KI REPORTS
KIReports.org
CLINICAL RESEARCH

A National Survey of Practice Patterns for Accepting Living Kidney Donors With Prior COVID-19

Muhammad Y. Jan[1], Areeba T. Jawed[2], Nicolas Barros[1], Oluwafisayo Adebiyi[1], Alejandro Diez[3], Jonathan A. Fridell[1], William C. Goggins[1], Muhammad S. Yaqub[1], Melissa D. Anderson[1], Muhammad A. Mujtaba[4], Tim E. Taber[1], Dennis P. Mishler[1], Vineeta Kumar[5], Krista L. Lentine[6] and Asif A. Sharfuddin[1]

[1]Indiana University School of Medicine, Indianapolis, Indiana, USA; [2]Wayne State University, Detroit, Michigan, USA; [3]The Ohio State University, Columbus, Ohio, USA; [4]University of Texas Medical Branch UTMB Galveston, Galveston, Texas, USA; [5]University of Alabama, Birmingham, Alabama, USA; and [6]St. Louis University, St. Louis, Missouri, USA

Introduction: A critical question facing transplant programs is whether, when, and how to safely accept living kidney donors (LKDs) who have recovered from COVID-19 infection. The purpose of the study is to understand current practices related to accepting these LKDs.

Methods: We surveyed US transplant programs from 3 September through 3 November 2020. Center level and participant level responses were analyzed.

Results: A total of 174 respondents from 115 unique centers responded, representing 59% of US LKD programs and 72.4% of 2019 and 72.5% of 2020 LKD volume (Organ Procurement and Transplantation Network-OPTN 2021). In all, 48.6% of responding centers had received inquiries from such LKDs, whereas 44.3% were currently evaluating. A total of 98 donors were in the evaluation phase, whereas 27.8% centers had approved 42 such donors to proceed with donation. A total of 50.8% of participants preferred to wait >3 months, and 91% would wait at least 1 month from onset of infection to LD surgery. The most common reason to exclude LDs was evidence of COVID-19–related AKI (59.8%) even if resolved, followed by COVID-19–related pneumonia (28.7%) and hospitalization (21.3%). The most common concern in accepting such donors was kidney health postdonation (59.2%), followed by risk of transmission to the recipient (55.7%), donor perioperative pulmonary risk (41.4%), and donor pulmonary risk in the future (29.9%).

Conclusion: Practice patterns for acceptance of COVID-19–recovered LKDs showed considerable variability. Ongoing research and consensus building are needed to guide optimal practices to ensure safety of accepting such donors. Long-term close follow-up of such donors is warranted.

Kidney Int Rep (2021) **6,** 2066–2074; https://doi.org/10.1016/j.ekir.2021.05.003
KEYWORDS: COVID-19; kidney transplantation; living kidney donation; pandemic; recovered living kidney donors

In 2019, before the COVID-19 pandemic, living donor (LD) kidneys comprised 29.3% of the 23,401 kidney transplantations performed in the United States.[1] Although there has been a slight decline in kidney transplants overall due to the COVID-19 pandemic, there has been a significant decline in use of LD kidney transplants (LDKTs). Specifically, for LDKTs, the year 2020 saw the lowest number of performed since the year 2000, dropping from 6867 in 2019 to 5234 in 2020.[2]

Postponement of elective procedures to provide more beds, resources, and personnel to be able to handle COVID-19 cases, along with the uncertainty regarding the recipient's risk and outcomes after becoming infected with COVID-19, have severely affected LDKT programs, and a majority of LDKT programs have suspended their activities. In the United States, a survey conducted across a majority of transplant centers in May 2020 reported that almost 66% of the LDKT programs were on hold, and 36% reported cessation of new donor evaluations.[3] A study by Bordes *et al.*[4] compared LDKT activity in the United States from 15 March (after the declaration of a national

Correspondence: Asif A. Sharfuddin, 550 North University Boulevard, UH 4620, Indianapolis, Indiana, 46202, USA. E-mail: asharfud@iu.edu

Received 18 February 2021; revised 7 April 2021; accepted 3 May 2021; published online 15 May 2021

health emergency in the United States) to 1 August 1 2020 with LDKT activity over this time frame in 2019. They noted 2717 LDKTs in 2019 compared to only 1508 in 2020. This showed a significant decrease from approximately 286 LDKTs per month in 2019 to 195 LDKTs per month in 2020 for the same time period.[4]

As the pandemic progressed, many potential LDs contracted COVID-19 and have since recovered from the infection. As programs resume their LDKT activities, and as candidates who have contracted and cleared the infection step forward to become kidney donors, there are a number of concerns surrounding donation from such candidates. These include the risk of COVID-19 transmission (through blood or organs), the impact of the infection on kidney function of both the donor and recipient, the risk of perioperative pulmonary and cardiovascular decompensation adding to surgical risk in the donor, and healthcare resource use, leading to questions among transplant programs about the safety, testing, medical clearance, and post-transplantation course.

To facilitate discussions of best practices and to obtain an overall view from transplant programs regarding the above questions, we designed a survey to assess the acceptance criteria and practice patterns by US transplant programs for LD candidate evaluation and surgery. Herein we report the findings based on responses at US transplant programs from 3 September 2020 to 3 November 2020.

MATERIALS AND METHODS

Survey Design

The survey was developed by the study investigators comprising transplant nephrologists, transplantation surgeons, and transplantation infectious disease experts from multiple institutions. Key questions related to living donor evaluation in light of COVID-19 infection were identified, debated and developed after direct discussion or e-mail among the study investigators. The final survey comprised 25 questions (Supplementary Table S1). Participation in the survey was voluntary, and participation was considered as indicating consent for the study. Study investigator contact information was provided to participants. The survey asked for the participant's role at their transplant center, United Network for Organ Sharing (UNOS) center ID (optional), followed by questions related to inquiries and completed evaluations of LDs who had recovered from COVID-19. This was followed by questions related to participant concerns regarding accepting such donors, inclusion/exclusion criteria, timeframe of COVID-19–recovered LD evaluation and surgeries, opinions regarding COVID-19–related testing, and recipient immunosuppression protocol. This study was approved as Human Subject Exempt by the Indiana University Institutional Review Board.

Survey Distribution

The survey was intended to reach transplant program staff comprising transplant nephrologists, surgeons, transplant infectious disease experts, administrators, coordinators, social workers, advocates, advanced practitioners, and transplantation fellows in training at all US LDKT programs active during 2020 (n = 194). Study data were collected and managed using Research Electronic Data Capture (REDCap) tools hosted at Indiana University.[5] REDCap is a secure, Web-based software platform designed to support data capture for research studies.

All potential participants were e-mailed the survey via a Redcap survey link through the investigators' professional links. A REDCap link was also posted to professional society e-mail listservs (i.e., American Society of Transplantation [AST], infectious disease community of practice, living donor community of practice [LDCOP], AST Outstanding Questions in Transplantation [OQiT]), and AST newsletters). The community of practice postings were approved by community of practice leadership, and the OQiT posting was approved by the AST Education Committee. Data were analyzed from distribution between 3 September and 3 November 2020. Up to 2 reminders were provided for nonrespondents. A total of 25 directly emailed survey participants were randomly selected to receive a $20 gift card.

Statistical Analysis

All analysis was done after exporting data into the Statistical Package for Social Sciences (SPSS) version 27 (IBM Corporation, Armonk, NY). Because of the lack of formal protocols for COVID-19–recovered LDs at many programs, and to account for differences in opinion among participants, responses were analyzed based on question type and categorized into either center-based responses or opinion-based responses. This was important in able to obtain accurate denominators for responses, as the total number of participants was 174 from 115 unique programs. If there was more than 1 response for a center, only 1 response with complete answers was selected for analysis. Results were described as a percentage and/or frequency where indicated and presented in text, table, or figure form. For opinion-based questions, the denominator was taken as the total number of participants answering that question, and missing entries were excluded from the denominator. There were 10 "check all that apply" questions, for which the totals would exceed 100%.

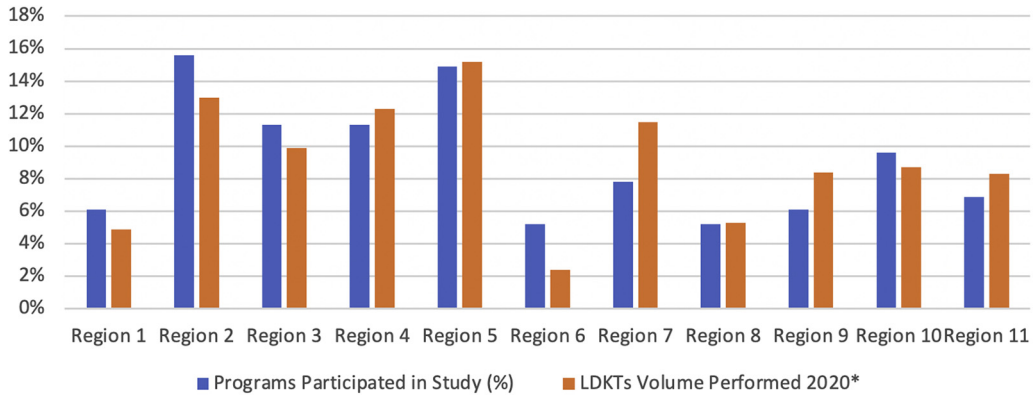

Figure 1. Survey participation by United Network for Organ Sharing (UNOS) region among programs with living donor kidney transplantation volume, 2020.

Data were also assessed for participation based on UNOS regions and where the program was located, by state.

RESULTS

Survey Participation

The survey results describe responses from centers in the Unites States that perform living donor kidney transplantations (LDKT). A total of 115 unique programs participated in the survey, which represent 59.5% of all US living donor transplant programs, and 72.4% of 2019 and 72.5% of 2020 LDK volume.[1] We received responses from all UNOS regions, with higher participation from UNOS regions with higher volumes of LDKT performed in 2020, as shown in Figure 1. Within transplant programs, the survey was completed by participants with a variety of roles, as shown in Table 1. Participants from transplant programs in 36 states responded to the survey.

Living Donor Evaluation During the Pandemic

Among the 115 transplant centers from which participants filled out the survey, almost half of the programs (48.6%) had received LD candidate inquiries from such LKDs since the start of the pandemic to the survey period, and 44.3% were currently evaluating such donors. At the time of the survey, 98 donors were reported to be in the evaluation phase, and 27.8% of centers had approved 42 such donors to proceed with donation.

Willingness to Accept COVID-19–Recovered LDs, Perceived Concerns, and Criteria for Consideration of Living Donor Transplants

Overall 54.7% of participants said that their program would consider accepting an LD who had recovered from COVID 19, whereas 38.9% mentioned doing so on a case-by-case basis. A very small percentage stated that they would decline or were unsure about such donors (6.4%). The greatest concern among participants (59%) was related to donor kidney health postdonation. This is shown in Figure 2. Additional concerns expressed by participants included hypercoagulable state, long-term cardiovascular risk, and development of lung disease as a sequala of COVID-19 to the donor.

In consideration of such LDs, a significant trend of uncertainly was observed, with very few participants actually choosing not to decline such donors but choosing the answer "Unsure." In consideration of accepting such donors, an overwhelming majority mentioned that they would consider only those donors who had had mild disease who were managed as outpatients without requiring any treatment. A smaller but significant percentage of participants stated that their decision to accept an LD would depend on degree of recovery and not the severity of that individual's COVID-19 disease (Figure 3). Reasons for the main preferences for exclusion are shown in Figure 4.

Participant preferences regarding consideration of COVID-19–recovered LD for altruistic kidney donation, paired kidney donation, and donation for high immunological risk are shown in Table 2.

Timeframe of LD Evaluation and Surgery

If considered for an LD transplant, most participants' preference or opinion was to wait for at least 1 month after infection and before the LD initial evaluation was done, followed by preferring waiting for at least 3

Table 1. Participant characteristics

Role at transplant center (n = 174)	% (n)
Transplant nephrologist	53.4% (93)
Transplant surgeon	19.5% (34)
Transplant infectious disease specialist	11.5% (20)
Transplant clinical coordinator	9.8% (17)
Administrator	1.7% (3)
Social worker	1.2% (2)
Other	2.9% (5)

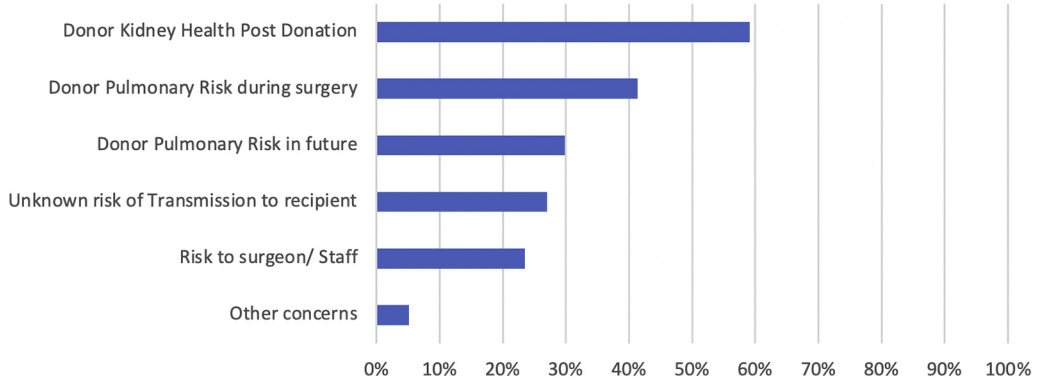

Figure 2. Most common specific concerns among study participants about COVID-19–recovered living donors.

months. Slightly more than half of the participants (50.8%) indicated that they would like to wait for more than 3 months for surgery, and the overwhelming majority would wait at least 1 month (91%) after the onset of infection. These trends are shown in Figure 5.

Pretransplantation Testing

During the survey study period, for LD transplant evaluation, just over half of the participants (54.8%) would start with COVID-19–specific testing before any other evaluation, followed by 24.6% of participants who would perform COVID-19 testing as part of routine evaluation (Figure 6). For COVID-19–specific testing, most participants (85.6%) would obtain a nasopharyngeal (NP) swab for COVID-19 polymerase chain reaction (PCR), followed by IgG antibody (52.3%). Most participants (90%) would prefer to have testing done at their own hospital laboratory compared to using a community or public laboratory.

In the hypothetical scenario of choosing between living donors with available serologies and COVID-19 NP-PCR test results, most participants (85.1%) chose NP-PCR–negative individuals with negative IgM and positive IgG against COVID-19 antibody. The remainder of the scenarios are shown in Table 3. The most common additional testing preferred by participants included chest computed tomography (64.9%) and pulmonary function tests (51.1%), followed by cardiac transthoracic echocardiography (3%) and ambulatory pulse oximetry.

With regard to final preoperative testing, a majority of participants (86.2%) indicated that they would perform NP-PCR for COVID-19 only, whereas 9.2% of participants would prefer to do no additional testing. In all, 97.5% of participants preferred to keep their standard COVID-19 surgical protocol during the laparoscopic donor surgery procedure.

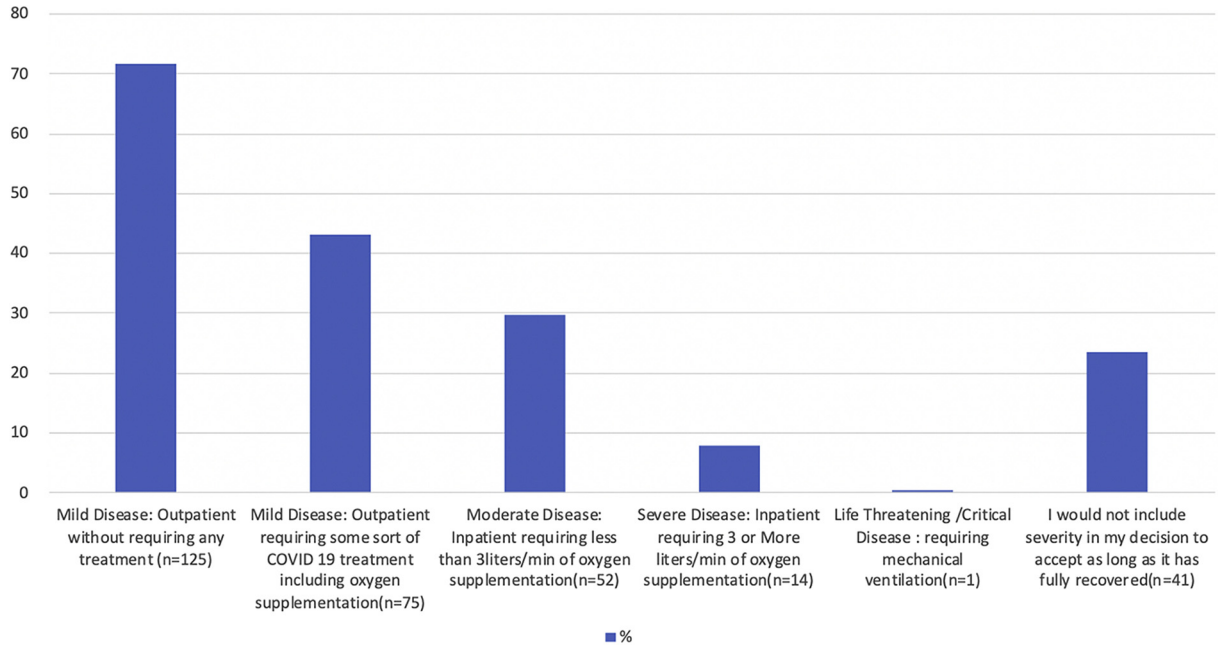

Figure 3. Participant preferences for inclusion criteria of living donors (LDs) who have recovered from COVID-19.

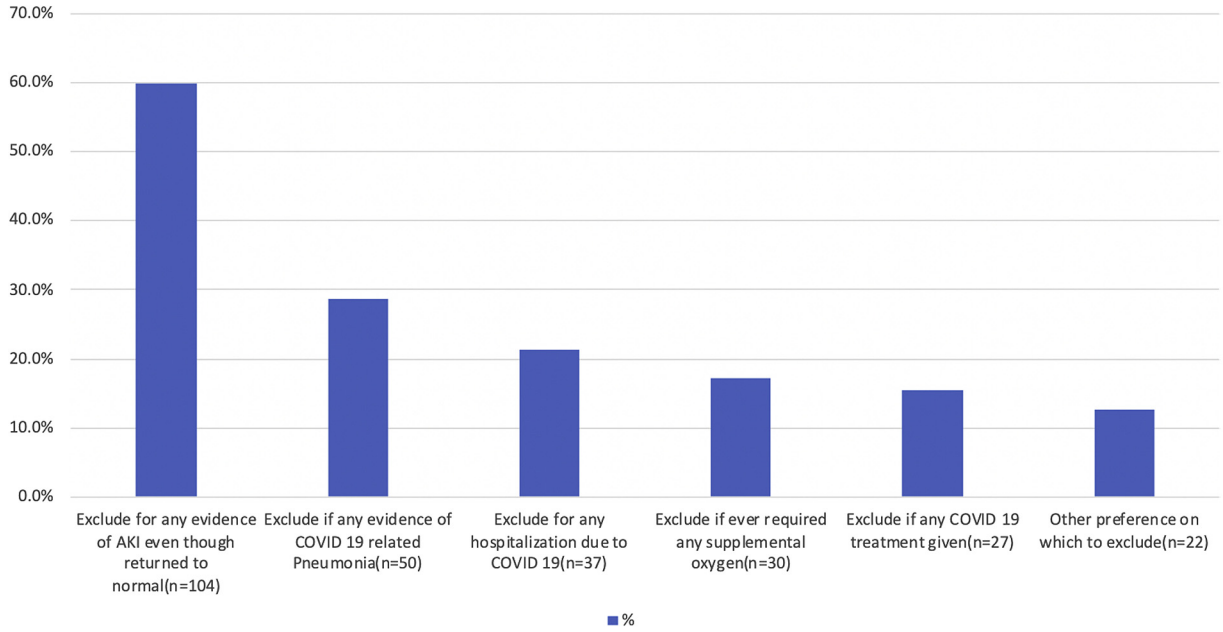

Figure 4. Participant preferences for exclusion criteria of living donors (LDs) who have recovered from COVID-19.

Recipient Care of LDs

In the case of a successful donation from a donor who had recovered from COVID-19, a majority of participants (67.9%; n =112 of 165) indicated that they would not change the immunosuppressive protocol, whereas 14.5%; n = 24 of 165) said that they would modify the protocol on a case-by-case basis. If participants had to modify the immunosuppressive regimen, the most common preference was not to use a T-cell–depleting induction agent (6.8%) followed by lower anti-metabolite dose (6.3%). Practices regarding testing and screening LDKT recipients from such COVID-19–recovered LDs are shown in Table 4.

The majority of participants preferred to screen recipients within the first month of transplantation, as shown in Table 4.

During the survey period, the majority of participants (82.9%) were not aware of any former LDs becoming infected with COVID-19, whereas 44 living donors were reported to programs and were known to have had COVID-19.

DISCUSSION

Our national survey of transplant centers across the United States regarding criteria and practice patterns for acceptance of LDs with prior COVID-19 infection was well distributed and received. Our center survey representation rate (59.1%) was higher than most surveys, which generally average around 30%. Participants from transplant centers in all UNOS regions responded with participation mirroring the LDKT volume performed in 2020, as shown in Figure 1. Although preferences do not necessarily reflect practice patterns at their respective centers and/or UNOS regions, cumulatively they do help show prevalent trends and add more weight to the results of the survey.

Table 2. Participant preferences in considering COVID-19–recovered living donor for nondirected, paired-kidney donation, and for high–immunological risk recipients

Would you consider accepting a living donor kidney with recovered COVID-19 in the following situations:	Yes	Unsure or case-by-case basis
Any living donor with recovered COVID-19?	54.7%	38.9%
Nondirected (altruistic) living donor?	63.1%	29.2%
Consideration for paired-kidney donation?	69.5%	22.8%
High–immunological risk recipient?	64.9%	26.9%

With resumption of LDKT activity close to pre-pandemic levels, an important question emerged for LDKT programs: how and when to optimally consider evaluating LD who have recovered from COVID-19. A majority of transplant programs were willing to accept such donors for evaluation, whereas some of them wanted to proceed on a case-by-case basis.[6,7] A majority of participants were accepting of evaluating altruistic donors and also COVID-19–recovered LDs for paired kidney donations, which adds to the complexity of another living donor center having to follow evaluation guidelines, travel, quarantine, and kidney transport. This is still encouraging, given the fact that a survey from May to June 2020 showed that 56% of LDKTs paused kidney-paired donation (KPD).[8]

LD Acceptance Preferences and Concerns Among LDKT Programs

We found variability in accepting COVID-19–recovered donors for LD based on preferences related to severity of COVID-19 infection and the timeline for initiating evaluation and donor surgery.

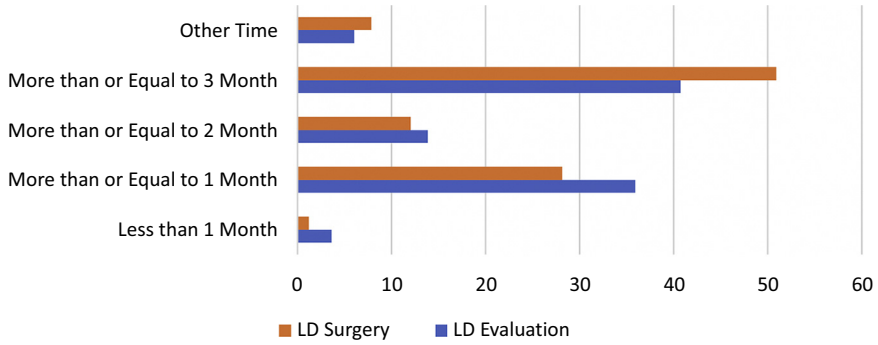

Figure 5. Preferences to start living donor (LD) evaluation and surgery after recovery from COVID-19 (percentage of responses).

Not surprising, the most common concern observed in our survey was related to donor kidney health post-donation even in the setting of recovered kidney function, and a preference not to not accept such LDs was noted. Although kidney donation does not result in reduced or compromised immunity, the main concern stems from reduced renal reserve from donor nephrectomy, which could result in a higher likelihood of severe acute kidney injury (AKI) in the case of severe infection. A meta-analysis from November 2020 showed the incidence of AKI to be 22.6% among studies analyzed from North America in all hospitalized patients with COVID-19.[9] Similarly, the study showed an overall incidence of acute kidney injury in hospitalized patients with COVID-19 at 10.6%.[9] A study comparing AKI occurrence and outcomes in COVID-19–associated AKI versus non–COVID-19 AKI showed that in the setting of COVID-19, AKI occurred twice as often as in non–COVID-19 patients (26% vs. 12 %).[10] It also showed that patients with chronic kidney disease had higher odds of developing AKI (odds ratio = 2.81). Postdonation LDs have been shown to have a lower glomerular filtration rate, and there are emerging data that show potentially higher chronic kidney disease and ESKD risks in patients with a lower glomerular filtration rate.[11] However, these risks need to be looked at in the context of the severity of COVID-19 infection.

Hospitalization for mild or asymptomatic COVID-19 among healthy individuals, who constitute the majority of LDs, is exceedingly rare, and we do not have data on the incidence and severity of AKI in this group. Moreover, lack of any abnormal findings on established LD evaluation tools such as computed tomography, 24-hour creatinine clearance, and albuminuria are reassuring in healthy individuals with recovered COVID-19. This, combined with rigorous testing in the LD evaluation process and strict observance of protocols regarding the timing of this testing in relation to timeline of COVID-19 recovery, should enable such LDs to proceed with donation. This is especially important for LDs who want to proceed with donation given the long wait times for deceased donor kidney transplants and the high mortality rates, ranging from 8.1% in 2017 to 6.8% in 2019 among recipient candidates who were waitlisted in 2014 and 2016, respectively.[1]

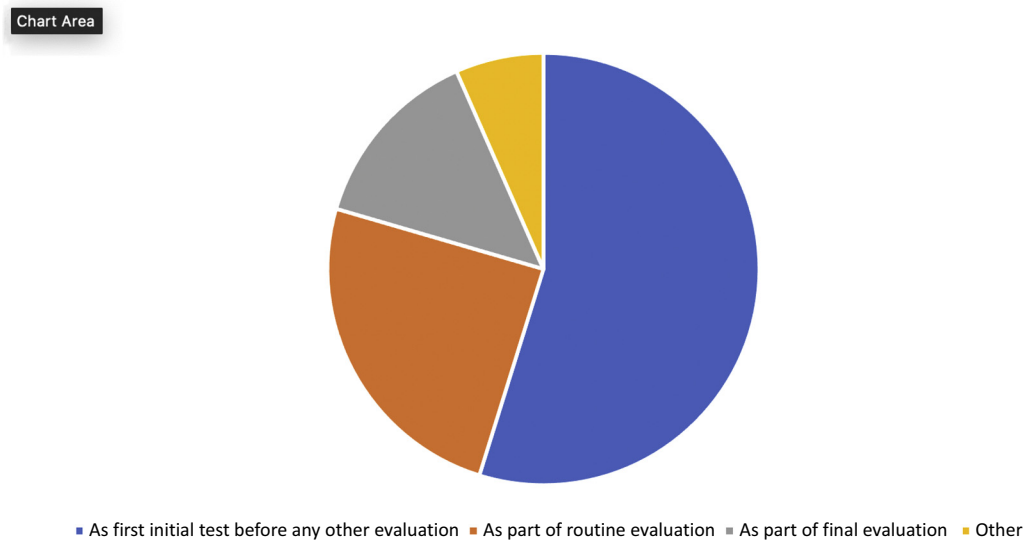

Figure 6. Timing of COVID-19–specific testing in recovered living donors (LDs) during evaluation process.

Table 3. Preferences regarding accepting asymptomatic COVID-19–recovered living donor with the following COVID-19 test results, and preferences for final preoperative testing of such a donor

Would you accept an "asymptomatic" living donor who has the following testing profile?	Yes % (n)	No % (n)
NP-PCR Neg, IgM Neg, IgG +	85.1% (148)	14.9% (26)
NP-PCR Neg, IgM +, IgG Neg	18.4% (32)	81.6% (142)
NP-PCR Neg, IgM +, IgG +	30.5% (53)	60.5% (121)
NP-PCR +, IgM Neg, IgG +	9.2% (16)	90.8% (158)

Choice of final preoperative repeat testing for asymptomatic donor after initial testing and approval			
NP-PCR	Serum IgM	Serum IgG	No additional testing
150/174 (86.2%)	17/174 (9.8%)	19/174 (10.9%)	16/174 (9.2%)

Perioperative and postdonation pulmonary risk to donors remained the second main concern among participants. An international cohort study[12] reviewed 1128 surgeries among people who were positive for COVID-19 perioperatively. Of these, 280 were elective surgeries, which showed a 30 day mortality of 18.9%, with risk of pulmonary complications being 53.1%.[12] This study suggested that consideration should be given to postponing non-urgent procedures.[12]

Currently, there is no conclusive evidence to show transmission of COVID-19 via bloodborne or urinary route; however, concern regarding the potential for viral transmission with kidney transplantation remains.[13] A recent study from India reported 31 such LDKTs in patients who received a kidney from a COVID-19–recovered donor, and none of the recipients turned positive for COVID-19 during the follow-up period. The study followed a protocol of strict social distancing, hand hygiene, and designated healthcare worker teams to care exclusively for such donor–recipient pairs. Donor, recipient COVID-19 NP-PCR, and chest computed tomography were performed on every donor–recipient pair within 42 to 72 hours of surgery.

Table 4. Preferences related to testing and immunosuppression regimen for recipients of living donor kidney transplant from COVID-19–recovered living donors

When using a living donor with recovered COVID 19, would you screen the recipient for COVID 19 posttransplantation?	
Yes: 42.5% (74/164)	No: 51.7% (90/164)
If Yes, which test would you use to screen the recipient?	
NP-PCR swab	62/74 (83.8%)
Serum IgM	21/74 (28.4%)
Serum IgG	22/74 (29.7%)
COVID Antigen	17/74 (23.0%)
If Yes, what time frame will you consider screening the recipient posttransplantation?	
<1 mo	52/73 (71.2%)
≥1 mo	15/73 (20.5%)
≥2 mo	1/73 (1.4%)
≥3 mo	1/73 (1.4%)
Other	4/73 (5.5%)

NP, nasopharyngeal; PCR, polymerase chain reaction.

Acceptance versus case-by-case evaluation was a common finding in our survey. This may be related to the variability of the disease presentation and timeline for recovery leading to different observance of isolation protocols. Lack of ability to quantify long-term sequelae from COVID-19, as well as prolonged and often bothersome symptoms in certain people,[14] are other challenges. Most participants considered donors who had mild disease requiring outpatient management of COVID 19 or inpatients who required less than 3 L of supplemental oxygen. Some participants considered a need for hospitalization or a need for supplemental oxygen as an exclusion criterion. However, this shows the absence of clear inclusion or exclusion criteria for such donors. Currently, the AST and other society guideline recommendations do not take into consideration the severity of the donor's COVID-19 illness. To date, in the largest study, by Kute *et al.*, of 31 such LDs, 71% of the LDs had an asymptomatic infection, whereas 29% had only mild disease.[7] A recent case report[6] from the United States did not mention severity of the disease in the donor; however living donation that lead to a kidney transplant was complicated by slow graft function in the recipient.

Timing of LD Evaluation and Surgery Post–COVID-19

A number of transplant societies provide recommendation guidelines for LDs with a history of prior COVID-19. The AST/UNOS guidelines suggest considering donors who had a positive test result if the donor is between 21 and 90 days from initial symptoms that have resolved (irrespective of repeat nucleic acid testing [NAT] test results) and in consultation with an infectious diseases specialist.[15] The National Institute for Health and Clinical Excellence (NICE) in the United Kingdom suggests deferring living donation for at least 28 days from symptom resolution with a negative nasopharyngeal swab test result for COVID-19.[16] They also recommend checking clinical history for isolation, as well as 2 weeks of social distancing, and a negative nasopharyngeal swab test result within 3 days of donation.

Our survey also showed that a majority of participants chose to wait, with one-third preferring to wait at least 1 month and one-third preferring to wait even further, up to at least 90 days from infection onset to LD evaluation. Similarly, approximately one-half of the participants (85 of 167) wanted to wait at least 3 months before proceeding with LD surgery. Studies done previously on LD programs nationally[3] and internationally[8] seem to reflect similar practices being reported by participants at their transplant centers.

Testing of COVID-19–Recovered LKDs

In the case series by Kute *et al.*, the average time from first positive NP-PCR test result to first negative NP-PCR test result was a median of 24 days; from first negative NP-PCR test result to transplantation was a median of 25 days; and from first positive with NP-PCR test result to surgery was a median of 52 days. In this study, donors had to be symptom free for 28 days and needed to have 2 negative NP-PCR test results, with an additional test at the time of surgery. Indeed, a similar trend was seen among our study participants, who preferred to have COVI9-19–specific testing as part of the initial testing before any other evaluation was pursued.

Timing of testing as well as timing of surgery for potential LDs is highly intertwined with recipient evaluation and testing. Clearly, preemptive transplantations are superior in most cases, and LD donation quite often is the only way to prevent a recipient from needing renal replacement therapy. The variability in testing and timing likely also reflects a participant's concern for balancing the risks of a recipient medical condition, which currently also includes higher mortality due to COVID-19.

As the most common practice for testing, an NP swab for a COVID-19 NP-PCR was considered to be the standard test by most participants, given that the utility and interpretation of serological testing and its protective ability is unknown at this time.[17] Moreover, based on AST recommendations, serological testing is not included as part of the COVID-19 screening process. Similarly, in the case of asymptomatic recovered LDs, our study showed that participants mostly preferred to see COVID-19 PCR results, with limited decisions based on serological status.[15] This is different from the findings of a previous international survey[8] that showed 21% of LDKT centers choosing serum IgG only. More than half of the participants (113 of 174) preferred to add chest computed tomography to standard LD evaluation, closely followed by pulmonary function tests, and transthoracic echocardiography, which reflects the concern for cardiovascular and pulmonary effects from COVID-19 in the short and long term. This reflects the LD community's high level os concern for this healthy population to ensure both their short- and long-term safety.

Recipient Immunosuppression Regimens and Testing

At this point, there are no evidence-based recommendations from any professional society regarding changes to reduce induction or maintenance immunosuppression in view of COVID-19 infection. Our study participants showed that a majority chose not to modify the recipient immunosuppression protocol (67.9%), whereas 14.5% would do so only on a case-by-case basis. This is consistent with a current AST statement[15] regarding recipients infected with COVID-19, which recommends that the decision to change immunosuppression should be based on a balance between disease severity and risk of rejection. More than half of the participants (90 of 164) preferred not to screen LDKT recipients of kidneys from COVID-19–recovered donors. To date, there have been no proven cases of donor-derived COVID-19 transmission to recipients.[15] A study from India performed COVID-19 NP-PCR tests in 77% of recipients, with none of them testing positive, although the timing of NP-PCR testing after transplantation was unclear over a reported 44-day follow-up period.[7] No reduction in induction immunosuppression therapy was done in this study.[7]

It is unclear how these responses would have been addressed, now that we have vaccinations available. However at this point, there is no guideline to safely delay kidney transplantations from LDs in order to wait for the vaccination of LDs, which may pose a further dilemma to LDKT programs and cause delays in going ahead with LDKTs. As the pandemic evolves, the number of LDs who eventually are vaccinated hopefully will reduce the number of such donors that we encounter in the future. As of this writing, 24 million cases of COVID-19 have been detected in the United States, of which 52% are people within the age group of 30 to 64 years, which compromises almost 70% of all healthy LDs.[18]

It remains to be seen how many healthy potential LDs have been affected by COVID-19 and how many potential LD transplant opportunities have been lost—and, more importantly how many ESKD recipient candidates were not able to receive a preemptive transplantation or one at all. Based on OPTN data, 67.8 % of living kidney donors in 2020 were 35 to 64 years of age. According to the Centers for Disease Control and Prevention (CDC) data as of 6 January 2021, 18.4% of the 313,171 deaths in the United States from COVID-19 occurred in people 35 to 64 years of age.[19] Although this, by itself, is very significant, it becomes even more significant knowing that this is the age group with the most LDs. Some such LDs may choose not to come forward in the future because of the uncertain long-terms effects of COVID-19. Only time will reveal the true contributions of all of these factors on LDKT activity.

Study Limitations

Our study has some limitations. First, the survey study design lends itself to potential participant recall bias as well as transplant center selection bias. Second, participants' reported preferences and opinions may not represent the actual practices at those LDKT programs. As such, with an evolving pandemic and with changing guidelines, there are no such protocols at individual centers. The intention was not to evaluate protocols but rather to assess where the transplant community

stands during this pandemic. Third, as the pandemic evolves, with changes in case incidence rates and accompanying changes in public health policy and vaccination, COVID-19–recovered LD evaluation practices and guidelines will likely evolve over time. Fourth, close to 60% of all LDKT programs participated in the survey; this may not represent the practices at centers that did not participate in the survey. Finally, program size and resources may also affect the local protocol for such LD evaluations, and, as centers gain clinical experience with more COVID-19–recovered LD evaluations, these practices may change.

Conclusion

Our study results show that LDKT programs are open to considering donors who have recovered from COVID-19. However, there is variation in the inclusion and exclusion criteria and the timeline considered for workup of these LDs. Further data are needed for consensus and guideline development in order to standardize the evaluation for such LDs. LDKT programs may have to potentially wait for vaccinating those LDs who have not had COVID-19, in order to avoid this uncertainty in the coming months.

DISCLOSURE

All the authors declared no competing interests.

ACKNOWLEDGMENTS

Funding was provided by the Nephrology Research Fund from the James O. and Alice F. Cole Foundation from donors Stephen and Margaret Russell.

SUPPLEMENTARY MATERIAL

Supplementary File (PDF)

Table S1. Survey questions and response options (administered electronically)

REFERENCES

1. OPTN OPaTN. National data, transplants by donor type based on OPTN data as of January 10, 2021. 2021. Available at: https://optn.transplant.hrsa.gov/data/view-data-reports/national-data/#. Accessed January 10, 2021.
2. OPTN OPaTN. National data, transplants by donor type based on OPTN data as of January 21, 2021. 2021. Available at: https://optn.transplant.hrsa.gov/data/view-data-reports/national-data/#. Accessed January 8, 2021.
3. Lentine KLVL, Schnitzler MA, et al. Survey of US living kidney donation and transplantation practices in the COVID-19 Era. *Kidney Int Rep*. 2020;11:1894–1905.
4. Bordes SJML, West-Ortiz W, et al. Trends in US kidney transplantation during the COVID-19 pandemic. *Cureus*. 2020;12:12.
5. Harris PA, Taylor R, Minor BL, et al. The REDCap Consortium: building an international community of software platform partners. *J Biomed Inform*. 2019;95:103208.
6. Safa K, Elias N, Gilligan HM, et al. Successful living kidney donation after COVID-19 infection. *Transplantation*. 2021;105:e4–e5.
7. Kute VB, Godara S, Guleria S, et al. Is it safe to be transplanted from living donors who recovered from COVID-19? Experience of 31 kidney transplants in a multicenter cohort study from India. *Transplantation*. 2021;105:842–850.
8. Salvalaggio PR, Ferreira GF, Caliskan Y, et al. An international survey on living kidney donation and transplant practices during the COVID-19 pandemic. *Transpl Infect Dis*. 2020:e13526.
9. Lin L, Wang X, Ren J, et al. Risk factors and prognosis for COVID-19-induced acute kidney injury: a meta-analysis. *BMJ Open*. 2020;10, e042573.
10. Kolhe NV, Fluck RJ, Selby NM, Taal MW. Acute kidney injury associated with COVID-19: a retrospective cohort study. *PLoS Med*. 2020;17, e1003406.
11. Massie AB, Holscher CM, Henderson ML, et al. Association of early postdonation renal function with subsequent risk of end-stage renal disease in living kidney donors. *JAMA Surgery*. 2020;155. e195472–e195472.
12. COVIDSurg Collaborative. Mortality and pulmonary complications in patients undergoing surgery with perioperative SARS-CoV-2 infection: an international cohort study. *Lancet*. 2020;396:27–38.
13. Wang W, Xu Y, Gao R, et al. Detection of SARS-CoV-2 in different types of clinical specimens. *JAMA*. 2020;323:1843–1844.
14. Huang C, Huang L, Wang Y, et al. 6-Month consequences of COVID-19 in patients discharged from hospital: a cohort study. *Lancet*. 2021;397:p220–p232.
15. American Society of Transplantation. COVID-19 resources for transplant community. 2020. Available at: https://www.myast.org/covid-19-information. Accessed January 7, 2020.
16. National Institute for Health and Care Excellence. COVID 19 rapid guideline: renal transplantation: NICE Guideline [NG178]. 2020. Available at: https://www.nice.org.uk/guidance/ng178/chapter/3-Transplant-donors. Accessed May 20, 2021.
17. Sethuraman N, Jeremiah SS, Ryo A. Interpreting diagnostic tests for SARS-CoV-2. *JAMA*. 2020;323:2249–2251.
18. Centers for Disease Control and Prevention. CDC COVID-19 Data Tracker. CDC; 2021. Available at: https://covid.cdc.gov/covid-data-tracker/#demographics, 2021. Accessed January 22, 2021.
19. Centers for Disease Control and Prevention. Provisional death counts for Coronavirus Disease 2019 (COVID-19). 2020. Available at: https://www.cdc.gov/nchs/nvss/vsrr/covid_weekly/index.htm#AgeAndSex. Accessed January 11, 2021.