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Outcomes of Live Kidney Donors who Develop End Stage Renal Disease

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Abstract

Background—Kidney donors can develop ESRD after donation, but the outcomes of those who do remain poorly characterized.

Methods—Using USRDS and SRTR data, we compared access to kidney transplantation (KT), time from ESRD to listing, time from listing to KT, and post-KT graft failure and death between donors and matched nondonors with ESRD.

Results—Among 99 donors between April 1994 and November 2011 who developed ESRD, 78 initially received dialysis (of whom 37 listed for KT, 2 received live donor KT without listing, and 39 never listed for or received a KT), 20 listed preemptively (of whom 19 were subsequently transplanted), and 1 received a preemptive live donor KT without listing or ever receiving dialysis. Donors were listed earlier (median time-to-listing 17 months versus 120 for nondonors; $p < 0.001$), received KT earlier (median waiting-time 2.8 months versus 21.5 for nondonors; $p < 0.001$), and received 13% live donor, 87% standard criteria, and 0% expanded criteria deceased donor KT (39%, 50%, and 11% in nondonors). Post-KT graft failure (adjusted hazard ratio [HR], 1.9; 95% confidence interval [CI], 0.9 to 4.1; $p = 0.1$) and patient mortality (HR, 0.7; 95% CI, 0.2 to 2.4; $p = 0.5$) were comparable in donors and nondonors.

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DISCLOSURE

The authors of this manuscript have no conflicts of interest to disclose.

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Conclusions—Our finding that 39 of 99 donors who developed ESRD never listed for a transplant warrants further study to ascertain why these donors with ESRD never gained access to the waiting list.

INTRODUCTION

Carefully screened live kidney donors have a demonstrated, albeit low, risk of end stage renal disease (ESRD) following donor nephrectomy.^{1–5} We have previously reported 99 cases of ESRD among 96,217 donors between April 1994 and November 2011 in the United States;⁴ however, the sequelae of ESRD following donor nephrectomy remain poorly characterized.

Although the optimal treatment for ESRD is KT,⁶ and although the transplant community has a responsibility to ensure that live donors who develop ESRD receive optimal care, barriers to KT are known to exist even for patients who would be good KT candidates. In a national study of all incident ESRD patients in the US, 30% were not informed about transplantation, of which 42% were not even assessed for suitability of KT by their dialysis provider (let alone by a transplant center).⁷ Although donors who develop ESRD, because of their prior contact with the transplant community, are likely to know more about KT than other patients with ESRD, it remains unknown whether listing practices in this population are optimal.

Also, although locally recovered standard criteria deceased donor organs are allocated preferentially to donors who later list for KT,⁸ the impact of waitlist priority on utilization of live versus deceased donor KT and on post-KT outcomes remains unknown. It is certainly possible that this allocation priority might have the same effect that a similar priority had for children, namely the unintended consequence of decreased live donation to the prioritized population.⁹

To better understand whether listing practices and transplant rates in live donors who subsequently develop ESRD are optimal, and whether the waitlist priority given to donors affects utilization of deceased versus live donor transplant options and post-KT outcomes, we compared overall mortality after ESRD diagnosis, time from ESRD to listing, time from listing to transplantation, and post-KT graft and patient survival in donors with ESRD versus demographically and clinically matched nondonors.

METHODS

Data sources

This study used data from the Scientific Registry of Transplant Recipients (SRTR). The SRTR data system includes data on all donor, waitlisted candidates and transplant recipients in the United States, submitted by the members of the Organ Procurement and Transplantation Network (OPTN) and has been described elsewhere.¹⁰ The Health Resources and Services Administration, US Department of Health and Human Services, provides oversight to the activities of the OPTN and SRTR contractors.

This study also used data from the United States Renal Data System (USRDS), a national registry that captures Centers for Medicare & Medicaid Services (CMS) reporting forms for all patients who develop ESRD in the United States, to determine outcomes (including listing, receipt of transplant, graft failure, and death) after ESRD onset.

Study population

SRTR data were linked to CMS data by the SRTR to identify donors from April 01, 1994 to November 30, 2011 who developed ESRD. These donors were matched to nondonors at various points along the road from ESRD to listing for transplantation, receipt of a transplant, and post-transplant outcomes as described below.

Outcome ascertainment

Incident ESRD was defined as the initiation of maintenance dialysis, placement on the waiting list, or receipt of a living or deceased donor KT, whichever was identified first.⁴ This information was also available through USRDS for matched nondonors. Among KT recipients, graft loss was defined as the resumption of maintenance dialysis, relisting for KT, or retransplantation. SRTR and USRDS data are linked by the respective organizations to the Social Security Master Death File for augmented ascertainment of death, and to CMS data for augmented ascertainment of both death and graft loss.

ESRD to death and ESRD to listing

Using iterative expanded radius matching,^{4,11–15} each of the 99 donors with ESRD was individually matched to five nondonors with ESRD drawn from the USRDS registry. Matching was based on age, sex, race-ethnicity, year of ESRD-onset, and cause of ESRD (categorized as hypertension, glomerulonephritis, diabetes, other/unknown). Donors who joined the waitlist or received a KT preemptively (i.e. before initiating dialysis) were considered to have developed ESRD at the time of listing or KT event. For mortality analyses, donors and nondonors were followed until death or censoring.

Listing to transplant

Those transplanted preemptively were considered to have achieved transplantation at the time of listing. For this analysis, iterative expanded radius matching was used to match each donor who listed or who received a preemptive KT with five nondonors drawn from the SRTR registry who were listed or received preemptive KT. Matching was based on panel-reactive antibody level (PRA) (0–9%, 10–79%, and 80–100%), ABO, year of listing, age at listing, sex, race-ethnicity, cause of ESRD, and BMI.

Post-transplant graft failure and patient death

The dates of transplantation and of post-transplant graft failure and death were defined as outlined above. We matched each donor who received a KT individually to five nondonor KT recipients drawn from the SRTR registry. Matching was based on year of transplant, donor-recipient haplotype mismatch (A, B, and DR Mismatch), recipient age at KT, sex, race-ethnicity, cause of ESRD, body-mass index (BMI), donor type (live donor, standard criteria deceased donor, expanded criteria deceased donor), donor age, and donor creatinine.

ESRD to death for those who never listed or received KT

Donors who never listed or received KT were compared to donors who listed or received KT without matching. They were followed until death or end of study.

Statistical analysis

We evaluated each time-to-event outcome (overall mortality, ESRD to listing, listing to transplant, post-KT graft failure and mortality, and ESRD to death for those who never had access to KT) using Kaplan-Meier curves and Cox regression. We handled potential confounding via matching, but also used multivariable models to adjust for potential residual confounding after matching. We used robust variance estimators in all our analyses. And all analyses were performed using Stata 13.0/MP for Linux (Stata Corp, College Station, TX). All hypothesis tests were 2 sided ($\alpha = .05$).

RESULTS

Study population

Of 96,217 individuals who donated kidneys between April 1, 1994 and November 30, 2011, 99 developed ESRD through November 30, 2011. Median age at time of ESRD diagnosis was 50 years, 56% were male, and 34% were black. Of the 99 donors that developed ESRD, 5.1% developed ESRD secondary to diabetes a median (interquartile range) of 9.9 years (8.2–10.9) after donation, 24.2% developed ESRD secondary to hypertension a median of 12.0 years (8.0–13.0) after donation, 29.3% developed ESRD secondary to glomerulonephritis a median of 7.4 years (5.3–10.2) after donation, and 41.4% developed ESRD secondary to other causes a median of 9.6 years (7.0–11.2) after donation. The matched population of nondonors with ESRD had characteristics comparable to the population of donors with ESRD (Table 1).

Treatment after development of ESRD

Of the 99 donors who developed ESRD, 78 initially received dialysis (of whom 37 listed for KT, 2 received live donor KT without listing, and 39 never listed for or received KT), 20 were listed preemptively (of whom 19 were subsequently transplanted), and 1 received a preemptive live donor KT without listing (Table 2 & Figure 1). Of the 60 donors who listed for or received KT, 1 died while waiting, 54 received KT (7 of whom received live donor and 47 standard criteria deceased donor grafts), and 5 were still waiting with a median waiting time of 18 months.

Mortality after development of ESRD

Overall mortality for the 99 donors, regardless of whether they were listed for KT or received KT, was lower (at 1-year, 9.1%; 95% confidence interval [CI], 4.8 to 16.7; 3-years, 20.2%; 95% CI, 13.6 to 29.6; 5-years, 25.5%; 95% CI, 17.8 to 35.8; and 10-years, 32.4%; 95% CI, 21.3 to 47.4) for donors compared with matched nondonors (at 1-year, 15.6%; 95% CI, 12.7 to 19.1; 3-years, 26.1%; 95% CI, 22.5 to 30.22; 5-years, 34.9%; 95% CI, 30.8 to 39.4; and 10-years, 43%; 95% CI, 38.0 to 9.2). The difference in mortality rate between

donors and matched nondonors was statistically significant (HR, 0.7; 95% CI, 0.4 to 1.0; $p<0.05$) (Figure 2).

ESRD to listing

Among the 99 donors with ESRD, the percentage listed for KT within a year of ESRD diagnosis was higher (within 1-month, 22.2%; 95% CI, 15.3 to 31.8; 6-months, 32.8%; 95% CI, 24.3 to 42.9; and, 12-months, 43.4%; 95% CI, 34 to 54) for donors compared with matched nondonors (within 1-month, 9.5%; 95% CI, 7.2 to 12.4; 3-years, 17.4%; 95% CI, 14.3 to 21.2; 5-years, 25.6%; 95% CI, 21.8 to 29.9). Median time to listing (interquartile range, IQR) was 17.0 months (1.7 to 117.0) compared with 120.0 months (12.0 to undefined) for matched nondonors (HR, 1.9; 95% CI, 1.4 to 2.5; $p<0.001$) (Figure 3).

Listing to transplant

Among 60 donors who listed for KT, the percentage transplanted within a year of listing was higher (1-month, 21.7%; 95% CI, 13.2 to 34.4; 6-months, 61.0%; 95% CI, 48.9 to 73.4; and, 12-months, 71.7%; 95% CI, 59.8 to 82.5) for donors compared with matched nondonors (1-month, 5.3%; 95% CI, 3.3 to 8.6; 6-months, 23.1%; 95% CI, 18.7 to 28.3; and 12-months, 36.0%; 95% CI, 30.4 to 41.4). Median time to transplant (IQR) was 2.8 months (1.3 to 14.7) compared with 21.5 months (6.9 to 39.5) for matched nondonors (HR, 2.8; 95% CI, 1.9 to 3.9; $p<0.001$) (Figure 4).

Post-transplant graft failure and death

Among 54 donors who received KT, post-KT graft failure rates (at 1-year, 3.7%; 95% CI, 0.9 to 14.0; 3-years, 9.9%; 95% CI, 4.2 to 22.2; 5-years, 14.8%; 95% CI, 7.3 to 29.9; and 10-years, 33.4%; 95% CI, 17.2 to 58.3) were comparable to matched nondonor graft failure rates (at 1-year, 4.2%; 95% CI, 2.3 to 7.4; 3-years, 8.4%; 95% CI, 5.6 to 12.6; 5-years, 16.1%; 95% CI, 11.6 to 22.0; and 10-years, 27.7%; 95% CI, 20.0 to 37.8%; HR, 1.7; 95% CI, 0.7 to 3.8; $p=0.2$) (Figure 5A). Similarly, post-KT donor mortality (at 1-year, 1.9%; 95% CI, 0.3 to 12.4; 3-years, 1.9%; 95% CI, 0.3 to 12.4; 5-years, 5.5%; 95% CI, 1.3 to 21.6; and 10-years, 11.4%; 95% CI, 3.4 to 34.4) was comparable to matched nondonor mortality (at 1-year, 2.2%; 95% CI, 1.0 to 4.9; 3-years, 6.3%; 95% CI, 3.9 to 10.1; 5-years, 9.6%; 95% CI, 6.3 to 14.3; and 10-years, 15.2%; 95% CI, 9.9 to 22.9; HR, 0.5; 95% CI, 0.2 to 1.6; $p=0.3$) (Figure 5B).

Donors who never listed or received KT

Compared to those donors with access to transplantation, the 39 donors who initiated dialysis but never listed for KT or received KT were older (median age [IQR] 56 [45–64] versus 46 [39–53] years old; percentage 60–64 years-old, 65+ years-old 15%, 21% versus 10%, 7% for nondonors; $p=0.07$), but less likely to be black (18% versus 45%), or to have glomerulonephritis (5% versus 45%; $p<0.001$). The unadjusted mortality rates in this subgroup were 23.1%, 95% CI, 12.7% to 39.7% at 1-years, 49.0%, 95% CI, 34.6% to 65.6% at 3-years, and 59.6%, 95% CI, 43.8% to 75.9% at 5-years (Figure 6).

DISCUSSION

In this national study of the 99 individuals who donated kidneys between April 1, 1994 and November 30, 2011 and subsequently developed ESRD, donors were listed and transplanted faster than demographically and clinically matched nondonors. Donors received 13% live donor KT, 87% standard criteria deceased donor KT, and 0% expanded criteria deceased donor KT compared with 39% live donor KT, 50% standard criteria KT, and 11% expanded criteria KT among nondonors, with equivalent adjusted post-transplant outcomes between donors and nondonors. However, 39 live donors with ESRD were never listed or transplanted throughout our study period. While somewhat older than those who had access to transplantation, 79% of donors who did not have access to listing or KT were younger than 65 and likely transplant candidates by what can be ascertained from the registry data. The 5-year mortality for donors who were never listed or transplanted was 56%.

The high rate of KT among donors who have access to the waiting list was consistent with a recent study of prior live organ donors.¹⁶ In this study, they identified 252 donors who were listed for deceased donor KT from 1996 through 2010. However, Potluri and colleagues did not link to CMS, and so were only able to identify donors who were listed for KT; our study uniquely identified, in addition to donors who developed ESRD and were listed for KT, a very large proportion of donors with ESRD who never accessed the waitlist for KT.

Also, in their post-KT analysis, Potluri and colleagues did not match on donor type (live donor versus deceased donor), as they were primarily interested in the effects of deceased donor organ allocation policy on deceased donor KT outcomes. They purposefully did not match on dialysis time for post-KT analyses for the same reason. As such, they compared donors with high-quality organs, who had been on the waitlist for a much shorter time, with nondonors with lower-quality organs, who had been on the waitlist for a much longer time. By contrast, our study was able to assess the impact of waitlist priority on utilization of live versus deceased donor KT. After adjusting for pre-transplant differences between donors and nondonors, post-KT outcomes in these two populations were comparable.

In showing that only 7 donors with ESRD received a live donor KT, our findings are consistent with the observation among children listed for KT following the introduction of waitlist priority for this population. These findings suggest a common mechanism of decline in utilization of live donor KT in groups that are given waitlist priority.⁹

Although waitlist priority points offered to donors clearly provided a benefit to donors who listed for KT, these benefits were not extended to a significant proportion of donors with ESRD who never listed for KT in our study period. Our finding that almost half of donors who developed ESRD did not achieve access to the transplant waiting list, let alone transplantation, is noteworthy. Since donors have a point of contact with the transplant community during their evaluation for donor nephrectomy, donor evaluation might be a potential point at which to educate donors about the benefits of (and ways to achieve) KT should they ever themselves suffer from ESRD.¹⁷

The key strength of this study is that it drew from two comprehensive national registries to provide critical information that can be used by policy makers, care providers, donors who

have already developed ESRD, and prospective donors. By comparing to matched nondonors, we were able to directly assess the impact of donor waitlist priority on time from listing to transplantation and to assess any potential post-KT consequences of this policy. And since the allocation priority for donors was introduced on September 2, 1996 (before any donor in our study cohort developed ESRD), there was no era-effect in our analysis. Another strength is that we identified and characterized a subgroup of donors who appeared to have had limited access to transplant services and who might be good candidates for targeted intervention.

A noteworthy limitation of this analysis is that we were not able to study the barriers and/or more granular medical conditions that might have prevented some donors from accessing the KT waitlist. A mechanistic understanding of these barriers will enable the transplant community to develop interventions that lead a larger proportion of donors to list for KT and to benefit from the priority accorded to donors on the waitlist. However, since the OPTN, as of February 2013, requires explicit disclosure in informed consent of the potential donor about the allocation priority accorded to donors if they become KT candidates,⁸ and since the same policy requires transplant centers to follow-up donors, our finding of no access to KT in a large proportion of donors not only reiterates the relevance of this policy but also provides a benchmark against which to assess the effect of this policy on access to KT in the future among donors who develop ESRD.

A second limitation of this analysis is that we defined ESRD as the initiation of dialysis, wait-listing or transplantation. It is possible that donors with ESRD in later life, or with multiple co-morbidities, were treated conservatively and would therefore not be identified in this study. A third limitation of this analysis is that SRTR did not have recipient comorbidity data beyond cause-of-ESRD, and donors with ESRD could not be matched to nondonors with ESRD on these comorbidities, if present. However, we matched donors to nondonors on substantive differences; that is, we matched using characteristics that affect listing rates, transplant rates, graft failure rates, and mortality rates in patients with ESRD in the United States.

In conclusion, we have shown in a national study that live donors who develop ESRD were listed and transplanted faster than demographically and clinically matched nondonors, with equivalent adjusted post-transplant outcomes. This study shows that the transplant community treats live donors with dignity and respect long after they have donated, but only after they are "back in the system." Of concern is the 39% of donors who developed ESRD, were never listed nor transplanted, and suffered a very high mortality rate. This finding warrants further study to ascertain why these donors with ESRD never gained access to the waiting list.

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ABBREVIATIONS

ESRD	End Stage Renal Disease
USRDS	United States Renal Data System
SRTR	Scientific Registry for Transplant Research
KT	Kidney Transplantation
OPTN	Organ Procurement and Transplantation Network

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Figure 1. Dialysis, Access to Listing or Kidney Transplantation (KT), and Follow-up of Donors and Nondonors with End Stage Renal Disease (ESRD) in the United States between April 1994 and November 2011.

Dialysis data were obtained from the United States Renal Data System (USRDS) (*within dotted rectangle*), and Listing and Transplant data were obtained from the Scientific Registry of Transplant Recipients (SRTR) (*within dotted & dashed rectangle*). Each donor with ESRD (99), who listed or received a preemptive KT (60), and who received a KT (54) was matched with five nondonors drawn from the USRDS (495 nondonors with ESRD), and SRTR registry (300 nondonors who listed or received a preemptive KT, and 270 nondonors who received a KT).

Figure 2. Mortality in donors and nondonors after diagnosis of end stage renal disease (ESRD)
 The figure shows mortality regardless of access to listing or kidney transplantation. Donors had lower short-term and long-term mortality than matched nondonors ($p=0.04$).

Figure 3. Access to listing for and kidney transplantation among donors and nondonors with end stage renal disease in the United States from 04/1994—07/2014

Median (IQR) time to listing (censoring for mortality) was 17 (1.7–117) months for donors versus 120 (12–undefined) months for nondonors.

Listing-to-Transplant

Figure 4. Access to kidney transplantation among listed donors and nondonors in the United States from 04/1994—31/07/2014

Median (IQR) time to transplant (censoring for mortality) was 2.8 (1.3–14.7) months for donors versus 21.5 (6.9–39.5) months for nondonors.

Transplant-to-Graft Failure

Transplant-to-Death

Figure 5. Post-transplant outcomes in live kidney donors and matched nondonors who receive kidney transplantation

Figure 5A shows graft failure; Figure 5B shows mortality. There was no difference in post-transplant graft failure (p=0.7) or mortality (p=0.3) between donors and nondonors.

ESRD-to-Death

Figure 6. Mortality in donors with no access to listing or kidney transplantation

Donors with no access to listing or kidney transplantation had unadjusted 1-year mortality of 23.1%; 95 percent confidence interval, 12.7 to 39.7; at 3-year, 49.0%; 95 percent confidence interval, 34.6 to 65.6; and 5-years, 59.6%; 95 percent confidence interval, 43.8 to 75.9)

Table 1

Characteristics of live kidney donors and matched nondonors in the United States at the time of end stage renal disease diagnosis (ESRD), listing for deceased donor transplantation, and at transplant, April 01, 1994 – November 30, 2011

	Donors	Nondonors ^I	P-value
ESRD-to-listing			
	n=99	n=495	
Age	50.3 [13.2]	50.4 [13.2]	0.9
Age Categories (%):			
18–39	21.2	20.6	1
40–49	31.3	32.9	
50–59	23.2	21.0	
60+	24.2	25.5	
Sex (%):			
Male	55.6	55.6	1
Female	44.4	44.4	
Race/Ethnicity (%):			
White/Other	52.5	52.5	1
Black	34.3	34.3	
Hispanic	13.1	13.1	
Year (%):			
1998–2001	6.1	6.1	1
2002–2005	14.1	14.1	
2006–2009	56.6	56.6	
2010–2011	23.2	23.2	
Diagnosis (%):			
Diabetes	5.1	5.1	1
Hypertension	24.2	24.2	
Glomerulonephritis	29.3	29.3	
Other	41.4	41.4	
Listing-to-transplant			
	n=60	n=300	
Age	48.1 [12.3]	48.2 [11.9]	1
Sex (%):			
Male	55.0	55.0	1
Female	45.0	45.0	
Race (%):			
White/Other	39.7	39.7	1
Black	46.6	46.0	
Hispanic	13.8	14.3	

	Donors	Nondonors ^I	P-value
BMI	29.1 [5.2]	28.8 [5.0]	0.7
Diagnosis (%):			
Diabetes	5.0	5.0	1
Hypertension	28.3	28.3	
Glomerulonephritis	26.7	26.7	
Other	38.3	38.3	
Missing	1.7	1.7	
Blood Group (%):			
A	16.7	16.7	1
B	11.7	11.7	
O	71.7	71.7	
Peak PRA (%):			
0–9	65.0	65.0	1
10–79	18.3	18.3	
80–100	3.3	3.3	
Missing	13.3	13.3	
Year Listed (%):			
1994–1997	0.0	0.3	1
1998–2001	1.7	2.0	
2002–2005	15.5	16.4	
2006–2009	43.1	42.5	
2010–2013	39.7	38.8	
Transplant-to-graft failure			
	n=54	n=270	
Age	46.6 [11.5]	46.8 [11.5]	0.9
Sex (%):			
Male	57.4	57.4	1
Female	42.6	42.6	
Race/Ethnicity (%):			
White/Other	40.7	40.7	1
Black	46.3	46.3	
Hispanic	13.0	13.0	
BMI	29.0 [5.0]	28.8 [5.5]	0.8
Diagnosis (%):			
Diabetes	5.6	5.6	1
Hypertension	25.9	25.9	
Glomerulonephritis	27.8	27.8	
Other	40.7	40.7	
Time-on-Dialysis	1.2 [1.5]	3.8 [3.1]	<0.001

	Donors	Nondonors ^I	P-value
Peak PRA (%):			
0–9	72.2	58.5	0.2
10–79	20.4	28.1	
80–100	3.7	10.0	
Missing	3.7	3.3	
Organ Shipped (%):			
Not Shipped	74.1	71.9	0.7
Shipped	25.9	28.1	
HLA Mismatches (%):			
0 A/B/DR Mismatch	1.9	1.9	1
0 DR Mismatch	5.6	5.6	
1 DR Mismatch	40.7	40.7	
2 DR Mismatch	51.9	51.9	
Donor Type (%):			
Standard Criteria	87.0	87.0	1
Live Donor	13.0	13.0	
Donor/Recipient Weight Ratio	1.0 [0.3]	1.0 [0.4]	0.9
Year-of-Transplant (%):			
1998–2001	3.7	4.8	0.9
2002–2005	16.7	13.3	
2006–2009	35.2	38.9	
2010–2013	44.4	43.0	
Donor Age	30.0 [13.4]	30.2 [13.0]	0.9
Donor Creatinine	1.0 [0.4]	1.0 [0.4]	0.6
Kidney Pumped (%):			
Pumped	12.8	24.3	0.1
Not pumped	87.2	75.7	
Donor Hypertension (%):			
No History	92.6	90.0	0.6
History of Hypertension	7.4	10.0	
Donor Diabetes (%):			
No History-of-Diabetes	94.4	96.7	0.4
History-of-Diabetes	5.6	3.3	
Donor Cause Of Death (%):			
Other	75.9	84.1	0.1
Stroke	24.1	15.9	
Donor Cardiac Death (%):			
Donated After Cardiac Death	7.4	7.0	1
Donated After Brain Death	79.6	78.9	

	Donors	Nondonors ^I	P-value
Missing	13.0	14.1	

^I Nondonors were individually matched to donors in a 5:1 ratio without replacement at diagnosis, at listing, and at transplant. For post-KT patient and graft survival analyses, time-on-dialysis, peak PRA, kidney pumped (yes/no), donor hypertension, donor diabetes, and donor cause of death were included in multivariable Cox regression to adjust for residual confounding.

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Table 2

Characteristics of live kidney donors in the United States following end stage renal disease (ESRD) diagnosis, grouped by access to listing or kidney transplantation, April 01, 1994 – November 30, 2011

	Access to Listing or Kidney Transplantation	Access to Kidney Transplantation	Dialysis Only
	n=60	n=54	n=39
Age, mean (sd) years	46.7 (11.7)	45.8 (11.0)	55.8 (13.6)
Age Categories (%):			
18–39	28.3	29.6	10.3
40–49	38.3	38.9	20.5
50–59	16.7	16.7	33.3
60+	16.7	14.8	35.9
Male	55.0	57.4	56.4
Race-Ethnicity (%):			
White/Other	41.7	40.7	69.2
Black	45.0	46.3	17.9
Hispanic	13.3	13.0	12.8
Year (%):			
1998–2001	8.3	7.4	2.6
2002–2005	18.3	18.5	7.7
2006–2009	51.7	53.7	64.1
2010–2013	21.7	20.4	25.6
Time On Dialysis:			
Mean (sd) months	13.8 (27.3)	8.5 (12.4)	40.1 (33.0)
<6 months	55.0	59.3	12.8
6–12 months	16.7	16.7	10.3
12 months+	28.3	24.1	76.9
Cause of ESRD (%):			
Diabetes	3.3	3.7	7.7
Hypertension	23.3	22.2	25.6
Glomerulonephritis	45.0	44.4	5.1
Other/Missing	28.3	29.6	61.5
Donor-Recipient Unrelated	8.3	9.3	28.2

All the 54 transplanted donors were a subset of the 60 listed donors (including 3 that received live donor transplants without ever listing)