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Evaluating graft function in pediatric recipients for living donor renal transplantation: Is laparoscopic donor nephrectomy safe?

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Abstract

Objective:

To evaluate the surgical and functional outcomes of laparoscopic graft procurement in pediatric patients undergoing renal transplantation.

Materials and Methods:

A retrospective chart review of the cohort records of 54 pediatric living donor renal transplant recipients from 1985 through June 2006 was performed. We compared results of laparoscopic donor nephrectomy (LDN, n = 15) and open donor nephrectomy (ODN, n = 39). Parameters analysed included donor technique and morbidity, operative complications, immediate postoperative renal function, the incidence of early and delayed graft function, and long-term graft survival.

Results:

The mean age of these recipients was 14.8 years (5-18) in the LDN group and 13.9 years (8-18) in ODN group. Serum creatinine (mg/dl) was 1.5 ± 0.7 vs 1.8 ± 1.3 at day 1 (P = 0.20), 1.0 ± 0.3 vs 1.4 ± 1.3 at day 2 (P = 0.12), 1.1 ± 0.9 vs 1.3 ± 1.0 at day 7 (P = 0.25), 1.2 ± 0.5 vs 1.6 ± 1.8 (P = 0.20) at day 14, 1.1 ± 0.7 vs 1.2 ± 1.4 (P = 0.39) at 1 month in LDN vs ODN groups, respectively. Early graft function was 35.7 vs 46.4% in the respective groups. There were two delayed graft function and one graft nonfunction in ODN group. Over all graft and patient survival at 1 year was 86.67 and 82.22% (P = 0.34) in LDN and ODN groups, respectively.

Conclusion:

Pediatric recipients of the LDN grafts have outcomes comparable to those of ODN graft recipients. Laparoscopic donor nephrectomy is safe and efficacious for graft procurement for pediatric recipients.

Keywords: Graft function, laparoscopic donor nephrectomy, open donor nephrectomy, pediatric

INTRODUCTION

Renal transplantation confers substantial benefits to children with end-stage renal disease (ESRD),

including improved growth, longer life, and better quality of life.[1] Graft outcomes are better with living donor transplantation as compared to deceased outcomes. The advent of laparoscopic donor nephrectomy (LDN) has lead to a significant increase in the number of living donor renal transplants performed in pediatric recipients.[2,3] Benefits to the donor of LDN compared with ODN include shorter postoperative hospital stay, reduced requirements for postoperative analgesia, and improved convalescence and cosmesis.[4]

A few studies have shown higher postoperative creatinine values among LDN recipients compared with ODN recipients.[2,5] Troppmann *et al.* observed that pediatric recipients of age <18 years who underwent laparoscopic donor graft procurement had significantly more acute rejection episodes, and higher incidence of delayed graft function, with poor graft survival rates.[5] These studies warrant careful analysis of the role of LDN grafts being transplanted into recipients in this age group.

We compare here the surgical and functional outcomes of all pediatric living donor renal transplant recipients.

MATERIALS AND METHODS

The medical records of all pediatric transplant patients from 1985 through June 2006 were reviewed at Muljibhai Patel Urological Hospital. The etiology of end-stage renal disease (ESRD), demography of donors and recipients, vascular anatomy of the donor kidney, method of donor nephrectomy (LDN *vs* ODN), warm and total ischemia time, the need for bench surgery, and any intra and perioperative complications that occurred were analysed. Postoperative renal function was measured by serum creatinine levels at day 0, 1, 2, 7, 14, and 30. The incidence of early and delayed graft function, acute rejection episodes, complication rates, and graft survival was recorded. Early graft function was defined as >25% decline of two separate serum creatinine samples taken within first 24 h.[5] Delayed graft function was defined as requirement of hemodialysis within seven-post transplantation.[5] Acute rejection was defined as treatment for rejection given for rising serum creatinine (postrenal biopsy histopathologically confirmed). Renal function was further assessed at 3, 6, and 12 months postoperatively. Graft failure was defined as permanent return to dialysis or death with a functioning graft. We compared demographic and operative data between groups with student t test. Graft survival was compared with the Kaplan-Meier's survival probability. All statistical analyses were performed with SPSS 10.0 software package.

Surgical techniques

Open donor nephrectomy (ODN) Kidney was procured through a flank incision overlying the 11th or 12th rib depending on the topography of the kidney. The incision was carried out through all the muscle layers, kidney dissected, and hilum bared. Prior to ligation of the renal pedicle, patients received a bolus of 10 mg of intravenous frusemide and 100 ml of 20% mannitol. The kidney was then harvested through a flank incision, immediately placed in an ice bath, and perfused with a heparinized ringer lactate solution. The postoperative analgesia was tramadol-based.

Laparoscopic donor nephrectomy (LDN) Patients were placed in the lateral flank position and a transperitoneal LDN was performed.[6] All the donors underwent overnight hydration and enemas for bowel preparation. Nasogastric tube and urethral catheter was placed intraoperatively and patient was put in 45° lateral tilt position. Pneumoperitoneum was created in closed technique with the initial flow rate of 1l/min. Working pressure was maintained at around 15 mm Hg. The kidney perfusion was maintained throughout the procedure with a urine output of 10 ml/min. Papaverine was instilled around bare hilum. At this time Pfannenstiel incision was placed and deepened upto the peritoneum taking care not to incise the peritoneum at this point of time. Prior to securing the renal artery, the patient received a bolus of 10 mg of intravenous frusemide and 100 ml of 20% mannitol. The kidney was retrieved through the preplaced Pfannenstiel incision and was immediately placed in an ice bath

and perfused with a solution of heparinized ringer lactate. Postoperatively, the patients were placed on tramadol-based analgesia.

Renal transplantation A modified Gibson incision was made and the renal bed prepared by dissecting the external iliac vein and internal/external iliac artery. Appropriate measures were taken to preserve the cord structures in male recipients and secure the lymphatics. The donor renal vein was anastomosed to the recipient external iliac vein in an end-to-side fashion. Standard end-to-end renal artery to internal iliac artery anastomosis was done with single artery grafts (*n* = 46). Bench surgery was done in early branching renal artery (*n* = 2), and separate double anastomosis, one with external iliac (end-to-side) and other with internal iliac artery (end-to-end) was done for double renal artery (*n* = 6) patients. We performed modified Grigoir Lich ureteroneocystostomy in all patients.

RESULTS

The demographic profile and the etiology with respect to both the groups are depicted in Table 1. The mean age of recipients was 14.8 years (range 5-18) in LDN and 13.9 years (range 8-18) in ODN. The operative data is given in Table 2. The left kidney was harvested in all patients of both the groups. There was no difference between the groups with regard to vascular anatomy. The warm ischemia time (WIT) was significantly longer in the LDN group. Total ischemia time (TIT) was significantly higher in grafts procured by laparoscopic approach. Patients in the LDN group had significantly lower analgesia requirement and shorter hospital stay.

Five patients in the LDN group received induction immunosuppression (4 received daclizumab and 1 basiliximab) while none of the patients in ODN received induction. The posttransplant immunosuppression protocol was a triple drug immunosuppression (TDI). The LDN group received prednisone all, calcineurin inhibitor [cyclosporine (11), tacrolimus (4)], and purine antagonists [azathioprine (11), mycophenotil (4)]. The ODN group received prednisone all, calcineurin inhibitors [cyclosporine (35), tacrolimus (0), (not given in 4)], and purine antagonists [azathioprine (39), mycophenotil (0)]. Cyclosporine was stopped in two ODN patients at 3 and 12 years with stable serum creatinine. One patient required cyclosporine to be stopped at 10 days due to leucopenia. This patient ultimately developed graft failure.

The patient and their graft outcome are shown in Table 3. No differences were noted in graft function during the first postoperative week. Postoperative serum creatinine was comparable at day 1 (*P* = 0.20), day 2 (*P* = 0.12), day 7 (*P* = 0.25), day 14 (*P* = 0.20), 1 month (*P* = 0.39) in LDN *vs* ODN groups. Early graft function was 35.7 *vs* 46.4% in the respective groups. There were two delayed graft functions in ODN group. Both of the patients had acute vascular rejection which required treatment with OKT3. The first patient required one session of hemodialysis on the third day while the second patient required two hemodialysis sessions on the second and fourth day. The subsequent graft function became normal. Over all graft survival at 1 year was 86.67 and 82.22% (*P* = 0.34) in LDN and ODN groups, respectively.

The cause of early adverse renal outcome and their complications are shown in Table 4. An acute cellular rejection was noted in 10 ODN patients. Cause of the six grafts lost (LDN, *n* = 1 and ODN, *n* = 5) were: graft artery aneurysm in 1 (LDN), graft artery thrombosis (*n* = 1), septicemia (1), acute left ventricular failure (1), acute vascular rejection (1), and hypertensive encephalopathy (1).

DISCUSSION

Laparoscopic donor nephrectomy has previously been demonstrated to be safe and efficacious in pediatric renal transplant in single institution studies.[7] Pediatric renal transplants pose unique challenges, including operative technical aspects, hemodynamics at the time of graft reperfusion, and increased immune reactivity as compared to adults, resulting in higher rejection rates.[8–10] Troppmann *et al.*, in United Network for Organ Sharing database study raised concerns about higher

incidence of delayed graft function, acute rejection episodes, and higher discharge serum creatinine levels in LDN compared with recipients of ODN.[5] The authors hypothesized that probably immunological and hemodynamic properties of these young patients make them unsuitable for additional physiological insults due to laparoscopic renal procurement. It is also postulated that a combination of prolonged pneumoperitoneum and WIT occurring during LDN predispose the allograft to increased risk of early graft dysfunction.[10] There is a concern regarding impaired renal function secondary to prolonged warm ischemia in grafts with multiple vessels. However, Desai *et al.* showed that long-term graft survival and graft function at 1 month and 1 year are not adversely impacted by the presence of multiple renal arteries in grafts procured laparoscopically.[11] Salvatierra *et al.* hypothesized that, due to decreased intravascular volume in these pediatric recipients, allograft receives suboptimal renal perfusion compared to that prior to nephrectomy. This can be deleterious resulting in increased risk of vascular thrombosis, delayed graft function, or primary nonfunction.[9]

The recipient outcome did not differ in either renal units harvested by LDN or ODN; graft survival at 1 year was comparable in both the groups. This may be related to a combination of decrease in the total operative time, adequate perioperative and intraoperative donor hydration, measures to reduce WIT, and meticulous attention to recipient hydration. Modifications in our LDN technique include: Preplaced Pfannenstiel kidney retrieval incision; and bathing bare hilum in papaverine to avoid spasm of the renal artery. Donor hydration is also optimized. We ensure that donor veins are full at the time of bed preparation by infusing intravenous fluids. Ureter, renal artery, and renal vein are clipped and cut in that order prior to graft retrieval.[6]

All pediatric recipients receive aggressive hydration both intraoperatively and postoperatively. Additionally, intraoperative attention is directed at maintaining recipient central venous pressure at 15 cm H_2O and systolic blood pressure above 120 mm Hg. If the systolic blood pressure remains low, intravascular volume expansion with colloids is instituted to achieve the desired hemodynamic parameters. Just prior to vascular anastomosis declamping, 100 ml of 20% mannitol is given intravenously to diurese the graft.

It is believed that pneumoperitoneum of ≤10 mm Hg has a minimal affect on renal physiology.[12] We thus maintain an insufflation pressure of 15-20 mm Hg throughout the LDN procedure; this has not been shown to have adverse effect on immediate postoperative renal function in our study. On the contrary, it aids in dissection by minimizing oozing and making the surgery quicker, thus effectively decreasing the operative time.

Although, the number of patients in our cohort is comparable to any published single institution series, we had no pediatric recipient aged ≤5 years. Finally, our study was limited by its retrospective nature and use of historical ODN cohort. Further randomized prospective studies would clarify the safety and efficacy of the laparoscopic harvesting in pediatric renal transplantation.

CONCLUSION

We found that in our experience, LDN does not adversely affect graft outcome in pediatric recipients of living donor renal transplants. Laparoscopic donor nephrectomy was not associated with an increased risk of delayed graft function, acute rejection, or diminished graft function. In addition to shortening hospitalization and reducing postoperative pain for the adult donors, LDN confers improved convalescence and ameliorates cosmetic concerns. Based on our findings, we find no contraindication to the continued use of LDN in pediatric renal transplantation. Strict attention to perioperative donor and recipient fluid status and limited use of pneumoperitoneum should be considered for optimal graft outcome.

Footnotes

Source of Support: Nil

Conflict of Interest: None declared.

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Figures and Tables

Table 1

Patient demography between the LDN and ODN groups

	LDN group (*n* = 15)	ODN group (*n* = 39)	*P* value
Donor age in years (average, range)	42.0 (27-56)	37.7 (19-57)	0.34

Related /unrelated	3/12	27/12	
Recipient age in years (average, range)	14.8 (5-18)	13.9 (8-18)	0.49
Recipient weight in kg (average ± SD)	40.4 ± 16.9	31.6 ±9.4	0.23
Donor weight in kg (average ± SD)	64.4 ± 8.9	59.2 ± 6.8	0.56
Sex donor (male/female)	9/6	27/12	
Sex recipient (male/female)	4/11	33/6	
Recipient native kidney disease			
Nephrological cause	12	30	
Urological cause	3	9	
Preoperative dialysis			
Hemodialysis	7	28	
Peritoneal dialysis	3	10	
Preemptive transplantation	5	1	
Donor renal artery	13	35	
Single			
Double	2	4	

LDN: Laparoscopic donor nephrectomy, ODN: Open donor nephrectomy

Table 2

Operative parameters

	LDN group	ODN group	P value
Warm ischemia time (in min)	5.9 ± 1.73	4.7 ± 1.1	0.0004
Total ischemia time (in min)	59.1 ± 9.8	44.4 ± 8.7	0.0003
Mean operative time (in min)	151.2 ± 44.2	165.0 ± 44.4	0.0003
Analgesic requirement (mg tramadol)	111.6 ± 70.30	320.0 ± 120.0	<0.0001
Mean hospital stay (days)	4.3 ± 1.0	5.7 ± 2.3	<0.0001

LDN: Laparoscopic donor nephrectomy, ODN: Open donor nephrectomy

Table 3

Serum creatinine (mg/dl) at various postoperative time

	LDN group	ODN group	P value
Day 0	5.1 ± 1.7	4.9 ± 1.6	0.34
Day 1	1.5 ± 0.7	1.8 ± 1.3	0.20
Day 2	1.0 ± 0.3	1.4 ± 1.3	0.12
Day 7	1.1 ± 0.9	1.3 ± 1.0	0.25
Day 14	1.2 ± 0.5	1.6 ± 1.8	0.20
Day 30	1.1 ± 0.7	1.2 ± 1.4	0.39

LDN: Laparoscopic donor nephrectomy, ODN: Open donor nephrectomy

Table 4

Early adverse renal function and complications

	LDN group	ODN group
Acute tubular necrosis	1	2
Acute cellular rejection	2	10
Acute vascular rejection	2	2
Hemorrhage	0	1
Graft artery thrombosis	1	1
Graft artery stenosis	1	1
Graft artery aneurysm	1	1
Ureteral leak	0	2
Lymphocele	2	4
Ureteric stenosis	0	2

LDN: Laparoscopic donor nephrectomy, ODN: Open donor nephrectomy