

Knowledge of Chronic Kidney Disease Among Liver Transplant Recipients

TO THE EDITOR:

Chronic kidney disease (CKD) after liver transplantation (LT) is an important comorbidity that negatively affects patient and graft survival.^(1,2) Additionally, it adds to resource utilization in LT recipients leading to increased health care costs.⁽¹⁻⁴⁾ Although LT recipients have an established framework of care and access to education as part of the transplant process, there may be significant modifiable gaps in their knowledge and understanding of CKD after LT.

Wright et al. developed a reliable and validated instrument called Kidney Disease Knowledge Survey (KiKS) that identified the areas of and risk factors for poor kidney knowledge in the nontransplant CKD population.⁽⁵⁾ To assess the CKD knowledge among LT recipients, we modified the KiKS survey by adding 4 LT-specific questions to the KiKS and performed the face validity and content validity before administering the survey to the study cohort. The KiKS-LT survey examined the CKD knowledge in the following domains:

1. General knowledge of kidney disease.
2. LT-specific kidney and immunosuppression knowledge.
3. Knowledge of kidney function.
4. Knowledge of symptoms of CKD progression or kidney failure.

Abbreviations: BMI, body mass index; BP, blood pressure; CI, confidence interval; CKD, chronic kidney disease; eGFR, estimated glomerular filtration rate; ESRD, end-stage renal disease; HbA1C, hemoglobin A1C; HCC, hepatocellular carcinoma; HR, hazard ratio; IQR, interquartile range; KiKS, Kidney Disease Knowledge Survey; LT, liver transplantation; NAFLD, nonalcoholic fatty liver disease; PBC, primary biliary cirrhosis; PSC, primary sclerosing cholangitis.

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Patients and Methods

STUDY DESIGN AND POPULATION

We conducted a cross-sectional survey study among LT recipients who had a routine post-LT appointment at the University of Michigan LT outpatient clinics between July 1, 2016 and September 30, 2017. The follow-up period lasted until May 31, 2018. Our study included the recipients of LT between January 1, 2008 and December 31, 2016, age ≥ 18 years, ≥ 3 months after LT, and those with an estimated glomerular filtration rate (eGFR) ≥ 30 mL/minute at the time of survey. We excluded the recipients of kidney transplant at or after LT, eGFR < 30 mL/minute, and those on dialysis or listed for kidney transplant. The University of Michigan Institutional Review Board approved this study.

KIKS-LT SURVEY INSTRUMENT

After a content review of CKD knowledge questionnaire in general population, we chose the validated KiKS survey.⁵ To make it LT-specific, we added 4 LT-specific questions to the KiKS. The KiKS-LT survey was comprised of 31 questions (see Supporting Material) with 1 best answer for each question. We asked additional questions at the end of the KiKS-LT survey from the respondents: Do you use the patient portal (your electronic health record)? How would you like to receive a CKD educational and goal setting tool if you are interested in learning more about CKD?

To establish the face validity, content validity, and construct validity of the KiKS-LT survey, we convened experts in various areas of LT and CKD care (transplant providers with expertise in liver disease, kidney disease, and transplant surgery, $n = 4$; nurses, $n = 2$; research personnel, $n = 2$; and transplant pharmacists, $n = 2$). We also solicited method input from experts in health literacy, scale validation, and psychometric analysis. We used the Kuder-Richardson 20 coefficient to determine internal consistency.

STATISTICAL ANALYSIS

Continuous and categorical variables were expressed as median and interquartile range (IQR) and n (%), respectively. The eGFR was calculated using the 4-variable Modification of Diet in Renal Disease Study equation. CKD stage was assigned based on the KDOQI guidelines. The Z test was used to compare the distribution of CKD knowledge scores of LT recipients with the distribution of CKD knowledge scores in nontransplant recipients.⁽⁵⁾ The main outcome was CKD knowledge score, calculated as the proportion of all correct answers on the KiKS-LT survey by each patient. We used linear regression to examine the associations between CKD knowledge and patient characteristics (age, education level, CKD stage, and diabetes). Exploratory analyses were performed for sex, etiology, seen by a nephrologist, and time from LT to survey. Multicollinearity of the covariates was tested using tolerance and variance inflation factors.

Cox regression was used to examine the effect of CKD knowledge on CKD progression to stage 4-5 CKD during the follow-up period. The time to event was calculated from the date of survey to the date of event or end of follow-up period. The model was adjusted for age at survey, decile of knowledge score, diabetes, answering “yes” to learn more about post-LT CKD, hypertension, and eGFR at the time of survey.

We performed all statistical analyses using SPSS, version 24 (IBM Corp., Armonk, NY).

Results

After obtaining the informed consent, the KiKS-LT survey was administered to 175 patients. Of these patients, 1 withdrew consent and 11 did not return the survey. The final study cohort consisted of 163 LT recipients (Table 1). More than half of the respondents

(55%) were actively using patient portal messaging through electronic health records. Sixty-five percent of those who responded “yes” were interested in learning more about CKD in LT recipients through an

TABLE 1. Characteristics of LT Recipients at the Time of Survey

Characteristics at Survey	Value (n = 163)
Age at survey, years	60 (51-64)
Sex, male	117 (71.8)
Race	
Caucasian	140 (85.9)
African American	14 (8.6)
Hispanic	1 (0.6)
Asian	5 (3.1)
Other	3 (1.8)
Etiology of liver disease	
Hepatitis C	54 (33.1)
Alcoholic liver disease	27 (16.6)
Cryptogenic cirrhosis/NAFLD	22 (13.5)
Autoimmune/PBC/PSC	35 (21.5)
Other	25 (15.3)
HCC	43 (26.4)
Time from LT to survey, years	2.7 (1.1-6.1)
Serum creatinine, mg/dL	1.2 (1.0-1.4)
eGFR, mL/minute	57.7 (47.0-76.0)
CKD	
Stage 1	22 (13.5)
Stage 2	55 (33.7)
Stage 3	86 (52.8)
Established nephrology care	23 (14.1)
BMI at survey, kg/m ²	28.2 (24.9-32.9)
<25 kg/m ²	41 (25.2)
25-29 kg/m ²	57 (35.0)
30-34 kg/m ²	28 (23.3)
≥35 kg/m ²	27 (16.6)
Systolic BP, mm Hg	137 (125-150)
Diastolic BP, mm Hg	75 (67-75)
Hypertension	69 (42.3)
Diabetes	42 (25.8)
Education	
High school or less	65 (39.9)
Some college or completed college	60 (36.8)
Graduate school or higher	13 (8.0)
Missing	25 (15.3)
Use patient portal of electronic health record	92 (56.4)
Interested in education	106 (65.0)
Via phone	47 (44.3)
Patient portal	33 (31.1)
At clinic visit	26 (24.5)

NOTE: Data are given as n (%) or median (IQR).

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educational tool. Three-fourths of those interested in learning more about CKD wanted to be contacted either via patient portal (electronic health record) or via telephone.

The median eGFR at the time of survey was 57.7 mL/minute. More than half had stage 3 CKD. Only 14% had seen a nephrologist. The prevalent risk factors for CKD like diabetes, hypertension, and obesity were present in 26%, 42%, and 40% of the respondents, respectively. The median time from LT to survey was 2.7 years (IQR, 1.1-6.1 years). Median time from survey to last follow-up was 16 months (IQR, 14-17 months).

PRIMARY AND SECONDARY OUTCOMES

The 31-question KiKS-LT survey was analyzed for internal consistency (Kuder-Richardson 20 = 0.77). Table 2 shows the degree of difficulty and item correlation. The mean knowledge score defined as the proportion of correct answers to the KiKS-LT survey was 0.60 (95% confidence interval [CI], 0.57-0.63). The CKD knowledge score among LT recipients with stage 1-3 CKD was significantly lower compared with the non-LT CKD population surveyed by Wright et al. using KiKS (0.66; 95% CI, 0.65-0.67).⁽⁵⁾

TABLE 2. Item Difficulty and Item Correlation

Topic	Item Difficulty (Percent Correct)	Item-Rest Correlation
General knowledge		
Understanding the risk factors of CKD	83%	0.32
Understanding increased risk of heart disease	75%	0.27
Understanding increased risk of mortality	96%	0.26
Definition of GFR	56%	0.35
Knowing there are stages of CKD	85%	0.37
Medications a person with CKD should avoid	60%	0.27
Medications important to kidney health	86%	0.36
Treatment options for kidney failure	88%	0.34
Understanding BP goals	85%	0.19
Definition of HbA1C	60%	0.20
Understanding blood sugar goals	47%	0.26
LT-specific kidney and immunosuppression knowledge		
Understanding that risk of CKD is increased	67%	0.29
Understanding side effects of calcineurin inhibitors	82%	0.33
Immunosuppression and graft health	85%	0.11
Understanding common cause(s) of death after LT	9.2%	-0.07
Knowledge of kidney function		
Role in glucose control	65%	0.37
Role in bone health	26%	0.41
Role in anemia	59%	0.42
Role in hair loss	81%	0.36
Role in BP control	55%	0.49
Urine production	74%	0.30
Role in waste clearance	67%	0.35
Knowledge of symptoms of CKD progression or failure		
No symptoms	12%	0.004
Unusual itching	45%	0.47
Confusion	64%	0.44
Metallic/bad taste	47%	0.38
Shortness of breath	41%	0.42
Increased fatigue	80%	0.58
Hair loss	76%	0.46
Difficulty sleeping	61%	0.44
Weight loss	45%	0.37

NOTE: Degree of difficulty and item correlation are grouped by the domains.

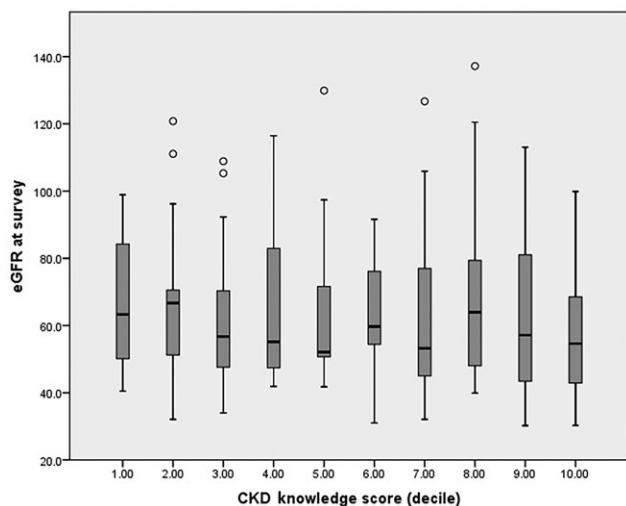


FIG. 1. Distribution of eGFR at the time of survey within each decile of CKD knowledge score. The ends of the box are the upper and lower quartiles, so the box spans the IQR.

INDEPENDENT PREDICTORS OF CKD KNOWLEDGE AMONG LT RECIPIENTS

Figure 1 showed the spread of eGFR within each decile of the CKD knowledge score. In an adjusted analysis, younger age ($\beta = -0.003$ per year decrease in age; $P = 0.02$) and higher CKD stage ($\beta = 0.041$ per stage increase in CKD; $P = 0.04$) at the time of survey were associated with high CKD knowledge. Education above high school and diabetes were independently associated with an 8.3% ($P = 0.002$) and 7.7% ($P = 0.01$) increase, respectively, in the CKD knowledge.

PROGRESSION TO ADVANCED CKD AND PREDICTORS

A total of 9 patients progressed to stage 4-5 CKD after the median follow-up of 16 months (IQR, 14-17 months) from the date of survey. As expected, eGFR at the time of survey (hazard ratio [HR], 0.92; 95% CI, 0.86-0.99; $P = 0.02$) was the independent predictor of stage 4-5 CKD. Those who answered “yes” to more CKD education trended toward lower risk of advanced CKD ($P = 0.14$) compared with those who responded “no.”

Discussion

This is the first study to examine the CKD knowledge among LT recipients with stage 1-3 CKD using the modified KiKS-LT survey. The distribution of CKD knowledge scores among LT recipients was lower than the distribution of those with CKD in non-LT populations. Only 14% had established nephrology care in our cohort, possibly because a majority had early-stage CKD (eGFR > 45 mL/minute).

We also showed that the presence of diabetes and high CKD stage were associated with higher CKD knowledge among LT recipients.

The majority of participants were aware that calcineurin inhibitors are a risk factor of CKD. Interestingly, time from LT to survey was not associated with the patient’s level of CKD knowledge. This finding suggests that CKD educational programs are needed for LT recipients regardless of transplant duration.

Our study indicates that CKD knowledge among LT recipients is low and may be a barrier for self-care. Encouragingly, more than two-thirds of the LT recipients were interested in learning more about CKD progression and prevention. The majority indicated that they would like to receive the education remotely instead of at their clinic visit. This reflects that LT recipients are open to using technology for education.

Many studies have addressed the burden of post-LT CKD progression.⁽¹⁻³⁾ However, there is an unmet need for patient-centered studies examining the barriers and attitudes toward gaining knowledge about this major comorbidity that affects their quality of life. Our work will start that dialogue despite the limitations, including a cross-sectional design from a single center consisting of early-stage CKD outpatient LT recipients who are predominantly white.

In conclusion, the results of this study will facilitate evidence-based development of a personalized CKD education and goal-setting tool for LT recipients with early stages of CKD.

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