

Characteristics and Evaluation of Geographically Distant vs Geographically Nearby Living Kidney Donors

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ABSTRACT

Background. Living donor kidney transplant (LDKT) can be impeded by multiple barriers. One possible barrier to LDKT is a large physical distance between the living donor's home residence and the procuring transplant center.

Methods. We performed a retrospective, single-center study of living kidney donors in the United States who were geographically distant (residing ≥ 150 miles) from our transplant center. Each distant donor was matched to 4 geographically nearby donors (< 150 miles from our center) as controls.

Results. From 2007 to 2010, of 429 live kidney donors, 55 (12.8%) were geographically distant. Black donors composed a higher proportion of geographically distant vs nearby donors (34.6% vs 15.5%), whereas Hispanic and Asian donors composed a lower proportion ($P = .001$). Distant vs nearby donors had similar median times from donor referral to actual donation (165 vs 161 days, $P = .81$). The geographically distant donors lived a median of 703 miles (25% to 75% range, 244 to 1072) from our center and 21.2 miles (25% to 75% range, 9.8 to 49.7) from the nearest kidney transplant center. The proportion of geographically distant donors who had their physician evaluation (21.6%), psychosocial evaluation (21.6%), or computed tomography angiogram (29.4%) performed close to home, rather than at our center, was low.

Conclusions. Many geographically distant donors live close to transplant centers other than the procuring transplant center, but few of these donors perform parts of their donor evaluation at these closer centers. Black donors comprise a large proportion of geographically distant donors. The evaluation of geographically distant donors, especially among minorities, warrants further study.

LIVING donor kidney transplant (LDKT) is considered the optimal treatment for end-stage renal disease. Since peaking in 2004, however, the annual number of LDKTs in the United States has decreased [1]. This decrease has been attributed to numerous factors, including the growing prevalence of comorbidities in the general population that preclude living donation, use of more strict and different eligibility criteria for certain groups of donor candidates (eg, Black donors), and financial disincentives to living donation due to the out-of-pocket costs of donation [2].

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The Best Practices in Living Kidney Donation Consensus Conference in June 2014 recommended that to increase the number of LDKTs, the transplant community should aim to improve efficiencies in the donor evaluation process and reduce systemic barriers to LDKT [3].

One possible barrier to LDKT and living kidney donation is the physical distance between the living kidney donor's home residence and the transplant center where the donor nephrectomy will be performed. Prior studies of access to transplantation have focused on the distance of the end-stage renal disease patient, rather than the living donor, from the transplant center [4-6]. To our knowledge, prior studies have not examined the impact, if any, of distance between the living donor and the transplant center. Distance is a plausible barrier to LDKT, given that completion of the multistep donor evaluation can require living donors to travel to a transplant center multiple times. Anecdotally, we have observed that living donors who reside a long distance from our center have had difficulty completing the donor evaluation. In addition, these geographically distant donors are seldom able to perform any of the needed evaluations at a transplant center closer to home. In this retrospective study, we sought to determine (1) the proportion of living kidney donors at our center who are geographically distant from our center, (2) characteristics of geographically distant vs geographically nearby living donors, and (3) the proportion of geographically distant donors who perform predonation testing and evaluations at a center closer to home.

MATERIALS AND METHODS

Study Design and Setting

We performed a single-center, retrospective study of living kidney donors who donated at Saint Barnabas Medical Center (SBMC), a kidney and pancreas transplant center located in suburban Livingston, New Jersey, in the northeastern United States. We included persons who donated from 2007 to 2010, during which SBMC performed 429 LDKTs. We excluded persons who donated after December 2010 because at that time we started a clinical trial of an educational intervention designed to increase knowledge of LDKT among potential transplant candidates [7].

The study protocol was approved by the human subjects Institutional Review Boards at SBMC and New York University School of Medicine. The clinical and research activities being reported are consistent with the Principles of the Declaration of Istanbul as outlined in the Declaration of Istanbul on Organ Trafficking and Transplant Tourism.

Selection of Geographically Distant vs Nearby Living Donors

We classified living kidney donors as geographically distant if they lived within the United States (including its territories) but ≥ 150 miles from our transplant center. The 150-mile cutoff, which represents at least a 2.5-hour drive, was chosen a priori. This distance has been used in prior studies to categorize transplant candidates as living "too far" from a transplant center to be expected to return easily [8,9].

For comparison, we matched each geographically distant donor to 4 control donors who were geographically nearby, which was

defined as residing < 150 miles from our transplant center. These controls were the 2 geographically nearby donors whose donor nephrectomies occurred immediately before and the two nearby donors whose nephrectomies occurred immediately after each geographically distant donor. We chose controls in this way to account for the influence of any subtle changes during the study period in how we perform the donor evaluation. We did not match controls to the geographically distant donors using variables (eg, age, race, sex) other than date of donation. Matching on other variables would have prevented estimation of any associations between these other matching variables and the outcome (geographically distant donation) [10].

We excluded donors who resided outside the United States. We also excluded nondirected living donors, defined as donors without an intended recipient on the waiting list at SBMC when they initially volunteered. At our center, the evaluation of nondirected donors differs from the evaluation of directed donors and includes additional psychosocial evaluations.

We calculated the Euclidean distance between the centroid of each donor's ZIP code and the geocoded addresses of (1) SBMC, and (2) each approved transplant center that performs LDKTs (to determine the closest transplant center). We used the centroid of the donor's ZIP code due to privacy concerns that precluded sharing the donors' actual addresses with our collaborator (D.C.L.). ZIP code centroids were obtained from a shapefile available from the Environmental Systems Research Institute [11]. We used data from Centers for Medicare and Medicaid Services to identify Medicare-approved kidney transplant programs and their addresses [12] and data from the Scientific Registry of Transplant Recipients to identify transplant centers that performed LDKTs [13]. Distances between these centroids and the geocoded location of transplant centers were calculated in ArcGIS 10.2 (Environmental Systems Research Institute: Redlands, CA; 2013). The living donor's ZIP code was also linked to the median household income for the corresponding ZIP code tabulation area (ZCTA), according to 2007-2011 U.S. Census Bureau data.

Data Collection and Analysis

For each geographically distant and geographically nearby donor, we reviewed their electronic records and, if available, paper medical records. We have previously described our evaluation of living kidney donors [14,15]. We determined the initial date of donor referral, defined as the date that our center received a completed donor referral form. For donors with complete records available, we also determined where (at SBMC vs another center) the donors completed the nursing assessment and education, evaluation by a transplant physician, psychosocial evaluation, CT angiogram of the native kidneys, and evaluation by an independent living donor advocate.

Categorical variables were expressed as proportions, and their values between groups (geographically distant vs nearby) were compared using χ^2 testing or Fisher exact test where appropriate. Continuous variables were expressed as means (if normally distributed) or as medians with 25% to 75% interquartile ranges (if not normally distributed) and compared using *t* tests or Wilcoxon rank-sum tests as appropriate. *P* values are 2-sided, with statistical significance defined as $P < .05$. Analyses were performed using Stata SE 9 statistical software (Stata Corp., College Station, Texas, USA).

RESULTS

Of 429 living donors during the study period, 55 (12.8%) were geographically distant. We were able to locate the

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