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CASE REPORT

TRANSPLANTOLOGY

En bloc kidney transplantation from a 24 month-old donor to an adult recipient: case presentation and literature review

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Paediatric kidney transplantation into adult recipients is a well-recognised technique. However, there are different opinions regarding two methods of transplantation. These two opinions are single kidney transplantation (SKT) and en bloc kidney transplantation (EBKT) from donors up to 20 kg. We are reporting the first successful en bloc kidney transplantation from a small, paediatric donor into an adult recipient in our institution and discussing the appropriate recent literature regarding possible concerns using this technique. Despite the fact that paediatric donors are uncommon and surgical experiences are limited, en bloc kidney transplantation can be performed successfully and could be used to expand the donor pool.

Key Words: en bloc kidney transplantation ‹› paediatric donor

CASE PRESENTATION

The donor was a 24-month-old, 15 kg male patient (BMI 19.4), who died from drowning. Donor's liver and kidneys were accepted for transplantation. The recipient for kidney transplantation was a 61-year old, 59 kg female (BMI 23.9) with end stage renal failure, secondary to chronic glomerulonephritis. The recipient was on haemodialysis for the last 10 months. The donor-recipient antigen mismatch was 3/6 with moderate immunological risk.

The patient was being treated in the paediatric intensive care unit when he was diagnosed with brain death. The patient was qualified as a potential donor and all the legal documentation, including the informed consent were signed; therefore the donor was brought to operating theater. The standard laparotomy was made as the donor's heart was still beating. The liver and kidneys were perfused with University of Wisconsin solution, cathetered from the aorta above the bifurcation and the inferior vena cava was intubated. The kidneys were retrieved en bloc with the proximal end of the aorta and vena cava inferior over sewn and ureters dissected as close to the bladder as possible (Figure 1). The distal ends of the vena cava inferior and aorta were anastomosed end-to-side to the recipient external iliac vein and artery, respectively, with 5–0 prolene stitches (Figure 2). The ureters were implanted separately and double-J catheters (6-French) were inserted in each ureter and were withdrawn four weeks after transplantation. The cystoureteric anastomoses (according to Lich-Gregoir technique) were performed using 4–0 Vicryl for each ureter. No intravenous heparin was administered during the procedure. The cold and warm ischaemic times were 14 hours and 45 min, respectively.

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Post-operative recovery was uneventful. Serum creatinine level three weeks after transplantation decreased from 489 to 92 μmol/L. Glomerular filtration rate (GFR) improved from 24 mL/min on the second day to 61 mL/min at three weeks post-surgery. Immunosuppressant drugs used were basiliximab for induction and afterwards cyclosporine, mycophenolate mofetil and methylprednisolone.

Doppler ultrasound scans performed on day one and day four post-operatively showed normal blood supply, normal collecting system and normal (0.70–0.75) renal resistive indices in both kidneys (Figure 3). A renal perfusion study, using a 99MTc-MAG.3 performed 11 days after transplantation, demonstrated that the tracer storage and excretion from both kidneys are normal. Excreted tracer was seen in the bladder at 3 min post-injection. Tmax and T1/2 for laterally located kidney were 3.24 and 16.49 min, for medially located kidney – 3 and 13.24 min, respectively. Hilson perfusion index was not calculated because of the high possibility of error. At three months after transplantation serum creatinine level was 80 μmol/L, GFR increased up to 70.2 mL/min. Ultrasound showed normal blood supply, no hydronephrosis and normal (0.72 and 0.76) renal resistive indices in both kidneys.

The recipient regularly visits outpatient department and sixteen months after the surgery no hydronephrosis or urinary tract infection has been present and serum creatinine level decreased even more, to 61 μmol/L.

DISCUSSION

Deciding the best technique to transplant a paediatric donor's kidney is difficult. In recipients of young age, the most common concerns, when using surgical techniques – EBKT or SKT, are rate of complications and risk of early graft failure. Historically, the main factors that led to reluctance in using paediatric kidneys were technical difficulties in salvage and transplantation, early graft failure, high rates of graft thrombosis, concern for hyperfiltration injury, frequent rejection episodes, suboptimal nephron mass and lack of long term graft and overall survival outcomes [1]. EBKT was originally developed to increase the transplanted nephron mass and to overcome the technical challenges of small diameter vessels performing SKT in paediatric donors. While it has made the technical aspects of procuring and transplanting small paediatric kidneys easier, challenges are still present and surgical experience and technique has been shown to greatly affect outcomes [2].

The number of paediatric donors is low compared to adult donors, therefore EBKTs are uncommon. Between 2000 and 2015, 341 kidney transplantations were performed in our hospital from cadaveric donors and only 33 were from paediatric donors, under 18 years of age. There was only one donor under the age of 5 and his weight was less than 20 kg. The presented EBKT case is the very first in our centre and the first successful in Lithuania.

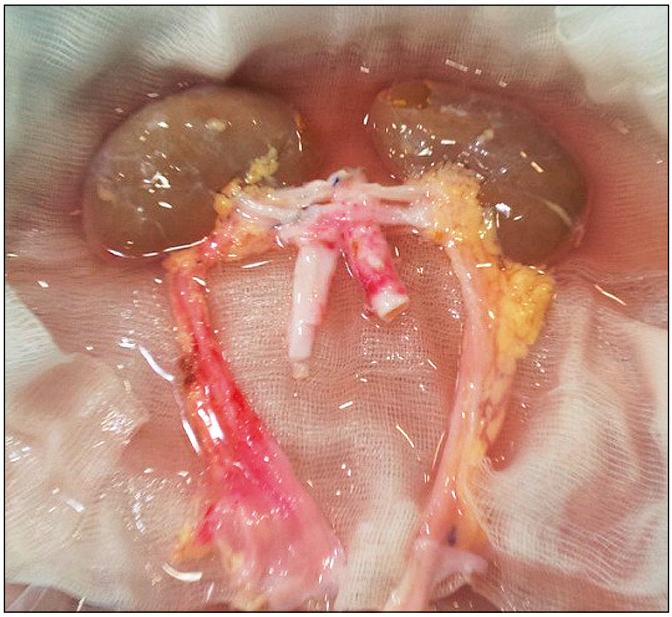

Figure 1. *Retrieved en bloc kidney with the proximal end of the aorta and vena cava over sewn and ureters disected as close to the bladder as possible.*

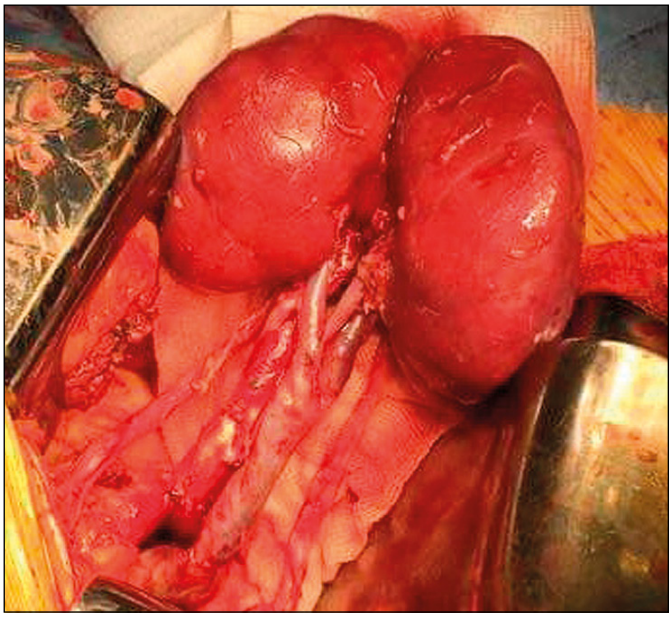

Figure 2. *The distal ends of the vena cava inferior and aorta were anastomosed end-to-side to the recipient external iliac vein and artery, respectively, with 5–0 prolene.*

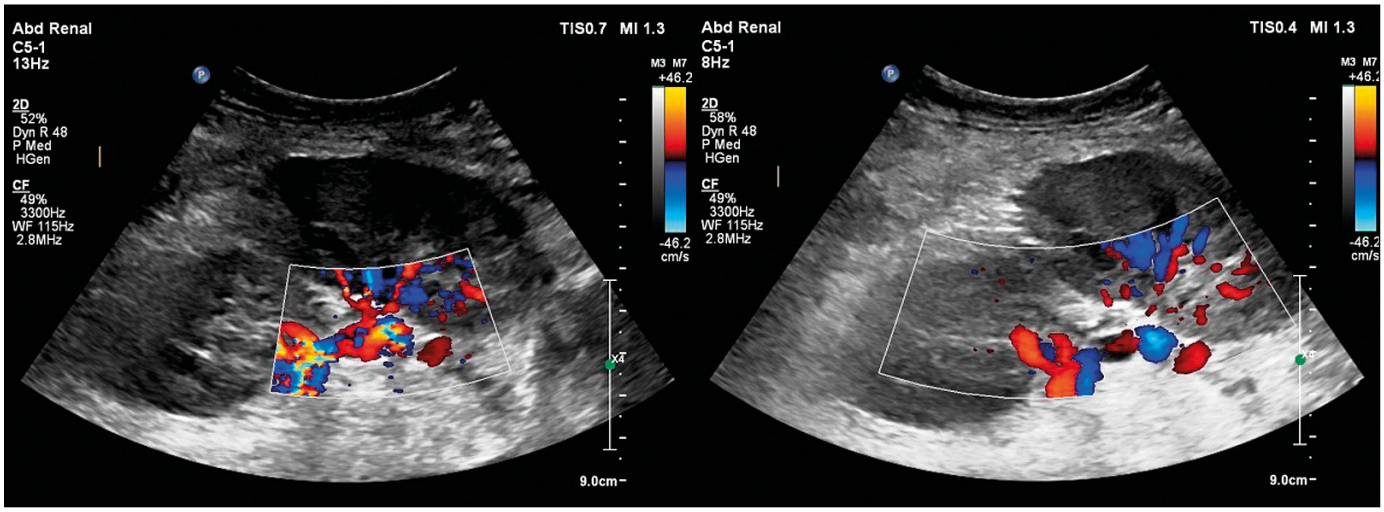

Figure 3. *Doppler ultrasound scans with normal blood supply, not enlarged collecting system and normal renal resistive indices in both kidneys.*

Bhayana et al. used the United Network of Organ Sharing data and reported that pediatric EBKT has better longer term graft survival (GS) than SKT and the best long-term GS over adult standard criteria donor transplant. Despite higher graft loss during the first 12 months post transplantation, the GS probability estimates at 5 and 10 years were 74.8% and 64.0%, respectively, for EBKT compared to SKT rates of 65.2% and 52.5%, and standard criteria donor transplant rates of 75.2% and 57.4%, respectively (P <0.001) [3]. Thomusch et al. reported a 20-year GS from a matched pair study between pediatric EBKT and adult donor grafts. EBKT with a mean donor age of 15 months he also reported a higher early graft loss (first post-operative year) but superior long-term outcomes in GS and function with EBKT (1, 5, 10-year GS of 83.1%, 76%, 73.9% *vs.* 89.6%, 78.7%, 57.8%, respectively) [4]. This confirms good long-term GS results in EBKT.

Another very important aspect is that there are still no accepted guidelines that can be used to determine when it is more appropriate to perform SKT and EBKT in pediatric donors. Recently the <5 years or <20 kg is being used as the cut-off where EBKT is preferred versus SKT. Mohanka et al. compared SKT and EBKT from pediatric donors' ≤15 kg and no significant difference was noted in one-year survival rates between EBKT (79%) and SKT (86%) [5]. Similarly, Kayler et al. found that best GS regarding donor weight for SKT was ≥35 kg and EBKT ≥10 kg. In donors with weight of 10 to 34 kg, EBKT had superior outcomes over standard criteria donor transplant [6]. Bhayana et al. and Sureshkumar et al. showed, that one year after transplantation, EBKT had the same overall survival rates as SKT, and even found that EBKT had more superiority over living donor kidneys [3, 7].

The most common causes for early graft failure are vascular complications, with reported rates of thrombosis between 2.5 to 12.5% and even higher thrombosis rates compared to adult donors [3, 5, 6, 7]. Vessels or kidney torsion, vessel caliber, perioperative blood pressure management, surgical technique, haematomas, lymphocytes and acute rejection have all been suggested as causes for thrombosis [5, 8]. Risk factors for thrombosis in all renal transplants include young donor age (<5 years), cold ischaemia time >24 h, previous recipient transplantation, African-American race and increased panel reactive antibody [5, 9, 10]. Absence of aortic patch in SKT and donor age less than 12 months in EBKT in paediatric donors are also risk factors for thrombosis [7, 10]. Venous, arterial or combined thrombosis, was the dominant etiology of graft failure within 1 year of transplant, occurring in 67 of 1516 (4.4%) of transplants from small pediatric donors. Thrombosis rates were 6.0% (42 of 710) after SKT and 3.0% (25 of 821) after EBKT [11]. Despite the relatively high risk of thrombosis in pediatric donors the routine anticoagulation has not been shown to affect graft thrombosis rates [2, 12].

Acute rejection is another aspect that needs to be considered, as paediatric donors have higher rates of acute rejection compared to adult donors. Bhayana et al. demonstrated acute rejection rates of 6% in EBKT *versus* 9% in SKT and similar results have been reported in other studies [3, 13, 14, 15]. Complications regarding the urinary tract have been reported from 2.5 to 11% in paediatric donor kidneys with no significant differences between EBKT and SKT [5].

Surgical technique is also an aspect that needs to be discussed. In our case we flushed kidneys with University of Wisconsin solution (UWs) from the aorta above bifurcation with inferior vena cava intubation and we found that the amount of solution flow was sufficient to perfuse the kidneys and liver. Peng et al. in one of their cases found that this method is not sufficient and UWs did not flow smoothly. Therefore, in their second case presentation, they chose to incise the thoracic aorta and flush the donor organs using an anterograde approach, and as a result there was no tube inside the abdominal aorta lumen, and the perfusion fluids flowed more smoothly compared with the retrograde approach [16].

Handling the ureter and bladder anastomosis is another concern in transplantations with pediatric donors with small kidneys. In our case, we implanted both ureters separately to the bladder with inserted double-J catheters (6-French). The cystoureteric anastomoses (according to the Lich-Gregoir technique) were performed using 4–0 Vicryl for each ureter. Kato et al. reported successful EBKT that was retrieved with donor's bladder patch that included the vesical trigone. The patch was anastomosed using a running 4-0 polydioxanone suture to the dome of the recipient bladder. After 18 month follow-up the recipient is doing well with normal serum creatinine and no ureterohydronephrosis [17]. Dogan et al. demonstrated another successful EBKT together with both ureters and a partial bladder segment to preserve the natural anti-reflux mechanism in childhood. After 12 month follow-up there was no sign of vesicoureteral reflux [18].

The last question that needs to be raised is the age of the recipient to whom the kidney from a pediatric donor should be offered. Kidneys from small pediatric donors have often been primarily transplanted into other children or small adults. The rationale behind this regarded concerns about causing hyperfiltration injury, whereby compensatory changes in the transplanted kidney result in hypertension, proteinuria, and glomerulosclerosis and ultimately, graft failure [19]. Borboroglu et al. reported that SKT recipients did not experience hyperfiltration injury if the donor's weight exceeded 14 kg and the kidney length exceeded 6 cm [20]. Tittelbach-Helmrich et al. showed that a recipient's BMI of less than 25 kg/m^2, a recipient to donor body weight ratio between 0.2 and 0.25 as well as the absence of renal hypertension played a key role for the outcome of transplantation following pediatric kidney transplantation [21]. Peng et al. found that in their 2 successful paediatric EBKT recipients' BMI was evaluated according to the criterion to ensure that it was below 25 kg/m^2 and the recipient to donor body weight ratio was close to 0.2 [16]. Recently some studies have demonstrated that pediatric transplanted kidneys underwent compensatory hypertrophy to reach normal adult size by approximately 18 months and thereby improve transplant function over time and maintain better glomerular filtration than adult donor kidneys [22]. This shows that no specific selection of recipients is required for pediatric donors.

CONCLUSIONS

Our results and the recent literature demonstrate that pediatric donors are excellent resources that should be procured whenever available. The decision to perform EBKT or two SKTs is difficult. While some centres have reported excellent outcomes with SKT, overall GS is inferior to EBKT. Despite this, paediatric donors are uncommon and surgical experiences limited, and EBKT could be used to expand the donor pool.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

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