ORIGINAL ARTICLE

# Feasibility and safety of transvaginal specimen extraction for laparoscopic living donor nephrectomy: an Indonesian perspective compared with three different approaches

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**ABSTRACT**

**Introduction: Laparoscopic live donor nephrectomy (LLDN) continues to expand in minimally invasive surgery; nevertheless, the studies are inadequate to compare standard kidney extraction with TV-NOSE in less-developed countries. This study compared TV-NOSE with conventional kidney specimen extractions.**

**Objective: To examine the feasibility of TV-NOSE in live donor nephrectomy.**

**Materials and Methods: 53 patients received LDN surgery at our hospital from September 2017 to December 2021. Retrospectively, living donor nephrectomy with TV-NOSE was compared to three different surgical procedures with standard specimen extraction.**

**Results: 53 donor patients were included: 15 open (OLDN), 12 retroperitoneoscopic living donor nephrectomy (RPLDN), 10 transperitoneal living donor nephrectomy (TPLDN), and 16 standard laparoscopic living donor nephrectomy with transvaginal extraction (SLLDN TV-NOSE). SLLDN TV-NOSE's longer operating time (p<0.0041) did not affect graft function. SLLDN TV-NOSE and RPLDN had shorter lengths of stay and better VAS trends than open LDN and TPLDN (p<0.05). SLLDN TV-NOSE donors reported acceptable surgical outcomes and unchanged sexual function. All patients had similar discharge creatinine levels, with 1-year transplant survival of 98% and just 1 graft loss in the TPLDN group.**

**Conclusion: SLLDN TV-NOSE is equivalent to RPLDN and better than open LDN and TPLDN in terms of duration of stay, VAS score, surgical outcomes, and sexual function. TV-NOSE is a safe surgical procedure with an acceptable donor complication. TV-NOSE may be safely conducted in both developed and developing countries with proper patient selection.**

**KEYWORDS:**
*Laparoscopic Nephrectomy; NOSE; Transvaginal; Laparoscopic live donor nephrectomy (LLDN)*

## INTRODUCTION

Compared with open surgery, laparoscopic surgery has many superiorities and has become the standard for nephrectomy donors. Laparoscopic surgery reduces the risk of early postoperative wound complications and long-term incisional hernia.[1] The smaller incision of the laparoscopic technique also reduces the length of hospital stay and the patient's recovery period.[2] However, traditional laparoscopic donor nephrectomy usually requires an additional large abdominal incision to remove the kidney. The additional incision increases the risk of abdominal wound complications and impairs postoperative recovery.[3] It also causes significant postoperative pain and cosmetic problems.[4]

Natural orifice specimen extraction (NOSE) allows laparoscopic donor nephrectomy to be performed through a standard trocar hole in the abdominal wall without additional incisions or extensions. Vaginal, gastral, rectal and bladder routes can be used for NOSE. However, for laparoscopic donor nephrectomy, transvaginal extraction seems to be the only suitable method.[5]

NOSE surgery for specimen extractions in living donors has been deployed previously in countries with more developed medical care systems, such as the Spain, Turkey and India.[6] However, because this method only requires some basic endoscopic instruments, NOSE can be applied in many health facilities worldwide, even in a resource-poor setting. Since January 2019, our institution has optimised TV-NOSE's application in our kidney transplant program, becoming the first hospital in Indonesia to adopt this new technology. The trial was initially conducted on 18 patients in Indonesia. It has become essential to critically assess its safety and efficacy against the well-established procedures of other previous laparoscopic living donor nephrectomy (LLDN). Thus, we retrospectively analysed the results of our first consecutive TV-NOSE with other previous laparoscopic approaches to donor nephrectomy and compared the outcome of our initial experience. The objective of this study was to describe the safety and feasibility of TV-NOSE during LLDN, especially in Indonesia. In addition, this study will mark a significant milestone for kidney transplantation surgery in Indonesia.

## MATERIALS AND METHODS

*Patient Population*

In this study, we retrospectively examined the medical records of living kidney donors. This study was conducted in accordance with the local ethical committee and was approved by the Institutional Review Board of our University

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(Ref. No: KE/FK/0594/EC/2022). Between September 2017 and December 2021, 53 kidney donor surgeries were performed by a surgeon in our hospital. All donor patients were hospitalised in the period of January 2017 to December 2018 underwent open surgery, and continued with laparoscopy transperitoneally with conventional specimen extraction (January 2019 to July 2019). By the August 2019, we started to perform TV-NOSE techniques for female donors and nephrectomy retroperitoneoscopically for male. We explained the procedure and received informed consent from all the patients. The study flow chart is shown in Figure 1.

In general, our institution's inclusion criteria for nephrectomy donor were institutional board approved considering its medical, ethical, legal and social aspects in live voluntary kidney donors, both in related and unrelated live voluntary kidney donors. The additional inclusion criteria for Standard Laparoscopic Living Donor Nephrectomy with Transvaginal-Natural Orifice Specimen Extraction (SLLDN TV-NOSE) used in our study were:

1. Patients are voluntarily willing to donate their kidney, hoping for minimal abdominal scarring;
2. The age range was determined based on previous literature where the minimum age was around marital age and no maximum age was imposed;[7–10]
3. Already given birth to a child; and
4. Patients having elastic and suitable diameter (7 cm) of vagina proven by gynaecologic exams.

We assessed the objective parameters including the patient demographics (gender, age, height, body mass index [BMI]), perioperative data (length of procedure, estimated blood loss and warm ischemic time [WIT]), postoperative data (length of hospital stay and visual analogue score [VAS]) and complications related to surgery (peri- and post-operatively). Donors were evaluated periodically after the surgery during the first 1 month, 3 months, 6 months, 1 year, and annually thereafter. The receiver of the kidney was also evaluated, especially for peri- and postoperative complications, graft function and post-implantation creatinine trends. Graft loss was defined as the loss of kidney function that occurred anytime post-transplantation due to either irreversible graft damage necessitating a return to dialysis, retransplantation (graft failure), graft removal, or recipient death with a functional kidney (patient death).[11] Acute rejection was defined as either biopsy-confirmed rejection or given antirejection therapy without a biopsy.[11]

The Female Sexual Function Index (FSFI) was collected from all patients who had undergone SLLDN TV-NOSE to evaluate the effect of transvaginal surgery on their sexual function, recorded 1 week before surgery and 3 months after the surgery. This tool is the most widely used to effectively measure the domains of sexual response according to criteria of both the Diagnostic and Statistical Manual of Mental Disorders, 4th edition (DSM-IV) and the 1st International Consensus Conference Guidelines on female sexual dysfunction. This tool consists of a 19-item questionnaire, with the FSFI full-scale score of 26.55 as the best cut-off score for distinguishing between women with and without sexual dysfunction.[12] We also collected the postoperative Surgical Satisfaction Questionnaire (SSQ-8) modified for SLLDN TV-NOSE. This questionnaire requires patients to use the Likert scale (1 - very satisfied; 5 - very dissatisfied) to evaluate their SLLDN TV-NOSE surgical experience based on eight areas: pain control experience both in hospital and home care, their recovery to daily activities, returning to work, get back to exercise, the surgical results, the possibility of making the same treatment decision again, and their likelihood of recommending SLLDN TV-NOSE to other potential kidney donors.[13] The raw SSQ-8 data were then normalised to determine the SSQ-8 score by scaling from 0 to 100 according to the patient's level of satisfaction.

*Pre-operative Preparations*

According to guidelines issued by the American Society of Transplant Physicians,[14] all the donors underwent extensive medical and psychological evaluations. A thorough laboratory evaluation was performed for histocompatibility testing to ensure that healthy donors retain normal renal function after nephrectomy. Standard blood tests included the ABO histocompatibility, HLA cross-matching, complete blood count (CBC), serum chemistry (including liver function tests) and coagulation profiles. Donors were also screened for viral exposure, including hepatitis profile and exposure to human immunodeficiency virus, cytomegalovirus, varicella, and Epstein-Barr virus. Urinalysis, urine culture and 24-hour urine collection analysis were performed to assess the urine protein levels and creatinine clearance. Female patients with age >40 needed to have a recent negative Pap smear and negative mammogram. Radiographic assessments were performed using computed tomography (CT) angiography to obtain a preoperative mapping of the number and location of main and accessory renal vessels (if any) to obtain safe hilar anatomy and minimize the risk of vascular complications. Patients were advised to maintain a clear liquid diet during the day before surgery without preoperative bowel preparation. Prior informed consent was obtained for each surgical approach, including transvaginal kidney extraction. Vaginal speculum examination is performed only in SLLDN TV-NOSE donors to determine pelvic space adequacy, continued with vaginal douching preoperatively.

**Intra-operative - Surgical Techniques**

*Standard Laparoscopic Living Donor Nephrectomy with Transvaginal-Natural Orifice Specimen Extraction*

Under general anaesthesia, the donor is positioned in a right lateral decubitus position with modified lithotomy of the left leg to facilitate specimen extractions (Figure 2). Four laparoscopic ports were inserted: the first camera port was established at the apex of the umbilicus, two additional ports were established at the lateral upper and lower abdomen, one additional port was placed in the midline below the umbilicus and just above the pubic symphysis under direct vision (using all 11 mm ports or two 11 mm plus 5 mm ports) (Figure 3A). Under direct vision, a 12 mm trocar was inserted through the posterior fornix of the vagina. A vaginal tube (diameter 4.5 cm) was then placed in this entrance site to facilitate the specimen extractions. Dissection was performed according to standard laparoscopic transperitoneal nephrectomy. The ureter was cut, and the kidney was freed from the surrounding attachment. The Endo CatchTM pouch (Medtronic, Dublin, Ireland) was inserted through the

**Table I: Demographic data of donors**

| Demographics | Surgery approach | | | | *p* value |
|---|---|---|---|---|---|
| | SLLDN TV-NOSE (n = 16) | Open LDN (n = 15) | RPLDN (n =12) | TPLDN (n = 10) | |
| Age (year) | 49.81 | 36.40 | 35.92 | 38.22 | 0.0007* |
| Gender (Male/Female) | 0/16 | 11/4 | 11/1 | 9/1 | 0.8333* |
| BMI (kg/m$^2$) | 24.87 | 25.72 | 24.17 | 23.42 | 0.5218* |
| ASA score, mean, range | 1.563 (1-3) | 1.400 (1 2) | 1.308 (1-2) | 1.444 (1 2) | 0.7131* |
| Multiple renal arteries, n (%) | 2 (12.5) | 2 (13.3) | 3 (25) | 1 (10) | 0.0014* |
| No complications after surgery, % | 100 | 100 | 100 | 90 | 0.1150* |

ASA indicates American Society of Anesthesiologists; BMI, body mass index; SLLDN TV-NOSE: Standard Laparoscopic Living Donor Nephrectomy with Transvaginal Natural Orifice Specimen Extraction; Open Living Donor Nephrectomy; TPLDN: Transperitoneal Laparoscopic Living Donor Nephrectomy; RPLDN: Retroperitoneoscopic Living Donor Nephrectomy; Open LDN: Open Living Donor Nephrectomy. Key: * – *p* value for Kruskal–Wallis test comparing four groups (SLLDN TV-NOSE versus Open LDN, RPLDN and TPLDN)

**Table II: Intraoperative characteristics**

| | SLLDN TV-NOSE (n = 16) | Open LDN (n = 15) | RPLDN (n =12) | TPLDN (n = 10) | *p* value |
|---|---|---|---|---|---|
| Operating time, min (range) | 216.3 (150 390) | 154 (115-190) | 173.8 (130 210) | 197.5 (120 270) | 0.0041* |
| Operative blood loss (mL) | 175.6 (50 500) | 182 (90 260) | 175.0 (100 250) | 215.5 (100 300) | 0.4080* |
| Warm ischaemia time (s) | 274 (120 450) | 231 (111 502) | 264 (126 732) | 251 (121 507) | 0.7226* |
| Bleeding requiring transfusion rate (%) | 0 | 0 | 0 | 0 | |
| Percentage of conversion rate to open surgery | 0 | N/A | 0 | 0 | |
| Intraoperative complications n (%) | | | | | |
| Vascular (aortic/lumbar vein/gonadal vein) injury | 0 | 0 | 0 | 0 | |
| Colonic/liver injury | 0 | 0 | 0 | 0 | |
| Splenic injury | 0 | 0 | 0 | 0 | |
| Pleural/lung injury requiring drainage | 0 | 0 | 0 | 1 (10) | |
| Total | 0 | 0 | 0 | 1 (10%) | <0.0001* |
| Postoperative complications | | | | | |
| Pulmonary | 0 | 0 | 0 | 0 | |
| Vascular | 0 | 0 | 0 | 0 | |
| Urological | 0 | 0 | 0 | 0 | |
| Wound infection | 0 | 0 | 0 | 0 | |
| Incisional hernia | 0 | 0 | 0 | 0 | |
| Chronic wound pain | 0 | 0 | 0 | 0 | |
| Total | 0 | 0 | 0 | 0 | N/A |
| Recipient complications, n (%) | | | | | |
| Overall ureteric complications | 0 | 0 | 0 | 0 | |
| Ureteric leak | 1 (6.25%) | 0 | 0 | 0 | |
| Ureteric stricture | 0 | 0 | 0 | 0 | |
| Total | 1 (6.25%) | 0 | 0 | 0 | <0.0001* |

Key: * – *p* value for Kruskal–Wallis test comparing four groups (SLLDN TV-NOSE versus Open LDN, RPLDN and TPLDN)

**Table III: Perioperative outcomes and graft function**

| | SLLDN TV-NOSE (n = 16) | Open LDN (n = 15) | RPLDN (n =12) | TPLDN (n = 10) | *p* value |
|---|---|---|---|---|---|
| Mean VAS score, mean (range) | | | | | |
| Day 1 | 2.1 (2 3) | 3.7 (2-6) | 2.1 (2 3) | 2.2 (2 3) | <0.0001* |
| Day 2 | 1.3 (1 2) | 2.5 (2-4) | 1.25 (1 2) | 1.8 (1 3) | <0.0001* |
| Day 3 | 0.68 (0 1) | 1.6 (1-3) | 0.75 (0 2) | 1 (0-2) | 0.0028* |
| Recipient discharge serum creatinine (mg/dL), mean (range) | 1.3 (0.79 1.98) | 2.1 (0.6-7.8) | 1.8 (0.5 5.1) | 1.7 (0.7 4.8) | 0.6857* |
| Mean of donor postoperative hospital stay (days) | 4.2 ± 1.18 | 6.1 ± 2.11 | 4.15 ± 1.14 | 5.6 ± 0.86 | 0.0025* |
| Acute rejection†, n (%) | 0 | 2 (13.3) | 0 | 2 (20) | <0.0001* |
| 1 year graft survival‡ (%, death-censored) | 100 | 93.3 | 100 | 100 | <0.0001* |

VAS indicates Visual Analog Scale; Key: † – Defined as either biopsy-confirmed rejection or given antirejection therapy without a biopsy. ‡ – Graft loss to determine the survival, was defined as the loss of kidney function that occurred anytime post-transplantation due to either irreversible graft damage necessitating a return to dialysis, retransplantation (graft failure), graft removal, or recipient death with a functional kidney (patient death). *– *p* value for Kruskal–Wallis test comparing four groups (SLLDN TV-NOSE versus Open LDN, RPLDN and TPLDN)

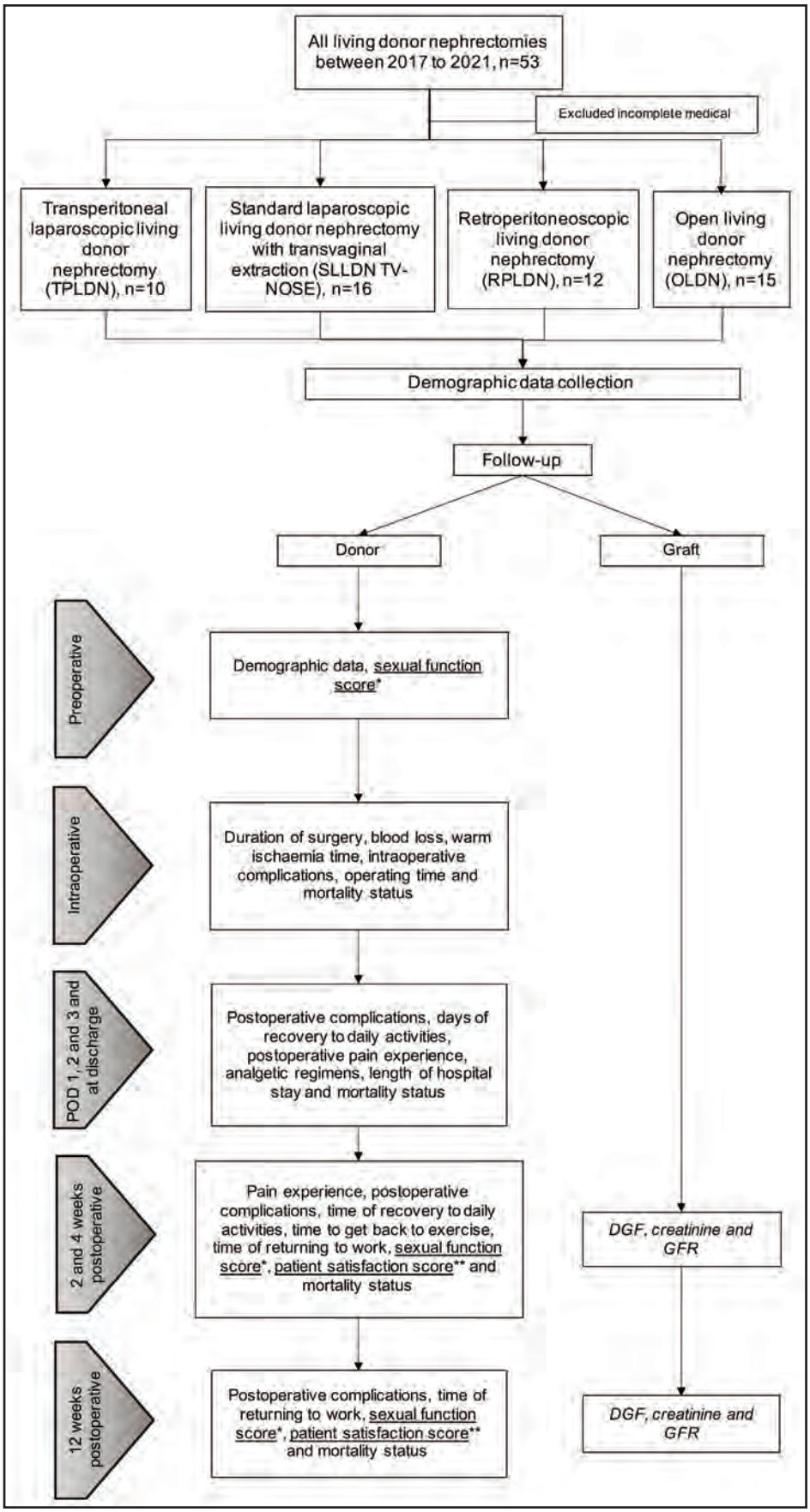


**Fig. 1:** Study design flow chart
Highlighted underlined texts: only performed in SLLDN TV-NOSE group; DGF delayed graft function; GFR glomerular filtration rate. *Assessed using the Surgical Satisfaction Questionnaire (SSQ-8) modified for SLLDN TV-NOSE. **Assessed using the Female Sexual Function Index (FSFI) score.

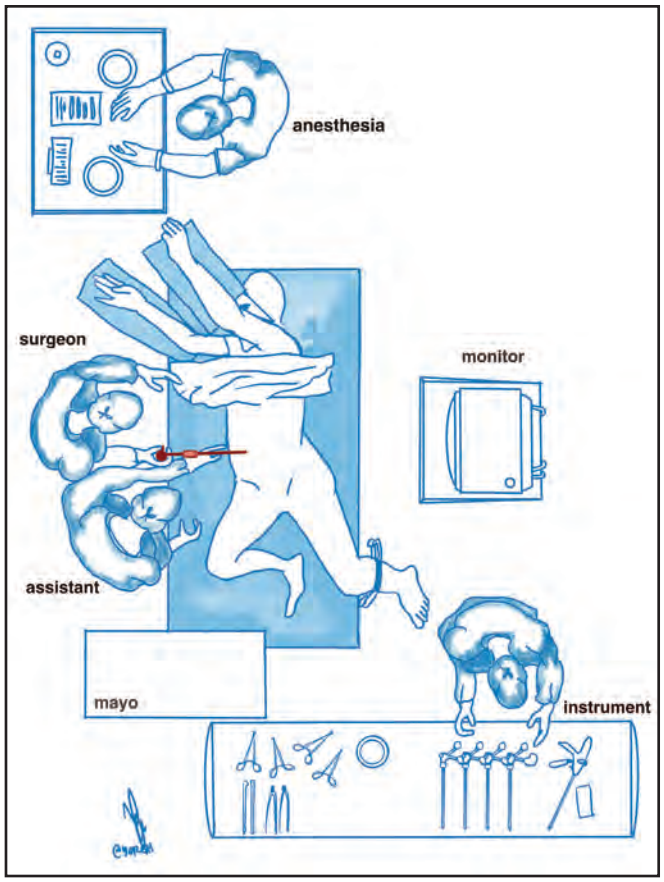


**Fig. 2:** Laparoscopic surgery personnel and operating room setup for Standard Laparoscopic Living Donor Nephrectomy with Transvaginal-Natural Orifice Specimen Extraction (SLLDN TV-NOSE) technique

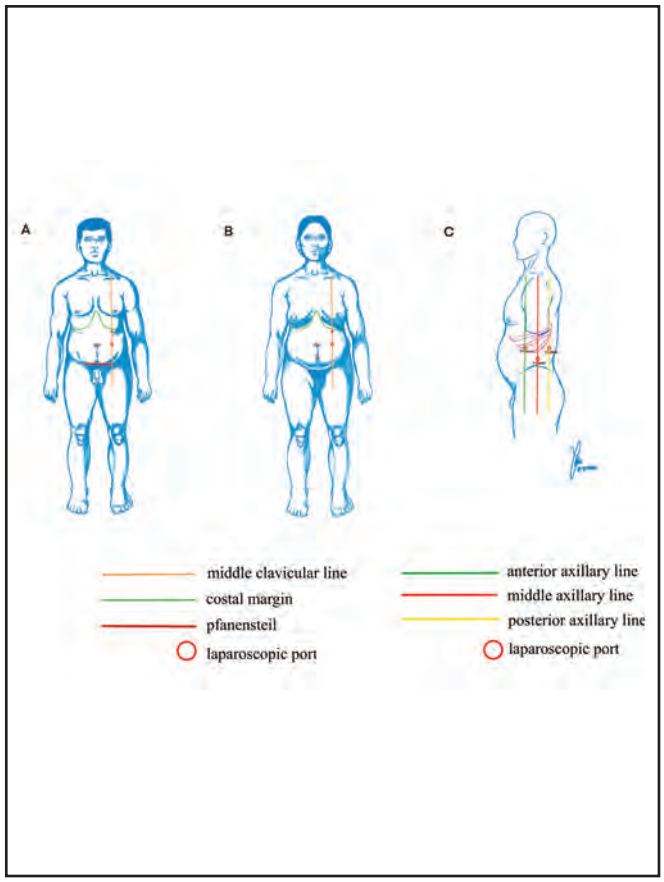


**Fig. 3:** Schematic laparoscopic ports access setup; (A) Standard Laparoscopic Living Donor Nephrectomy with Transvaginal-Natural Orifice Specimen Extraction (SLLDN TV-NOSE) technique; (B) Transperitoneal Laparoscopic Living Donor Nephrectomy (TPLDN); and (C) Retroperitoneoscopic Living Donor Nephrectomy (RPLDN)

vaginal tube. Preoperatively, we already made sure that the pouch is working properly and prepared to be completely open before vascular transection. The renal vessels were cut after double proximal clips' placement (Hem-o-lok, Teleflex, Wayne, PA, USA). The kidney specimen was extracted transvaginally using the Endo Catch™ pouch. The vaginal incision was sutured transvaginally under per speculum vision and interruptedly sutured through the entire thickness of the vaginal wall. A vaginal tampon was placed and maintained for 24 hours.

*Transperitoneal Laparoscopic Living Donor Nephrectomy*

Under general anaesthesia, the patient was positioned in lateral decubitus. The first camera port was established at the apex of the umbilicus. Three additional ports were established at lateral upper and lower abdomen under direct vision followed by insufflation of carbon dioxide up to 15 mm Hg (Figure 3B). The white line was opened, then the colon was moved towards the midline. On the left, the descending colon and spleen were assembled medially to improve the display of the whole kidney. A suprapubic transverse (Pfannenstiel) incision was made just before the vascular transection. After the dispensing access was ready, the renal vascular was clipped using the Hem-o-lok (Teleflex, Wayne, PA, USA). The kidney was then mobilised through the exit site. Abdominal wound closure was then performed.

*Retroperitoneoscopic Living Donor Nephrectomy*

Under general anaesthesia, the patient was placed in a lateral (right or left) lying position, with the operative bed was flexed to expand the space between the iliac crest and the costal margin. We made the small incision at the tip of the palpable 12th rib, and the retroperitoneal working space was developed using the modified balloon dilator inserted through this incision. Three 11 mm ports or two 11 mm and one 5 mm ports, were inserted. In some cases, an additional 5 mm port was inserted (Figure 3C). A Gibson incision was made just before the vascular transection. The Gerota's fascia was opened, and the kidney was dissected free from the surrounding tissue using a Harmonic Scalpel (Ethicon, Cincinnati, Ohio, USA) and LigaSure (Covidien, Boulder, CO, USA). The ureter was clipped and cut. The renal vessels were cut after being secured with a clip (Hem-o-lok, Teleflex, Wayne, PA, USA). The kidney was extracted through the Gibson incision.

*Open Living Donor*
The standard open donor nephrectomy was done through a flank incision with retroperitoneal access. The patient was placed in a full or half flank position. The incision was typically made at the intercostal between the 11th and 12th ribs and should not be longer than 12 cm. If necessary, it can be lengthened medially, as in the case of obese people. The renal artery was immediately ligated once it splits from the aorta. It was sewn or securely ligated across the remaining renal arterial trunk. The Satinsky clamp partially occluded the vena cava and the respective renal vein in the case of a suitably lengthy left or, more specifically, right renal vein. The vena cava was sown with non-resorbable sutures after the renal vein was transected. The muscle and fascia were carefully sewn layer by layer, and the skin incision was stitched intracutaneously.

*Postoperative Care*
Prophylactic drains were routinely maintained as least 24 hours postoperatively to ensure no post-operative complications such as active bleeding and to monitor the residual intraperitoneal fluid, but it should be removed no longer than 36 hours postoperatively to prevent surgical infection. We used epidural bupivacaine and an acetaminophen-based narcotic-free as the postoperative pain regimen. Most patients were discharged on the 4th day for laparoscopic donors. Vaginal packs were removed 24 hours postoperatively in SLLDN TV-NOSE donors.

*Outcome Parameters*
We collected data which may represent two main outcomes. The first was safety, indicated by blood-loss volume, WIT, surgery-related complications. The second was benefits or the efficacy, indicated by acute graft rejection and graft survival rate.

*Statistical Analysis*
Statistical analysis was done using SPSS version 13.0 (IBM Corp., Armonk, NY). One way ANOVA was performed on variables with parametric data. Kruskal Wallis test was used for those with non-parametric data. Post hoc analysis was performed using Bon Ferroni's test. The p-value of $< 0.05$ was considered statistically significant.

## RESULTS

*Patient Demographics*
Demographic data of all subjects are shown in Table I. The total number of SLLDN TV-NOSE was 16. The other approaches included for comparison in this study were open (15 cases), retroperitoneoscopic (12 cases), and transperitoneal (10 cases). The mean age of SLLDN TV-NOSE was older than the other groups, and this was statistically significant (49.8 years vs. 36.4 years vs. 35.9 years vs. 38.2 years, $p$=0.0007). The baseline data of the donor's BMI and preoperative ASA score did not differ among the groups. The number of renal arteries was estimated by 3-dimensional CT. Of the 53 patients, eight of them had multiple arteries. The differences in the number of renal arteries were significant among the groups, with three patients in RPLDN, two patients in both SLLDN TV-NOSE and open groups, and only one patient in TPLDN group. Complication-free rate differences were not significant among the groups.

*Intraoperative Donor Outcomes*
The overall operating time was significantly longer ($p$<0.0041) in the SLLDN TV-NOSE group than in the other three groups (Table II). However, blood loss and WIT did not differ among the groups. The intraoperative complications rate did not differ among the groups, with one case of hemopneumothorax in the TPLDN group. No patients needed transfusion due to severe bleeding nor a surgical conversion from the laparoscopic surgery. There were no postoperative complications that required further surgical interventions. The length of postoperative hospital stay was significantly shorter in the SLLDN TV-NOSE and RPLDN groups ($p$=0.0025).

*Perioperative Outcomes and Graft Function*
VAS scores at postoperative days 1, 2, and 3 are shown in Table III, with significant differences, especially between the laparoscopic and open LDN groups. There was a trend towards better scores on the patient-reported VAS score in the SLLDN TV-NOSE and RPLDN groups compared to the TPLDN and Open LDN groups, with no significant differences between the first two groups. There were no cases of delayed graft dysfunction in this series.

The recipient discharge serum creatinine did not differ among groups. The acute rejection rate was 13.3% and 20% in the Open LDN and TPLDN groups, respectively. There was no acute rejection case in the SLLDN TV-NOSE and RPLDN groups. The overall 1 year graft survival of 98% (52 of 53 patients) was significantly different among the groups. The causes of graft loss were early patient death with a functioning graft for one case in the open LDN group.

Surgical satisfaction and sexual function in SLLDN TV-NOSE
The SSQ-8 modified for SLLDN TV-NOSE score postoperatively was 88.17. The pre- and post-operative FSFI score was 25.35 and 24.52, respectively. The FSFI score pre-and postoperatively did not significantly differ ($p$=0.52).

## DISCUSSION

As part of the transplant surgery entity, nephrectomy for a living donor is considered one of the most demanding procedures because it is performed in a healthy individual rather than a sick patient.[15] Therefore, striving for the lowest potential morbidity without compromising graft function is mandatory.

The growing popularity of laparoscopic surgery throughout the world is making this technique begin to be widely used and become the current standard for nephrectomy donors. However, there are still several problems of traditional laparoscopic due to the requirement of the abdominal incision for specimen extraction. This increases the risk of complications of the abdominal wound and hinders post-operative recovery.[3] It also causes significant post-operative pain and aethetic problems.[4]

To counter the current problems and improve the surgical results, some surgeons have developed a new technique, the so-called NOSE surgery. This utilises an available natural orifice to facilitate specimen extraction from the body, thus

avoiding notable scars on the body's surface. Today, most NOSE procedures in urology use transvaginal routes, including nephrectomy donors. This can be explained by the following advantages[5]: (1) The risks of postoperative wound infection and leakage are lower due to less pathogenic bacteria and abundant blood supply in the vagina; (2) The vagina provides easy access to the peritoneal cavity, immediately entering the rectouterine pouch (pouch of Douglas) after accessing the posterior fornix; (3) The vaginal fornix mucosa has no somatic nerve sensation, thus minimising postoperative pain; (4) The vagina tissue has good flexibility and elasticity, which is suitable for the use of rigid instruments and beneficial during specimen extractions; (5) The vaginal incision can be done freely and safely, and then sutured under direct vision. Overall, patients may have benefited from superior psychological and cosmetic outcomes resulting in prompter recovery. It was in 2011 that the LLDN with transvaginal extraction was reported to be successfully accomplished.[6] Recently, this technique has been done in several other countries, such as Spain, Argentina, Italy, Turkey, and India. With the available literature, it is logical to assume that this technique can also be used in less developed regions because it only requires basic laparoendoscopic instruments.

Our study showed that comparing conventional laparoscopic and transvaginal extraction of nephrectomy donors has showed no significant difference in WIT and blood loss. Nevertheless, our WIT averaged 274 sec, which was longer than the other series, ranging from 165-220 sec.[7–9,16] A slightly longer period of warm ischemia is likely related to the early learning curve on laparoscopy but within limits that do not compromise the function of overall quality grafts, with a total ischemia time limit of 45 min.[17]

The SLLDN-TV NOSE has a slightly longer operating time than other groups, but the graft function showed no significant differences among the groups. Our initial experience showed that the mean operating time was 178 min. This was slightly longer than in the previous series by Kishore et al. (mean 155 min), Gurluler et al. (mean 156 min), and Karayagiz et al. (mean 150 min).[7–9] We assume the longer operating time is partly due to TV-NOSE surgery's single operator early learning curve. The SLLDN-TV NOSE was performed after the surgeon became more proficient in laparoscopic surgery and embarked upon further innovation. This procedure can be performed more effectively as the surgeon gets more proficient and gains more experience, as described by the improved duration of the last SLLDN-TV NOSE reaching statistical significance (first surgery vs. the 16$^{th}$, 200 vs. 175 min [$p$=<0.0001]). Older age of the patient also strongly predicts the surgical difficulties and may affect the operating time in minimally invasive surgery, and this study showed significantly older age in the SLLDN-TV NOSE group than in the others.[18] Other factors such as BMI and gender can also potentially predict surgical difficulties, but we found homogeneity among the population in this study.

The recipient creatinine values were similar after periodic follow-up, showing no increasing value over time. Similar result was seen in a retrospective review which showed no significant difference in mean recipient creatinine level.[7,9,16]

The donor complications were relatively acceptable, shown by the no differences among the groups while ascertaining the safety of the extraction technique for kidney viability. These results were comparable to the other series.[7,9,16] Literature records, although rare, the complications that may occur have consisted of intraoperative colonic injury and bladder injury, and postoperative fever and bleeding requiring transfusions.[19,20]

Although the majority of open nephrectomy living donations are associated with shorter operative time and WIT, laparoscopic nephrectomy could be beneficial for patients through a shorter hospital stay, better aesthetics and a prompter return to work without affecting graft function.[2] Recent advancements also introduced the retroperitoneoscopic approach, which has advantages, particularly in patients who have undergone previous transabdominal surgery or have a high BMI. Nevertheless, in certain circumstances where instinctive positioning from anatomical landmarks and a larger workspace is needed, the transperitoneal approach remains favourable to most surgeons.[21] Our study shows that RPLDN is superior compared to open LDN and TPLDN in terms of shorter length of stay and post-operative pain experience.

We only performed the nephrectomy on the left kidney for every SLLDN-TV NOSE procedure. This is based on the earlier published meta-analysis implying that the left kidney has superior early outcomes, with lower rates of delayed graft function, technical failure, and graft thrombosis,[22] which was validated by another, more recent meta-analysis.[23]

Specifically for the use of the vagina as the extraction specimen route, several points are essential to thoroughly consider its viability prior to the surgery and overcome the potential intraoperative problems. Rigorous vaginal exams, usually performed by gynaecologists in our centre, were done to assess the vaginal elasticity and distensibility. The diameter of the vagina is standardised to a minimal 7 cm to facilitate convenient and safe specimen extraction. This is important to prevent any possible complications related to surgery in the future, such as uterine bleeding due to varicose vascular injury. Another critical point is to keep the vaginal trocar inserted in the midline during trocar insertion to avoid uterine vessel injury. Also, using a digital extension of the vaginal incision is considered safe and effective during specimen extraction, without increasing the risk of surrounding tissue injury and more bleeding with instrumentation tissue cutting. It is also essential to monitor any active bleeding after trocar removal. Lastly, the vaginal closure is to be sutured entangling the entire thickness of the vaginal wall to achieve homeostasis. By adhering to the components of this algorithm, we have standardised our approach to selecting the patients, optimised our transvaginal specimen extractions, and minimising the possible problems. To date, no significant challenges were encountered.

A previous study involving high populous kidney donors revealed that most kidney donors were female, which was found more in developing regions, including our study.[24] Most of the women had aesthetic interests concerning the post-

operative wound, which can be solved with minimally invasive surgery as in the NOSE technique. Most donors in our study were satisfied with the NOSE surgery, shown by a good SSQ-8 modified score. The utilisation of the vaginal route for specimen extractions may raise concerns about sexual function after the surgery. However, our study showed that the surgery did not affect the women's sexual function, with the FSFI score showing no significant differences pre-and postoperatively. These results proved that transvaginal extraction of kidney specimens was safe and acceptable among women donors.

This study has several limitations. First this cohort represents a small window to the learning curve data of a single surgeon, which may not be generalisable to others. However, a single surgeon's experience can be considered to minimise surgical confounders' bias. Second, the patient data were obtained retrospectively, and selection bias could impact the results. Third, we employed the nonmatched comparison among the study groups. We have tried to include patients with similar demographic profiles, however, the number of kidney donors in our centre is still limited.

## CONCLUSION

This paper is the first to report our ongoing experience performing the Standard Laparoscopic Living Donor Nephrectomy With Transvaginal-Natural Orifice Specimen Extraction (SLLDN TV-NOSE) in Indonesia. This technique is evidently safe and feasible to be performed routinely in women living donors. It is also reproducible in developing regions as in our Indonesian centre. Despite taking longer operating time, the important perioperative variables and graft function are comparable between SLLDN TV-NOSE groups and conventional surgery. Promising results await in the future as the surgeon gains more proficiency and achieves a higher learning curve, in order to perform this technique more time-effectively. With the comparable graft function parameter and good postoperative satisfaction rate compared to conventional nephrectomy donors, SLLDN TV-NOSE can be considered as an excellent alternative to encourage more female donors. However, it is essential to select the patients carefully before surgery to minimise the complications. SLLDN TV-NOSE can not only be performed in developed countries with appropriate facilities but also in less-developed countries. Further studies are warranted to confirm our findings, since our data were collected retrospectively and only covered single-centre populations.

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## REFERENCES

1. Jensen KK, Krarup P-M, Scheike T, Jorgensen LN, Mynster T. Incisional hernias after open versus laparoscopic surgery for colonic cancer: a nationwide cohort study. Surg Endosc 2016; 30: 4469-79.
2. Tan YH, Lim YMJ, Ng YW, Tiong YH. Taking a step forward in laparoscopic donor nephrectomy: transvaginal retrieval of donor's kidney. J Laparoendosc Adv Surg Tech 2016; 26: 721-4.
3. Kayaalp C, Yagci MA. Laparoscopic right colon resection with transvaginal extraction: a systematic review of 90 cases. Surg Laparosc Endosc Percutan Tech 2015; 25: 384-91.
4. Hisada M, Katsumata K, Ishizaki T, Enomoto M, Matsudo T, Kasuya K, et al. Complete laparoscopic resection of the rectum using natural orifice specimen extraction. World J Gastroenterol 2014; 20: 16707-13.
5. Peterson CY, Ramamoorthy S, Andrews B, Horgan S, Talamini M, Chock A. Women's positive perception of transvaginal NOTES surgery. Surg Endosc 2009; 23: 1770-4.
6. Alcaraz A, Musquera M, Peri L, Izquierdo L, García-Cruz E, Huguet J, et al. Feasibility of transvaginal natural orifice transluminal endoscopic surgery–assisted living donor nephrectomy: is kidney vaginal delivery the approach of the future? Eur Urol 2011; 59: 1019-25.
7. Kishore TA, Shetty A, Balan T, John MM, Iqbal M, Jose J, et al. Laparoscopic donor nephrectomy with transvaginal extraction: initial experience of 30 cases. J Endourol 2013; 27: 136105.
8. Gurluler E, Berber I, Cakir U, Gurkan A. Transvaginal route for kidney extraction in laparoscopic donor nephrectomy. JSLS 2014; 18: e2014.00156.
9. Karayagiz AH, Erturk T, Cakir U, Berber I. Comparison of two different laparoscopic donor nephrectomy with vaginal extraction techniques—a single-center experience. Transplant Proc 2017; 49: 411-4.
10. Gundogan E, Kayaalp C, Gokler C, Gunes O, Bag M, Sumer F. Natural orifice specimen extraction versus transabdominal extraction in laparoscopic right hemicolectomy. Cir Cir 2021; 89: 326-33.
11. Fonseca I, Teixeira L, Malheiro J, Martins L. S, Dias L, Castro Henriques A, et al. The effect of delayed graft function on graft and patient survival in kidney transplantation: an approach using competing events analysis. Transpl Int 2015; 28: 738–50.
12. Meston CM, Freihart BK, Handy AB, Kilimnik CD, Rosen RC. Scoring and interpretation of the FSFI: what can be learned from 20 years of use? J Sex Med 2020; 17: 17-25.
13. Sardiwalla Y, Jufas N, Morris DP. Long term follow-up demonstrating stability and patient satisfaction of minimally invasive punch technique for percutaneous bone anchored hearing devices. J Otolaryngol - Head Neck Surg 2018; 47: 71.
14. Kasiske BL, Ravenscraft M, Ramos EL, Gaston RS, Bia MJ, Danovitch GM. The evaluation of living renal transplant donors: clinical practice guidelines. Ad Hoc Clinical Practice Guidelines Subcommittee of the Patient Care and Education Committee of the American Society of Transplant Physicians. J Am Soc Nephrol 1996; 7: 2288.
15. Liu N, Wazir R, Wang J, Wang KJ. Maximizing the donor pool: left versus right laparoscopic live donor nephrectomy—systematic review and meta-analysis. Int Urol Nephrol 2014; 46: 1511-19.
16. Eroğlu A, Şener C, Tabandeh B, Tilif S, Okçuoğlu Kadıoğlu Z, Kaçar S. Transvaginal laparoscopic donor nephrectomy. Transpl Proc 2013; 45: 881-2.
17. Khan TFT, Ahmad N, Serageldeen AS, Fourtounas K. Implantation warm ischemia time in kidney transplant recipients: defining its limits and impact on early graft function. Ann Transpl 2019; 24: 432-8.
18. Wang J, Yang B, Sun S, Zhang Y. Perioperative factors influencing the difficulty of retroperitoneal laparoscopic adrenalectomy: a single-center retrospective study. BMC Urol 2022; 22: 22.
19. Alcaraz A, Peri L, Molina A, Goicoechea I, García E, Izquierdo L, et al. Feasibility of transvaginal NOTES-assisted laparoscopic nephrectomy. Eur Urol 2009; 57: 233-7.
20. Georgiopoulos I, Kallidonis P, Kyriazis I, Adonakis G, Stolzenburg JU, Schwentner C, et al. Hybrid transvaginal nephrectomy: development of our technique. Urology 2014; 84: 99-104.
21. Tay WK, Kesavan A, Goh YSB, Tiong HY. Right living donor nephrectomies: retroperitoneoscopic vs laparoscopic transperitoneal approach. Transplant Proc 2018; 50: 2333-7.

22. Broudeur L, Karam G, Chelghaf I, De Vergie S, Rigaud J, Perrouin Verbe MA, et al. Feasibility and safety of laparoscopic living donor nephrectomy in case of right kidney and multiple-renal artery kidney: a systematic review of the literature. World J Urol 2019; 38: 919-27.
23. Carolan C, Tingle SJ, Thompson ER, Sen G, Wilson CH. Comparing outcomes in right versus left kidney transplantation: A systematic review and meta-analysis. Clin Transplant 2021; 35: e14475.
24. Bikbov B, Purcell CA, Levey AS, Smith M, Abdoli A, Abebe M, et al. Global, regional, and national burden of chronic kidney disease, 1990–2017: a systematic analysis for the Global Burden of Disease Study 2017. The Lancet 2020; 395: 709-33.