

# Kidney transplant outcomes following the introduction of hand-assisted laparoscopic living donor nephrectomy: a comparison of recipient groups

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**Background:** Laparoscopic donor nephrectomy has become the procedure of choice for living donor kidney transplantation in many centres. We report on our experience with hand-assisted laparoscopic donor nephrectomy (HALDN). We concentrated on graft function and postoperative surgical complications in the recipient population, and compared outcomes to a similar recipient group who had received kidneys procured by open living-donor nephrectomy (OLDN).

**Method:** Following the receipt of institutional approval, the files of all patients who received a kidney transplant between September 2008 and June 2011 were reviewed. One hundred patients with end-stage renal disease received kidney transplantations from living donors. OLDN was performed in 65 donors, and 35 underwent HALDN. Delayed graft function (DGF) and postoperative complications were recorded.

**Results:** Six adverse events were reported, during which five patients presented with DGF. One DGF was reported in the HALDN group, and four in the OLDN group. The morbidity in the HALDN group (1/35, 3%) was a graft rupture secondary to acute rejection which required exploration and transplant nephrectomy. Reoperation was required in five patients in the OLDN group (5/65, 8%). This amounted to overall morbidity of 6%, with no recipient mortalities.

**Conclusion:** As previously documented, HALDN is safe for the donor, and not inferior to OLDN. In this study, it was associated with neither an increased incidence of DGF, nor a higher complication rate in the transplant recipient, when compared to the cohort that received a kidney harvested using the OLDN technique.

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Kidney transplantation remains the treatment of choice for patients with end-stage kidney disease. There is good evidence that transplantation improves both the quality and quantity of life in renal transplant recipients when compared with dialysis.<sup>1,2</sup> Living donor kidney transplantation has gained popularity, not only owing to the discrepancy between the supply and demand of cadaveric organs and patients with end-stage renal disease,<sup>3</sup> but also because of the profound advantages of live versus cadaveric renal transplantation.<sup>4</sup> Living-related donation has the potential to increase the number and the quality of transplants compared with other strategies, such as the use of suboptimal marginal organs from deceased donors. Kidneys from live donors, when compared with those from deceased donors, have been found to increase recipients' life expectancy and reduce the requirement for retransplantation.<sup>5</sup>

Since the introduction of laparoscopic living-donor nephrectomy (LLDN) by Ratner et al. in 1995,<sup>6</sup> this procedure has established itself as the preferred technique in many

institutions, resulting in less postoperative pain, a shorter hospital stay and more expedient donor convalescence.<sup>7,8</sup> Patients have an improved experience with the donation process, and present for assessment for donation in greater numbers, when compared to those presenting for open donor nephrectomy.<sup>3</sup> Safety in living donor nephrectomy is of utmost importance as the donor is a healthy person undergoing a very demanding and sophisticated elective procedure.<sup>9</sup> Therefore, the procedure must entail the lowest possible morbidity and mortality for the donor, without compromising graft function in the recipient. LLDN has been validated to be a safe procedure for the living donor after an intensive learning process.<sup>10</sup>

The aim of this study was to retrospectively review 100 transplants, and to compare the incidence of delayed graft function (DGF) and postoperative surgical complications in the recipients of kidneys harvested by either hand-assisted laparoscopic donor nephrectomy (HALDN) or open living-donor nephrectomy (OLDN).

## Method

After institutional approval, data from 100 consecutive related living donor (RLD) nephrectomies performed over a 33-month period between September 2008 and June 2011, were retrospectively collected and analysed. Thirty-five RLD nephrectomies were performed utilising a HALDN technique, performed by two surgeons. The remaining 65 procedures were performed by standard OLDN by five surgeons. The recipient implant procedures were conducted by two surgeons. The object of our study was to document the incidence of DGF and postoperative complications in the transplant recipients. Postoperative complications recorded included renal artery thrombosis, renal vein thrombosis, ureteric leak or stenosis, reoperation for bleeding, or any other event requiring reoperation. DGF remains a surrogate marker of graft function, or not, and the described surgical complications are well documented to deleteriously impact graft function. The patients' creatinine levels were monitored to assess immediate allograft function and the need for dialysis in the early postoperative period. However, the need for dialysis was not defined by the specific creatine level or urine output. Instead, the decision was guided by, and in conjunction with, the other clinical and metabolic parameters. DGF is defined as the need for any dialysis session in the first week after the transplant in our unit. The Z-test for proportions was used to compare the proportions of DGF and postoperative complications in the two groups.

## Results

None of the laparoscopic procedures required conversion to open surgery. Of the 100 RLD transplants performed in the given period, six adverse events were reported, resulting in an overall morbidity of 6% in the recipients. There were no recipient mortalities in the study group. One patient (1/35, 3%) in the HALDN recipient group presented with a ruptured kidney secondary to acute rejection for which reoperation and transplant nephrectomy were required. A histological examination of the explanted kidney confirmed this diagnosis. Importantly, neither reoperation nor percutaneous intervention was required as there were no ureteric or vascular complications in this group. Five patients (5/65, 8%) in the group of recipients who had received an OLDN kidney required reoperation, two with postoperative bleeding, one with a hyperacute rejection (again, confirmed histologically), one with infarction of the kidney secondary to renal vein thrombosis and one with evidence of ureteric obstruction, for which ureteric revision with conversion to a ureteroureterostomy was required (Table 1).

## Discussion

Receiving a kidney from a living donor is an important alternative organ source for patients with end-stage renal disease. Kidney transplantation from living donors confers several advantages, compared to those offered by dialysis and

the transplantation of a deceased donor kidney. Patients have the option of being transplanted pre-emptively before the need for dialysis, have a higher chance of the allograft functioning immediately, and have improved long-term survival and a better quality of life.<sup>11-19</sup>

**Table 1. Delayed graft function in patients following hand-assisted laparoscopic donor nephrectomy and open living-donor nephrectomy**

<b>Donor nephrectomy</b>
<b><i>Hand-assisted laparoscopic donor nephrectomy (n = 35)*</i></b>
<i>Delayed graft function [1 (3%)]</i>
Ruptured kidney (1)
<b><i>Open living-donor nephrectomy (n = 65)**</i></b>
<i>Delayed graft function [5 (8%)]</i>
Postoperative bleeding (2)
Hyperacute rejection (1)
Infarction in the kidney (1)
Ureteric obstruction (1)
Postoperative bleeding (2)

LLDN was introduced in 1995 to reduce the disincentives with respect to live donation by reducing the impact of the open nephrectomy procedure on the kidney donor.<sup>7</sup> The laparoscopic procedure results in less postoperative pain, a reduced hospital stay and shorter convalescence.<sup>8</sup> After an intensive learning process and subsequently high morbidity rate of 21% reported in the literature, the current figure has declined to a complication rate of 10%, which is comparable to the reported contemporary open nephrectomy rate of 8-20%.<sup>20</sup> Although not pertinent to this paper, our units' HALDN donor morbidity rates fall well within these norms, and our experience with our initial cohort of LLDN patients has recently been published.<sup>21</sup>

The urgent investigation of absent or declining urine output after kidney transplantation is required. Both immunological and nonimmunological factors contribute to DGF.<sup>22</sup> Technical problems are assessed by Doppler ultrasound investigation of the allograft, which provides important information on the arterial and venous reconstruction, documents vascular anastomotic patency, and measures arterial and venous flow and resistance indices in the kidney. In addition, by demonstrating the presence or absence of hydronephrosis and/or perinephric fluid collection, evidence of ureteric complications is documented. Once the surgical causes of anuria and oliguria have been eliminated, the patient must be assessed for alternate causes of DGF.

## Immunological and physiological considerations

DGF describes dysfunction of the kidney allograft immediately after transplantation, and is associated with an increased risk of premature graft failure and worsened residual graft function.<sup>23</sup> The incidence of DGF in RLD

renal transplantation has been reported to be 4–10%.<sup>9</sup> In addition to increased morbidity to the patient, the higher cost and prolonged hospital stay associated with DGF, patients also have a higher incidence of acute rejection episodes (i.e. a 38% increased risk of acute rejection in the first year), which, in turn, is associated with decreased allograft survival.<sup>22–24</sup> This then results in patients being subjected to ever-increasing immunosuppressive protocols and the risks associated with high-dose immunosuppression. Another significant finding is that patients with DGF after living donor kidney transplantation have a higher incidence of death with graft function.<sup>25,26</sup> A variety of factors contribute to the development of DGF. These may relate to the donor and/or recipient, as well as organ procurement and storage techniques. It is characterised by acute tubular necrosis on biopsy. Immunological causes of DGF refer to hyperacute and acute rejection in the immediate postoperative period. This has now become less common owing to improved tissue typing techniques, but has not yet been completely eliminated. Predictors of DGF in the living donor recipient include a human leukocyte antigen mismatch, preformed donor-specific antibodies, high panel-reactive antibodies, patients undergoing desensitisation protocols, and previous transplants. Nonimmunological causes include deceased donor grafts, advanced donor age, prolonged cold ischaemia time, a sex mismatch between the donor and recipient, and recipient variables of sex, weight, ethnicity and medical status.<sup>27,28</sup> Post-transplant acute tubular necrosis is caused by ischaemic injury to the kidney, which is further aggravated by multiple other factors, such as clinical and subclinical episodes of rejection, as well as the effects of nephrotoxic immunosuppressive agents.<sup>13</sup>

### **Anatomical and technical considerations**

It has been reported in most studies that longer operative and warm ischaemic times in the laparoscopic donor nephrectomy group do not affect the incidence of DGF and the long-term outcome. They conclude that the initial concerns of prolonged warm ischaemic times have not translated into poorer postoperative graft function.<sup>10,29</sup>

Renal artery and/or renal vein thrombosis usually results in loss of the allograft. Technical modifications in the dissection of the kidney during the HALDN technique have resulted in fewer vascular complications. The most important principle is to adopt a “no touch” technique to the renal hilum, minimising the manipulation of both the renal artery and vein. In addition, by maintaining lateral, posterior and inferior attachments to the kidney, repetitive torsion and kinking of the vascular pedicle is prevented during dissection, thereby minimising the potential for traumatic injury, preserving the integrity of the intima and lowering the incidence of vascular thrombosis.<sup>20</sup> While numerous options exist for vascular control of the hilum, our preferred technique is to use an Endo GIA™ stapler with vascular staples. This device applies two layers of staples to each extent of the vessel, and while potentially

losing 2 mm of length, has well proven integrity of closure, without vascular length being compromised. It should be noted that the Hem-o-lok® clip is no longer registered for use in the USA.

With increasing confidence and experience with the laparoscopic donor procedure, initially high rates of recipient ureteric complications of 11% have declined to 5%.<sup>20</sup> Modifications in the technique and adherence to the principles of preserving vascular supply to the ureter by including a generous amount of mesoureter, and the use of blunt rather than sharp dissection around the ureter, have resulted in a decrease in the rate of ureteric complications in the recipient.<sup>20</sup>

Multiple renal vessels have been reported to be an independent risk factor for DGF in some series. However, with increasing experience, most centres now report no difference in vascular complication rates, graft or patient survival in kidneys harvested with multiple vessels.<sup>30,31</sup>

Izquierdo et al. report a small increased risk of allograft loss with the use of the right kidney (4% right kidney versus 3% left kidney). This risk is appropriately low in their opinion, making a right-sided procurement an appropriate alternative, when a contraindication prohibits procurement of the left kidney.<sup>32</sup> Lind et al. found there to be no higher incidence of adverse outcomes after the use of the right kidney for living donor nephrectomy in their reported series, and concluded that there should be no reluctance to using the right kidney for living donor nephrectomy.<sup>33</sup> Dols et al. have even reported the right-sided procedure to be faster, with less blood loss, and with fewer conversions to open, and suggest that this might be the preferred approach.<sup>34</sup>

### **Conclusion**

Since its introduction to the transplant unit at the University of the Witwatersrand in September 2008, HALDN has proved itself to be safe for both the renal donor and the kidney transplant recipient, and is our routine approach to the donor operation. The traditional open approach is not favoured in any clinical scenarios. Apart from the validated advantages for the donor with regard to postoperative pain, a shorter hospital stay and earlier return to work, our analyses have demonstrated that there is no disadvantage to the recipient with the use of the laparoscopic procedure. Statistically significant differences have not been demonstrated in outcome between the two procedures. Although the sample size is small, at least equivalence is conferred when compared with the open group. Further studies are required to validate any possible advantages to the recipient.

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## Conflict of interest

The authors declare no conflict of interest.

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