

# Attitudes Among Surgeons Towards Live-Donor Nephrectomy: A European Update

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**Background.** The increasing number of living kidney donors in the last decade has led to the development of novel surgical techniques for live-donor nephrectomy. The aim of the present study was to evaluate the current status of the surgical approach in Europe.

**Methods.** A survey was sent to 119 transplant centers in 12 European countries. Questions included the number of donors, the technique used, and the acceptance of donors with comorbidities.

**Results.** Ninety-six centers (81%) replied. The number of living donors per center ranged from 0 to 124. Thirty-one institutions (32%) harvested kidneys using open techniques only. Six centers (6%) applied both endoscopic and open techniques; 59 centers (61%) performed endoscopic donor nephrectomy only. Lack of evidence that endoscopic techniques provide superior results was the main reason for still performing open donor nephrectomy. In seven centers, a lumbotomy is still performed. Seventy-two centers (75%) accept donors with a body mass index of more than 30 kg/m<sup>2</sup>, the median upper limit in these centers was 35 kg/m<sup>2</sup> (range, 31–40). Donors with an American Society of Anesthesiologists classification higher than 1 were accepted in 55% of the centers.

**Conclusions.** Live kidney donation in general and minimally invasive donor nephrectomy in particular are more commonly applied in Northern and Western Europe. However, a classic lumbotomy is still performed in a minority of centers. Because minimally invasive techniques have been proven superior, more attention should be given to educational programs in this field to let many kidney donors benefit.

**Keywords:** Living donors, Laparoscopic donor nephrectomy, Open donor nephrectomy, Survey, Surgical technique, Kidney transplantation.

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Live-donor kidney transplantations have stabilized waiting lists for kidney transplantation in some countries in Western Europe. As long as the rate of deceased donation does not change, increasing the number of live donors is the most realistic option to further reduce the number of patients awaiting kidney transplantation. In the Eurotrans-

plant countries, the number of live-donor nephrectomies increased from 864 in 2005 to 1262 in 2010 (1, 2). The excellent results achieved with various minimally invasive variations of laparoscopic donor nephrectomy (LDN) form the base of this increase. With the introduction of these techniques, recovery is fast, and quality of life of the live donor has been improved significantly. These surgical approaches include the retroperitoneoscopic technique with and without hand assistance (3, 4), the fully laparoscopic techniques, and the modified open donor nephrectomy using mini-incision techniques (5–7).

In 2006, we published the results of a survey on live-donor nephrectomy in 12 countries in Northern and Western Europe. We evaluated the status of the surgical approach as of 2004 (8) and observed a great variation in the technique preferred within and between European countries. One of the most important reasons for still performing the open donor nephrectomy (ODN) was the assumed lack of evidence showing the superiority of LDN over ODN. Since then, a number of randomized studies have been published demonstrating the superior results of LDN with regard to pain, postoperative recovery, and quality of life (9–11). Some safety issues were mentioned as arguments against the introduction of new techniques. The aim of this study was to assess the current status of the surgical approach in Europe and evaluate the changes since 2004.

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## RESULTS

We received 97 replies (82%). One center expressed unwillingness to cooperate. Therefore, these results are based on 96 replies received from 12 countries. Surgeons who responded and stated their name at the end of the questionnaire were included in the acknowledgments with their affiliations.

### Number of Transplantations

Figure 1 shows the case volume of the responding centers in 2004 and 2009. In 2009, 2824 live-donor kidney transplantations were carried out in the 12 aforementioned countries. The responding centers were responsible for 2516 (89%) of these transplantations. In these 12 countries and the rest of Europe, 3589 live-donor nephrectomies were performed. The responding centers accounted for 70% of these procedures (12). The median number of live-donor kidney transplantations per center in 2009 was 20 (range, 0–124). With regard to the annual number of live-donor kidney transplantations in the last 5 years, 6% reported a decrease, 33% reported no changes, and 61% reported an increase. The median increase in this last group was 50% (range, 2%–400%). Ninety-two percent of the centers had a registry of live-donor nephrectomies.

The responding centers performed 6039 transplantations with kidneys originating from deceased donors in 2009. The median percentage of live-donor kidney transplantations of the total number of kidney transplantations per center was 26% (range, 0%–82%). This percentage was below 10% in 18 centers (19%), between 10%–25% in 27 centers (28%), between 25%–50% in 44 centers (46%), and more than 50% in seven centers (7%).

### Open Donor Nephrectomy

Thirty-seven centers (39%) reported to perform ODN. Thirty-one of these centers used open techniques exclusively. These 31 centers were responsible for 482 live-donor nephrectomies, nineteen percent of all live-donor nephrectomies performed by the reporting centers. The median number of live-donor nephrectomies per center in this group was 10 (range, 0–82). Sixteen of these clinics had never tried a laparoscopic technique for live donation for reasons summa-

**TABLE 1.** Reasons for centers to stick to open donor nephrectomy

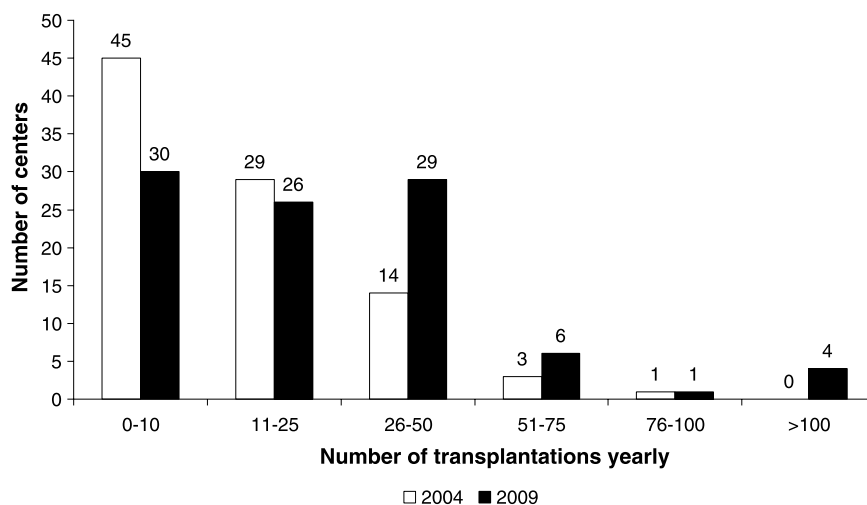
Reasons for	No. times mentioned (%)
Centers never performing LDN (n=16)	
Lack of evidence that LDN is better	9 (56)
Evolution of ODN	4 (25)
Other techniques hard to learn	1 (6)
Safety	1 (6)
Costs	1 (6)
Other reasons	4 (25)
Centers performing LDN simultaneously or in the past (n=21)	
Lack of evidence that LDN is better	7 (33)
Evolution of ODN	7 (33)
Other techniques hard to learn	2 (10)
Safety	4 (19)
Costs	0
Other reasons	4 (19)

LDN, laparoscopic donor nephrectomy; ODN, open donor nephrectomy.

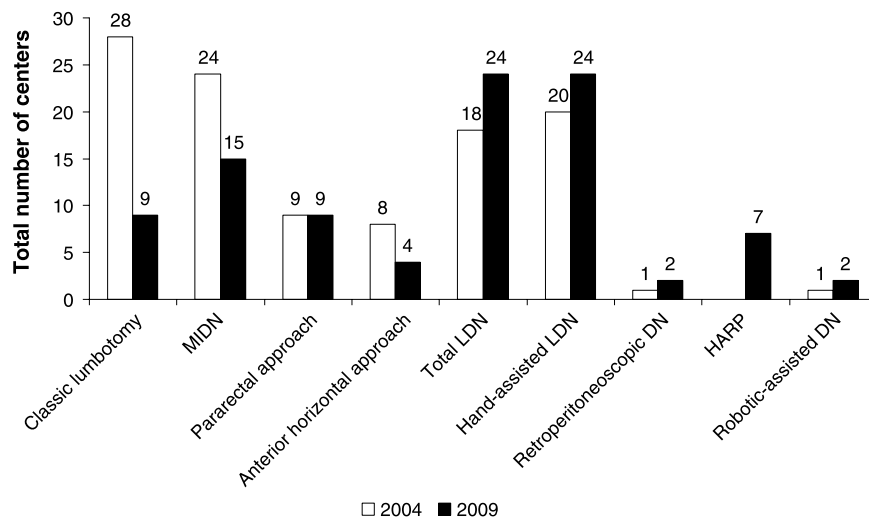
rized in Table 1. Lack of evidence that LDN was superior seemed to be an important reason to still prefer ODN. The other 15 centers had practiced endoscopic techniques in the past. The main reasons to perform ODN were the evolution of this technique in the center, safety, and lack of evidence that LDN was superior. In 7 of the aforementioned 31 centers, a lumbotomy was still performed. In six centers, ODN and endoscopic techniques were used simultaneously, although ODN was preferred in these centers. The main reason to choose for an open approach in these clinics was also lack of evidence that LDN was superior.

### Techniques of ODN

The preferred techniques used by the responding centers in both 2004 and 2009 are displayed in Figure 2. Classic lumbotomy was defined as a 15–20 cm loin incision. A mini-incision donor nephrectomy was defined as a small flank



**FIGURE 1.** Case volume in responding centers in 2004 and 2009.



**FIGURE 2.** Preferred techniques in the responding centers in 2004 and 2009. DN, donor nephrectomy; HARP, hand-assisted retroperitoneoscopic donor nephrectomy; LDN, laparoscopic donor nephrectomy; MIDN, mini-incision donor nephrectomy.

incision varying from approximately 7 cm in lean donors to 15 cm in obese donors. A fourth option was the pararectal vertical skin incision.

#### Incisional Hernias and Incision Length

Incisional hernias were reported after all types of incision. Twelve centers in total reported to encounter incisional hernias. Two centers reported incisional hernias in 1% of the cases, three centers reported 2%, one center reported 3%, four centers reported 5%, and two centers reported an incisional hernia rate of 10%. The median incision length for classic lumbotomy was 14 cm (range, 11–20 cm). Median incision lengths for mini-incision donor nephrectomy, transverse, and vertical incisions were 10 cm (range, 7–15 cm), 17.5 cm (range, 15–20 cm), and 9 cm (range, 7–18 cm), respectively. Median incision length in both the groups with and without hernias was 10 cm ( $P=0.847$ ).

#### Laparoscopic Donor Nephrectomy

Fifty-nine centers (61%) reported to prefer endoscopic techniques for donor nephrectomy; the preferred techniques used by these centers are displayed in Figure 2. These centers were responsible for 1853 live-donor nephrectomies, 74% of all live-donor nephrectomies performed by the reporting centers. The median number of live-donor nephrectomies per center in this group was 26 (range, 0–124). This median was significantly higher than the median number of live-donor nephrectomies per center in the group of centers performing only open techniques ( $P<0.001$ ). Five of these centers started their laparoscopic program in 2010; and one center, in 2011. Therefore, data on numbers were available from 53 centers. In 2009, 22 centers performed 20 or less procedures, 7 centers performed between 21 and 30 procedures, 8 centers performed 31 to 40 procedures, 5 centers performed 41 to 50 procedures, and 11 centers performed more than 50 laparoscopic procedures.

#### Experience

Seven centers (12%) performed less than 25 laparoscopic procedures up to and including 2009. Eight centers

(14%) performed 25 to 50 procedures, 7 centers (12%) performed 50 to 100 procedures, 10 centers (18%) performed 100 to 200 procedures, and 25 centers (44%) performed more than 200 procedures; 2 centers did not report on this item. Twenty-four centers (41%) had introduced laparoscopic techniques to their transplantation programs since 2005. Thirty-seven centers (63%) stated that the introduction of laparoscopic techniques may have attributed to an increase of live kidney donation.

#### Instruments, Extraction Site, and Conversion Rate

In three centers, titanium clips were used to secure the renal vessels; in nine centers, self-locking clips were used; and in 43 centers, an endostapler was used. The remaining centers used a combination of these three tools. For extraction of the kidney, 40 centers (69%) used a Pfannenstiel incision. Other common extraction sites were subumbilical and anterolateral. Only two centers used a midline incision for kidney extraction. In 13 centers, an endoscopic procedure was converted to an open nephrectomy. The median conversion rate was 2% (range, 1%–7%). The median case volume in centers that converted one or more procedures in 2009 was significantly higher than centers that did not, 44 (range, 7–115) and 20 (range, 0–104) ( $P=0.006$ ), respectively. There was no significant difference in years of experience between centers that did and did not convert ( $P=0.933$ ).

#### Right-Sided LDN and Hand Assistance

Eight centers (14%) performed left-sided LDN only. The median percentage of right-sided LDNs in the remaining centers is 27% (range, 2%–98%). Indications for right-sided donor nephrectomy are summarized in Table 2. No relation was assessed between performing only left-sided LDN and years of experience ( $P=0.059$ ) or case volume ( $P=0.091$ ). Thirty-three centers (56%) used some form of hand assistance during LDN; reasons for hand assistance are stated in Table 2. No relation was found between the use of hand assistance and years of experience ( $P=0.247$ ) or case volume ( $P=0.533$ ).

**TABLE 2.** Indications for right-sided laparoscopic donor nephrectomy and reasons for hand assistance

Indication for	No. times mentioned (%)
Right-sided endoscopic DN (n=51)	
Multiple vessels on the left side	43 (84)
Dependent on split function/kidney size	34 (66)
Easier anatomy on the right side	27 (53)
Stenosis right renal artery	22 (43)
Always right side	3 (6)
Individual decision of surgeon	1 (2)
Hand-assisted endoscopic DN (n=33)	
Shorter operation time	16 (48)
Shorter warm ischemia time	10 (30)
Easier than traditional LDN	9 (27)
Safer with hand assistance	7 (21)
Donor/surgeon dependent	3 (9)
Learning LDN setting	2 (6)
Other	2 (6)

DN, donor nephrectomy; LDN, laparoscopic donor nephrectomy.

### Comorbidities

Seventy-two centers (75%) accepted donors with a body mass index (BMI) above 30 kg/m<sup>2</sup>. Twenty-eight centers had no specific upper limit because individual donor selection was at the discretion of the operating surgeon. In the remaining 44 centers, the median upper limit was 35 kg/m<sup>2</sup> (range, 31–40). Eighty of the responding 96 centers (83%) accepted donors with hypertension. Donors with an American Society of Anesthesiologists classification higher than 1 were accepted in 55% of the centers.

### Developments

The percentage of centers using endoscopic techniques only increased from 45% in 2004 to 61% in 2009. The percentage of centers using open techniques only decreased from 55% in 2004 to 33% in 2009. The number of centers performing a classic lumbotomy decreased from 28 (30%) to 9 (9%). In 2004, 21 (51%) of 41 centers used some form of hand assistance during donor-nephrectomy; in 2009, this increased to 33 (56%) of 58 centers. In 2004, 20 (49%) of 41 centers believed that the introduction of endoscopic techniques led to an increase of live kidney donors. Currently, 37(63%) of 59 centers think that the introduction of endoscopic techniques led to an increase of live kidney donation. The number of centers restricting LDN to the left kidney decreased from 12 (29%) to 8 (14%).

### Matching Centers

In the study published by Kok et al. (8) in 2006, the results were based on the replies from 92 different centers from 12 countries. Four of these centers no longer performed live kidney donation or merged with other centers by 2009. In the current study, we received 71 replies from the 88 remaining centers (81%). In these centers, the number of live-donor kidney transplantations increased from 1169 (81% of the total number operated on in these 12 countries) in 2004 to 1920 (73%) in 2009. There was a significant increase in the median number of endoscopic donor nephrectomies per cen-

ter in 2009 when compared with 2004, 11.5 and 18 ( $P=0.028$ ), respectively. The percentage of centers restricting LDN to the left side decreased from 32% in 2004 to 6% in 2009 ( $P=0.002$ ). There was no significant difference in the percentage of centers using hand assistance, 48% in 2004 and 58% in 2009 ( $P=0.184$ ).

## DISCUSSION

The results of this survey confirm the increase of live-donor kidney transplantations in Northern and Western Europe; more transplant centers are performing more live-donor nephrectomies per year. Most transplant centers stated that this increase may partially be because of the introduction of laparoscopic techniques; this is confirmed by a significant difference in median case volume between centers performing only open and only endoscopic techniques. The number of centers performing LDN and its variants has increased since 2004. A minority of the centers decided not to adopt minimally invasive endoscopic techniques. In the last 5 years, a decrease of centers performing a classic lumbotomy can be noted.

The most important reason to choose for an open approach was lack of evidence favoring LDN. This finding is surprising because recent randomized trials have shown a shorter convalescence time, less pain, and better quality of life after LDN when compared with ODN (9–11). Regarding safety and graft function, no significant differences were found between these techniques. Recently a Cochrane review was published, confirming the results of these randomized trials. If the learning curve can be safely passed, LDN offers significant advantages (13). The results of these trials show that benefit is to be gained by expanding the use of minimally invasive techniques. Another important argument provided by transplant centers that favor ODN is the evolution of this technique in their center. Two recent meta-analyses provided evidence that LDN may even be preferred over mini-incision techniques (14, 15). However, we would rather recommend a shift from classic lumbotomy to one of the less invasive open techniques than advocate that all donors should be operated on laparoscopically. In our opinion, the benefit of mini-incision techniques over conventional open approaches is larger than the benefit of LDN over mini-approaches. However, the mini-incision techniques are harder to learn than (hand-assisted) laparoscopic techniques for the currently trained generation of surgeons and urologists. Therefore, investing time and money to incorporate (hand-assisted) LDN in the donation program may show to be beneficial for donors, hospitals, and society.

The number of centers reporting on incisional hernias and the reported rate may be an underestimation. Donors do not necessarily return to the transplantation center to undergo a correction for an incisional hernia. Furthermore, duration of follow-up may differ between transplantation centers. However, incisional hernia rates after transverse incisions of the abdomen have been reported to be low (16).

Remarkably, 9 (15%) of the 59 centers performed endoscopic donor nephrectomy using self-locking clips for renal arterial control. A nationwide class II recall of the Hemo-lok locking clip by the Food and Drug Administration in the United States was issued in 2009 (17), that is, before the survey. However, hemorrhagic deaths of live kidney donors

from the failure of these clips have been reported before then (18). The use of these clips to secure the renal artery, in contradiction to Food and Drug Administration recommendations, is a major concern. The use of self-locking clips should be avoided to maximize donor safety.

This survey shows that approximately 54% of all centers use hand assistance; this is comparable with the latest report from the United States (19). The most important arguments for using hand assistance concerned reduction of the operating time, warm ischemia time, and increased safety and control. These arguments confirm that hand-assisted LDN is not only used during the learning phase of LDN but has also become a true alternative with similar outcomes (20). Our results confirm this because there was no relation between the use of hand assistance and years of experience or case volume. To date, little evidence supporting either hand-assisted LDN or total LDN has been published. These current data indicate that the superior technique for kidney donation is still open for discussion, and randomized controlled trials are needed to define the most appropriate approach that will optimize the safety and comfort of donors.

LDN is restricted to the left kidney in 14% of the centers. A significant increase in centers performing right-sided LDN was observed; in these centers, approximately one-third of all donor nephrectomies are right-sided. Indications for right-sided LDN were related to donor anatomy or split function. No centers mentioned shorter vessel length or renal vein thrombosis as reasons to prefer the left kidney over the right. Three centers always perform a right-sided donor nephrectomy when possible. These changes may reflect the effect of recent publications describing the feasibility and the superiority of right-sided LDN (21, 22). The results of this survey demonstrate that the prejudice against right-sided LDN is indeed declining in Western Europe. Fear of right renal vein thrombosis caused by shorter vessel length seems ungrounded.

The eligibility criteria for live kidney donation have been extended. The vast majority of centers accept donors with a BMI above 30 kg/m<sup>2</sup>. In developed countries, an increase in BMI is seen in the entire population. This inevitably leads to an increase of potential donors with a higher BMI. Although short-term results of obese donors are comparable to lean donors, more research is necessary to establish long-term outcomes (23). Donors with hypertension and an American Society of Anesthesiologists classification of 2 or higher were also increasingly accepted. Long-term follow-up studies on live kidney donors have been published demonstrating excellent results. No detrimental effect on kidney function was observed nor did donors show more hypertension than matched controls (24, 25). However, these studies all focus on healthy, carefully screened donors. More research is necessary on donors with (minor) comorbidities.

We recognize that our study has the weakness associated with a retrospective survey. Given these limitations, the present study with a response rate of 82% representing nearly all live-donor nephrectomies in the corresponding countries provides the best possible reflection of the current status and is a realistic update.

In conclusion, live kidney donation in general and minimally invasive donor nephrectomy in particular are more commonly applied in Northern and Western Europe. How-

ever, a classic lumbotomy is still performed in a minority of centers. Because minimally invasive techniques have been proven superior, this should be addressed through guidelines training and education to let all kidney donors benefit from minimally invasive approaches. The introduction of a prospective European registry focusing on surgical technique, donor selection, and follow-up to evaluate and develop the current live kidney donation program is warranted.

## MATERIALS AND METHODS

A questionnaire was sent to 119 transplant centers in Austria, Belgium, Denmark, France, Finland, Germany, Ireland, the Netherlands, Norway, Sweden, Switzerland, and the United Kingdom. In each center, a surgeon or a urologist was approached by mail and e-mail. The list of centers invited to participate in 2004 was updated using the websites of the national transplant societies.

**TABLE 3.** Questions on live-donor nephrectomy

- A. No. kidney transplantations
- How many kidney transplantations from a deceased donor were performed in your center in 2009?
  - How many kidney transplantations from a living donor were performed in your center in 2009?
  - Did these numbers change during the past 5 years?
  - Do you have a registration of live-donor nephrectomies?
- B. Open donor nephrectomy
- Is the ODN technique preferred?
  - If yes, for what reason did you not experience other techniques?
  - What kind of open technique do you perform?
  - Do you have experience with other techniques than ODN?
  - Could you estimate you average incision length?
  - Do you see incisional hernias postoperatively?
- C. Laparoscopic donor nephrectomy
- Is LDN currently performed in your center?
  - If no, why not? If yes, what kind of technique?
  - In which year was LDN introduced?
  - In your opinion, has introduction of LDN contributed to increased live kidney donation in your center?
  - How many LDNs have been performed in your center in 2009 and in total?
  - How many percent of the LDNs in 2009 was converted to open?
  - Do you operate all donors laparoscopically?
  - Who does perform LDN in your center and how is your operation team composed?
  - Which extraction site is favored?
  - Which instrument is used to divide the renal vessels?
  - Is LDN restricted to left kidneys? If no, how many percent is right-sided LDN?
  - What indications do you use to perform right-sided LDN?
  - Do you use hand assistance? If yes, for what reason?
- D. Comorbidities
- Do you accept donors with a BMI of more than 30 kg/m<sup>2</sup>? If yes, what is your upper limit?
  - Do you accept donors with hypertension? If yes, what are your limits?
  - Do you accept donors with ASA classification >1?

ASA, American Society of Anesthesiologists; BMI, body mass index; LDN, laparoscopic donor nephrectomy; ODN, open donor nephrectomy.

In November 2010, questionnaires were sent out, and in February 2011, nonresponding centers were invited to participate for the second time. Remaining nonresponding centers were approached individually by e-mail or by telephone. The questionnaire included issues on live kidney donation in four sections (Table 3). Part A included questions on the number of kidneys that were transplanted from both deceased and living donors. Part B included questions on ODN, and part C included questions on LDN. Part D focused on donors with comorbidities. Both open and multiple-choice questions were included in the questionnaire. In most multiple-choice questions, free text could be recorded for additional comments. Reported numbers were cross-checked using national databases from the British Transplantation Society, Eurotransplant, Scandiatransplant, Swisstransplant, Agence de la Biomédecine, and the Transplant Newsletter 2010 from the Council of Europe (26).

We used descriptive statistics to present our data. Differences between groups were analyzed using a Mann-Whitney *U* test. Differences in measures at two different time points within the same group were analyzed using the paired samples *t* test. Analyses were conducted using SPSS (version 17.0.2; SPSS Inc., Chicago, IL). A *P* value <0.05 was considered statistically significant.

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