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Authors

Goussous, Naeem

De Leon, Fransia

Alghannam, Karima

et al.

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Outcomes Using High KDPI Kidneys in Recipients Over 65 y of Age

Naeem Goussous, MD,[1] Fransia De Leon, MD,[1] Karima Alghannam, BS,[1] Brian C. Howard, BS[1] Peter A. Than, MD,[2] Aileen X Wang, MD,[3] Junichiro Sageshima, MD, FACS,[1] and Richard V. Perez, MD[1]

Background. Kidney transplantation has been shown to improve life expectancy when compared with remaining on dialysis. However, there is an ever-expanding shortage of available organs for transplantation. The use of high kidney donor profile index (KDPI; >85) kidneys is 1 strategy to address this shortage. The current study aims to evaluate the advantage of accepting a high KDPI versus a low KDPI kidney (KDPI ≤85) in patients 65 y or older. **Methods.** A single-center retrospective review of all patients, ages 65 y or older, who underwent deceased donor kidney transplantation between 2010 and 2020 was performed. Outcomes and wait times of recipients undergoing low KDPI (KDPI ≤85) versus high KDPI (KDPI >85) kidney transplantation were compared. Significance was defined as $P < 0.05$. **Results.** Four hundred ninety-two patients were identified; 317 (64.4%) were men with a median age at transplantation of 69 y. Four hundred five patients received low KDPI kidneys, whereas the remaining received high KDPI grafts. High KDPI kidneys were procured from older donors (60 versus 47, $P < 0.001$) and had shorter cold ischemic time (25.0 versus 28.3 h, $P = 0.01$) compared with low KDPI kidneys. There was no significant difference in graft and patient survival between low and high KDPI recipients, with 85.1% and 86.2% grafts functioning at a follow-up of 4.85 (2.9–7.0) y, respectively. Pretransplant wait time was significantly shorter in the high KDPI group (2.7 [1.8–4.1] versus 3.5 [2.3–4.8] y; $P = 0.004$). **Conclusions.** In patients 65 y or older undergoing deceased donor kidney transplantation, high KDPI kidneys may offer shorter pretransplant waiting times without compromising graft or patient survival.

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Kidney transplantation (KTx) is known to improve patient survival and quality of life compared with remaining on dialysis.[1] However, access to transplantation is limited by organ shortage, and there is an expanding gap between supply and demand.[2] This equates to more patients maintained on dialysis for longer durations. Despite advances in dialysis, prolonged dialysis vintage has been associated with increased waitlist mortality and worsened posttransplant survival.[3,4] In an attempt to minimize pretransplant dialysis duration, several studies showed the benefits of preemptive (before dialysis initiation) KTx using kidney grafts from marginal donors.[5,6]

Since the introduction of the new kidney allocation system in 2014, the kidney donor profile index (KDPI) has been used to quantify kidney graft quality. The KDPI is a quality score derived from the kidney donor risk index derived from 10 donor factors. The KDPI summarizes the risk of graft failure after transplantation, with higher scores indicating worse graft survival.[7,8] Kidneys from donors with a KDPI >85% (high KDPI) are considered marginal and offer inferior long-term survival to kidneys from lower KDPI donors.[9] Accepting a kidney from a donor with a KDPI >85% potentially offers a shorter wait time as these organs are offered to a truncated list of patients who consented to receive such organs.

The objective of our study is to analyze our center's experience in using high KDPI kidneys in patients 65 y or older undergoing KTx, looking specifically at pretransplant waiting time (WT).

MATERIALS AND METHODS

We retrospectively reviewed all patients 65 y or older who underwent a deceased donor KTx at a single transplant center from January 2010 to December 2020. Donor, recipient, and outcome data were obtained from the United

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[1] *Division of Transplant Surgery, Department of Surgery, University of California Davis, Sacramento, CA.*

[2] *Division of Transplant and Hepatobiliary Surgery, Department of Surgery, University of California San Diego, San Diego, CA.*

[3] *Division of Transplant Nephrology, Department of Medicine, University of California Davis, Sacramento, CA.*

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Correspondence: Naeem Goussous, MD, Division of Transplant Surgery, University of California Davis, 4010 V St, Ste 2212, Sacramento, CA 95817. (nmgoussous@ucdavis.edu).

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Network of Organ Sharing. Patients were compared on the basis of the KDPI of the kidney transplanted: KDPI >85% (high KDPI) versus KDPI ≤85 (low KDPI). Primary outcomes included posttransplant patient and graft survival and pretransplant WT. Patients accrued WT from the date of listing (dialysis initiation or when the glomerular filtration rate is <20 mL/min/1.73 m^2 in preemptively registered patients). Cold ischemia time was defined as the time from donor cross-clamp to reperfusion in the recipient. Delayed graft function was defined as the need for dialysis in the first week posttransplantation. Primary nonfunction (PNF) was defined as dialysis dependence or failure to achieve adequate graft function (glomerular filtration rate >20 mL/min/1.73 m^2) 90 d posttransplant. Graft failure was defined as death with a functioning graft or return to maintenance dialysis.

All patients received induction immunosuppression with intravenous antithymocyte globulin (thymoglobulin). Based on our institution's protocol, all patients 65 y or older received a thymoglobulin dose of 2 mg/kg unless sensitized (calculated panel-reactive antibody >40 or with current or historic preformed donor-specific antibodies) irrespective of donor kidney's KDPI. This is followed by steroid-free maintenance with tacrolimus and mycophenolate mofetil.

The Fisher exact test and the Mann-Whitney *U* test were used where appropriate. The Kaplan-Meier estimator with a log-rank test was performed to calculate graft and patient survival. *P* values of <0.05 were considered statistically significant. The data were analyzed using SPSS version 28. Our institutional review board approved this study and deemed it exempt from informed consent.

RESULTS

A total of 492 patients were identified; 317 (64.4%) were men with a median age of 69 y at transplantation. There were 87 patients (17.7%) who underwent KTx from a high KDPI donor (median KDPI 90%), whereas the rest received a low KDPI graft (median KDPI 58%). Donors in the high KDPI groups were expectedly older (60 versus 47 y, $P < 0.001$), more likely to be women (59.8% versus 41.2%, $P = 0.002$), less likely to be White (29.9% versus 68.9%, $P < 0.001$), more likely to have a history of diabetes (34.5% versus 10.1%, $P < 0.001$), more likely to have a history of hypertension (78.2% versus 39.0%, $P < 0.001$), and more likely to have cerebrovascular disease as the cause of death (75.9% versus 35.8%, $P < 0.001$) compared with the low KDPI group. However, there was a lower percentage of donation after circulatory death donors in the high KDPI group (11.5% versus 29.1%, $P < 0.001$). There was a higher utilization of dual kidney grafts in the high KDPI group (8.0% versus 2.0%, $P = 0.01$). The median cold ischemia time was shorter in the high KDPI group (25.0 versus 28.3 h, $P = 0.01$; Table 1).

There was no significant difference in recipient characteristics between both groups except for lower percentage of female recipients (19.5% versus 39.0%, $P < 0.001$), lower percentage of White recipients (29.9% versus 39.0%, $P = 0.001$), and lower degree of sensitization as seen by the lower percentage of calculated panel-reactive antibodies (0 [1–5] % versus 0 [0–56] %, $P < 0.001$; Table 2).

The use of high KDPI grafts offered shorter pretransplant WT compared with low KDPI grafts (2.7 versus 3.5 y, $P = 0.004$). The shorter WT was seen among different blood

TABLE 1.

Donor characteristics

	High KDPI (N = 87)	Low KDPI (N = 405)	*P*
Age, y	60 (57–64)	47 (33–54)	<0.001
Female sex	52 (59.8)	167 (41.2)	0.002
BMI, kg/m^2	27.3 (25–30)	27.4 (25–30)	0.91
Race and ethnicity			<0.001
White	26 (29.9)	279 (68.9)	
Black	25 (28.7)	32 (7.9)	
Asian	6 (6.9)	22 (0.5)	
Hispanic	30 (30.5)	61 (15.1)	
Other	0 (0.0)	11 (2.7)	
History of diabetes	30 (34.5)	41 (10.1)	<0.001
History of hypertension	68 (78.2)	158 (39.0)	<0.001
Cause of death			<0.001
Anoxia	14 (16.1)	163 (40.2)	
CVA	66 (75.9)	145 (35.8)	
Head trauma	6 (6.9)	85 (20.9)	
Other	1 (1.1)	12 (3.0)	
Terminal creatinine, mg/dL	1.2 (1.0–2.3)	1.1 (0.7–2.1)	0.14
Cold ischemic time, h	25.0 (19.0–31.3)	28.3 (20.8–35.5)	0.01
Dual kidney transplantation	7 (8.0)	8 (2.0)	0.01
Share type (imported)	63 (72.4)	287 (70.9)	0.87
Hypothermic machine perfusion	74 (85.1)	331 (81.7)	0.55
Kidney donor profile index	90 (88–95)	58 (35–74)	<0.001
Donation after circulatory death	10 (11.5)	118 (29.1)	<0.001

Data are presented as numbers (percentages) and medians with interquartile ranges where appropriate.
BMI, body mass index; CVA, Cerebrovascular accident.

TABLE 2.

Recipient characteristics

	High KDPI (N = 87)	Low KDPI (N = 405)	*P*
Age, y	70 (66–73)	69 (67–71)	0.06
Female sex	17 (19.5)	158 (39)	<0.001
BMI, kg/m^2	27.3 (24.7–30.3)	27.4 (24.8–30.3)	0.64
Blood type			0.001
O	55 (63.2)	180 (44.4)	
A	16 (18.4)	167 (41.2)	
B	13 (14.9)	45 (11.1)	
AB	3 (3.4)	13 (3.2)	
Race and ethnicity			0.001
White	26 (29.9)	158 (39.0)	
Black	5 (5.7)	55 (13.6)	
Asian	32 (36.8)	111 (27.4)	
Hispanic	18 (20.7)	76 (18.8)	
Other	6 (6.8)	5 (1.2)	
Preemptive	17 (19.5)	91 (22.5)	0.67
History of diabetes	50 (57.4)	211 (52.1)	0.40
Prior transplant	1 (1.1)	23 (5.6)	0.1
Estimated posttransplant survival	0.89 (0.72–0.94)	0.85 (0.66–0.93)	0.25
Calculated panel-reactive antibodies	0 (1–5)	0 (0–56)	<0.001

Data are presented as numbers (percentages) and medians with interquartile ranges where appropriate.
BMI, body mass index; KDPI, kidney donor profile index.

types but was only statistically significant for blood type O (2.7 versus 3.6 y, $P = 0.009$; Table 3).

In terms of outcomes, there was no difference between both groups in terms of delayed graft function, hospital length of stay, or graft failure within 90 d (Table 4). Four patients had graft loss within 90 d in the high KDPI group: 1 PNF, 1 graft thrombosis, 1 disease recurrence, and 1 death with a functioning graft. In the low KDPI group, 24 patients had graft loss in the first 90 d: 12 PNF, 4 deaths with a functioning graft, 5 graft thrombosis, 2 due to infectious complications, and 1 patient required an allograft nephrectomy after identification of malignancy in the graft. There was no significant difference in graft failure or mortality between high and low KDPI recipients (Figure 1), with the most common cause of death being infectious complications in both groups, and the most common cause of graft loss was death with functioning graft followed by rejection. We observed an overall graft survival of 62.1% (high KDPI) and 62.5% (low KDPI) and death-censored graft survival of 86.2% (high KDPI) and 85.1% (low KDPI) at a median follow-up of 4.85 (2.9–7.0) y.

TABLE 3.

Pretransplant wait times based on different blood types

	High KDPI (N = 87)	Low KDPI (N = 405)	*P*
Pretransplant wait time, y	2.7 (1.8–4.1)	3.5 (2.3–4.8)	0.004
O	2.7 (1.7–4.2)	3.6 (2.7–5.2)	0.009
A	2.6 (2.2–3.5)	3.0 (2.1–4.2)	0.36
B	3.7 (2.7–4.8)	4.5 (2.8–6.3)	0.19
AB	1.2 (0.4–1.2)	2.4 (1.5–3.0)	0.12

Data are presented as medians with interquartile range.
KDPI, kidney donor profile index.

TABLE 4.

Posttransplant outcomes

	High KDPI (N = 87)	Low KDPI (N = 405)	*P*
Delayed graft function	26 (29.9%)	130 (32.1%)	0.8
Hospital length of stay, d	4 (4–5.75)	5 (4–6)	0.1
90-d graft failure	4 (4.6%)	26 (6.4%)	0.63

Data are presented as numbers (percentages) and medians with interquartile ranges where appropriate.
KDPI, kidney donor profile index.

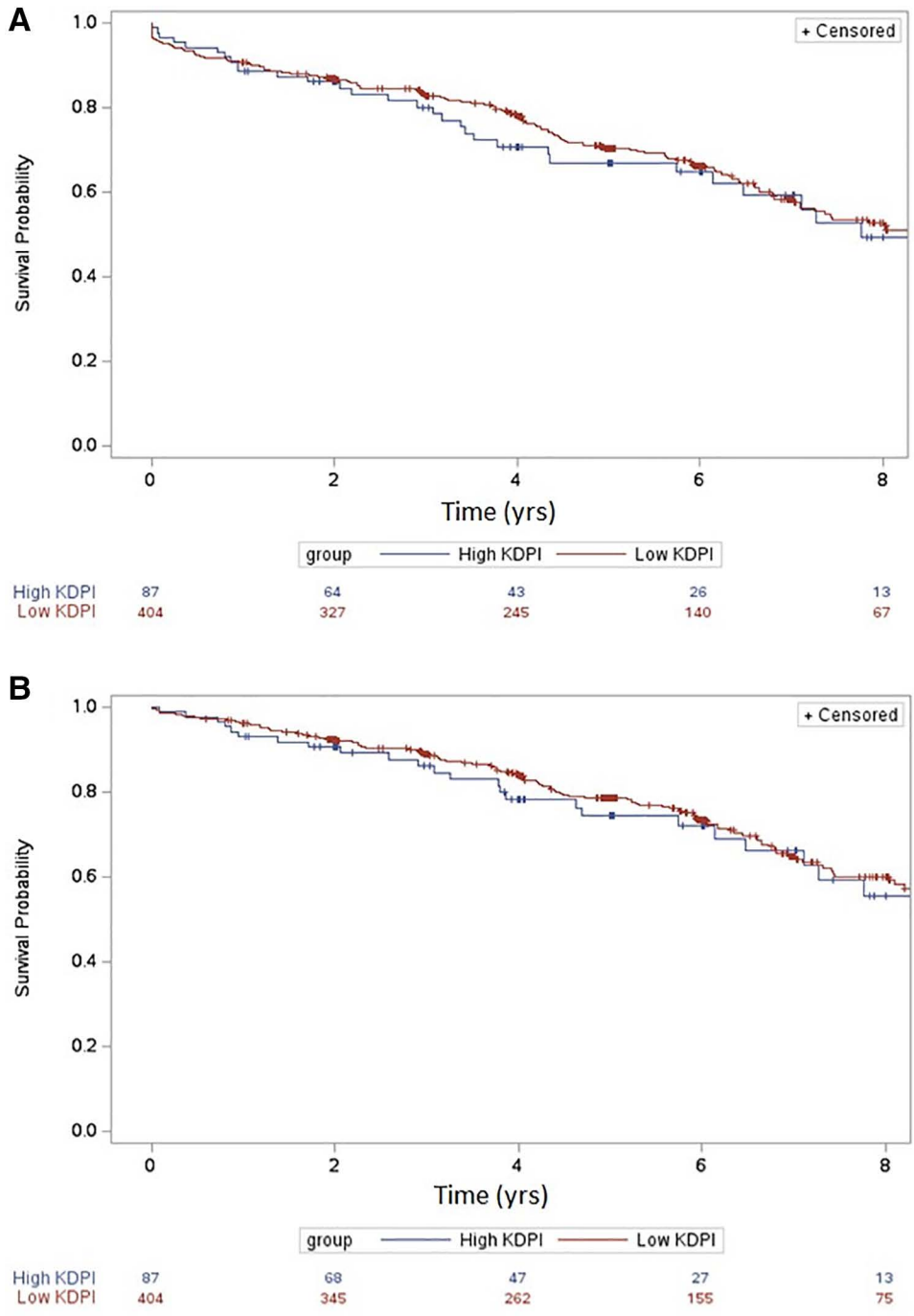

FIGURE 1. High KDPI >85% and low KDPI ≤85% kidney graft and patient survival curves. A, Graft survival ($P = 0.51$). B, Patient survival ($P = 0.4$). KDPI, kidney donor profile index.

DISCUSSION

The use of "marginal" kidneys is an important strategy in expanding the pool of available donors.[10-13] However, it is equally critical to identify subpopulations of patients awaiting KTx that will derive the greatest benefit from these "marginal" kidneys. Results of our study demonstrate that in patients 65 y or older, carefully selected high KDPI kidneys offer shorter pretransplant WT without compromising patient or graft survival compared with low KDPI kidneys.

To mitigate the lower graft survival for high KDPI kidneys, the practice in our center has evolved to minimize additional insults. This is evidenced by the shorter cold ischemic time, lower percentage of grafts from donors after circulatory death, higher percentage of dual KTx observed in the high KDPI group, and the heavy reliance on hypothermic machine perfusion (HMP). Careful evaluation of procurement biopsies and HMP parameters is vital when assessing high KDPI kidneys. Based on our center's practice, we generally tend to avoid using high KDPI kidneys with poor HMP parameters (low-flow, high-resistive indices); also, we avoid using high KDPI kidneys with >20% glomerulosclerosis as a solitary graft. Careful donor and recipient matching is of paramount importance, and we typically place high KDPI kidneys with recipients who are older, have lower immunologic risk, and

have an estimated posttransplant survival score of 80% and higher. The estimated posttransplant survival score is a score that is used to estimate posttransplant survival, and it was introduced after the adoption of the kidney allocation system and is used in the allocation system. It is calculated on the basis of the candidate's age, duration of dialysis, history of diabetes, and history of prior organ transplant, with lower scores indicating better survival and longevity.[14]

We acknowledge several limitations of this study. First, although we routinely assess procurement biopsies and HMP parameters before accepting kidney grafts, we did not analyze these data in this current study, possibly introducing a selection bias in deciding which kidneys we used. Second, this is a single-center study, which makes generalization of these findings difficult given the variability in WT among different centers.

We believe that this study adds to the existing literature regarding outcomes of high KDPI kidneys; in addition, it provides center-specific practices when using these grafts without compromising patient outcomes. The added advantage of shorter pretransplant WT suggests that more consideration should be given to high KDPI kidneys when considering organ offers for patients 65 y or older.

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