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Successful laparoscopic living donor nephrectomy: first experience in Lithuania

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Background. The aim of this paper is to share the initial results of LLDN in high-volume university centre that is performing laparoscopic nephrectomies for other indications**.**

Materials and methods. During 2017, four LLDNs were performed. The transperitoneal approach was used in all cases and the kidney was removed using a suprapubic incision. All donors and recipients were prospectively analysed within six-month follow-up. The patients' clinical, laboratory, and operation-related data were collected from direct interviews with them and from medical records. All patients signed written informed consent.

Results. One male and three females donated their left kidneys by using the LLDN technique. The mean age was 58 ± 9 years; two of them with a history of previous cholecystectomy. All donated kidneys had a single renal artery and renal vein. Pre-operative average eGFR was 94.2 ± 7.1 ml/min/1.73 m^2, immediately after LLDN 57.5 ± 10.3 ml/min/1.73 m^2, after one month 56.0 ± 9.1 ml/min/1.73 m^2. There were no intraoperative complications; surgery duration was 223.75 ± 21.74 min, the cold ischemia time was 77.5 ± 28.77 min, and the warm ischemia time 6.37 ± 3.14 min. There was one postoperative donor complication, one case of acute kidney injury, and one case of prolonged postoperative abdominal pain. The only recipient complication was one case of acute kidney rejection; there were no cases of delayed graft function.

Conclusions. Our initial experience confirms that LLDN is an approach that is easy to learn, especially in a high-volume university hospital with expertise in performing laparoscopic nephrectomies for other indications.

Keywords: laparoscopic nephrectomy, living donor, kidney transplantation, transperitoneal approach

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INTRODUCTION

End-stage renal disease (ESRD) is prevalent in 0.1% of population worldwide (1). There is no perfect renal replacement therapy method for ESRD, but a kidney transplant should be a treatment of choice for these patients. There is no doubt that a living donor kidney transplant is superior to a deceased donor kidney transplant. However, since 2005 only 99 living kidney transplants have been accomplished in Lithuania, 95 of them by using open donor nephrectomy (ODN) approach. The introduction of AB0 incompatible kidney transplant in our centre had only temporary beneficial effect in increasing the numbers of living kidney donations. We observed that the choice of the surgical technique might also play an important role for possible kidney donors before making the final decision (2).

Our high-volume university hospital is skilled in performing laparoscopic nephrectomies secondary to other pathologies (renal cell carcinoma etc.). Based on the experience of other centres, laparoscopic living donor nephrectomy (LLDN) was introduced in Lithuania in 2017. The intent of this publication is to evaluate whether the transition from ODN to safer LLDN will be complicated for our surgeons and share our insights regarding possible difficulties. In this report we review recently published articles about LLDN and present the first four cases of LLDN in Lithuania.

Laparoscopic living donor nephrectomy: outcomes

The postoperative period after LLDN is accompanied by a lesser intraoperative blood loss, a shorter hospital stay, and fewer scars (3) compared to ODN. LLDN should be the surgical technique of choice for living kidney extraction.

Regarding long-term outcomes of LLDN, there are several reports focusing on the quality of life, proteinuria rate, pregnancy, and hypertension. Bahler et al. (4) observed significant mental stress in LLDN compared to extirpative laparoscopic nephrectomy. On the contrary, Friedersdorff et al. (5) found an insignificantly milder fatigue syndrome in patients after LLDN compared to ODN. They also reported lower prevalence of proteinuria and no significant difference in newly diagnosed hypertension and pregnancy rates. A meta-analysis in 2013 (3) revealed that physical functioning but not physical or mental health favours LLDN versus ODN.

A large recent Swiss study (6) shared their experience about all types of living donor nephrectomies and showed a higher rate of severe complication in LLDN than in ODN according to Clavien-Dindo classification. However, the overall postoperative complication rate was similar in both groups and independent of the BMI (body mass index). It should be mentioned that in statistical analysis they included all LLDN techniques (fully laparoscopicnephrectomy, hand-assisted laparoscopic nephrectomy, retroperitoneoscopic nephrectomy) under one "laparoscopic" category.

LLDN causes postoperative pain and its management is still a matter of debate (7). Some reports claim that ODN is related to more severe pain than laparoscopic techniques (8–10). The others analysed patients diagnosed with renocelular carcinoma and showed no difference in postsurgical acute and chronic pain (11). Based on reports about low pressure pneumoperitoneum in laparoscopic cholecystectomy (12), Warle et al. (3) designed a randomized pilot study to test postsurgical pain in low pressure (7 mmHg) vs. normal-pressure (14 mmHg) pneumoperitoneum in LLDN. The results confirmed that low pressure penumoperitoneum leads to lower postoperative pain. Surprisingly, a later laparoscopic cholecystectomy review (14) doubted that there was a benefit in pain management by using different pressure of pneumoperitoneum.

Laparoendoscopic single-site donor nephrectomy (LESS-DN) (15), an alternative technique of LLDN, has some promising results regarding postoperative pain scores. However, there is still a lack of randomized controlled trials proving the superiority of LESS-DN over standard LLDN.

Laparoscopic living donor nephrectomy techniques

Several LLDN surgical methods have been proposed since the first procedure in 1995, which was performed using the transperitoneal technique (16). This includes retroperitoneal (17), hand-assisted transperitoneal (18), robotic-assisted nephrectomy (19). However, the so-called "pure" transperitoneal LLDN has been advocated to be superior over other methods in centres with laparoscopic experience.

In our centre, we used the transperitoneal approach when optic and working trocars were placed

in the pararectal line with one additional 5.5 mm more laterally located trocar for the assistant. This trocar served for kidney lateralisation during kidney mobilisation. ECHELON FLEX™ GST System (Ethicon Ltd., USA) was applied for the transection of the kidney vessel in all cases. The use of polymer ligating clips is regulated by the Food and Drug Administration (20) and is contraindicated for ligating the renal artery during laparoscopic donor nephrectomies. The graft was removed by using a specimen retrieval bag through a horizontal 5–6-cm Phannenstiel-type suprapubic incision.

The meta-analysis by Wang et al. (21) advocated the selection of the right side over the left side for LLDN. The main advantage in choosing the left kidney was a longer renal vein, but there was no significant difference in other outcomes, including the rate of the delayed graft function.

MATERIALS AND METHODS

In Lithuania, LLDN was introduced only in 2017. We report the primary results of four successful LLDNs performed at Vilnius University Hospital Santaros Klinikos. The transperitoneal approach was used in all cases; kidney were removed using suprapubic incision. All donors and recipients were prospectively analysed within six-month follow-up. The patients' clinical, laboratory, operation-related data were collected from direct interviews with them and from medical records. All patients signed written informed consent.

RESULTS

The donors' main characteristics are listed in Table 1. All donors underwent 223.75 ± 21.74 min duration left site LLDN with no intraoperative complications. The average cold ischemia time was 77.5 ± 28.77 min, and the warm ischemia time 6.37 ± 3.14 min. All donated kidneys had a single renal artery and vein. Normal-pressure pneumo-peritoneum (11–12 mmHg) was used. The donors' postoperative hospital stay ranged from five to six days.

We also evaluated biochemical parameters before and after surgery. Average preoperative creatinine level was 66.25 ± 7.45 mkmol/l, immediately after LLDN 104 ± 31.40 mkmol/l, and one month after LLDN 105 ± 23.50 mkmol/l (Fig. 1).

Table 1. Baseline demographic characteristics of the living donors

No.	Donor sex	Age before LLDN	Kinship	Comorbidities	Prievious surgeries
1st	Female	51	Wife	–	–
2nd	Female	57	Mother	Nonallergic bronchial asthma	Cholecystectomy Hysterectomy
3rd	Male	54	Father	Dyslipidemia	–
4th	Female	71	Mother	–	Cholecystectomy Open appendectomy

LLDN – laparoscopic living donor nephrectomy

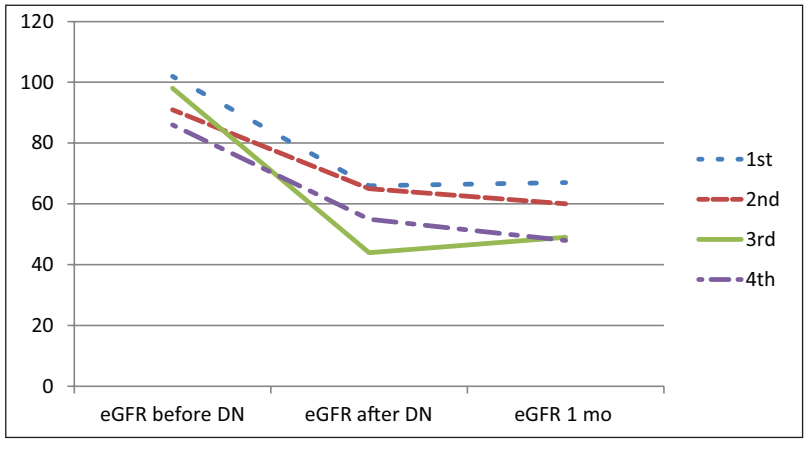

Fig. 1. eGFR values before and after living donation. Blue line – 1st donor, red line – 2nd donor, green line – 3rd donor, purple line – 4th donor; DN – donor nephrectomy; mo – month

The eGFR was calculated by using CKD-EPI equation (22) (Fig. 1). The third donor developed stage 2 acute kidney injury based on the Acute Kidney Injury Network (AKIN) postoperative creatinine doubling criterion (23).

One of the donors reported weak post-operative abdominal pain not requiring repeated hospitalization.

The main characteristics of kidney transplant recipients (KTR) after LLDN are presented in Table 2. All recipients had more than 500 ml of daily diuresis. Two kidney transplantations were performed for pre-emptive transplant recipients. All recipients had HLA 3 mismatch and received tacrolimus, methylprednisolone, and mycophenolate mofetil-based immunosupression regimen after kidney transplantation. Only one recipient received basiliximab (simulect) for induction immunosuppression therapy.

There were no cases of delayed graft function among kidney graft recipients. The creatinine levels and eGFR levels decreased significantly after the transplantation (Fig. 2). No single pattern in plasma tacrolimus concentration in posttransplant period was observed.

It should be noted that the second kidney graft recipient (preemptive) experienced atypical haemolytic uremic syndrome and kidney transplant injury. Thankfully, it was timely diagnosed and treated.

Table 2. Baseline characteristics of recipients for LLDN-derived kidney

Donor No.	KTR age (y)	KTR sex	The cause of CKD	Dialysis	Previous surgeries	Comorbidities
1	55	Male	Polycystosis	no	Anterior communicating artery aneurism surgery	Status post subarachnoid haemorrhage
2	30	Female	Kidney dysplasia	no	–	Cholelithiasis
3	21	Female	FSGS	HD	–	–
4	38	Female	Diabetic nephrophaty	PD	Coronary artery bypass surgery	Status post myocardial infarction. Chronic pancreatitis

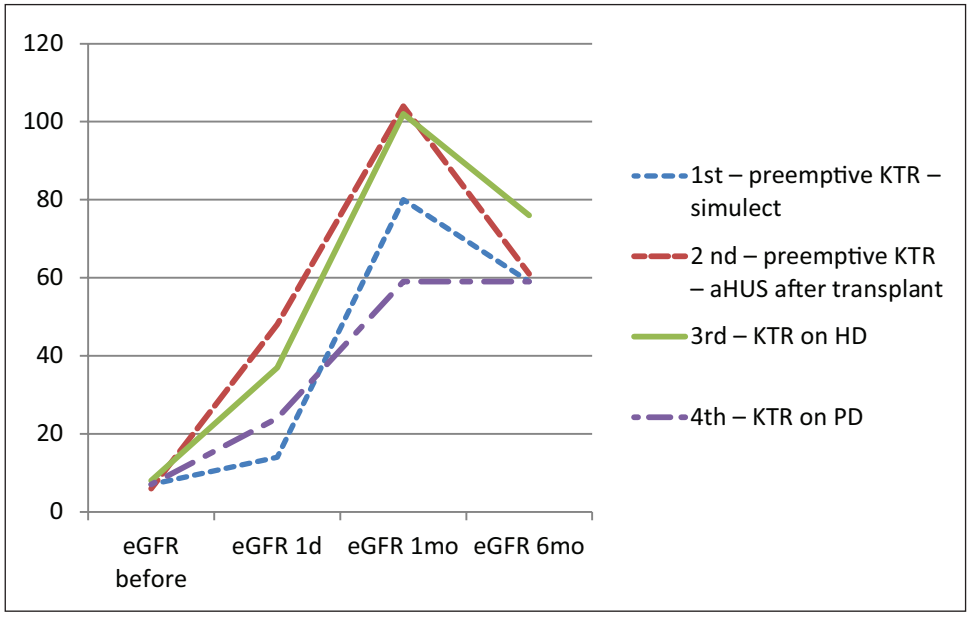

Fig. 2. eGFR values of kidney transplant recipients. Blue line – 1st recipient, red line – 2nd recipient, green line – 3rd recipient, purple line – 4th recipient; mo – month; d – days

DISCUSSION

According to the data of the National Transplant Bureau in Lithuania, there are 153 patients on the kidney transplant waiting list (24), or 53.7 registrations for kidney transplantation per million population (pmp). After the successful introduction of AB0 incompatible kidney transplantation in Lithuania in 2010, the number of living donations slightly improved and reached 3.9 living kidney graft transplantations pmp in 2012. However, despite all the efforts of optimizing our living kidney donor programme, a dramatic decrease in living donation was observed over the last few years, reaching 2.1 living donations pmp. Compared to other European countries it is the lowest rate of living donor kidney transplantations along with Poland, Belarus, Bulgaria, Romania, Croatia, Bosnia and Hercegovina, and Ukraine (25).

The unwillingness of local dialysis centres to educate patients with ESRD about the benefits of kidney transplantation, the fear of the feeling of debt for a kidney received from a living donor, and religious believes can only partially explain such "unpopularity" of living kidney donation in Lithuania. Given that before 2016 we performed only ODN, the main concerns of possible living donors were the recovery time and flank pain after kidney nephrectomy. Unfortunately, there is no registry of the trends of surgical living kidney harvesting techniques in Europe. To our knowledge, this issue was covered in at least two reports. Klop et al. (26) surveyed several European transplant centres and compared the progress of living donor nephrectomy techniques from 2004 to 2009. They found out that 31 centres used ODN technique only and 16 of them had never tried LLDN. The two main reasons named for not keeping up with a newer approach were a lack of evidence of superiority of LLDN over ODN and the evolution of ODN. The other report by Lennerling et al. (27) in 2013 revealed that ODN was prevalent in 31 (20.18%) of 109 European transplant centres (including Lithuania); the LLDN approach was popular in 71 centres. Based on our experience, initially the surgeons were sceptical about the new laparoscopic technique for living donor nephrectomy. They doubted the safety and advantages of LLDN. However, the stagnation in living donor management contributed to low rates of living donor transplantations in Lithuania. Thankfully, the motivation of some younger colleagues helped to easily implement LLDN at our centre.

The first cases of LLDN resulted in a shorter hospital stay and minor cosmetic defects. One case of weak postoperative abdomen pain might be particularly caused by a longer operating room time and pneumoperitoneum. Research from the USA (28) showed that operating room time significantly decreased with accumulation of skills when using LLDN (from 227 ± 58 min to 205 ± 42 min) in comparison to ODN (234 ± 612 min), especially in the cases with single renal arteries. Regarding pneumoperitoneum, some papers on abdominal and shoulder pain after cholecystectomy (29) or hysterectomy (30) reported a beneficial effect of lower intraabdominal pressure (≤8 mmHg). In comparison to LLDN, the mean operating room time for laparoscopic cholecystectomy is less than 60 min and for laparoscopic hysterectomy around 70–110 min. The intraabdominal pressure used in our four cases was 11–12 mmHg. Together with approximately 2.5 h surgery time, it possibly resulted in higher residual carbon dioxide pneumoperitoneum under the diaphragm. Whether a lower intraabdominal pressure results in lesser postoperative pain in LLDN still needs to be studied.

Our initial experience confirms that LLDN is an approach which is easy to learn, especially in a high-volume university hospital with expertise in performing laparoscopic nephrectomies for other indications. Therefore we would like to encourage the centres that are still performing open living donor nephrectomies to introduce laparoscopic method into their everyday practice. We believe that changing the nephrectomy technique could increase the numbers of living donation in the centre.

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CONFLICT OF INTEREST STATEMENT

On behalf of all authors, the corresponding author states that there is no conflict of interest.

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SĖKMINGAS LAPARASKOPINĖS GYVO DONORO NEFREKTOMIJOS PRITAIKYMAS. PIRMOJI PATIRTIS LIETUVOJE

Santrauka

Tikslas. Pasidalyti gyvo donoro laparaskopinės nefrektomijos (GDLN) patirtimi didelėje universiteto ligoninėje, kurioje įprastai laparaskopinės nefrektomijos atliekamos dėl kitų priežasčių.

Darbo metodika. 2017 m. buvo atliktos 4 GDLN. Naudota transperitoninio priėjimo prie donoro inksto operacinė metodika; inkstas buvo išimamas atlikus viršgaktinį pjūvį. Šešių mėnesių stebėjimo laikotarpiu atlikta visų inksto donorų ir recipientų perspektyvi analizė. Pacientai buvo apklausti, analizuota medicininė dokumentacija: surinkti klinikiniai, laboratoriniai ir su operacija susiję duomenys. Visi pacientai pasirašė sutikimo formą, kad jų duomenis būtų galima naudoti mokslo tikslams.

Rezultatai. Vienas vyras ir trys moterys donavo kairį inkstą pasirenkant GDLN metodiką. Vidutinis donorų amžius 58 ± 9 metai, du iš jų jau buvo patyrę cholecistektomijos operaciją. Visi donuoti inkstai turėjo po vieną inkstų arteriją ir vieną veną. Prieš operaciją vidutinis donorų eGFG buvo 94,2 ± 7,1 ml/min/1,73 m^2, iš karto po GDLN – 57,5 ± 10,3 ml/min/1,73 m^2, po vieno mėnesio – 56,0 ± 9,1 ml/min/1,73 m^2. Per operacijas donorai nepatyrė komplikacijų, operacijos trukmė – 223,75 ± 21,74 min., šaltos išemijos laikas – 77,5 ± 28,77 min., šiltos išemijos laikas – 6,37 ± 3,14 min. Pooperacinės donorų komplikacijos: vienam pacientui – ūminis inkstų pažeidimas; vienam – užtrukęs pooperacinis pilvo skausmas; recipientų komplikacijos – viena ūminė transplantuoto inksto atmetimo reakcija. Nebuvo nei vieno uždelstos transplantuoto inksto veiklos atvejo.

Išvados. Mūsų pirma patirtis patvirtina, kad GDLN yra nesudėtingas greitai išmokstamas donorinio inksto pašalinimo metodas, ypač centruose, kuriuose įprastai laparaskopinės nefrektomijos atliekamos dėl kitų priežasčių.

Raktažodžiai: laparaskopinė nefrektomija, gyva donorystė, inksto transplantacija, transperitoninė metodika