperitoneum; retro, retroperitoneum.			
* <0.05			

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- [Additionalfile1.docx](#)