# Illinois Statewide Dual Kidney Transplantation Experience—Are We Appropriately Selecting Kidneys?

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**Abbreviations and Acronyms**

CIT = cold ischemia time
DCD = donation after cardiac death
DGF = delayed graft function
DKT = dual kidney transplant
DM = diabetes mellitus
DSA = donation service area
ECD = expanded criteria donor
GS = glomerulosclerosis
HTN = hypertension
MP = machine perfusion
OPO = organ procurement organization
SKT = single kidney transplant

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**Purpose:** Dual kidney transplantation is a technique that some transplant centers have adopted to increase organ use. We investigated whether kidneys that were recovered and discarded were similar to those kidneys used for dual kidney transplantation.

**Materials and Methods:** We reviewed all kidneys recovered, biopsied and placed on machine perfusion in the state of Illinois from January 2002 to October 2009. We selected those kidneys used in dual kidney transplant, and compared their characteristics to those of kidneys that were recovered and biopsied but ultimately discarded. The immediate and 1-year outcomes of the dual kidney transplant recipients were analyzed.

**Results:** During the study period 60 dual transplants were performed while 94 kidney pairs were discarded. Overall donors from the used group had a lower mean creatinine clearance, older mean patient age, lower percentage of glomerulosclerosis, higher final flow rate and lower resistance. However, the comparison between those kidneys used successfully with 1-year graft survival and those discarded demonstrated only 3 less favorable parameters among the discarded group, namely a higher percentage of glomerulosclerosis (18.5% vs 13.9%, $p = 0.024$), a higher degree of interstitial fibrosis and a higher final resistance (0.39 vs 0.31, $p<0.001$).

**Conclusions:** The considerable overlap in demographics, histology and perfusion parameters between used and discarded kidneys suggests that many kidneys that were recovered and discarded could have been used in dual kidney transplantation with acceptable outcomes. This highlights the need for further study of how kidneys are selected and used.

**Key Words:** kidney transplantation, perfusion, graft survival

Since the Crystal City report was published proposing guidelines to maximize the use of organs recovered from deceased donors,[1] there has been an increase in the number of patients consented for organ donation, kidneys recovered and kidneys ultimately transplanted. Although the total number of kidneys recovered in the last decade has increased by nearly 4,000 over the number from the prior decade, the proportion of these kidneys that are ultimately discarded has also increased significantly from 10% in 1998 to 17% in 2007.[2] A factor which has likely contributed to this phenomenon is the increased recovery of DCD and ECD kidneys.[3]

Studies examining the factors that determine whether a kidney is used



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or discarded have found that biopsy findings, the use of machine perfusion and the donation service area from which the kidney originates all have a role in the selection process.[4] Some studies have reported that kidneys with a higher percentage of glomerulosclerosis on biopsy are associated with worse outcomes,[5,6] but other studies have not corroborated these findings.[7,8] Thus, there is no clear consensus regarding the importance of GS in kidney selection. Additionally, kidneys placed on MP have been shown to have a lower incidence of DGF,[9] increased use[10] and improved 1-year graft outcomes.[11]

Dual kidney transplantation, a technique that some transplant centers have adopted to increase organ use, has traditionally been performed when pediatric kidneys are offered for an adult patient or when it is believed that a single kidney would not suffice due to the marginal status of the donor. Recent studies have shown that DKT provides excellent long-term outcomes even when performed with kidneys classified as DCD or ECD.[7,12,13] Despite numerous studies demonstrating that patients who undergo kidney transplantation have improved survival and quality of life compared with those who remain on dialysis[14] even when marginal kidneys are used,[15] thousands of kidneys are recovered and then discarded each year. All agree we must increase our efforts to maximally use the existing supply of deceased donor kidneys. To determine whether those kidneys ultimately discarded could possibly have been used successfully with DKT, we examined the Illinois statewide experience of DKT, and compared the characteristics of kidney pairs used for DKT with those of kidneys that were recovered, biopsied and perfused but then discarded.

## MATERIALS AND METHODS

With institutional review board approval a review of all kidneys recovered and subsequently placed on MP in the state of Illinois from January 2002 to October 2009 was performed. Information was extracted from a database which is maintained prospectively by the organ procurement organization serving the entire state of Illinois. This OPO served 8 transplant centers during the study period. Donor demographic and clinic data were entered into the database as recorded by the OPO transplant coordinator at the time of donation. Creatinine clearance was calculated using the Cockcroft-Gault equation. Recipient followup information was reported from the transplant center to the OPO at 1 week, 1 month, 6 months and 1 year. Restricted access to this database was granted by the OPO director.

All kidney pairs used for DKT were identified. The donor demographics, kidney biopsy results and MP parameters were analyzed. The characteristics of these kidneys were then compared with available organs that were biopsied and perfused but ultimately discarded. To see if there were differences between the discarded pairs and those used successfully in DKT, we selected only recipients with functioning grafts after 1 year of followup. The donor demographics, kidney biopsy results and MP parameters of these proven kidneys were compared with those that were discarded.

All biopsies were reviewed by a single pathologist employed by the OPO. GS was reported as a raw percentage in the original database, and for the purposes of analysis the kidneys were categorized into group 1—0% to 5%, group 2—6% to 10%, group 3—11% to 15%, group 4—16% to 20%, group 5—21% to 25% and group 6—greater than 25% GS. Arteriolosclerosis was reported as none, mild, moderate or severe. Interstitial fibrosis was reported by the pathologist as none, mild, moderate or severe, and kidneys were analyzed according to these groupings. All kidneys included in this analysis were placed on MP according to the OPO protocol to place all DCD and ECD kidneys on MP or at the discretion of the OPO medical director. Kidneys were perfused using a LifePort® Kidney Transporter or RM3 (Waters Medical Systems, Rochester, Minnesota) perfusion machine. Statistical analysis was performed using SPSS® 16.0 for Windows. Bivariate analyses included chi-square tests of association and t tests, with results considered significant at $p < 0.05$.

## RESULTS

During the study period 60 DKTs (120 kidneys) were performed and 94 pairs (188 kidneys) were discarded. The donor demographic and clinical data as well as the kidney biopsy results and perfusion parameters are detailed in table 1. Mean ± SD cold ischemia time for the used group was 26.3 ± 7.5 hours. A total of 15 (25%) DKT recipients experienced DGF, defined as the need for some form of renal replacement therapy in postoperative week 1.

Overall donors from the discarded group had a higher mean admission creatinine clearance (87.4 vs 76.9, $p = 0.008$) and a younger mean age (57 vs 62, $p < 0.001$) than those in the used group. There were no significant differences in initial and final creatinine levels, the proportion of patients with HTN and DM, or biopsy findings of interstitial fibrosis and arteriolosclerosis between the groups. However, those in the used group did have a lower mean percentage of glomerulosclerosis (14.7 ± 12.1 vs 18.5 ± 17.9, $p = 0.042$), higher final flow rate and lower resistance.

There were 58 recipients (97%) with a complete set of 1-year followup data. Of these patients 50 (87%) were alive off dialysis, 4 (7%) were alive on dialysis and 4 (7%) were deceased. The mean serum creatinine of the 50 patients off dialysis was 10.69 ± 0.68 mg/dl at 1 year. A comparison between those kidneys used successfully with 1-year graft survival and those discarded is presented in table 2. We found that all parameters were similar between the groups except younger donor age (57 vs 62, $p = 0.001$), higher admission creatinine clearance (87.4 vs 76.6,