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A retrospective multi-center experience of renal transplants from India during COVID-19 pandemic

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Abstract

Introduction: Coronavirus disease 2019 (COVID-19) pandemic led to a sudden drop in renal transplant numbers across India in the initial months of 2020. Although the transplant numbers increased with easing of lockdown, the outcome of these transplants remains unknown.

Methods: This was a retrospective, observational, multi-center study done across eight different transplant centers in India. All the transplants done from January 30, 2020 to December 31, 2020 were included. The primary outcomes studied were patient and death censored graft survival as well as incidence of COVID-19 infection and its outcomes.

Results: During the study period a total of 297 kidney transplants were done. After a median follow up of 265 days the patient and death censored graft survival was 95.3% and 97.6%, respectively. Forty-one patients (13.8%) developed COVID-19 post-transplant. Majority (58.5%) were asymptomatic to mildly symptomatic and the case fatality ratio was 14.6%. On multivariable logistic regression analysis older age was

associated with higher likelihood of COVID-19 infection (odds ratio 1.038; CI 1.002–1.077).

Conclusions: Patient and graft outcome of kidney transplants done during the COVID-19 pandemic in India was acceptable. The incidence of COVID-19 was 13.8% with a high case fatality ratio.

KEYWORDS
coronavirus, COVID-19, India, kidney transplantation, pandemic, SARS-CoV-2

1 | INTRODUCTION

COVID-19 caused by novel coronavirus, severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) was declared a global pandemic on March 11, 2020 by the World Health Organization. First case of COVID-19 in India was detected on January 30, 2020. As on June 14, 2021, India is the second worst affected country after the United States.[1] The vaccination program was rolled out in January 2021, but a second wave of the pandemic spread rapidly from March '21 onwards, peaked in first week of May '21 and is on a decline now.

Patients developing COVID-19 mostly have mild symptoms although few patients develop severe disease and require intensive care unit (ICU) management. The presence of multiple comorbidities and the use of immunosuppressive medications puts a renal transplant recipient at high risk of COVID-19 related morbidity and mortality. But the waitlisted patients on dialysis have been reported to have even higher incidence of SARS-CoV-2 infection and crude and age adjusted mortality because of COVID-19.[2–5] Limited access to the dialysis facility in India makes the situation even worse. There is a constant threat of SARS-CoV-2 and other infections as well as other dialysis related adverse events. Most of the transplant centers stopped the transplant program during the initial lockdown period which was declared in India on March 23, 2020. Although the gross case counts of COVID-19 was high, the number of cases per 100 000 population as well and death per million population was relatively low throughout the year of 2020. As the lockdown was eased various centers cautiously started transplants with strict protocols in place. Despite the increase in number of the renal transplants lately during the COVID-19 pandemic, there is no published experience from India about the outcome of such transplantations. We hereby present a multi-center experience of renal transplantation done during COVID-19 pandemic from India.

2 | MATERIALS AND METHODS

This was a multi-center retrospective observational study. The study population consisted of end stage renal disease (ESRD) patients who got transplanted across eight different centers in the various cities of India (Table 1). The study period was from January 30, 2020 to December 31, 2020. Patients were followed up till May 31, 2020. Data was collected retrospectively from the hospital information system and medical records. Baseline characteristics including donor and recipient age, gender, body mass index (BMI), type of transplant (living or deceased, compatible or incompatible), HLA matching, type of induction used, presence of diabetes or hypertension, chronic lung disease, ischemic heart disease and history and details of pre-transplant COVID-19 infection (if any) in the recipient or the donor were noted. Outcome parameters studied were patient survival, death censored graft survival, mortality, biopsy proven acute rejection rate, infections. Details of post-transplant COVID-19 infection including presentation, severity, need for mechanical ventilation, mortality, graft dysfunction, graft loss, and rejection rates as well as treatment given for COVID-19 were noted. Baseline characteristics of transplant recipients getting infected with SARS-CoV-2 in the post-transplant period were compared with those not contracting it. The outcomes were also compared between the two groups. The study was approved by the institutional review board of Medanta-The Medicity (MIRC 1268/2021) and completed in accordance with 1975 declaration of Helsinki.

2.1 | Donor and recipient workup

The donor and recipient were worked up in detail including the immunological evaluation as per the center protocol. All the transplant pairs were advised to strictly practice preventive measures such as using surgical facemask, social distancing, and hand hygiene for at least 14 days prior to the transplantation. A detailed discussion was done about the possibility of the recipient or the donor contracting COVID-19 infections during the pre-transplant or post-transplant period and the possibility of a poor outcome including higher mortality chances in such a case. All the pairs signed a written and informed consent explaining these points. All the prospective donors and the recipients underwent SARS-CoV-2 reverse transcription polymerase chain reaction (RT-PCR) test within 72 h pre-transplantation. A negative SARS-CoV-2 RT-PCR was mandatory for the transplantation. If any prospective recipient or donor developed COVID-19, he/she was treated as per the local government authorities' protocol for COVID-19 management. The disease severity was classified into asymptomatic, mild, moderate, and severe as per the government clinical management protocol.

The recipients or donors who had recovered from the COVID-19 disease underwent renal transplantation only if there was a complete

TABLE 1 Participating centers with number of transplants done from January 30, 2020 to December 31, 2020

S. No.	Hospital name	Number of transplants performed during study period (total = 297)
1	Medanta- The Medicity, Gurugram	140
2	Asian Institute of Medical Sciences, Faridabad	36
3	Manipal Hospital, Bangalore	30
4	KIMS Hospital, Hyderabad	26
5	Manipal Hospital, Delhi	24
6	Yashoda Hospital, Hyderabad	15
7	Fortis Memorial Research Institute, Gurugram	14
8	Aditya Birla Hospital, Pune	12

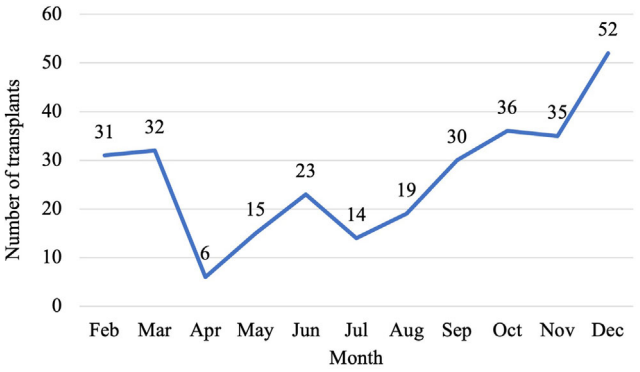

FIGURE 1 Trend of renal transplantation from February 2020 to December 2020

symptom resolution for at least 28 days and had documented two negative PCR test. The waiting time post disease resolution was variable and those with severe disease waited longer. Those who had recovered from severe COVID-19 also underwent CT chest pre-transplantation.

The centers ensured availability of access to a rapid turnaround testing for COVID-19 (by in house SARS-CoV-2 reverse transcription polymerase chain reaction (RT-PCR) test) and COVID-19 secure areas during the inpatient stay of the transplant recipients and donors. Exclusive healthcare workers were designated for transplant patients in order to reduce the transmission risk. The induction and maintenance immunosuppression were decided depending upon the immunological risk of the patients as was practiced in the centers in the pre-COVID era. Both the recipients and donors were counseled in detail about the required preventive measures to be taken post-transplant including social distancing, use of mask and hand hygiene. Post-transplant the patients were followed up in person in the OPD or over video consultation.

Statistical analysis was done using MedCalc software, version 20.008 (MedCalc Software Ltd, Belgium). Results for continuous variables were reported as either mean values ± standard deviation or median with interquartile range. For categorical variables this was reported as percentage. Continuous variables were compared using unpaired *t*-test in case of normally distributed data and Mann-Whitney Wilcoxon test in case of non-normally distributed data. Categorical values were compared using Chi-square test or Fisher's exact test. $P < .05$ was considered as statistically significant. Missing data for any variable was dealt as available case analysis. The loss to follow up was 2% and hence not a potential for significant bias.

3 | RESULTS

During the study period, a total of 297 renal transplants were done. Figure 1 shows the trend of renal transplantation in 2020 during the study period across different centers. There was a progressive increase in transplant numbers after the initial drop during the months of April and May 2020 coinciding with the lockdown period. Maximum number of transplants (52) were performed in the month of December while minimum (six) was in the month of April 2020.

The median follow-up duration was 265 days (interquartile range: 203–379). Six patients (2%) were lost to follow-up. The baseline characteristics of the patients is shown in Table 2. Majority (95%) of these were living donor transplants. Human leucocyte antigen (HLA) test report was available in all but 18 patients (6%). Incompatible transplants (ABO and HLA incompatible) constituted 13.5% of the total transplants. Antithymocyte globulin rabbit (ATG) was the most commonly used induction agent (57.5%).

There were 12 recipients and seven donors who contracted COVID during pre-transplant evaluation. Tables 3 and 4 shows clinical characteristics of these recipients and donors, respectively. Median duration from SARS-CoV-2 positivity to the renal transplant was 57.5 days (interquartile range: 38.5–83.25 days) for the recipient. In case of donors the median time from COVID-19 diagnosis to donation was 39 (interquartile range: 33–53.5) days.

Table 5 shows overall outcome of the recipients. There were 14 mortalities during the study period. Most common cause of death was infections followed by cardiac. Most common infection was COVID-19.

Forty-one transplant recipients (13.8%) developed COVID-19 in the post-transplant period. Table 6 shows clinical characteristics of these patients. Of these, 18 patients had developed the infection till January 2021 while the remaining 23 developed it between February and May 2021 during the second wave. Table 7 compares the baseline characteristics and outcomes of the patients who developed COVID-19 post-transplant with those who did not. On univariate analysis patients who developed COVID-19 were significantly older (42.9±11.4 vs. 38.4±12.9 years; $P = .036$) and were more likely to have a history of biopsy proven acute rejection (BPAR) (14.6% vs. 5.1%; $P = .033$). Patient contracting COVID-19 also had significantly higher mortality (14.6% vs. 3.1%; $P = .006$). Other parameters were comparable between the two groups. On performing a logistic regression analysis after adjusting for the various baseline variables only older age was found to be associated with higher likelihood of developing COVID-19 infection (Table 8). Three patients developed post COVID-19

TABLE 2 Baseline characteristics of the transplanted patients

Variable	Value ($n = 297$)
Average recipient age (years), mean ± SD	39.1±12.8
Average donor age (years), mean ± SD	46.4±11.8
Recipient gender (*n* (%))	
Female	62 (21)
Male	235 (79)
Donor gender (*n* (%))	
Female	195 (66)
Male	102 (34)
Type of Transplant (*n* (%))	
Living donor	282 (95)
Deceased donor	15 (5)
Mean HLA match (mean ± SD)	2.3±1.4
Comorbidities (*n* (%))	
Diabetes mellitus	65 (21.8)
Hypertension	286 (96.3)
Chronic lung disease	15 (5.1)
Ischemic heart disease	32 (10.8)
Hepatitis B or C	16 (5.4)
Obesity (BMI ≥ 30 kg/m^2)	16 (5.4)
CMV IgG status (pre-transplant)	
D+R+	282 (94.9)
D+R-	8 (2.7)
D-R-	0
D-R+	3 (1)
ABO incompatible transplant (*n* (%))	35 (11.8)
HLA incompatible transplant (*n* (%))	5 (1.6)
Induction used (*n* (%))	
ATG	171 (57.5)
Grafalon	17 (5.7)
Basiliximab	44 (14.8)
Rituximab	1 (.3)
Rituximab + ATG	7 (2.4)
None	57 (19.2)
Number of patients infected with COVID-19 pre-transplant (*n* (%))	12 (4)
Number of donors infected with COVID-19 pre-donation (*n* (%))	7 (2.4)

Abbreviations: SD, standard deviation; CMV, cytomegalovirus; HLA, human leucocyte antigen; ATG, anti-thymocyte globulin.

superinfection. One had mucormycosis sinusitis, another had CMV infection while the third one had Klebsiella and enterococcus. All of them recovered.

Figures 2–4 show the Kaplan Meier curves for patient, graft, and acute rejection free survival of the transplanted patients. Figure 5 shows the Kaplan Meier curve for COVID-19 free survival.

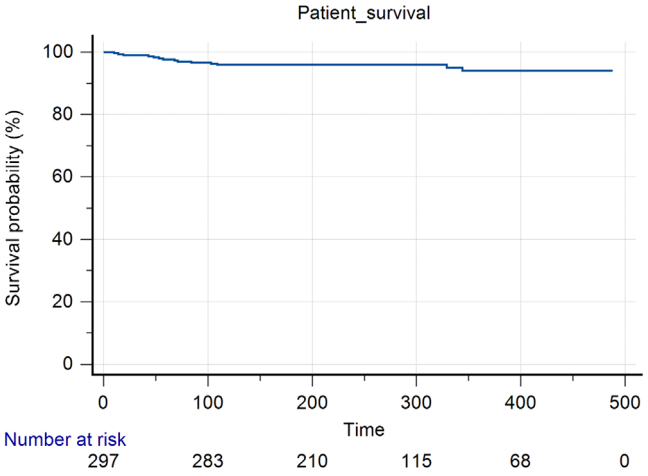

FIGURE 2 Kaplan Meier curve for patient survival post kidney transplant. The x-axis represents time in days

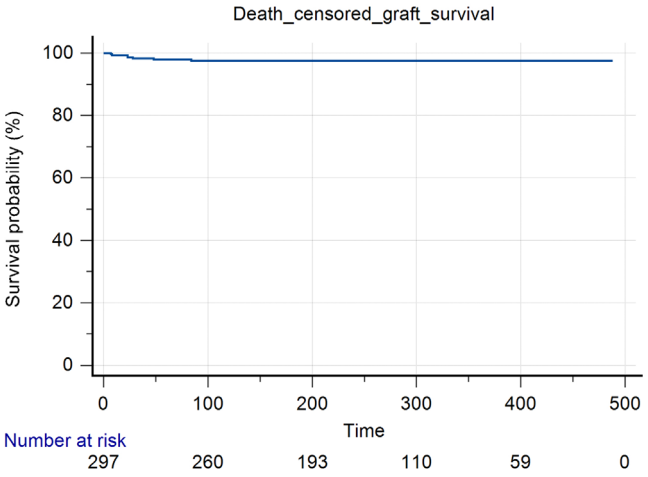

FIGURE 3 Kaplan Meier curve for death censored graft survival post kidney transplant. The x-axis represents time in days

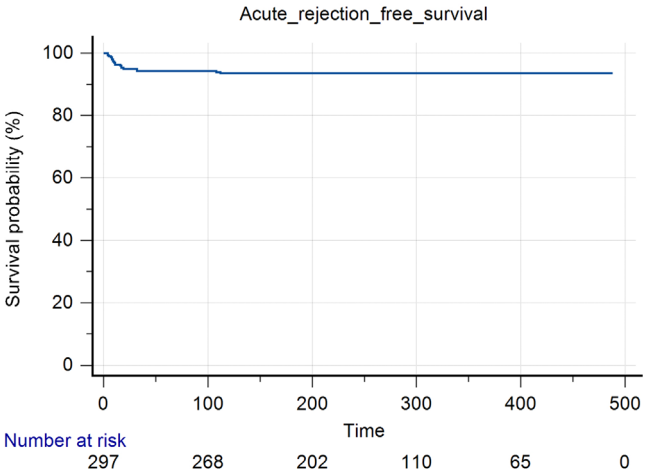

FIGURE 4 Kaplan Meier curve for acute rejection free survival post kidney transplant. The x-axis represents time in days

TABLE 3 Characteristics of transplant recipients getting COVID-19 pre-transplant

S.No	Age (in years)	Gender	Disease severity	Symptoms at presentation	Hospitalization requirement	Treatment given	Days after first positivity to transplantation
1	7	M	Asymptomatic	None	No	None	90
2	32	M	Mild	Fever	Yes	R/S	39
3	47	M	Moderate	Fever	Yes	A/Az/F/S	75
4	23	M	Asymptomatic	None	No	None	24
5	34	M	Asymptomatic	None	No	None	15
6	42	M	Moderate	Fever, cough, breathlessness, myalgia	yes	A/S	81
7	39	M	Asymptomatic	None	No	None	37
8	43	M	Asymptomatic	None	No	None	48
9	46	M	Asymptomatic	None	No	None	50
10	49	M	Severe	Fever, cough, breathlessness, myalgia	yes	A/R/S	107
11	18	M	Severe	Fever, cough, breathlessness, myalgia	yes	A/R/S	65
12	29	M	Moderate	Fever, breathlessness, myalgia	yes	A/R/S	108

Abbreviations: A, anticoagulant; Az, azithromycin; F, favipiravir; R, remdesivir; S, steroid; M, male.

TABLE 4 Characteristics of transplant donors getting COVID-19 pre-donation

S. No.	Age (in years)	Gender	Disease severity	Symptoms at presentation	Hospitalization requirement	Treatment given	Days after first positivity to transplantation
1	65	F	Asymptomatic	None	No	Fa	30
2	35	F	Asymptomatic	None	No	None	90
3	56	F	Asymptomatic	None	No	None	39
4	49	F	Asymptomatic	None	No	None	22
5	42	F	Asymptomatic	None	No	None	80
6	35	F	Asymptomatic	None	No	None	36
7	35	F	Asymptomatic	None	No	None	47

Abbreviations: F, Female; Fa, Favipiravir.

4 | DISCUSSION

COVID-19 pandemic has added to the woes of ESRD patients awaiting renal transplants. Dialysis patients contracting COVID-19 have high mortality.[2] But there have been concerns about doing renal transplant during the COVID-19 pandemic as well in view of the high morbidity and mortality in case a renal transplant recipient contracts SARS-CoV-2 infection.[6–8] In the initial phase of the pandemic, renal transplantation was advised on a case-to-case basis depending upon the urgency of the procedure such as in case of no vascular access and non-feasibility of dialysis.[9,10] The limited access to dialysis coupled with a constant threat of acquiring dialysis related infections makes the situation even more difficult for these patients in India. Hence, with the easing of lockdown various transplant centers cautiously started the renal transplantation. This study shows the outcome of such transplants done in eight different centers spread across India during the year of pandemic from February 2020 to December 2020.

In the present study, 95% of the transplants were living donation with a mean recipient and donor age of 39.1±12.8 years and 46.4±11.8 years, respectively. Living donor transplant accounts for almost 90% of the renal transplants in India.[11] Majority of the recipients were male (79%) while the donors were female (66%). Similar recipient and donor gender distribution have been reported in previous Indian studies.[12–14] There were 40 (13.5%) incompatible (five HLAi and 35 ABOi) transplants. Most of the patients (57.5%) received ATG induction and no induction was used in 19.2%. In a study of 30 renal transplants by Santeusanio et al. during the COVID-19 pandemic in New York, the risk for severe COVID-19 related disease was

TABLE 5 Outcome of transplant patients

Variables	Value ($n = 297$)
Patient survival (%)	95.3
Patient loss(*n* (%))	14 (4.7)
Reason for patient loss(*n* (%))	
Acute coronary syndrome	4 (1.3)
Pulmonary embolism	1 (0.3)
COVID-19 infection	5 (1.7)
Other infections	4 (1.3)
Death censored graft survival (%)	97.6
Death censored graft loss(*n* (%))	7 (2.4)
Serum creatinine (mg/dl)	
At one month	1.2±0.6
On last follow up	1.2±0.4
BPAR(*n* (%))	19 (6.4)
Infections(*n* (%))	74 (24.9)
COVID-19	41 (13.8)
UTI	18 (6.1)
CMV	3 (1)
BKV	2 (0.6)
Others	17 (5.7)

Abbreviations: BPAR, biopsy proven acute rejection; UTI, urinary tract infection; CMV, cytomegalovirus; BKV, BK virus.

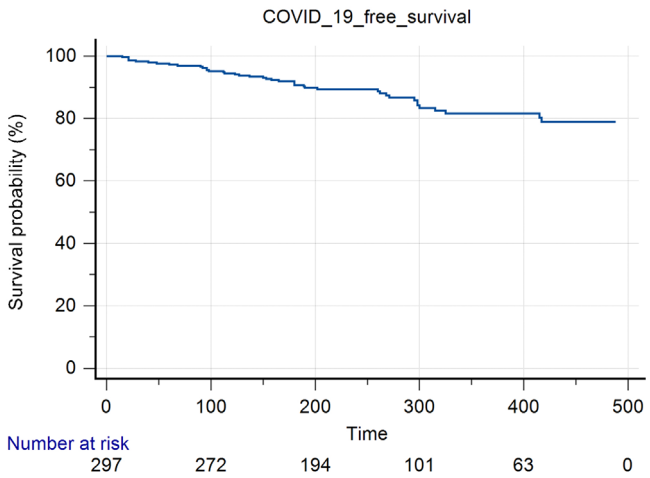

FIGURE 5 Kaplan Meier curve for COVID-19 infection free survival post kidney transplant. The x-axis represents time in days

TABLE 6 Clinical characteristics of patients who developed COVID-19 in post-transplant period

Variable	Outcome ($n = 41$)
Mean duration after transplant to COVID-19 (days), mean ± SD	167±109
Presenting symptom(*n* (%))	
Fever	31 (75.6)
Breathlessness	14 (34.1)
Cough	20 (48.8)
Myalgia	2 (4.9)
Loose stools	2 (4.9)
Asymptomatic	5 (12.2)
Disease severity(*n* (%))	
Asymptomatic	5 (12.2)
Mild	19 (46.3)
Moderate	9 (21.9)
Severe	8 (19.5)
Oxygen requirement(*n* (%))	17 (41.5)
COVID-19 specific treatment(*n* (%))	
Increased steroid	33 (80.5)
Remdesivir	18 (43.9)
Favipiravir	4 (9.8)
Doxycycline	4 (9.8)
Convalescent plasma	1 (2.4)
Anticoagulants	12 (29.3)
None	4 (9.8)
Immunosuppression modification(*n* (%))	
Antimetabolites stopped	33 (80.5)
Antimetabolites reduced	2 (4.9)
CNI stopped	2 (4.9)
None	5 (12.2)
Acute Kidney Injury(*n* (%))	12 (29.3)
Mechanical Ventilation(*n* (%))	5 (12.2)
Patient loss(*n* (%))	6 (14.6)
Death censored graft loss(*n* (%))	2 (4.9)
BPAR(*n* (%))	6 (14.6)

Abbreviations: CNI, calcineurin inhibitor; BPAR, biopsy proven acute rejection.

noted to be modest. In this cohort, 90% of the patients had received ATG.[15]

There were 12 recipients who got infected with SARS-CoV-2 in the pre-transplant period. Seven (58.3%) of them had asymptomatic to mild disease. Median waiting time from diagnosis of COVID-19 to transplantation was 57.5 days (interquartile range: 38.5–83.25 days). American society of anesthesiology guidelines suggest waiting period from COVID-19 diagnosis to any elective surgery varying from 4 weeks to 12 weeks depending upon the severity of symptoms.[16] National Institute for Health and Care Excellence (NICE) guidelines recommend that the patient must be symptom free for at least 28 days and have a negative swab test result for SARS-CoV-2.[17] Successful renal transplantation in patients recovering from COVID-19 have been reported.[18]

In the present study, there were seven donors who recovered from COVID-19 and proceeded for donation. All of them had asymptomatic disease. A study by Kute et al. showed that those donors who have recovered from COVID-19 and have remained asymptomatic with a

TABLE 7 Baseline characteristics and outcome of renal transplant patients who got COVID-19 post-transplantation compared to those who did not get it

Variable	Patients infected with COVID post-transplant ($n = 41$)	Patients not infected with COVID post-transplant ($n = 256$)	*P* value
Average recipient age (years), mean ± SD	42.9±11.4	38.4±12.9	.036*
Average donor age (years), mean ± SD	46.8±13.1	46.6±11.5	.919
Recipient gender(*n* (%))			.407
Female	6 (14.6)	56 (21.9)	
Male	35 (85.4)	200 (78.1)	
Donor gender(*n* (%))			.595
Female	29 (70.7)	166 (64.8)	
Male	12 (29.3)	90 (35.2)	
Type of transplant(*n* (%))			1
Living donor	39 (95.1)	243 (94.9)	
Deceased donor	2 (4.9)	13 (5.1)	
Mean HLA match	2.1±1.6	2.4±1.4	.213
Comorbidities(*n* (%))			
Diabetes mellitus	6 (14.6)	59 (23)	.309
Hypertension	39 (95.1)	247 (96.5)	.653
Chronic lung disease	3 (7.3)	12 (4.7)	.445
Ischemic heart disease	5 (12.2)	27 (10.5)	.786
Hepatitis B or C	2 (4.9)	14 (5.5)	1
Obesity (BMI ≥ 30 kg/m^2)	3 (7.3)	13 (5.1)	.478
ABO incompatible transplant(*n* (%))			
HLA incompatible transplant(*n* (%))	5 (12.2)	30 (11.7)	1
Induction used(*n* (%))			
Yes	0	5 (2)1	1
No			
Serum creatinine (mg/dl)			.287
At one month	36 (87.8)	204 (79.7)	
On last follow-up	5 (12.2)	52 (20.3)	
BPAR(*n* (%))			
Patient loss(*n* (%))	1.3±.7	1.2±.6	.161
Death censored graft loss(*n* (%))	1.3±.6	1.2±.4	.673
	6 (14.6)	13 (5.1)	.033
	6 (14.6)	8 (3.1)	*.006
	2 (4.9)	5 (2)	*.249

Abbreviations: HLA, human leucocyte antigen; BPAR, biopsy proven acute rejection.
*Significant.

negative COVID RT-PCR can proceed for donation with good recipient outcome.[19] The median time from COVID-19 diagnosis to donation in our study was 39 (interquartile range: 33–53.5) days. In a summary of international recommendations, the waiting period for a donor after resolution of symptoms varied from 14 to 28 days. Most of the guidelines recommend repeating nasopharyngeal swab test result for SARS-CoV-2 RT-PCR after symptom resolution wherein few suggest single while the others suggest two tests.[20]

Patient and death censored graft survival was 95.3% and 97.6% in the present study. Most common cause of death was infection (responsible for 64.3% of the deaths). In the study by Santeusanio et al., the patient survival was 93.3% while the death censored graft survival was 100% after a median follow up of 51.5 days.[15] Most common infection in our study was COVID-19, seen in 41 (13.8%) patients followed by UTI, seen in 18 (6.1%). Incidence of COVID-19 was 4.1% for the patients transplanted in 2020 in a national cohort study from

TABLE 8 Multivariable logistic regression analysis for variables associated with COVID-19 infection

Variable	Coefficient	Std. error	Odds ratio	95% confidence interval	*P* value
Age	.038019	.01861	1.0388	1.0015 to 1.0774	.0411*
Gender	-.044617	.53992	.9564	.3319 to 2.7556	.9341
HLA match	-.060018	.14449	.9417	.7095 to 1.2500	.6779
Obesity (BMI ≥ 30 kg/m^2)	-.54315	1.09014	.5809	.0686 to 4.9211	.6183
CLD	.67482	.71213	1.9637	.4863 to 7.9295	.3433
DM	-1.19602	.62449	.3024	.0889 to 1.0284	.0555
Hypertension	-.57485	.88569	.5628	.0992 to 3.1934	.5163
IHD	.073369	.68183	1.0761	.2828 to 4.0950	.9143
Induction	.36331	.62697	1.4381	.4208 to 4.9144	.5623
BPAR history	1.05211	.78090	2.8637	.6197 to 13.2325	.1779
Serum creatinine at last follow up	.51576	.50012	1.6749	.6285 to 4.4638	.3024

Abbreviations: HLA, human leucocyte antigen; CLD, chronic lung disease; DM, diabetes mellitus; IHD, ischemic heart disease; BPAR, biopsy proven acute rejection.
*Significant.

England.[21] In our study COVID-19 was the cause of mortality in five (1.7%) patients and the case fatality ratio in patients infected with COVID-19 was 14.6%. In a meta-analysis by Phanish et al., a pooled case fatality ratio of 24% was seen.[22] In a regionwide registry study by Meester et al., the crude cumulative mortality rate was 14% in kidney transplant recipients.[3] The COVID-19 related mortality was 26.8% in the Spanish Society of Nephrology registry data.[5]

There were 41 patients (incidence 13.8%) who got COVID-19 in the post-transplant period and fever was the most common presenting symptoms (75.6%) followed by cough (48.8%) and breathlessness (34.1%). Other studies also have reported these as the predominant presenting symptoms.[8,23] Disease was asymptomatic to mild in ten (58.5%). Most common COVID-19 treatment strategy consisted of increasing the dose of steroid (80.5%) followed by use of Remdesivir (43.9%). An open label study by the RECOVERY collaborative group showed that dexamethasone lowered the mortality in COVID-19 infected patients requiring oxygen or mechanical ventilation.[24] Remdesivir has been shown to shorten the time to recovery in adults admitted with COVID-19 and having evidence of lower respiratory tract infection.[25] Although later the SOLIDARITY trial showed little or no effect of this treatment in hospitalized COVID-19 patients.[26] Various drugs such as remdesivir, lopinavir/ritonavir, hydroxychloroquine, dexamethasone, azithromycin, tocilizumab, convalescent plasma have been used in transplant recipients in different studies in the absence of good evidence favoring one over the other.[6,27]

Anti-proliferative agent was stopped in majority of the patients (80.5%) with COVID-19, while CNI was stopped in two (4.9%) of them. These patients had severe disease and had deteriorating clinical condition despite stopping anti-proliferative agents. In other studies as well, stopping the anti-proliferative has been the predominant immunosuppression modification strategy used in management of the transplant recipients with COVID-19 while the calcineurin inhibitor (CNI) has been stopped in few severe cases.[6,22,27,28] Acute kidney injury was seen in 29.3% of the cases in the present study. Acute kidney injury has been reported to occur in 28%–77% of renal transplant patients with COVID-19 infection in various studies.[6,27]

On a multivariable logistic regression analysis older age was the only factor associated with significantly higher likelihood of developing COVID-19 infection in the present study. Increasing age has been associated with higher incidence of SARS-CoV-2 infection in solid organ transplant recipients in other study as well.[21] Patients contracting COVID-19 were noted to have higher mortality risk in our study.

The present study shows the feasibility and safety of renal transplant done during the COVID-19 pandemic in India with acceptable outcomes. The alteration in induction strategy was not necessary. The recipients as well as donor who contracted COVID-19 in pre-transplant period could safely proceed with the surgery after the necessary waiting time. The rate of contracting COVID-19 in recipients was 13.8%. As has been described in previous studies, the mortality in patients getting COVID was high at 14.6%.

There are few limitations of our study. It is a retrospective study. As there were eight different participating centers there was heterogeneity in the immunosuppression protocols. Also, the management protocols of COVID-19 were different. The genome sequencing of the virus was not done and so we do not have the information on the most common strain causing the infections. The follow up duration of the study is short. Despite these limitations, this is an important study as so far it is the only one from India about the outcomes of renal transplantation done during the pandemic. The multicenter nature of the study adds to the strengths. Also, it was a predominantly a living donor population (95%). The present study is one of the largest living donor transplantation experiences reported during the pandemic year of 2020.

With the rolling out of COVID-19 vaccination renal transplants are slated to increase in India. But a recent second wave (which is presently

subsiding) and the emergence of mutant strains (such as the delta strain (B.1.617.2)) makes it imperative to have protocols and policies in place for continuation of renal transplantation without compromising with the patient safety. Like in the first wave, most of the centers withheld the transplant (albeit for a shorter duration) during the second wave as well. Now as the transplantation activity is restarting, the findings of the present study becomes important for counselling the patients about the risks and benefits associated with undergoing this potentially lifesaving surgery during an ongoing pandemic. Outcomes of the present study are reassuring and provides confidence in this regard. The best way to treat a transplant patient getting COVID-19 in post-transplant period is still not known and good quality evidence is needed in this area. Good counselling, social distancing, hand hygiene, and use of masks remain the cornerstone of prevention as newly transplanted patients are not good candidates for vaccination in view of poor immune response.

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CONFLICT OF INTEREST

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AUTHOR CONTRIBUTIONS

Concept and designing of the study, data interpretation and manuscript drafting was done by Pranaw Kumar Jha. Data acquisition done by Dinesh Kumar Yadav, Ashwini Gadde, Manish Jain, Shyam Bihari Bansal, Sidharth Kumar Sethi, Vishwanath Siddini, Reetesh Sharma, Tarun Jeloka, Urmila Anandh, Salil Jain, Sreedhar Reddy. Literature search was done by Aseem Kumar Tiwari, Pranaw Kumar Jha, Feroz Amir Zafar, Prasun Ghosh, Shyam Bihari Bansal, Rohan Augustine. Manuscript editing, and revision was done by Vijay Kher, Reetesh Sharma, Rohan Augustine, Tarun Jeloka, Urmila Anandh, Vijay Kher, Rajesh Ahlawat, Puneet Sodhi, Pranaw Kumar Jha. All the authors were involved in manuscript review and final approval.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author (Pranaw Kumar Jha; dr.pranaw@gmail.com). The data are not publicly available due to privacy or ethical restrictions.

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