TOPIC PAPER

Complications of retroperitoneoscopic living donor nephrectomy: single center experience after 164 cases

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Abstract

Objectives Retroperitoneoscopic living donor nephrectomy (RLDN) is used by only a few centers worldwide. Similar to laparoscopic living donor nephrectomy it offers the donor rapid convalescence and excellent cosmetic results. However, concerns have been expressed over the safety of endoscopic living donor nephrectomy.

Methods We review the results of 164 consecutive RLDN from November 2001 to November 2007. Complications were classified into intra- and early postoperative.

Results Mean donor age was 53.4 ± 10.7 years (27–79). Left kidneys were harvested in 76% of cases. Mean operation time was 146 ± 44 min (55–270), and warm ischemia time 131 ± 45 s (50–280). In two patients (1.2%) conversion to open nephrectomy was necessary. The intraoperative complication rate was 3.0%. In the postoperative period we observed in 17.7% minor complications with no persisting impairments for the donor. The rate of major complications in the early postoperative period was 4.3%. Three patients (1.8%) necessitated revision, due to laceration of the external iliac artery in one patient and chyloretroperitoneum in two patients. Mean donor creatinine was 113.1 ± 26.6 mg/dl (63–201) on the first postoperative day, and 102.0 ± 22.2 mg/dl (68–159) on the fifth postoperative day.

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Conclusion Retroperitoneoscopic living donor nephrectomy can be performed with acceptable intraoperative and early postoperative morbidity. Operation times and warm ischemia times are comparable to the open approach.

Introduction

During the past 15 years, the use of minimal invasive renal surgery has increased tremendously. In 1995, Ratner et al. [1] performed the first laparoscopic living donor nephrectomy. Since then, minimally invasive techniques have become more and more favored procedures. In 2000, Gill et al. [2] reported for the first time of a retroperitoneoscopic approach to donor nephrectomy and autotransplantation where successful allograft outcome was achieved without vascular complications. Extensive data have been published showing that conventional laparoscopic and retroperitoneoscopic techniques for donor nephrectomy have a similar complication rate [3–5]. Retroperitoneoscopy provides two major advantages: first, it offers a quick access to the blood vessels comparable to the open approach and second, it has no interference with bowel, liver, or abdominal adhesions. The need to mobilize the colon like in transperitoneal kidney surgery is obviated.

Many studies demonstrated an improvement of donor outcome by means of minimally invasive techniques [4–7]. Furthermore, there is evidence that endoscopic minimal-invasive kidney donation can increase the number of kidney donations because of shorter hospital stay, earlier return to work, good cosmetic outcome and better overall

patient satisfaction [8–11]. More than 60% of the centers in the USA currently perform minimal-invasive donor nephrectomy and numbers are rising in Europe as well.

As kidney donors are healthy individuals, it is important to ensure that the donor operation is safe and allows a quick return to normal activity. Large series of laparoscopic living donor nephrectomies (LLDN) have reported that a lengthy learning curve is required to make this operation feasible. Furthermore, the complication rate has varied from 6.4 to 16.9% [12].

We reviewed our 6-year single-institution experience of 164 retroperitoneoscopic living kidney nephrectomies (RLDN), evaluating the incidence and management of complications.

Methods

From November 2001 to November 2007, 164 consecutive RLDNs were performed at our institution. Preoperatively, the suitability of all potential donors and recipients was discussed by an interdisciplinary transplantation team. The data obtained included donor age, sex, body mass index, operative time (OT), warm ischemia time (WIT), blood loss, and intra- and postoperative complications. After a complete history, physical examination, and laboratory investigation, contrast enhanced magnet resonance angiography was used for evaluation of vessel anatomy. If both kidneys were functionally and anatomically equivalent, the left kidney was preferentially selected to provide a longer length of the vein for the implantation process. The right kidney was taken if morphological findings such as multiple arteries, venous anomalies, or an early arterial branching were present on the left side. Furthermore, the decision was based on the policy of selecting the kidney with the lowest risk of technical failure, but most importantly, leaving the donor with the "better" kidney [13, 14]. Our retroperitoneoscopic technique was described recently in publication [3, 15].

Results

Preoperative donor characteristics and perioperative results

Table 1 shows detailed preoperative patient characteristics. The mean donor age was 53.4 ± 10.7 years with a mean body mass index of 25.6 kg/m². A total of 66% (n = 109) of the donors were females and 34% (n = 55) males. In 76% (n = 125) of the donors the left kidney was procured. Reasons for procurement of the right kidney were in most cases multiple arteries on the left side (n = 19, 49%) and an early left bifurcation (n = 7, 18%). In five patients (13%) we found

Table 1 Preoperative donor characteristics and perioperative data

	Mean ± SD (range)	No. (%)
Number of patients	164	
Age	53.4 ± 10.7 (27–79)	
Body mass index (kg/m²)	25.6 ± 4.0 (17–45)	
BMI < 25		87 (53%)
BMI 25–30		61 (37%)
BMI > 30		16 (10%)
Male		55 (34%)
Female		109 (66%)
Left kidney		125 (76%)
Right kidney		39 (24%)
Reason for right procurement		
Multiple arteries left		19 (49%)
Early bifurcation left		7 (18%)
Right renal artery stenosis		5 (13%)
Venous anomalis		5 (13%)
Double left sided pyelon		1 (3%)
Nephrolithiasis right		1 (3%)
Fibromuscular dysplasia		1 (3%)
Prior abdominal surgery in history[a]		19 (11.6%)
Baseline creatinine (mg/dl)	67.5 ± 13.1 (40–140)	
Creatinine day 1 (mg/dl)	113.1 ± 26.6 (63–201)	
Creatinine day 5 (mg/dl)	102.0 ± 22.2 (68–159)	
Operation time (min)	146 ± 44 (55–270)	
Warm ischemia time (s)	131 ± 45 (50–280)	
Blood loss (ml)	159 ± 108 (0–600)	
Hospitalization time (post op days)	6.8 ± 2.9 (1–29)	

[a] Including colon surgery, open cholecystectomy, etc

a right renal artery stenosis and in further five patients (13%) venous anomalies making right kidney harvesting necessary.

A total of 19 patients (11.6%) had a history of prior significant abdominal surgery (e.g. colon surgery, open cholecystectomy).

Mean OT was 146 ± 44 min, mean WIT, defined as the time from closure of the artery until clear outflow from the vein of the explanted and perfused kidney, was 131 ± 45 s, and mean blood loss was 159 ± 108 ml. All planned living donor nephrectomies were performed, and the kidneys were successfully transplanted. The average creatinine level on postoperative day five was 102.0 ± 22.2 mg/dl compared to 67.5 ± 13.1 mg/dl before the operation. The mean length of hospital stay was 6.8 days.

Intraoperative complications

Intraoperative complications are subdivided into minor and major complications (Table 2). In the early period after

Table 2 Intra- and postoperative complications after retroperitoneo-scopic donor nephrectomy

	n (% of 164 cases)
Intraoperative	
Minor[a]	
Injury of adrenal artery	1 (0.6%)
Pleural laceration	1 (0.6%)
Ureter injury	1 (0.6%)
Major[b]	
Disruption of artheriosclerotic left renal artery[c]	1 (0.6%)
Hemidiaphragm injury	1 (0.6%)
	5 (3.0%)
Postoperative	
Minor	
Hematoma	5 (3.0%)
Transient fever	4 (2.4%)
Wound pain	4 (2.4%)
Hypertonia	3 (1.8%)
Pneumonia	3 (1.8%)
Paralysis, nausea	2 (1.2%)
Pleural effusion	2 (1.2%)
Wound infection	2 (1.2%)
Urinary tract infection	2 (1.2%)
Ulcus gastrici bleeding	1 (0.6%)
Urinary retention	1 (0.6%)
	29 (17.7%)
Major	
Graft loss	1 (0.6%)
Cardiac ischemia	1 (0.6%)
Hematoma with blood transfusion	1 (0.6%)
Bleeding A. iliaca externa (reoperation)	1 (0.6%)
Chyloretroperitoneum	3 (1.8%)
Drainage	1
Reoperation	2
	7 (4.3%)

[a] Minor complications related to surgery, no reoperation required, no effects on graft function

[b] Major complications related to severe disadvantages for the donor, including conversion reoperation, transfusion or effects on graft function

[c] Leading to conversion and blood transfusion

switching from laparoscopic hand-assisted donor nephrectomy to RLDN two patients (cases 11 and 18) needed conversion. In a 71-year-old man a disruption of a fragile atherosclerotic left renal artery occurred, necessitating immediate open conversion and subsequent transfusion. Despite this event, the kidney was harvested safely and implanted successfully. Another patient with two very short veins on the right side was converted to open left kidney donation. The conversion had no persistent impairments for the donor or the recipient.

In a healthy slim 42-year-old female, a totally left hemidiaphragm rupture during left-sided retroperitoneoscopic donor nephrectomy occurred. This was most likely caused when creating the retroperitoneal working space by blunt balloon dilation. Because the cardiopulmonary situation of the patient remained stable, retroperitoneoscopic donor nephrectomy was performed with our standard technique. Afterwards, the diaphragm was repaired with three 2-0 polyglactin running sutures. Two large 2-mm absorbable clips were applied at the end of each suture to guarantee tightness. The postoperative course of the donor was uneventful.

Furthermore, two kidneys (1.2%) from the right side had renal veins shorter than 2 cm necessitating lengthening by means of v. saphena patch before implantation could be performed. Longer functional follow-up of both grafts was uneventful, although early glomerular function was delayed in these grafts.

In a female donor with a history of repeated pyelonephritis, ureteral injury in the region of the ureteropelvic junction occurred. The kidney was harvested, irrigated with cold UW Belzer solution, and an ex vivo pyeloplasty was performed. The kidney was implanted successfully without persisting impairments for the donor or the recipient.

Postoperative complications

Postoperative complications are shown in Table 2. Most of the complications were minor without persisting disadvantages for the donor or the recipient.

After an initial uncomplicated course, three left-sided kidney donors developed chyloretroperitoneum. After 6, 9, and 28 days the patients were readmitted to hospital due to increasing pain in the left lower abdomen. A major retroperitoneal fluid accumulation could be demonstrated sonographically. The abdominal CT scan revealed a retroperitoneal accumulation of fluid. In all three cases drainage was initially inserted and the patient's diet was switched to short- and medium-chain fatty acids. As a supporting measure, 0.1 mg somatostatin was administered subcutaneously three times a day. Despite this regime, two donors needed operative revision due to persisting chylus production and could be discharged after 18 and 30 days, respectively. The patient treated conservatively was discharged after a period of 45 days.

In a 48-year-old woman with left-sided kidney donation significant hemoglobin decrease was noticed immediately after operation. CT scan revealed bleeding from a laceration of the left external iliac artery. The patient was reoperated and the laceration was sutured. The further course was uneventful.

In another donor, bleeding at a trocar incision occurred 2 days after operation, necessitating blood transfusion. The bleeding was controlled with a deep skin suture.

We observed one postoperative myocardial infarction in a 79-year-old female donor with subsequent intensive care unit observation and uneventful further follow up. In our series one graft loss due to renal artery kinking after left-sided RLDN occurred. Although the diagnosis of impaired arterial blood flow by doppler ultrasonography led to immediate reoperation, the graft was lost.

Discussion

Living donor transplantation is unique in that it affects not just a patient but also a healthy donor. There is evidence that endoscopic minimal-invasive kidney donation can increase the number of kidney donations because of shorter hospital stay, earlier return to work, good cosmetic outcomes and better overall patient satisfaction [9–11, 16, 17]. Furthermore, it has been shown that LLDN and RLDN donors experience less postoperative pain than after open living donor nephrectomy over the early postoperative days [4, 18].

Today, most surgeons use the transperitoneal approach, except few clinics who established primarily the retroperitoneoscopic approach [19–22]. Although the limited working space makes the retroperitoneoscopic approach more demanding compared to the transperitoneal approach, it offers two major advantages: first, it is possible to operate without interfering with intraperitoneal organs or adhesions in case of prior abdominal surgery. Second, the approach provides quick access to the renal vessels, there is no need for mobilizing the ascending or descending colon which saves operation time. When compared to fully laparoscopic and hand-assisted laparoscopic living donor nephrectomy performed in other centers, we experienced lower OTs and WITs with RLDN [17, 23–26]. Furthermore, we found similar OTs and WITs compared to our own open series [27].

In 2005, we analyzed the outcome of 65 transplanted kidneys after RLDN and compared the results to 69 kidneys harvested with open nephrectomy [15]. Early functional follow-up showed significant lower 24-h urine output after RLDN. However, the creatinine reduction within 24 h was comparable between the groups and from the seventh postoperative day there was no statistically significant difference regarding serum creatinine levels. Overall recipient complication rate and total early rejection rate within 30 days were similar within the two groups.

While advantages of decreased pain, faster recovery, and shorter hospital stay are appealing to potential donors, overall safety and graft survival remain paramount in living donor nephrectomy. The relatively long hospitalization time in our series is related to the different health insurance arrangements of patients in European and US American hospitals. Since these are fundamentally different, the personal financial pressure to leave the hospital after the operation is low.

With increased attention to donor safety, we examined our results of 164 consecutive RLDNs performed by three surgeons.

We separated donor morbidity into intra- and postoperative complications, with rates of 3.0 and 22.0%, respectively. One of the largest series in the literature is from the University of Maryland, which reported a 6.8% intraoperative and 17.1% postoperative complication rate with 738 laparoscopic donor nephrectomies [24]. The rate of major complications in our series (5.5%) was in the range of published data for open (1–6%) or laparoscopic techniques (1–6.3%) [3, 4, 28].

Our conversion rate was 1.2%, which is comparable to the 1.6–2.8% reported in the literature [24–26]. The two conversions occurred within the first 20 operations (case numbers 11 and 18) and could be attributed to our learning curve.

Recently, we could also show that right kidney harvesting is feasible and safe with the retroperitoneoscopic approach [29]. At the beginning of right kidney procurement we had two patients with very short renal veins, necessitating vein lengthening using a venous saphena patch. After these initial problems we never experienced difficulties with right kidney donation. We prefer to use a TA-30-2.5 (AutoSuture®) disposable stapler on both artery and vein. It provides an additional 2–3 mm length of the right graft vein, compared to the commonly used Endo-GIA stapler. It is placed parallel and flushed to the vena cava, obtaining maximal renal vein length by raising the kidney with hand-assistance, thereby extending the renal vein.

In a 42-year-old slim female we observed a completely bisected hemidiaphragm after blunt creation of the retroperitoneal space with the dilation balloon. Our retrospective complication analysis revealed that the typical bulge of the lateral abdominal wall was less pronounced in this case. Additionally, the inflated volume of approximately 1,200 ml water was probably too much for the slim (BMI 19.8 kg/m^2) female donor. The diaphragmatic injury must be seen as a complication of blunt balloon dissection of the retroperitoneum, with the dilatation device placed too close to the diaphragm and inadequate inflated volume, consequently leading to its rupture. Pleural injury is an uncommon, but potentially serious complication. In a multi-institutional study reviewing 1,765 laparoscopic procedures pleural injury was detected in ten patients (0.6%) [30]. In most cases the diaphragm was injured during kidney dissection and rarely during inadvertent trocar placement into the pleural cavity. We recommend a careful and body-weight adjusted inflation of volume when water is used for blunt dilatation of the retroperitoneal space. If an air pump is used, endoscopic camera control should be used. Additionally, a correlating bulge of the lateral abdominal wall between chest and iliac crest must be identified.

In our series, we observed three patients with chyloretroperitoneum after a primary uncomplicated left-sided donor nephrectomy. One patient could be treated conservatively; the other two patients necessitated reoperation.

The left renal hilus is surrounded by well-developed lymphatics that often open directly into the cisterna chyli or variably into a lymphatic plexus. It is absolutely necessary to free the renal vessels as much as possible from the surrounding tissue. Perihilar and perivascular lymph nodes and lymphatics must be severed and coagulated in the course of this process. During the subsequent detachment of the kidney from the perirenal fatty tissue, iatrogenic injury to large lymphatic vessels, which are easy to overlook, may occur, in particular medial to the vascular pedicle. Especially in the case of these vessels, it is rarely possible to attain sufficient bipolar coagulation of the injury due to the dissection. In addition, minor damage may be overlooked as a result of the suppression of lymph flow by the pneumretroperitoneum of 10–15 mmHg. Consequently, the lymph/chylous fistula will only develop postoperatively. Iatrogenic injury should be treated directly with small clips, bipolar cautery, or, if possible, direct suturing with 4-0 monofilament sutures. As a prophylactic measure to prevent injuring the large lymphatics, care must be taken to achieve definitive coagulation of the lymphatics, especially medial to the renal vessels and anterior to the aorta.

Conclusion

The results of our series support the safety of RLDN. The observed complication rate is similar to other published data. We found that pure retroperitoneoscopy has a short learning curve. This is reflected by short operation times, which are comparable to the open approach. The main advantage of RLDN is the quick access to the renal vessels, without interfering with intraperitoneal organs or abdominal adhesions.

Conflict of interest statement There is no conflict of interest.

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