Urology Journal
UNRC/IUA

Vol. 3, No. 2, 82-86 Spring 2006
Printed in IRAN

Kidney Transplantation

En Bloc Kidney Transplantation from Pediatric Cadaveric Donors to Adult Recipients

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ABSTRACT

Introduction: The shortage of cadaveric donors for kidney transplantation has led to the expansion of the criteria used for donor selection, such as the use of pediatric cadaveric donors. In this study we reviewed our results of en bloc kidney transplantation of pediatric cadaveric donors to adults.

Materials and Methods: From May 2001 to May 2005, 245 cadaveric kidney transplants have been performed in our hospitals. Seven of these were en bloc kidney transplantations in adult recipients from *marginal* pediatric donors (age < 5 years, donor weight < 15 kg, high creatinine clearance, or kidney length < 8 cm). We reviewed their records. Follow-up (range, 3 to 24 months) included ultrasonography, dimercaptosuccinic acid renal scintigraphy, and magnetic resonance imaging.

Results: Serum levels of creatinine ranged between 0.8 m/dL to 1.9 mg/dL during the follow-up period. One patient died of myocardial infarction 3 months postoperatively. One-year graft and patient survivals were both 85.7%. Complications included acute tubular necrosis in 1 patient (managed by conservative therapy and dialysis for 2 weeks), renal vein thrombosis in 1 (treated by anticoagulation), and subcutaneous hematoma in 1. There were no urologic complications. Median size of the grafts was 7.2 cm preoperatively that reached 9.6 cm, 3 months postoperatively (P = .018). Twelve months following operation, the median size of the grafts reached 11 cm (P = .045).

Conclusion: En bloc pediatric kidney transplantation is a safe and suitable alternative for adult recipients. One-year graft and patient survivals are acceptable and complication rate is low.

KEY WORDS: kidney transplantation, pediatric donor, cadaveric donor

Received October 2005
Accepted February 2006
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Introduction

The shortage of cadaveric donors for kidney transplantation has prompted physicians to expand the criteria used for donor selection. The use of pediatric cadaveric en bloc kidneys is one of those expanded criteria.[1-3] The lower graft survival of pediatric kidney allografts due to the technical complications and hyperfiltration injury is challenging.[4,5] Several studies have shown that the outcomes of transplantation using pediatric donors are not favorable when compared with transplantation using adult donors.[6-8] However, some reports have recently revealed that survival of kidney allografts from pediatric cadaveric donors younger than 5 years is the same as those from adult donors.[8-10] In this study, we depicted our experience in transplantation of pediatric cadaveric en bloc kidney allografts to adult recipients.

Materials and Methods

From May 2001 to May 2005, a total of 245 cadaveric kidney transplants have been performed in our hospitals (Imam Reza Hospital in Mashhad, Shaheed Labbafinejad Medical Center and Chamran Hospital in Tehran, and Khorshid Hospital in Isfahan, Iran). Of those, 7 were en bloc kidney transplantations from *marginal* pediatric cadaveric donors (ie, donors with at least one of these criteria: age < 5 years, weight < 15 kg, a high creatinine clearance, and kidney length < 8 cm) which were transplanted to adult recipients. Immunosuppressive protocol was a triple therapy by prednisolone, cyclosporine, and mycophenolate mofetil. Acute rejection episodes were treated by pulse steroid and antilymphocyte globulin. The patients were followed up for 3 to 24 months. Dimercapto-succinic acid renal scintigraphy was performed during 24 months' follow-up periodically (Figure 1) and the sizes of the kidneys were evaluated by magnetic resonance imaging (MRI) and/or ultrasonography, 3 and 12 months post-operatively (Figure 2).

We reviewed the hospital records of our patients retrospectively, and collected data including demographic characteristics of the kidney recipients and donors; size and weight of the kidney allografts before and after transplantation; serum creatinine levels at postoperative months 3, 6, 12, 18, and 24; complications; and the overall outcome of patient and graft.

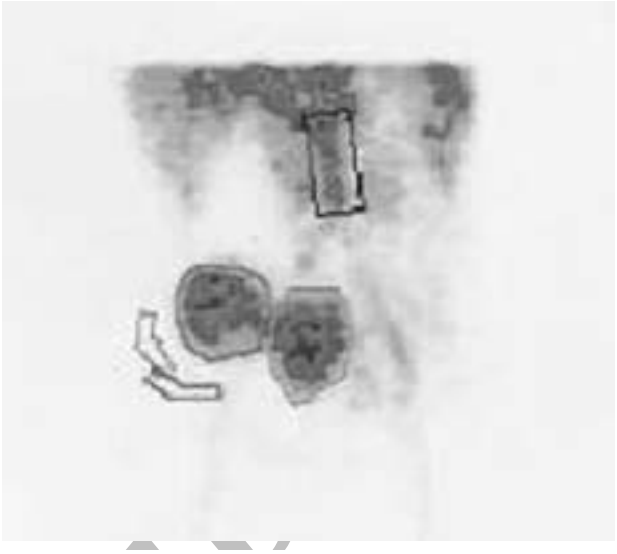

Fig. 1. Dimercaptosuccinic acid renal scintigraphy in a 34-year-old woman 3 months postoperatively

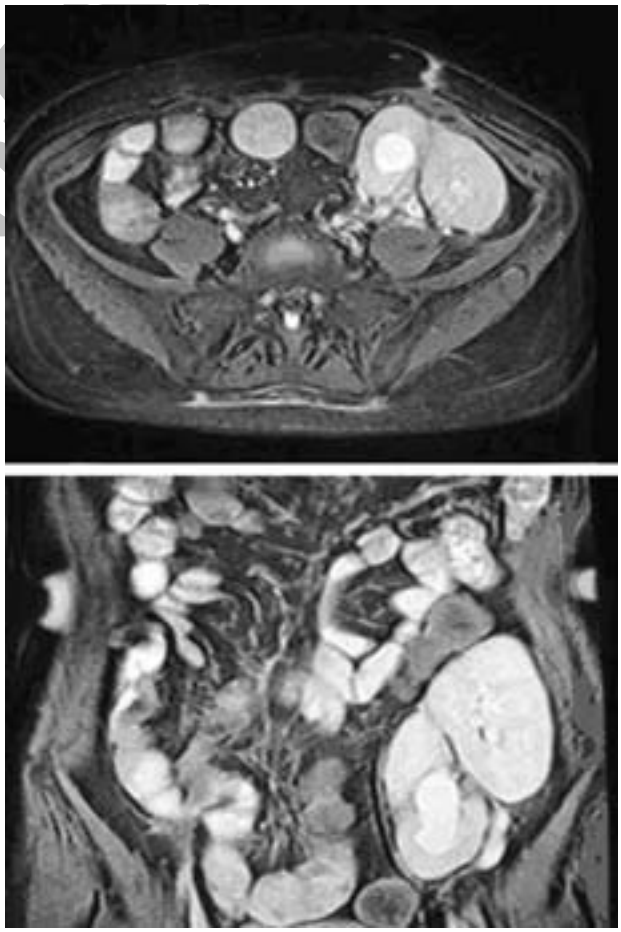

Fig. 2. Magnetic resonance imaging in a 43-year-old woman 3 months postoperatively

Technique. Both kidneys of pediatric cadaveric donors were harvested and irrigated with Wisconsin solution and heparinized ringer lactate in 3 and 4 cases, respectively. The kidneys were placed extraperitoneally in the iliac fossa of the recipients via a Gibson incision. In 6 patients, the

aorta and the inferior vena cava (IVC) of donor were anastomosed end to side to the external iliac artery and vein with 5-0 or 6-0 prolene sutures (Figure 3), but in 1 patient, the end-to-side anastomosis was made to the recipient's aorta and IVC. To prevent kinking of renal vessels, the upper pole of the grafts was fixed to the iliopsoas muscle. The ends of the two ureters were anastomosed medially together and then ureteroneocystostomy was performed using Lich Gregoir extravesical technique, but in 1 patient, ureteroureterostomy was carried out. In all patients, ureteral stents were placed for 4 to 6 weeks. The ureteral catheter was removed 5 days postoperatively.

Statistical analyses. The collected data were analyzed by SPSS software (Statistical Package for the Social Sciences, version 13, SPSS Inc, Chicago, Ill, USA). The Spearman rank correlation was used to determine the correlation between variables and Wilcoxon signed rank test to analyze the difference between size of the kidneys before and after transplantation. Kaplan-Meier method was used to determine non-death-censored graft survival and patient survival. Continuous variables were shown as medians and P values less than .05 were considered significant.

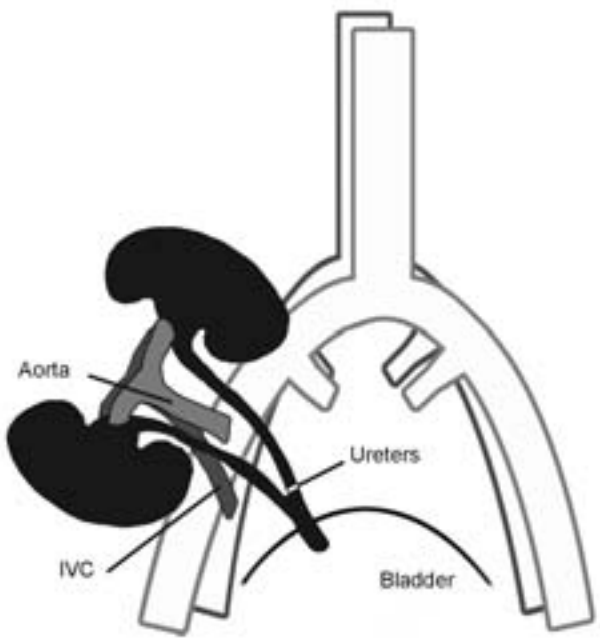

FIG. 3. End-to-side anastomosis of the aorta and the inferior vena cava (IVC) of donor to the external iliac artery and vein

Results

Median age of the donors was 4.2 years (range, 2 to 8 years) and their median weight was 12 kg (range, 8 to 20 kg). Four of them were boys and 3 were girls. Median age of the recipients was 34 years (range, 13 to 42 years) and their median weight was 58 kg (range, 37 to 70 kg). Three patients received their second kidney allografts.

One-year graft and patient survivals were both 85.7%. One patient died of myocardial infarction 100 days postoperatively while he had a functioning graft. The median follow-up was 12 months (range, 3 to 24 months). Delayed graft function occurred in 1 patient due to acute tubular necrosis, which was managed by medical therapy and dialysis for 2 weeks. The remaining 6 patients had a reasonable urine output early after transplantation. Complications included renal vein thrombosis in 1 patient, which was treated by anticoagulation, and subcutaneous hematoma in 1, which was drained completely. There were no reports of ureteral stenosis, ureteral leakage, or lymphocele during the follow-up period (Table 1).

Serum creatinine levels ranged between 0.8 mg/dL and 1.9 mg/dL from 3 to 24 months postoperatively (Table 2). There was not any correlation between the last serum creatinine levels and the recipients' weights and ages (P = .70; P = .39).

TABLE 1. *Demographic and clinical features of the patients with en bloc kidney transplantation*

Patients' number	Sex	Age (year)	Follow-up (month)	Last creatinine (mg/dL)	Complications
1	female	42	24	1	Subcutaneous hematoma
2	male	35	12	1.3	Acute tubular necrosis
3	female	13	18	1.2	-
4	male	25	24	1.1	Renal vein thrombosis
5	female	15	12	1.9	-
6	male	38	3*	1	-
7	female	34	12	.8	-

*The patient died of myocardial infarction 100 days postoperatively.

Table 3 demonstrates the sizes of grafts measured during the follow-up. Ultrasonography and MRI revealed a significant increase in sizes of grafts during 3 to 12 month postoperatively. Median size of the grafts was 7.2 cm preoperatively and reached 9.6 cm, 3 months postoperatively (P = .018). Twelve months following operation, the median size of the grafts reached 11 cm (P = .045).

Discussion

Mortality of patients who are on the waiting list of kidney transplantation is about 6.3% per year in the United States, but it reaches 10% in diabetics and/or old patients.[10] Therefore, in 5 years, mortality rate exceeds 30% in nondiabetic patients who are on a waiting list.[10] A limited graft procurement cannot supply the high demand, prompting the extension of the criteria used for donor selection. Using *Marginal* donors including nonheart-beating donors,[11] older donors,[12] hepatitis C positive donors for recipients with hepatitis C,[13] and pediatric donors[14-16] is now considered, especially in countries whose donor source is mainly cadaveric. The use of pediatric cadaveric donors younger than 5 years old can result in a high rate of technical complications; the main challenges are a high risk of graft thrombosis, suboptimal nephron mass, frequent rejection episodes, a low graft survival, an increased rate of hyperfiltration injury, and difficulties in adjustment of immunosuppressive drugs.[17-21] Thus, pediatric donors are marginal especially when a single pediatric kidney is transplanted to an adult. Pediatric grafts can be transplanted to pediatric patients; however, there is not always a pediatric recipient available for transplantation. We encountered this problem in our centers and adult recipients were allocated for pediatric donors. To reduce the risks, we preferred en bloc kidney transplantation.

Today, en bloc kidney transplantation is recommended for pediatric donors younger than 3 years, with a body weight less than 15 kg, and with a kidney length less than 8 cm.[22] Beasley and colleagues reviewed 16 en bloc pediatric kidney transplants performed in 2 centers and reported a 3-year graft survival of 94%. Two deaths with functioning grafts occurred secondary to cardiac and infectious etiologies. Graft thrombosis was not seen in any patients. Acute rejection developed in 7 patients who were treated with steroid and antilymphocyte antibody and the kidneys returned to the normal function. Other complications included 1 lymphocele and 4 ureteral complications (managed by ureteral reimplantation).[23] Between 1996 and 2002, El-Sheikh and colleagues performed 15 en bloc pediatric kidney transplants. One-year graft and patient survivals were 92.8% and 100%, respectively. There were no ureteral complications, but 1 lymphocele developed.[24] We had 1 death in our patients due to cardiac disorder. The resultant graft survival at 1 and 2 years was comparable to the survival of other cadaveric transplantations in our institutions. However, a more precise comparison is warranted with larger series.

We showed that the pediatric kidney allografts had a significant increase in size following en bloc transplantation, confirmed by MRI. It can be speculated that the kidneys grow rapidly in recipient's body to support the blood volume needed to be filtrated in an adult. In accordance with our findings, Merkel has demonstrated that the size of pediatric kidneys will be doubled within 2 to 3 posttransplant weeks and it reaches the adults' size 18 months after operation.[25]

In our series, 1 patient developed renal vein thrombosis 10 days postoperatively, which was treated by anticoagulation therapy. Hence, it

TABLE 2. *Postoperative serum creatinine levels in recipients of en bloc kidney allografts from pediatric cadaveric donors*

	Postoperative months				
Serum creatinine levels (mg/ dL)	3	6	12	18	24
Median	1.2	1.05	1	1.7	1.45
Minimum	.8	.8	.8	1.2	1.1
Maximum	1.9	1.9	1.9	1.7	1.8
Number of patients	7	6	6	3	2

TABLE 3. *Kidney allograft sizes before and after transplantation*

Kidney size (cm)	Before operation	Three months after operation	Twelve months after operation
Median	7.2	9.6	11
Minimum	5.5	6.25	10
Maximum	8.5	10.5	13
Number of patients	7	7	6

seems that technical problem was not the main cause of thrombosis. There were no urologic complications such as ureteral stenosis and ureteral leakage in our study, but Drakopoulos and coworkers reported ureteral complications in 28% of en bloc transplantations in 13 patients.[6] However, the reported complications did not affect graft function in long term. In our preliminary report, 1 graft developed acute tubular necrosis. Warm and cold ischemia may play a role in this complication.

Conclusion

Pediatric en bloc kidney transplantation is a safe and suitable alternative for adult recipients. One-year graft and patient survivals are acceptable and complication rate is low. To confirm these findings, a long-term follow-up of larger series and prospective studies comparing the outcome with other donor sources are required.

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