Transplantation of en bloc kidneys from cardiac deceased small pediatric donors: 2 case reports and literature review

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ABSTRACT

Objective: To gain an insight into the transplantation with donor kidneys from extended criterion donation after cardiac death (DCD) and to improve the management during and after renal transplantation

Methods: Renal transplantation in 2 patients who used organs from small pediatric donors (<3 years) was performed. The graft kidneys were procured from 1 donor aged 11 months and the other 1 year and 7 months. The 2 donors were diagnosed as brain death caused by serious infantile hepatitis syndrome and severe craniocerebral injury, respectively. After the cardiac death, en bloc organ resection was performed. En bloc kidneys were transplanted to 2 adult recipients who were 37 and 41 years old, respectively.

Results: The recipients were followed-up for 6 months. Both of them developed large volume of bloody drainage in the early post-operative period and relieved after relevant treatment. The kidney grafts functioned well and no other surgical complications or acute rejections happened during the follow-up.

Conclusion: Based on modified peri-operative techniques, it is safe to perform renal transplantation with kidneys procured from cardiac death donors who are younger than 3 years old, an important source to increase the number of organs available for transplantation, yet the vascular complications requir attention.

KEY WORDS

renal transplantation; cardiac death; organ donation; pediatric donor
Society of organ transplantation was perplexed by organ shortage severely. Organ donation after cardiac death (DCD) helps to relieve the tension of organ shortness. In this report, we summed up our experience of 2 cases of DCD renal transplantation with grafts from 2 pediatric donors <3 years.

1 Clinical resources and methods

1.1 Donor’s clinical resource
Donor of the first case (Donor No. 1), an 11-month-old male with 9 kg in weight and Type O blood was diagnosed as brain death because of deterioration of infantile hepatitis syndrome. He was supported by breathing machine, and his blood pressure was maintained by dopamine. Donor of the second case (Donor No. 2), a 1-year-and-7-month-old male with 10 kg in weight and Type O blood was diagnosed as brain death because of severe cranioencephalic injury. He was supported by breathing machine with stable blood pressure. Both of the 2 donors’ routine urine examinations were negative. Other tests included HIV, HBV, HCV, serological examination of virus were also negative. The 2 donors’ daily urine volumes were normal, and their serum creatinine values were 60 µmol/L and 67 µmol/L, respectively.

1.2 Recipient’s clinical resource
Recipient of the first case (Recipient No. 1) was a 37-year-old female with 47 kg in weight and body mass index (BMI) of 19.6. Recipient of the second case (Recipient No. 2) was a 41-year-old male with 51.5 kg in weight and BMI of 18.9. Both of the 2 recipients were Type O blood, and their primary diseases were chronic glomerulonephritis. The serum creatinine values before the transplantation were 1 204 µmol/L for recipient No. 1 and 1 306 µmol/L for recipient No. 2. Both of their HBV and syphilis were negative.

1.3 Immunologic match
Panel reactive antibody (PRA) of the 2 recipients were negative, and lymphocytotoxicity tests were also negative (<5%). Number of human leucocyte antigen (HLA) mismatch was 2 in both of the recipients.

1.4 Procurement of the donor kidney
After the patient was qualified as a potential donor, the coordinator of organ donation of the Red Cross Society was informed and intervened. All of the direct relatives of the patient claimed to give up further medical treatments and asked the doctors to withdraw the life support devices. All of the legal files including the informed consent were signed. The donors were sent to the operation room and respiratory machines were removed there. Heart beat stopped 10 minutes later in the donor No. 1 and 15 minutes later in donor No. 2. Cardiac death was diagnosed by an ICU specialist 2 minutes after cardiac arrest. Then, the organ procurement group (OPO) intervened. En bloc resection was performed in donor No. 1 with 2 000 mL hypothermia University of Wisconsin solution (UWs) perfused via F10 balloon catheter from aortic artery above bifurcation and with inferior vena cava intubated as efferent tract. As the liver of donor No. 1 was not suitable for donation, portal vein was not flushed. In the donor No. 2, we chose to incise the diaphragm and open the pleural cavity, then thoracic aorta was incised and an F14 rigid cone-tipped catheter was inserted via the incision, with...
the intubation depth being 2–3 cm. Perfusion started after fixation of the pipe and en bloc resection followed.

1.5 Trim of the donor kidney
Donor's kidneys were sent to aseptic work table where they were trimmed and stored in hypothermia UWs. Lumbar arteries and veins were connected to abdominal aorta and inferior vena cava was ligated. In the kidney of donor No. 1, the distal end of abdominal aorta and inferior vena cava of the donor kidney were closed with 7-0 prolene suture, and 3 cm proximal end of those vessels retained. However, in the kidney of donor No.1 the proximal end was closed and 3 cm distal end retained.

1.6 Kidney transplantation
En-bloc kidney (EBK) transplantation was performed in both cases. In recipient No. 1, proximal end of donor abdominal aorta was end-to-side anastomosed with the external iliac artery of recipient, and the proximal end of the donor inferior vena cava was also end-to-side anastomosed with the external iliac vein. Two fixed-point anastomosis approach was used with 7-0 Ethicon polyglyconate sutures. Anterior wall was interrupted sutured and posterior wall was continuously sutured. In recipient No. 2, the proximal end of donor abdominal aorta and inferior vena cava were closed and the distal end of them was end-to-side revascularized with the external iliac vessels of recipient. Ureter of graft was anastomosed with bladder via a submucous tunnel. Two drainage tubes were placed in operative field. Time of warm ischemia was 5 minutes in both cases. Cold ischemia time was 6 hours in the first case and 9 hours in the second case.

1.7 Program of immunosuppression
Methylprednisolone was prescribed 1 gram in the first 24 hours, and 0.5 gram in the next 24 hours. Then it was transferred to oral methylprednisolone tablet with the initial dosage of 64 mg/d, which decreased by 8 mg per day to 16 mg/d. Tacrolimus was taken orally in the first 24 hours after surgery with the initial dose of 0.1 mg/(kg·d) and the target concentration was 6–10 ng/mL. Cellcept was given in the first 24 hours after the transplantation with the dose of 1.5 g/d. Low molecular weight heparin (5 000 U/d) was subcutaneously injected. Thymoglobuline (ATG) was prescribed 25 mg daily for up to 3 days in the first recipient but not in the second recipient.

2 Results
Both of the kidney grafts functioned and micturated 2 minutes after blood reperfusion. The daily urinary volume was 2500–3 000 mL in the first recipient and 2500–7 000 mL in the second recipient. Neither rejection nor embolism occurred. The volumes of bloody drainage in the first recipient and the second recipient were 600 mL and 500 mL in the first 24 hours after surgery, respectively. Blood transfusion was not prescribed, and heparin was withdrawn the next day in both recipients. The bloody drainage decreased to 200 mL in the next 24 hours and gradually ceased, as shown in Figure 1. The levels of serum creatinine in the first recipient and the second recipient were 110 µmol/L and 140 µmol/L on the Day 7 after surgery, respectively. The recipients were discharged from hospital on the Day 14 after surgery. Three months after surgery, the levels of serum creatinine in the first recipient and the second recipient decreased to 62 µmol/L and 105 µmol/L, respectively.

3 Discussion
The number of patients awaiting transplantation continues to increase, creating a shortage of donor organs. One of the feasible resolutions is to adopt extended criterion of organ donation, including very old adult or very small pediatric donors. Because of the higher population in China, there were lots of potent pediatric donors who were diagnosed as brain death caused by inherent or acquired severe diseases. If part of the potent donors became available, it could relieve the shortage of the organ to the utmost degree. However, problems exist not only in the issue of organ donation but also in the surgical technique, the later was even more challenging in
the condition of that the pediatric donor was under 3 years old.

In the early years, there were several case reports on EBK transplantation with donor kidneys from fetus of anencephaly both domestically and abroad, whereas it was ceased with severe ethical problems. In recent years pediatric organ donation was pushed forward owing to the enforcement of the laws and regulations related to the organ donation after cardiac/brain death. So far the enforcement of the laws and regulations related to pediatric organ donation was pushed forward owing to the condition of that the pediatric donor was under 3 years old. The main causes for early graft loss were thrombosis in 2 cases and graft disruption in 1 case. Other post-operative complications included delayed graft function (DGF), urine leakage, and hemorrhage.

Here we added 2 successful experiences. One donor was 11 months old and the other was 1 year and 7 months, who belonged to infant and toddler period donors, respectively. Children <3 years had characteristics of low weight, usually < 20 kg, and their organs were not well-developed. As the ureters and vessels of pediatric kidneys are thin, it is a challenge for surgeon to perform the transplantation. It was reported that the discard rate of kidneys from low weight donors is high, and that in the subgroup <10 kg is even higher than that in the 10–20 kg subgroup (40.3% vs 10.5%) [5].

With respect to pediatric donors <3 years, criteria to determine when to split pediatric donor kidneys are not well established and are still controversy issues. Normally, EBK transplantation is a suitable way [6-7]. In rare cases single kidney from pediatric donor (5–10 kg) was transplanted either intentionally or unexpectedly [8]. Single kidney transplants from very young age donors are associated with a significantly higher rate of DGF and graft loss than EBK transplants [8].

The choice of suitable recipient is also very important. Tittelbach-Helmrich et al. [9-10] recommended that a recipient’s BMI of less than 25 kg/m², 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. In our research, the 2 recipients’ BMI was evaluated according to the criterion to ensure that it was below 25 kg/m² and the recipient to donor body weight ratio was close to 0.2.

To ensure the success, some modifications were introduced based on the surgery techniques in adult. Guarantee of the donor kidney quality is the basis for transplant success. Firstly, it is beneficial to flush and store the donor kidney with UWs in contrast with hypertonic citrate adenine solution (HCA). Secondly, efficient perfusion is also important. In the first case, F10 balloon catheter was intubated into aorta abdominals right above the level of aortic bifurcation, however, we found that the UWs did not flow smoothly because of the small artery diameter. Therefore, in the second case, this method was abandoned. We chose to incise thoracic aorta and flush the donor organs with antegrade approach, as a result there was no tube inside the cavity of aorta abdominals, and the perfusion fluids flowed more smoothly compared with retrograde approach.

The major factor for influencing the graft survival is the early complication, especially the thrombosis. Several studies have reported that in renal transplantation with small pediatric donors (15–20 kg or <2 years of age), the thrombosis rates range from 2.5% to 12.5% [9-10]. Graft thrombosis has been attributed to hypotension or hypoperfusion, small vessel size, torsion of the vessels, thrombus formation within the blind end of aorta and/or cava, hypercoagulable state, and acute rejection. Surgical technique also influences outcomes [9-10]. As vascular complication is the most frequent cause of graft loss for the EBK, more attention should be paid to vascular anastomosis in kidney transplantation, especially for the infant and toddler period donors. The normal surgical approach is to connect the distal end of abdominal aorta and inferior vena cava of the donor kidney to external iliac artery and vein of the recipient by end-to-side while the proximal end of abdominal aorta and inferior vena cava is closed, which was used in the second case. However, in our first case, the distal end of abdominal aorta and inferior vena cava of donor kidney was closed while the proximal end of it was connected to the recipient. The difference between the 2 surgical approaches might result in different chances to form blood vortex and thrombus, which still need large samples and long-term observation to prove.

Hemorrhage is also the main complication. Firstly, it might be attributed to anti-coagulation drugs which are prescribed in most cases to prevent thrombosis [4]. Secondly, in small pediatric donors, the lumbar arteries and veins connected to abdominal aorta and inferior vena cava are so small as to be ignored while trimming the kidney. Such ignorance might lead to intra-operative and post-operative hemorrhage and should be avoided. In our transplant center, the placement of 2 drainage tubes in operative field was widely used. This method is proved to be useful, and the exudate in operative field could be drained thoroughly. It is more beneficial to the recipients who need the anti-coagulant therapy. In our study, large
volume of bloody drainage was found in 2 recipients who received anti-coagulant therapy in the first 24 hours after surgery, however, the bloody drainage gradually regressed after ceasing the anti-coagulant therapy as shown in Figure 1. Ultrasonography exam showed no effusion or hematoma which might suppress the allograft vessels and ureter. Therefore, with unobstructed drainage and undistorted vessels, the bloody drainage would be gradually regressed in 2–3 days owing to the functional recovery of graft kidney, and there is no complication which required operative intervention. Vitamin K could be added to promote the production of endogenous coagulation factors, if necessary, transfusion therapy or operative intervention should be adopted for patient’s safety. The use of the biological agents such as ATG prior to transplant and the reduction of hormone therapy can promote tissue recovery and healing, which may help to prevent complications such as urinary fistula and hemorrhage, and to reduce the rejection.

In summary, based on the modified operative techniques we successfully performed 2 cases of en bloc kidney transplantation with the graft from very small pediatric donors. Such transplantation would become more common with the modification of donation policies.

References


