

Successful Kidney Transplantation using Deceased Donor Kidney with Acute Tubular Necrosis

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We present here a case of success kidney transplantation from a deceased donor who showed a serum creatinine level of 5.5 mg/dl. A 52-year-old Asian female with blood type O was determined to be brain death after a compressive craniectomy. Her post-operative course was fatal. She had experienced acute renal failure with oliguria, and these conditions had persisted for 3 days, and the serum creatinine level was elevated up to 5.5 mg/dl. The random urine creatinine, sodium and osmolality levels were 17.6 mg/dl, 116 mmol/L and 346 mOsmol/L, respectively. However, the ultrasonographic and pathologic findings did not show any chronic structural abnormality in the kidneys. Two female patients with blood type O were transplanted with these donor kidneys. Both recipients experienced 2~3 days of delayed graft function, but the graft function was fully recovered at 4~5 day after transplantation. Both recipients were discharged with full-functioning grafts (1.1 and 0.9 mg/dl of serum creatinine, respectively). This shows that a deceased donor with reversible kidney damage, and even one showing a high serum creatinine level, can be acceptable for transplantation if the absence of chronic renal damage is confirmed by pathologic study. (*J Korean Surg Soc* 2008;75:430-433)

Key Words: Extended criteria donor, Serum creatinine, Reversible kidney damage

INTRODUCTION

In order to increase donor pools, transplantation using marginal donors or extended criteria donors (ECDs) has sometimes been accepted. Elderly donor, history of hypertension, brain death by cerebrovascular accident, and high serum creatinine (more than 1.5 mg/dl) were inclusion criteria of ECDs for kidney transplantation.(1) The negative effects of donors with high serum creatinine level on delayed graft function (DGF) and graft survival is well documented.(2) However, the elevation of serum creatinine

level does not directly indicate irreversible damage of a donor kidney.(3) Reversible kidney damage, such as toxic or ischemic acute renal failure, often occurs in brain dead patients. A few experiences using reversibly-damaged kidneys from deceased donors have been reported.(4)

Here, we present a case of successful kidney transplantation from a deceased donor with ischemic acute tubular necrosis, who showed a serum creatinine level of 5.5 mg/dl.

CASE REPORT

The patient was a 52-year-old Asian female with blood type O. The past medical history of the patient did not include malignancy or diabetes, but the patient did have a 10-year history of hypertension, which was controlled with anti-hypertensive medication. The patient fell into full

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coma suddenly, and was diagnosed with an acute subdural hematoma. In spite of decompressive craniectomy and hematoma evacuation being performed, the brain damage was irreversible. Brain death was diagnosed at 4 days after the operation by the Hospital Committee for Brain Death, and organ donation was approved.

The pre-craniectomy serum creatinine level was 0.9 mg/dl and urine protein was negative. Hypotensive episode and diabetes insipidus-induced diuresis were persistent for 2 days after the operation. At 3 days after the operation, the serum creatinine level reached 4.7 mg/dl, and the daily urine output was decreased to less than 1,000 ml. The systolic blood pressure was maintained by using 8 μ g/kg/min of dopamine and 0.1 μ g/kg/min norepinephrine. The blood urea nitrogen (BUN) and creatinine levels were 39.9 and 5.2 mg/dl, respectively, and were maintained at 40.9 and 5.5 mg/dl until organ donation at 5 days after the operation (Fig. 1). Random urine creatinine, sodium, and osmolality levels were 17.6 mg/dl, 116 mmol/L, and 346 mOsmol/L, respectively. Therefore, the BUN/creatinine ratio was 8.04, fractional excretion of sodium was 21.1%, and the urine/plasma creatinine ratio was 3.2. All laboratory findings suggested intrinsic renal disease. Ultrasonographic evaluation did not show anatomic structural abnormality in either kidney. We inferred that the renal disease was ischemic acute tubular necrosis (ATN). We decided to use the donor kidneys if there were no

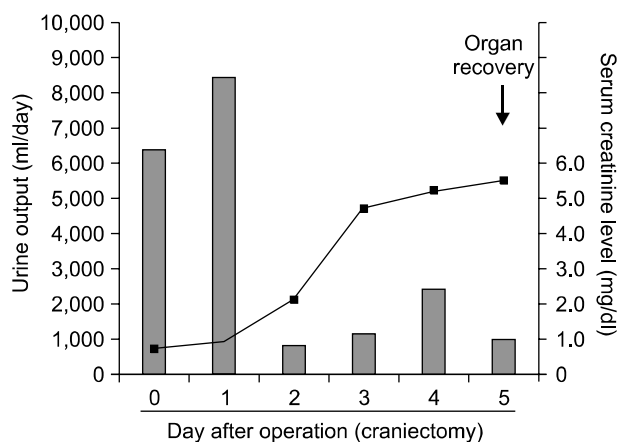


Fig. 1. Daily change of urine output and serum creatinine level of the deceased donor prior to organ donation.

pathologic findings on the renal biopsy.

Two stage 5 chronic kidney disease (CKD) patients without diabetes were enrolled as recipient candidates. One candidate was a 29-year-old female who had been on hemodialysis for 77 months, and the other candidate was a 44-year-old female who had been on peritoneal dialysis for 57 months. Both recipient candidates were blood type O and 3 Ag-mismatch with the donor, and both candidates were eligible for primary transplant and had a low body mass index (BMI) (16.5 and 20.0 kg/m^2 , respectively). Informed consent for acceptance of an extended criteria donor kidney was obtained from recipient candidates.

At 5 days after the operation, multivisceral organ recovery was performed in the normal manner. Cold perfusion was performed using histidine-tryptophan-ketoglutarate (HTK) solution. Grossly, both kidneys showed a normal appearance and consistency. Kidney biopsy by true-cut needle was performed. The frozen biopsy reading was reported as no histologic abnormality (Fig. 2). Permanent section revealed rare granular casts. Kidney transplantations for each recipient was simultaneously performed in the normal manner. The first recipient was given the left kidney (kidney weight=275 g) with 5 hours of cold ischemic time (CIT), and the second recipient was given the right kidney (kidney weight=292 g) with 6 hours of CIT.

Induction immunosuppression, composed of polyclonal anti-thymocyte antibody and steroid, was performed in

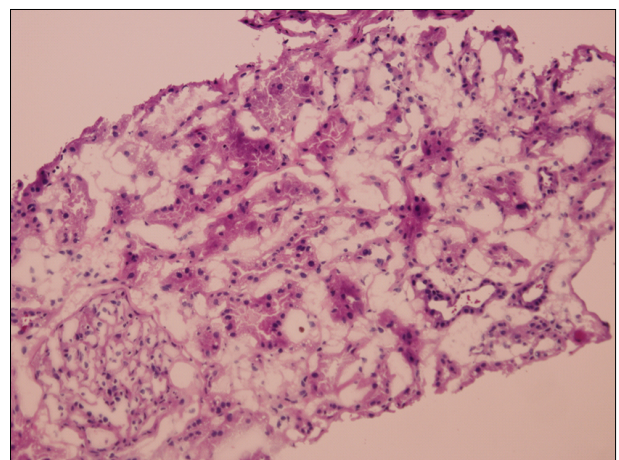


Fig. 2. Histopathologic findings of the kidney from the deceased donor (H&E stain, $\times 100$).

both recipients. Infusion of anti-thymocyte antibody was maintained for 10 days after transplantation, followed by the administration of cyclosporine (CsA) and mycophenolate mofetil as maintenance immunosuppressive regimens. Methylprednisolone was used as an induction steroid and tapered to prednisolone (10 mg per day) as a maintenance dose.

The first recipient showed post-transplant oliguria for 2 days after transplantation. Renal function was fully recovered at 4 days after transplantation (daily urine out > 2,000 ml). The first recipient was discharged at 21 days after transplantation without complications or acute rejection. The BUN and creatinine levels at discharge were 18.5 and 1.1 mg/dl, respectively. The second recipient, who was older than the first recipient, suffered from post-transplant oliguria for 3 days, and recovered at 5 days after transplantation. Without complications, the second recipient was also discharged with a well-functioning graft (31.2 mg/dl of BUN and 0.9 mg/dl of serum creatinine level) at 25 days after transplantation.

DISCUSSION

The shortage of organs available for transplantation is a worldwide problem. For countries in which the occurrence of deceased donors is extremely rare, such as Republic of Korea and Japan, maximal utilization of deceased donor organs is necessary. Because the blood type O patient restrictively receives organs from donors with blood type O, the chance of allocation to a blood type O patient is relatively lower than that for potential recipients with other blood types. Therefore, unusual use of blood type O donors for blood type O transplant candidates is necessary. This is the main motivation of using organs from a donor that showed an extremely high level of serum creatinine (5.5 mg/dl) in this case.

The quality of a donor kidney is a key parameter in decision about the acceptability of an organ. Many quantitative or qualitative criteria were developed for the assessment of organ quality.^(5,6) The donor age was found to be the strongest parameter affecting post-transplant graft

survival and function.⁽⁷⁾ In the United Network for Organ Sharing (UNOS), an elderly donor greater than 60 years of age is regarded as ECD.⁽¹⁾ History of hypertension, cerebrovascular accident-related brain death, and high serum creatinine in fifties aged donor were additional criteria for ECD.⁽¹⁾ The high serum creatinine level was an independent risk factor affecting post-transplant graft survival and function. Particularly, the final serum creatinine level measured just before organ recovery was a strong predictor of graft failure and delayed graft function (DGF).⁽⁸⁾ However, extended criteria took less into consideration about the reversibility of renal damage. The natural course of acute renal damage is different from that of chronic renal damage. The majority (more than 90%) of acute renal damage is caused by ischemic or toxic ATN, and such renal damage is reversible and may recover within 3 weeks. Therefore, the use of a donor kidney affected by reversible kidney disease is reasonable.

The permanent damage to the kidney can be confirmed by pathologic findings. Glomerulosclerosis, tubular atrophy, and interstitial fibrosis are typical pathologic findings. These morphological changes and a quantified score were found to be linearly correlated with post-transplant graft survival rates.⁽⁹⁾ Because the detection rate of positive pre-transplant pathologic findings was very small, the routine application of pre-transplant biopsy was not recommended.⁽⁹⁾ However, elevation of serum creatinine and oliguria are major hallmarks of permanent renal damage. Therefore, a pre-transplant kidney biopsy should be performed to assess a potential donor who has an extremely high serum creatinine level. In this case, both a radiological imaging study and a pre-transplant renal biopsy were performed. The pre-transplant pathologic confirmation of the absence of irreversible kidney disease was determined to be essential for kidney transplantation using an ECD kidney.

It is generally accepted that an ECD kidney has a suboptimal nephron mass. Therefore, ECD kidneys are allocated to patients who have low metabolic or immunologic demand, such as patients who are elderly (more than 40 years old), have low BMI, are primary transplants, have

well-matched HLA, and show low Panel Reactive Antigen (PRA) titers.⁽¹⁰⁾ In this case, we found two appropriate recipient candidates using the above mentioned principles. Both recipients were primary transplant patients and 3-antigen-mismatched in terms of immunologic demand, and both patients were female with low BMI.

In conclusion, deceased donors with reversible kidney damage, even those showing high serum creatinine levels, can be acceptable as donors for kidney transplantation if the absence of chronic or irreversible renal damage is confirmed by pathologic study.

REFERENCES

- 1) Port FK, Bragg-Gresham JL, Metzger RA, Dykstra DM, Gillespie BW, Young EW, et al. Donor characteristics associated with reduced graft survival: an approach to expanding the pool of kidney donors. *Transplantation* 2002;74:1281-6.
- 2) Chen CH, Hsu KH, Yang CR, Cheng CH, Wu MJ, Lian JD. The impact of donor serum creatinine level on long-term outcome of renal allografts. *Transplant Proc* 2000;32:1595-6.
- 3) Pokorná E, Schüick O, Vitko S, Ekberg H. Estimated and measured creatinine clearance are poor predictors of long-term renal graft function and survival. *Am J Transplant* 2002;2:373-80.
- 4) López-Navidad A, Caballero F. Extended criteria for organ acceptance. Strategies for achieving organ safety and for increasing organ pool. *Clin Transplant* 2003;17:308-24.
- 5) Nyberg SL, Matas AJ, Rogers M, Harmsen WS, Velosa JA, Larson TS, et al. Donor scoring system for cadaveric renal transplantation. *Am J Transplant* 2001;1:162-70.
- 6) Schold JD, Kaplan B, Baliga RS, Meier-Kriesche HU. The broad spectrum of quality in deceased donor kidneys. *Am J Transplant* 2005;5:757-65.
- 7) Mizutani K, Ono Y, Kinukawa T, Hattori R, Nishiyama N, Kamihira O, et al. Use of marginal organs from non-heart-beating cadaveric kidney donors. *Transplantation* 2001;72:1376-80.
- 8) Parzanese I, Maccarone D, Caniglia L, Pisani F, Mazzotta C, Rizza V, et al. Risk factors that can influence kidney transplant outcome. *Transplant Proc* 2006;38:1022-3.
- 9) Howie AJ, Ferreira MA, Lipkin GW, Adu D. Measurement of chronic damage in the donor kidney and graft survival. *Transplantation* 2004;77:1058-65.
- 10) Stratta RJ, Rohr MS, Sundberg AK, Armstrong G, Hairston G, Hartmann E, et al. Increased kidney transplantation utilizing expanded criteria deceased organ donors with results comparable to standard criteria donor transplant. *Ann Surg* 2004;239:688-95.