

Brief Communication

Regional and Racial Disparities in the Use of Live Non-Directed Kidney Donors

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Use of live non-directed donors (LNDDs), or altruistic donors, has increased significantly over the past decade and has fueled debate regarding the ethics and allocation of this new source of live donor kidneys. Three allocation philosophies are currently in use, including donor-centric, recipient-centric and socio-centric models, and our group has also advocated the use of LNDDs in paired donation. However, no universally accepted allocation policy exists, nor does national oversight. To determine allocation patterns resulting from current practice models, we analyzed the 372 LNDD kidney transplants performed in the United States since 1998. Most LNDD transplants occurred at a minority of centers, with only five centers performing over 10, and over 28% of LNDDs traveled out-of-state to donate. Furthermore, a center's use of LNDD kidneys did not correlate with that center's organ shortage. Finally, African Americans were significantly under-represented among recipients who were allocated LNDD kidneys, even after accounting for differences in the racial makeup of the waiting list representing centers using LNDD kidneys. These disparities suggest the need for continued monitoring and discussion of LNDD at a national level. If non-directed donation continues to rise at its current rate, a national allocation policy may be reasonable.

Key words: Altruistic donation, kidney allocation, kidney transplantation, live donation, live donor transplantation, non-directed donors, organ allocation

Received 29 November 2007, revised 15 January 2008 and accepted for publication 31 January 2008

Introduction

An increasing number of people are volunteering to donate a kidney without an identified recipient. These donors are termed live non-directed donors (LNDDs), and have also been referred to as Altruistic, Good Samaritan, Anonymous and Benevolent Community donors (1–3). Use of these donors has increased significantly over the past decade (Figure 1) and has fueled considerable debate regarding

the ethics and allocation of this new source of live donor kidneys (2,4–15).

We previously described the three main allocation philosophies that are currently being utilized by transplant centers in the United States (1). Programs that utilize the donor-centric allocation model direct LNDD kidneys to the recipients with the highest likelihood of having a successful and durable outcome. It is thought that a good result is the primary reason for permitting a non-ill individual to be placed in harm's way to aid another individual they have no connection with. In the recipient-centric allocation model, society is seen as having a responsibility to protect its most vulnerable and disadvantaged members. LNDD organs are allocated to those in the greatest need or those most disadvantaged within the current deceased donor allocation system. The socio-centric philosophy assumes that the LNDD organ is a public resource. LNDD kidneys are allocated in what is felt to be the most fair and equitable manner regardless of outcome or need, with priority on the UNOS waiting list used to achieve fairness (1,4).

The approach that our group has advocated is to place LNDD's kidneys into incompatible pools where their gift can be used to initiate domino paired donations in which multiple transplants are made possible where none would have otherwise occurred. The last kidney in the domino is allocated to the patient at the top of the UNOS waiting list in the appropriate blood group. Under this allocation system the medical community assists the LNDD in multiplying the benefit of the gift (1). In our center, we offer this option to LNDD's but do not require participation in domino paired donation as a prerequisite to non-directed donation.

However, distribution of LNDD kidneys has remained within the purview of the individual transplant center. No universally accepted allocation policy exists, nor does national oversight. The goal of this study was to determine current patterns arising from the distribution of LNDD kidneys.

Methods

This was a secondary data analysis of a prospective cohort of kidney candidates and recipients between 1 January 1998 and 2 June 2006, as recorded in the UNOS Kidney Standard Transplant Analysis and Research (STAR) files. Recipients of LNDD kidneys were identified among live donor recipients by the STAR variable 'liv_don_ty' with a value of 10 (Anonymous Donation).

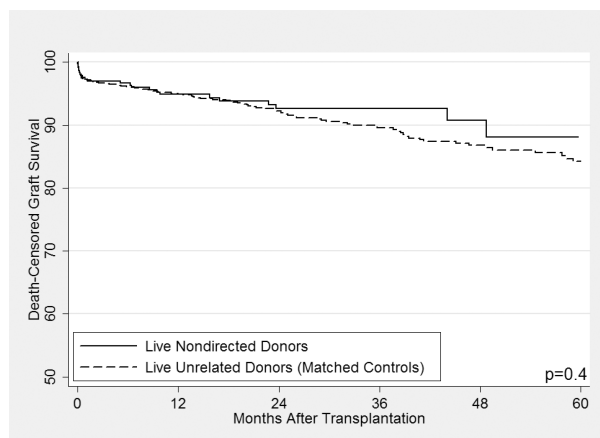
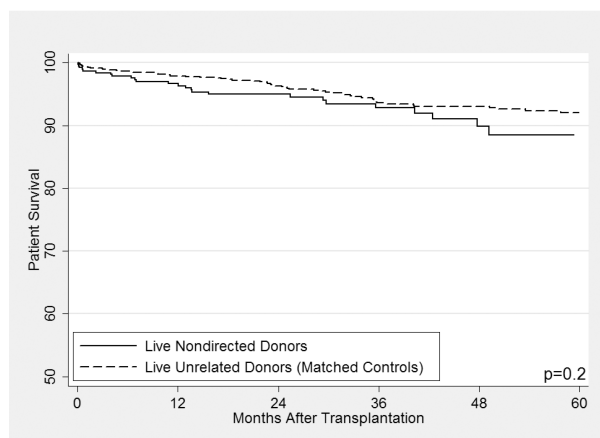
A Death-censored graft survival**B** Patient survival

Figure 1: Outcomes following kidney transplantation from live non-directed donors, compared with live unrelated donor controls (matched for recipient age, donor age and previous transplant). (A) Death-censored graft survival. (B) Patient survival.

Waiting time for a kidney transplant in a given center was used as a marker of the organ shortage in that center. Waiting time was determined by studying 115 280 primary kidney candidates who registered for the waiting list during the study period and who either received a deceased donor transplant or remained waiting at the end of the study. For each center, median waiting time was estimated by Kaplan-Meier time-to-event analysis censored for nontransplantation. Center-specific median waiting times were divided into quintiles.

Center volume was determined for both deceased donor and live donor metrics. Deceased donor and live donor volumes for each center were calculated from among 84 831 deceased donor and 49 241 live donor transplants performed during the study period. Center-specific deceased donor and live donor volumes were separately divided into quintiles.

Cross-sectional waiting list demographics were determined based on the 75 109 patients still awaiting a kidney transplant on the last day of the study period (2 June 2006). To determine waiting list attributes specific to the LNDD kidneys that were allocated during the study period, demographics

were weighted by the number of LNDD transplants performed at each center.

Survival analysis was performed using Kaplan-Meier estimates, censored for loss to follow-up or end-of-study. Graft survival estimates were censored for death. Unless otherwise specified, all tests were two-sided with statistical significance set at $\alpha = 0.05$. All analyses were performed using multiprocessor Stata/SE 9.1 for Linux (StataCorp, College Station, TX).

Results

Since 1998, 344 adults and 28 children (<18 years old) received kidneys from live non-directed donors (Tables 1 and 2). Most of the recipients and donors were under 60 (86.5% of recipients, 93.6% of donors), Caucasian (64.7% of recipients, 94.4% of donors) and college educated (53.8% of adult recipients, 82.6% of donors). Recipients were approximately half privately insured and half Medicare. Few recipients were highly sensitized (4.6%), preemptive (13.7%) or redo transplants (11.6%). Almost half of the recipients had waited fewer than 2 years for their transplant (49.3%) while few waited 6 or more years (5.6%). Many donors traveled to an out-of-state transplant center in order to donate (28.7%).

Outcomes after LNDD transplantation are shown in Figure 1. Death-censored graft survival was 94.9% at 1 year (95% CI 91.8–96.8), 92.6% at 3 years (95% CI 88.7–95.2), and 88.1% at 5 years (95% CI 79.0–93.4). Patient survival was 96.6% at 1 year (95% CI 94.2–98.1), 92.8% at 3 years (95% CI 88.9–95.3), and 88.5% at 5 years (95% CI 82.1–92.7). There were no differences between outcomes after LNDD transplants and outcomes after live unrelated donor transplants matched for donor age, recipient age and prior transplant ($p = 0.4$ for graft survival and 0.2 for patient survival by log-rank test).

During the study period, 256 transplant centers performed at least one live donor kidney transplant, and 107 transplant centers performed at least one LNDD transplants (Figure 2). However, most transplant centers performed only 1 or 2 transplants from LNDDs, and only 5 centers (5% of centers that performed LNDD transplants, 2% of centers that performed live donor transplants) performed over 10 transplants from LNDDs (Figure 2A). Furthermore, the majority of LNDD transplants was performed by a minority of transplant centers, with 18 transplant centers representing 50% of LNDD transplants (Figure 2B). LNDD volume was directly proportional to both live donor and deceased donor kidney transplant volume (Table 3), although not necessarily related to organ shortage as measured by median waiting time (Table 4) and widely varied by region (Table 5).

Most importantly, there were statistically significant disparities in the racial distribution of LNDD recipients (Figure 3). Although African American patients represented 33.1%

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Table 1: Characteristics of live non-directed donors and the recipients to whom their donated kidneys were allocated

	Recipient		Donor	
	No.	%	No.	%
Age				
<18	28	7.5%	0	
18–39	103	27.7%	116	31.2%
40–49	96	25.8%	120	32.3%
50–59	95	25.5%	112	30.1%
60–69	43	11.6%	21	5.7%
> = 70	7	1.9%	3	0.8%
Blood type				
A	147	39.5%	134	36.0%
B	60	16.1%	46	12.4%
AB	19	5.1%	15	4.0%
O	146	39.3%	177	47.6%
Gender				
Male	207	55.7%	164	44.1%
Female	165	44.3%	208	55.9%
Race				
Caucasian	236	64.7%	351	94.4%
African American	71	19.5%	6	1.6%
Hispanic	27	7.4%	4	1.1%
Asian	24	6.6%	8	2.2%
Other	7	1.9%	3	0.8%
Not Reported	7			
Education				
Pre-college	133	50.8%	43	17.4%
Post-college	129	49.2%	204	82.6%
Not Reported	110		125	
Insurance				
Private	167	45.0%		
Medicare	178	48.0%		
Medicaid	23	6.2%		
Other	3	0.8%		
Not Reported	1			
PRA				
<20	290	83.6%		
20–79	41	11.8%		
> = 80	16	4.6%		
Not Reported	25			
Years waiting				
<2	175	49.3%		
2–4	119	33.5%		
4–6	41	11.6%		
6–8	12	3.4%		
> = 8	8	2.3%		
Not Reported	17			
Preemptive	51	13.7%		
Prior transplant	43	11.6%		

of the waiting list, only 19.5% of LNDD recipients were African American; on the contrary, Caucasians received 64.7% of LNDD kidneys but represented only 42.3% of the waiting list ($p < 0.001$). This disparity was partially explained by the fact that most LNDD kidneys were used by transplant centers that served primarily Caucasian waiting lists. For example, Caucasians represented 42.3% of the national waiting list but as much as 58.4% of the pool of

Table 2: Increasing use of live non-directed kidney donors in the United States

Year	Pediatric	Adult
1998	1	1
1999	2	3
2000	2	18
2001	5	24
2002	4	52
2003	5	76
2004	4	81
2005	4	77

waiting list patients corresponding to allocated LNDD kidneys. Conversely, African Americans represented 33.1% of the national waiting list but only 23.4% of the pool of waiting list patients corresponding to allocated LNDD kidneys. Furthermore, even when the racial makeup of LNDD recipients was compared with an adjusted racial makeup

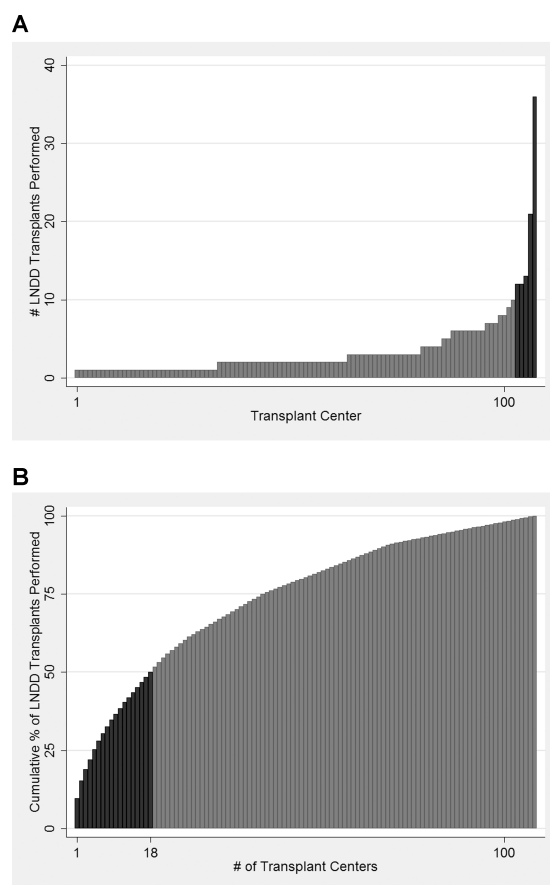


Figure 2: Distribution of live non-directed donors by transplant center. (A) Number of LNDD transplants performed, by transplant centers with increasing volumes. Note that only five transplant centers performed over 10 transplants from LNDDs. (B) Cumulative proportion of LNDD transplants performed, by transplant centers with decreasing volumes. Note that 50% of LNDD transplants were performed by only 18 transplant centers.

Table 3: Proportion of national LNDD transplants performed at transplant centers of varying live and deceased donor volumes

Deceased donor Volume quintile	LNDD Performed	%	Live Donor Volume quintile	LNDD Performed	%
1 (<54)	9	2%	1 (<35)	5	1%
2 (54–170)	31	8%	2 (35–80)	24	6%
3 (171–288)	68	18%	3 (81–152)	53	14%
4 (289–479)	115	31%	4 (153–291)	119	32%
5 (>479)	149	40%	5 (>291)	171	46%

of the transplant centers that allocated the LNDD kidneys, allocation disparities persisted. While African Americans represented 23.4% of the pool of waiting list patients corresponding to the allocated LNDD kidneys, they represented only 19.5% of LNDD recipients ($p = 0.04$).

Discussion

We have shown that the regional and racial makeup of LNDD recipients has not necessarily reflected that of the waiting list. Most of the LNDD kidney transplants in this country have been performed at a small minority of transplant centers, and over 28% of non-directed donors traveled to an out-of-state transplant center to donate despite consensus goals of minimizing donor travel requirements (4). Furthermore, use of LNDD kidneys has not correlated with a transplant center's organ shortage as measured by median waiting time.

Table 4: Proportion of national LNDD transplants performed at transplant centers with varying median waiting times

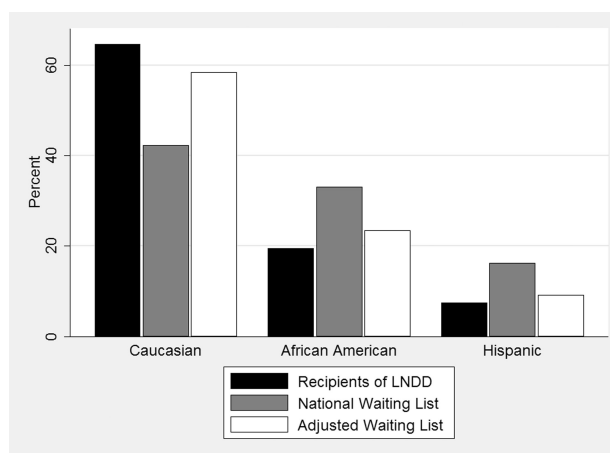
Median waiting Time quintile	LNDD Performed	%
1 (<416)	48	13%
2 (416–729)	47	13%
3 (730–1066)	94	25%
4 (1067–1579)	130	35%
5 (>1579)	53	14%

Table 5: Distribution of live non-directed donors by region

Region	LNDD Performed	%
1	51	14%
2	63	17%
3	12	3%
4	10	3%
5	55	15%
6	28	8%
7	73	20%
8	24	6%
9	12	3%
10	15	4%
11	29	8%

Ninety-five percent of the LNDD donors are Caucasian. It remains unclear why this racial imbalance exists. In current allocation practice, African Americans have been significantly under-represented in the cohort of recipients who are allocated LNDD kidneys. The racial makeup of the waiting list representing centers using LNDD kidneys, and as such the pool of patients among whom recipients of LNDD kidneys are selected, has been primarily Caucasian. And even after accounting for this difference, which is controversial in and of itself, disparities still exist between the proportion of African Americans on the waiting lists of centers performing LNDD kidney transplants and the proportion of African Americans that have received these kidneys.

Interestingly, a National Consensus manuscript was published in 27 August 2002 (4), so we looked at allocation patterns after that date (allowing several months for this

**Figure 3: Distribution of live non-directed donors by race.**

Black bars indicate the racial makeup of recipients of LNDD kidneys. Gray bars indicate the racial makeup of the UNOS kidney waiting list. Difference between racial makeup of national waiting list and LNDD recipients was statistically significant by chi-squared test of independence ($p < 0.001$). White bars indicate the racial makeup of patients awaiting kidney transplants at centers where LNDD kidneys were used, weighted by the number of kidneys used at each center. In other words, white bars represent the center-specific deceased donor pool corresponding to the LNDD kidneys that were allocated. Difference between racial makeup of adjusted waiting list and LNDD recipients was attenuated but remained statistically significant ($p = 0.04$).

information to be adopted). Allocation of LNDD to Caucasian patients was 64.4% after January 2003 (vs. 64.7% in the whole study) and allocation to African-American patients was 19.4% after January 2003 (vs. 19.5% in the whole study). Unfortunately, it seems that this consensus manuscript had very little influence on racial allocation patterns.

We have previously shown that domino paired donation might provide the ideal allocation policy as it unites the advantages of donor-centric, recipient-centric and socio-centric models (1). Although we draw no conclusions from this report regarding the relative merits of any allocation scheme, we do draw attention to disparities that have resulted from current practice patterns. These disparities suggest the need for continued monitoring and discussion of non-directed donation at a national level. If use of non-directed donors continues at its current pace, a national allocation policy may be reasonable.

Acknowledgments

Dr. Segev is supported by the American Society of Transplantation Clinical Science Faculty Development Award. As with all studies of the UNOS data set, this work was supported in part by Health Resources and Services Administration contract 234-2005-370011 C. The content of this work is the responsibility of the authors alone and does not necessarily reflect the views or policies of the Department of Health and Human Services, nor does mention of trade names, commercial products or organizations imply endorsement by the US Government.

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