Hand-Assisted Laparoscopic Living-Donor Nephrectomy Versus Open Surgery: Evaluation of Surgical Trauma and Late Graft Function in 82 Patients

F. Greco, A. Hamza, S. Wagner, M.R. Hoda, A. Inferrera, A. Lupo, K. Fischer, and P. Fornara

ABSTRACT

Objective. We evaluated and quantified surgical trauma and late graft function in cases of hand-assisted laparoscopic living-donor nephrectomy (HALLDN) versus open living-donor nephrectomy (OLDN).

Methods. This study is a retrospective nonrandomized single-center analysis. Between 1995 and January 2008, 82 patients with end-stage renal disease received kidney transplants from living donors. Open living-donor nephrectomy was performed in 37 donors, and 45 underwent laparoscopic hand-assisted nephrectomy. Demographic data and perioperative and postoperative data, such as markers of acute phase (C-reactive protein; serum amyloid A) and biochemical markers of glomerular filtration (serum creatinine, serum cystatin C), were compared at serial time points.

Results. The mean operative times for HALLDN and OLDN were 165 min and 195 min, respectively. The average warm ischemia time was 45 seconds for laparoscopy and 87 seconds for open surgery. The evaluation of acute phase markers demonstrated a minimally invasive nature of laparoscopy, with same late graft function compared with open surgery.

Conclusion. When the surgery was performed by experienced surgeons, hand-assisted living-donor nephrectomy showed shorter operative and warm ischemia times than open surgery, offering at least the same functional results and decreasing surgical complications compared with a completely laparoscopic technique.

O N THE half-century since the first successful procedure, living-donor renal transplantation has shown superiority over cadaveric-donor renal transplantation. Regarding the medical advantages, the evidence is convincing: The cold ischemia time in living-donor nephrectomy is significantly shorter than that of cadaveric-donor kidney transplantation; there is an almost complete absence of ischemic injury to the transplanted kidney, a relative insensitivity to poor tissue matching, and better long-term function.1

Since the 1990s, laparoscopy has represented an important development in urology as well as in other surgical areas. Because laparoscopy is generally less invasive than open surgical techniques, it may be preferable if it can be demonstrated to achieve the same results and patient safety with less operative trauma. Nevertheless, this difference remains the object of debate.

In the present study, we sought to evaluate differences in the hand-assisted laparoscopic technique versus the open technique for living-donor nephrectomy. After the technique had been developed in an animal model, in 1995, Ratner demonstrated the feasibility of laparoscopic living-donor renal-transplant nephrectomy in a 40-year-old man. Thereafter, the technique advanced to become an accepted method of transplantation.1 At present, more than 200 centers worldwide perform laparoscopic living-donor ne-
phrectomy; more than 10,000 kidneys have been retrieved from living donors with this approach.²

We sought to quantify surgical trauma in hand-assisted laparoscopic living-donor nephrectomy and in open living-donor nephrectomy.

MATERIALS AND METHODS

This study was a retrospective nonrandomized single-center analysis. From 1995 to January 2008, 82 kidneys from live donors (relatives, partners) were transplanted at our center. Until 2003, 37 kidneys were removed using a conventional open technique. From 2004, the remaining 45 donors underwent laparoscopic hand-assisted donor nephrectomy. Preoperatively, all the patients underwent intravenous urography (IVU), renal scintigraphy, and digital subtraction angiography (DSA). The immunosuppressive protocol was standardized in all patients, consisting of acrolimus, methylprednisolone, and mycosh enolate-mofetil³. Patients with a particular immunological risk also received antithymocyte globulin (ATG) or the IL-2R inhibitor basiliximab for induction therapy.

We compared demographic data (age, gender) as well as perioperative and postoperative data, including operative time, estimated blood loss, complications, length of hospital stay, analgiesic requirement, and markers of systemic reaction and renal function. We measured acute phase markers (CRP: C-reactive protein; SAA: serum amyloid A) as well as biochemical markers of glomerular filtration (serum creatinine and serum cystatin C) at serial pre-, intra-, and postoperative times. The renal parameters serum creatinine (S-Crea) and serum cystatin C (S-Cyst C) of both groups were compared at 12 months postoperative S-Crea was measured.

RESULTS

Preoperative Data

The mean age of the 45 patients who underwent hand-assisted laparoscopic living-donor nephrectomy was 44 ± 13 years, and the mean age of the 37 patients who underwent open living-donor nephrectomy was 40 ± 14 years (Table 1).

Perioperative Data

The mean operative times for HALLDN and OLDN were 165 min and 195 min, respectively. The average warm ischemia time was 45 seconds for laparoscopy and 87 seconds for open surgery. The hospital stay (4 vs. 7 days) showed a faster recovery among patients in the laparoscopic group (Table 1).

The preoperative and intraoperative serum concentrations of CRP were almost identical in both groups at times of measurement of T0, T1, and T2. At six hours postoperative (times of measurement T4, T5, and T6), CRP values averaged 20% to 40% lower in the laparoscopic group compared with the open group (Figure 1).

Table 1. Pre-, Intra-, and Postoperative Data (P < .05)

<table>
<thead>
<tr>
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<th>Open Living-Donor Nephrectomy (OLDN)</th>
<th>Hand-Assisted Laparoscopic Living-Donor Nephrectomy (HALLDN)</th>
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<tbody>
<tr>
<td>Number of patients</td>
<td>37</td>
<td>45</td>
</tr>
<tr>
<td>Age (y, mean ± SD)</td>
<td>40 ± 14</td>
<td>44 ± 13</td>
</tr>
<tr>
<td>Ratio male/female</td>
<td>3.9</td>
<td>3.3</td>
</tr>
<tr>
<td>Immunosuppression regimen</td>
<td>triple</td>
<td>triple+1</td>
</tr>
<tr>
<td></td>
<td>28/37</td>
<td>9/37</td>
</tr>
<tr>
<td></td>
<td>34/45</td>
<td>11/45</td>
</tr>
<tr>
<td>Mean operative time (min)</td>
<td>195 (150–240)</td>
<td>165 (120–210)</td>
</tr>
<tr>
<td>Mean estimated blood loss (mL)</td>
<td>110</td>
<td>60</td>
</tr>
<tr>
<td>Average time of warm ischemia (s):</td>
<td>87 (61–112)</td>
<td>45 (30–60)</td>
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<tr>
<td>Resumption of oral intake (d)</td>
<td>2.7</td>
<td>1.4</td>
</tr>
<tr>
<td>Hospital stay (d)</td>
<td>7</td>
<td>4</td>
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</table>
At timepoint T2, the intraoperative serum SAA values were lower in the laparoscopic group than the open group, remaining lower subsequently (Figure 2). Regarding renal function, serum markers of glomerular filtration rate in the recipient (S-Crea; Fig. 5) showed an initial relevant reduction at 12 hours postoperative (time of measurement T4), rapidly reducing the values at 24, 48, and 72 hours postoperative (times of measurement T5, T6, and T7). Two weeks after transplantation (time of measurement T8), the creatinine recovered to nadir levels.

Late graft function

In the open donor nephrectomy group, data of 37 transplant graft recipients were analysed. Of these, 31 transplants functioned well at the end of the first year. Of the remaining 6 recipients, 3 transplants never resumed their function, 1 patient died within the 1st year after transplantation for heart disease, 2 grafts had to be removed after the transplantation due to acute rejection. Among the laparoscopic nephrectomy group, we analyzed 45 transplanted recipients at one year. During this period, one graft had lost function and one transplanted graft had never resumed function. Furthermore, one patient died due to non-Hodgkin lymphoma. The other patients lost function owing to humoral reactions. Furthermore, both parameters of glomerular filtration rate that characterize renal function-

Table 2. Graft Function and Biochemical Markers of Glomerular Filtration Rate (GFR) One Year After Transplantation

<table>
<thead>
<tr>
<th></th>
<th>OLDN</th>
<th>HALLDN</th>
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<tbody>
<tr>
<td>Graft function</td>
<td></td>
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<tr>
<td>One-year post transplant graft function</td>
<td>31/37 (83.8%)</td>
<td>42/45 (93%)</td>
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<tr>
<td>Biochemical marker of GFR</td>
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<tr>
<td>S-Crea (μmol/L, mean ± SD)</td>
<td>154 ± 55.4</td>
<td>147 ± 45.9*</td>
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<tr>
<td>1 year post transplant</td>
<td></td>
<td></td>
</tr>
<tr>
<td>S-Cyst C (mg/L, mean ± SD)</td>
<td>1.91 ± 0.74</td>
<td>1.56 ± 0.49*</td>
</tr>
</tbody>
</table>

*S-Crea, serum creatinine (μmol/L); S-Cyst C, serum cystatin C (mg/L).
*P < .05.

DISCUSSION

Laparoscopic living-donor nephrectomy has revolutionized kidney transplantation. This surgical technique, introduced in 1995, has become an accepted method of kidney harvest for transplantation. Initially, LLDN was met with criticism, because a new method always has to be measured against the “gold standard” of the established surgical approach.
Increased warm ischemia times of 3 to 5 minutes after LLDN were the main point of criticism. The increased warm ischemia time associated with laparoscopy was criticized because it may predispose to rejection and increase the proportion of delayed graft function. The development of HALLDN reduced the warm ischemia time, making it similar to open nephrectomy. Therefore, our reasons for choosing HALLDN over a completely laparoscopic technique were as follows. First, HALLDN is generally considered to be quicker to perform than the completely laparoscopic approach. Second, HALLDN was safe for all of our donors, none of whom required conversion to the open approach. Even though HALLDN has additional costs related to the sleeve, we think the presence of the surgeon’s hand in the abdomen contributed to our 0% conversion rate. Third, warm ischemia times as reported for HALLDN were significantly shorter than those for the completely laparoscopic technique.

In the 1990s, when laparoscopic living-donor nephrectomy was established, there was a relatively high complication rate owing to ureteral injuries and loss of organs resulting from the laparoscopic extraction. Such complications have been reduced to a low level after completion of the initial learning curve that accompanies every new surgical technique. Recovery time for patients undergoing laparoscopic surgery was clearly faster and better.
nephrectomy, on the function of the donor’s remaining kidney at our center revealed that up to one year after the procedures, there was no significant difference in the GFRs.16

In conclusion, the increasing numbers of terminally ill patients with renal insufficiency in central Europe, the long waiting times for kidney transplants, and the organ shortage together have led to an increased proportion of living-donor nephrectomies.16

When the procedure is performed by experienced surgeons, hand-assisted living-donor nephrectomy shows shorter operative and warm ischemia times than open surgery, offering at least the same functional results and decreasing surgical complications compared with a completely laparoscopic technique.13 The various laboratory measurements obtained from our patient sample showed no disadvantages regarding transplanted kidney function in the recipient.

The reduced hospitalization time results in cost reduction and allows donors to return to work quickly. The explanation of the risks of the procedure to the donor and preparation for the procedure must be optimized. In addition, strict criteria should be established to decide in favor of either laparoscopic or open nephrectomy. A well-established kidney transplant center should have mastery of both operative techniques and be able to offer them to patients.

REFERENCES