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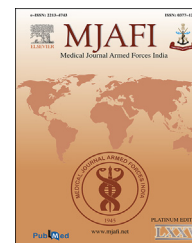
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## Original Article

# Chronic Kidney Disease and COVID-19: Outcomes of hospitalised adults from a tertiary care centre in North India

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## ABSTRACT

**Background:** Coronavirus disease 2019 (COVID-19) is a novel disease caused by the SARS-CoV-2 virus and has emerged as a deadly pandemic affecting countries all over the world. Here we share our experience of managing adults with chronic kidney disease (CKD) and concomitant COVID-19 infection jointly managed by pediatric and adult nephrology teams. **Methods:** This retrospective study was done on patient admissions (>18 years) between 20<sup>th</sup> June- 30<sup>th</sup> October 2020 with previously diagnosed CKD and hospitalised with COVID-19 infection. The demographic details, underlying comorbidities, clinical presentation, medications, laboratory, radiological profile and outcomes were studied.

**Results:** A total of 213 adults (62% males) with CKD were admitted during this period with a median (IQR) age of 52 (42, 60) years; 75 (35.2%) had associated diabetes mellitus, 83.1% hypertension, 5.2% hypothyroidism and 7% coronary artery disease. 165 (77.5%) were on maintenance haemodialysis (MHD), and 72.8% had arteriovenous fistula as vascular access at presentation. Most (84.5%) patients were symptomatic for COVID-19, and about 2/3 diarrhoea had moderate to severe disease. Oxygen therapy was needed in 62.9%, and medications used were hydroxychloroquine in 84.5%, azithromycin in 21.6%, ivermectin in 82.6%, steroids in 63.8% and Low molecular weight heparin in 59.2%. A further comparison of patients with CKD5D and CKDND revealed similar parameters except for a higher incidence of diarrhoea, acute kidney injury (AKI) and a shorter period to RTPCR negativity (12.5 vs 15 days;  $P = 0.038$ ) in CKDND. The overall mortality was 24.4%, with similar mortality rates in both groups ( $P = 0.709$ ) and 20.7% needed ICU transfer.

**Conclusions:** Adults with CKD especially on haemodialysis, are prone to more severe COVID-19 infection and take a longer time for viral clearance (>2 weeks); the mortality too is higher in these patients.

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## Introduction

The clinical spectrum of COVID-19 infection is variable, ranging from asymptomatic infection, anosmia, ageusia or minor upper respiratory tract illness to severe pneumonia with respiratory failure and even death.<sup>1</sup> While a majority have a mild infection, the presentation has been more severe in older patients, and those with comorbidities like diabetes, hypertension, obesity, and chronic kidney disease (CKD).<sup>2</sup> The morbidity and mortality has been higher in males in all regions.<sup>3</sup> Patients with CKD are expected to be at a higher risk of the severe disease since their rates of all-type infections and the prevalence of cardiovascular disease are higher than in the general population<sup>4</sup>; the risk for cardiovascular events being almost 10 times higher. Marked alterations in the immune system have been reported in CKD patients, leading to an immunosuppressed state and frequent infectious complications. Likewise, chronic systemic inflammation may also contribute to higher morbidity and mortality in CKD patients.<sup>5</sup> Besides, a significant proportion of them regularly visit the hospitals and health care facilities for haemodialysis, thus increasing their predisposition to COVID-19. The reported incidence of severe COVID-19 is high in CKD patients with mortality ranging from 31 to 53.3%.<sup>1,4,6</sup> CKD has been identified as an independent risk factor for mortality in adults admitted with COVID-19 infection.<sup>7</sup> In a large nationwide Brazilian survey of haemodialysis patients with COVID-19 infection, the incidence, mortality and fatality rates were 5.1, 33.4 and 6.4 times higher than general the population.<sup>8</sup>

As the pandemic spread in our city, our tertiary care hospital was converted to a COVID-19 only facility in April 2020, and since the month of June, hospitalised adults with CKD and COVID-19 infection were jointly managed by pediatric and adult nephrology teams. This retrospective study was planned to study the clinical profile, complications, outcomes and identification of risk factors for mortality in these patients.

## Materials and methods

This retrospective study was done for all CKD admissions between 20th June to 30th October 2020. The inclusion criteria were patients (above 18 years of age) with CKD admitted at LNJP hospital during the study duration and whose RTPCR test on the nasopharyngeal and oropharyngeal swab is reported as positive for SARS CoV-2. There was no exclusion criterion. The permission for the study was granted by the Institute's ethics committee. A significant proportion of the patients admitted were undergoing maintenance dialysis from other centres (government or private), mostly in the NCR-Delhi region, and once they were COVID positive were referred to our hospital as exclusive dialysis for COVID positive patients during the first wave were available at very few centres in the city. The

primary objective of the study was to describe the clinico-epidemiological, biochemical and radiological profile of adult patients (above 18 years) with laboratory-confirmed COVID-19 and kidney disease. Whereas the secondary objectives were a comparison of the baseline characteristics and outcomes between the non-dialysis CKD population and dialysis requiring CKD population, and a comparison of demographic and clinical parameters between deceased and non-deceased. The diagnostic criteria for COVID-19 infection was a laboratory-confirmed SARS-CoV-2 infection, detected in nasopharyngeal and/or oral swab by RT-PCR using methods recommended by the Indian Council of Medical Research, with or without clinical symptoms.<sup>9</sup> For patients on kidney replacement therapy, especially haemodialysis, most centres were adhering to the national guidelines for screening of patients for COVID-19 with RT-PCR or rapid antigen test.<sup>10</sup> As per national guidelines,<sup>10</sup> a policy of mandatory quarantine of all COVID-19 positive patient till 14 days of infection was being observed. Those with underlying comorbidity were advised admission to a hospital instead of a Covid-care centre/isolation facility, especially those undergoing regular haemodialysis. The cases were categorised into mild, moderate and severe based on the following definitions:<sup>11</sup>

Mild COVID-19 infection was defined as cases presenting with fever and/or upper respiratory tract illness with normal respiratory rates (14–16/min).

Moderate COVID-19 was defined as Pneumonia with no signs of severe disease (respiratory rates 15 to 30/minute, SpO<sub>2</sub> 90%–94% on room air).

Severe disease was defined as fever or suspected respiratory infection, plus one of the following; respiratory rate >30 breaths/min, severe respiratory distress, SpO<sub>2</sub> <90% on room air.

All patients on dialysis and detected COVID-19 positive were admitted to the dialysis facility in this Covid-dedicated centre. They were discharged once clinically stable and achieved RTPCR negativity so that they were fit to resume their maintenance dialysis requirements in a Covid-negative facility. The CKDND patients were also admitted as they were referred from non-Covid hospitals for COVID-19 related management to our hospital and were discharged once negative on RT-PCR. The RT-PCR was repeated on the 7th day to document clearing of infection so that those with mild infection could be discharged. The test was repeated after a 5–7 day interval till documented as negative based on the information available till then that most viral clearing should occur by 10–12 days.

The haematological and biochemical parameters, including haemogram, total leucocyte counts, neutrophil/lymphocyte ratio, kidney function tests, liver function tests were done at the time of admission in all the admitted patients, and the inflammatory markers like C-reactive protein, IL-6, procalcitonin (PCT) and thrombosis marker like D-dimer were done in most of the moderate and severe patients as per

the availability of the tests and the recommendations at that time. While KFTs were done twice a week, inflammatory markers were done within 48 h of admission and subsequently repeated after 3 days to see the decline in parameters. The blood tests were repeated at 12–24 h intervals for those with acute kidney injury (AKI) or any other clinical deterioration like encephalopathy, multisystemic inflammatory syndrome. Chest radiograph was done in all the admitted patients, whereas CT was done only in a select few; only for those patients with persistent oxygen requirement (more than 3 weeks) to look for pulmonary fibrosis/alternative aetiologies of lung involvement. A chest radiograph was repeated on clinical worsening like an increase in oxygen demand or suspicion of bacterial pneumonia. The frequency of repetition of the test was variable and depended on the clinical course of the patients and the clinician's discretion.

The treatment of all these patients was in accordance with the published national guidelines that were applicable during the first wave of the infection in India<sup>10,11</sup> Till then, the national guidelines were recommending the use of hydroxychloroquine and azithromycin as antiviral agents, and the use of remdesivir was for emergency and to be avoided in patients with eGFR of less than 30 ml/min/1.73 m<sup>2</sup>. The use of ivermectin in some patients was based on literature published during the period of study favouring its use as an antiviral agent and the most recent national guidelines recommended its use. Our hospital also framed guidelines for the use of drugs and treatments that were repurposed for use in patients with COVID-19 infection through a multidisciplinary committee. While they were in accordance with the national guidelines, they did not recommend the use of plasma in CKD patients and suggested cautious use of ivermectin. Dexamethasone was used in doses of 6 mg for all patients needing oxygen therapy for 5–10 days.<sup>11,12</sup> Methylprednisolone was used for patients with systemic lupus erythematosus or Rheumatoid arthritis. Steroid therapy was prolonged for patients with oxygen dependency and chronic lung changes on imaging.

The case records of patients were retrieved, and data pertaining to the demographic details, exposure history, underlying co-morbidities, clinical presentation, previous and present medications, dialysis requirement, laboratory and radiological profile, treatment, complications and outcomes were collected. The haematological and biochemical parameters, including haemogram, total leucocyte counts, neutrophil/lymphocyte ratio, kidney function tests, liver function tests, were recorded besides the inflammatory markers like C-reactive protein, IL-6, procalcitonin (PCT) and thrombosis marker like D-dimer.

The outcome of patients during the course of hospitalisation in terms of death or discharge and the proportion of patients developing complications (respiratory failure/myocarditis/AKI/thrombocytopenia/others) were noted. No prospective details were recorded after the patients were discharged.

Data were entered in a pre-determined proforma and duration of hospital stay, the proportion of patients requiring respiratory support i.e., O<sub>2</sub> by mask, high flow nasal cannula, non-invasive ventilation, mechanical ventilation and time to RTPCR negativity was recorded. Data of CKDND patients were

compared with the details of CKD5D patients. Likewise, the disease characteristics were compared between those who survived versus those who succumbed.

### Statistical analysis

Data entry was done using a Microsoft Excel spreadsheet and analysed using descriptive statistics/SPSS version 25. The mean and standard deviation (SD)/Median (IQR) were calculated for baseline characteristics and biochemical parameters. Student t-test or Mann–Whitney U test was applied for comparisons depending upon the use of mean or median for quantitative variables. Chi-square or Fisher's exact test were used for categorical variables. For all comparisons, 5% probability ( $p < 0.05$ ) was considered significant. Univariate and multivariate regression analysis was done to identify risk factors for mortality.

## Results

During the study period, 213 (62% males) patients with CKD and RTPCR positive for COVID-19 were admitted to the unit. The median (IQR) age of these patients was 52 (42, 60) years; 165 (77.5%) were in CKD stage 5D while 48 (22.5%) were in CKD stages 3 and 4. All patients in CKD stage 5D were on regular haemodialysis (HD), 2 to 3 times per week for a median (IQR) duration of 2 (1, 3) years. Ninety-seven (45.5%) patients were undergoing dialysis twice a week, 23% thrice a week, and the remaining had a variable frequency. None of the patients had received peritoneal dialysis. The baseline details of the patients are provided in Table 1. A history of contact with a COVID-19 patient or a positive family member was present for only 26 (12.2%) subjects. Of the 213 patients, 180 (84.5%) were symptomatic for COVID-19 infection at the time of admission while 33 (15.5%) were asymptomatic; major symptoms being fever in 60.6%, cough in 41.8% and dyspnoea in 44.6%, and the median duration of fever was 5 (3, 5) days. Sixty-two per cent of the patients had moderate to severe COVID-19 infection, and pneumonia was the commonest complication seen in 70% during the hospital stay and multisystem inflammatory syndrome in 2.8% of the patients (Table 1). Three patients were diagnosed to have pulmonary fibrosis based on the CT findings.

Of the 213 patients, 183 (85.9%) were anaemic, 45 (21.1%) had leukopenia, 29 (13.6%) thrombocytopenia and 82 (38.5%) had elevated D-dimer at presentation. The median neutrophil to lymphocyte ratio (N/L) was 5.3 (3.3, 10). Details of investigations are provided in Table 2. Further, a comparison of patients CKD5D (Chronic kidney disease Stage 5 on dialysis) to those CKDND (Chronic kidney disease not on dialysis) was made. Four patients in the CKDND group had undergone a transplant in the past. The clinical presentation of COVID-19 was similar in both groups except for a higher incidence of AKI and diarrhoea in the CKDND (Table 3). Twelve patients in CKD5D also developed AKI with a requirement of HD increase from 2 to 3 per week to 5–7 per week. Radiological abnormalities on chest radiograph were present in 149 (70%) of the patients, and the majority (63.8%) had bilateral involvement; ground-glass opacities characteristic of COVID-19 was seen in 54%, and 7.5% also had pleural effusions. Wherever required,

**Table 1 – Baseline clinical characteristics.**

Patient characteristics	N = 213
Median (IQR) age	52 (42,60)
Gender (M/F)	Male 132 (62%) Female 81 (38%)
CKD Stage 5D (on MHD)	165 (77.5%)
CKD ND	48 (22.5%)
Vascular Access Used for HD	Arteriovenous fistula (AVF) –155 (72.8%), Central venous catheter (CVC) –10 (4.7%) (3- IJV, 7 Femoral)
Comorbidities	
Hypertension	177 (83.1%)
Type 2 diabetes Mellitus	75 (35.2%)
Coronary artery Disease	15 (7%)
Cardiomyopathy	3 (1.4%)
RHD	1 (0.5%)
Hypothyroidism	11 (5.2%)
Hepatitis C	7 (3.3%)
Hepatitis B	1 (0.5%)
HIV	1 (0.5%)
Pulmonary Koch's	3 (1.4%)
Asthma	2 (0.9%)
COPD	2 (0.9%)
Chronic liver disease	2 (0.9%)
COVID-19 symptoms	
Fever	129 (60.6%)
Cough	89 (41.8%)
Dyspnoea	95 (44.6%)
Fatigue	27 (12.7%)
Sore throat	19 (8.9%)
Diarrhoea	5 (2.3%)
Severity of COVID	
Mild	81 (38%)
Moderate	30 (14.1%)
Severe	102 (47.9%)
Complications of COVID	
Pneumonia	88 (41.3%)
Encephalopathy	25 (11.7%)
AKI	31 (14.6%)
Pancreatitis	7 (3.3%)
Multisystemic Inflammatory Syndrome	6 (2.8%)
Cerebrovascular Event	3 (1.4%)
Myocarditis	2 (0.9%)
Cholelithiasis	2 (0.9%)
Pulmonary fibrosis	3 (1.4%)
Others	8 (3.8%)

MHD-maintenance haemodialysis, HD-Haemodialysis.

computerised tomography of the chest was done to identify the severity of the lung damage.

### Treatment and outcomes

For the treatment of COVID-19 infection, hydroxychloroquine (HCQS) was used in 84.5%, azithromycin in 21.6% and ivermectin in 82.6%; remdesivir was used only in 1 patient (post-transplant with eGFR of 45 ml/min/1.73 m<sup>2</sup>). Intravenous steroid, primarily dexamethasone, was used in 63.8% in the dose of 6 mg for 5–10 days. Methylprednisolone was used in 10% of those administered steroids; low molecular weight heparin (LMWH) was used in 59.2% of the patients, inotropes in 8.9% and intravenous antibiotics were used in 82.6%. Oxygen was

**Table 2 – Comparison of parameters between patients with CKD5D and CKD ND.**

Parameter	CKD 5D (n = 165)	CKD ND (n = 48)	P Value
Age (years)	50.5 (41,60)	55 (45–62)	0.157
Sex	M-101 (61.2%) F-64 (38.8%)	M-30 (62.5%) F-18 (37.5%)	0.872
Symptoms and Signs			
Fever	103 (62.4%)	26 (54.2%)	0.302
Cough	71 (43%)	18 (37.5%)	0.494
Dyspnoea	70 (42.4%)	25 (52.1%)	0.236
Diarrhoea	2 (1.2%)	3 (6.3%)	0.043*
Complications of COVID			
Pneumonia	71 (43%)	17 (35.4%)	0.346
Encephalopathy	21 (12.7%)	4 (8.3%)	0.405
AKI	12 (7.3%)	19 (39.6%)	0.00001*
Pancreatitis	5 (3%)	2 (4.2%)	0.698
Multisystemic Inflammatory Syndrome	4 (2.4%)	2 (4.2%)	0.520
Investigations			
Hb (g/dL)	7.7 (7,9)	8.6 (7.4,10.7)	0.01792
Neutrophil/lymphocyte (N/L) ratio	5 (3.3, 9.45)	6.65 (3.3,14.1)	0.3622
Platelet Count (X10 <sup>5</sup> /mm <sup>3</sup> )	1.47 (1.065,1.89)	1.69 (1.195, 2.165)	0.0853
Outcomes			
Total Days of admission	13.5 (8.75, 18)	12 (7.5,18.5)	0.4671
Days for RTPCR to turn negative	15 (11,21.75)	12.5 (8.25,15.5)	0.04573*
Mortality	37 (22.4%)	12 (25%)	0.709

CKD5D-Chronic Kidney Disease stage 5 on maintenance dialysis, CKDND-Chronic Kidney disease not on dialysis.

used in 62.9%, by venturi mask in 56 (42.4%) and non-rebreathing masks (NRM) in 76 (57.5%) at presentation and the median duration of oxygen use was 5 (3, 10) days. Fifteen (11.4%) patients needed non-invasive ventilation, while 11 (8.3%) had to be mechanically ventilated.

Of the 213 patients, 137 (64.3%) could be discharged (including ICU discharges) after a median hospital stay of 13 (8.3, 18.8) days; 44 (20.7%) needed to be transferred to the intensive care unit and 24 (11.3%) sought a transfer to other hospitals. Overall 52 (24.4%) patients died (including the ICU

**Table 3 – Investigations at admission.**

Laboratory Investigations	Median (IQR)
Haemoglobin (g/dL)	7.9 (7, 9.4)
Total leucocyte counts (/mm <sup>3</sup> )	6000 (4242.5, 9520)
Neutrophil/lymphocyte ratio	5.3 (3.3, 10)
Platelet Counts (X10 <sup>5</sup> /mm <sup>3</sup> )	1.5 (1.1, 1.9)
D dimer (ng/ml)	903 (373, 2050)
Creatinine (mg/dL)	8.8 (6.3, 11.9)
Serum albumin (g/dL)	3.3 (3.1, 3.6)
Radiological changes	149 (70%)
Bilateral Involvement	136 (63.8%)
Ground-glass opacities	115 (54%)
Pleural effusions	16 (7.5%)
Pericardial effusions	2 (0.9%)
Hydropneumothorax	1 (0.5%)

mortality) and the mortality rates were comparable in CKD5D and CKDND patient groups (22.4% vs 22.5%;  $P = 0.709$ ).

The median duration of attaining RTPCR negativity was 15 (10,19) days and was lower in CKDND patients (12.5 vs 15 days;  $P = 0.038$ ). Fifty two (24.4%) were still positive for SARS-CoV2 after 2 weeks, 22 (10.3%) after 3 weeks and 1 patient continued to be positive even after 6 weeks.

### Risk factors for mortality

A comparison of parameters according to survival showed that patients who could be discharged were younger

( $p = 0.001$ ), type 2 diabetes mellitus was less frequent amongst survivors (31.4% vs 50%;  $P = 0.0176$ ), with other comorbidities being similar (Table 4). Among complications, encephalopathy and multisystem inflammatory syndrome was less frequent in survivors compared to deceased (1.5% vs 36.5%;  $P < 0.00001$ ) and (0.7% vs 9.6%;  $P = 0.0039$ ) respectively. The leucocyte counts and neutrophil to lymphocyte ratio (N/L) were lower in survivors,  $P$  values being 0.039 and 0.007, respectively. Also, the radiological changes were more pronounced in deceased (Table 3). The univariate and multiple logistic analyses of different risk factors showed the presence of diabetes, encephalopathy

**Table 4 – Comparison of parameters according to survival.**

Parameter	Discharged (n = 137)	Expired (n = 52)	P value
Age	49 (39.8,58)	52 (48.5,67.5)	0.001*
Gender (M/F)	M 80, F 57	M 33, F 19	0.4
CKD 5D	103 (75.2%)	37 (71.2%)	1.0
CKD ND	34 (24.9%)	12 (23.1%)	
<i>Co morbidities</i>			
Hypertension	107 (78.1%)	46 (88.5%)	0.105
Type 2 diabetes Mellitus	43 (31.4%)	26 (50%)	0.0176*
Coronary artery Disease	8 (5.8%)	4 (7.7%)	0.64
Hypothyroidism	12 (8.8%)	5 (9.6%)	0.97
Pulmonary Koch's	4 (2.9%)	3 (5.8%)	0.35
<i>Symptoms and Signs</i>			
Symptomatic	111 (81%)	48 (92.3%)	0.057
Fever	76 (55.5%)	34 (65.4%)	0.217
Cough	56 (40.9%)	22 (42.3%)	0.858
Dyspnoea	43 (31.4%)	42 (80.8%)	0.00001*
Diarrhoea	4 (2.9%)	1 (1.9%)	0.82
<i>Complications of COVID</i>			
Pneumonia	47 (34.3%)	24 (46.2%)	0.133
Encephalopathy	2 (1.5%)	19 (36.5%)	<0.00001*
AKI	17 (12.4%)	10 (19.2%)	0.372
Pancreatitis	4 (2.9%)	3 (5.8%)	0.354
Multisystemic Inflammatory Syndrome	1 (0.7%)	5 (9.6%)	0.0039*
<i>Investigations</i>			
Creatinine (mg/dL)	9 (5.9,12.8)	8.3 (6.9,11.1)	0.29
Haemoglobin (g/dL)	8.3 (7.3, 9.5)	7.4 (6.7, 9.4)	0.103
Total leucocyte counts (/mm <sup>3</sup> )	6000 (4310, 8910)	7070 (4225, 13,650)	0.310*
Neutrophil/lymphocyte ratio	4.4 (2.9; 7.1)	11.3 (5.5; 18.5)	0.007*
Platelet Counts (X10 <sup>5</sup> /mm <sup>3</sup> )	1.5 (1.1; 1.9)	1.6 (1.1; 1.9)	0.115
D dimer (ng/ml)	552 (902; 3239)	1290 (1008.2; 2584)	0.258
Serum albumin (g/dL)	3.5 (3.2; 3.7)	3.2 (2.8; 3.5)	0.0148
<i>Radiological changes</i>			
Bilateral Involvement	95 (69.3%)	47 (90.4%)	0.0026*
Ground-glass opacities (GGO)	82 (86.3%)	46 (97.9%)	0.0087*
Pleural effusions	65 (47.4%)	41 (87.2%)	0.0028*
Patchy Opacities	9 (6.6%)	7 (14.9%)	0.132
Treatment			
<i>Drugs</i>			
HCQ	110 (80.3%)	45 (86.5%)	0.668
Azithromycin	33 (24.1%)	40 (76.9%)	<0.00001*
Ivermectin	114 (83.2%)	51 (98%)	0.404
Steroids	74 (54%)	51 (98%)	<0.00001*
LMWWH	52 (37.9%)	46 (88.5%)	<0.00001*
Other Antibiotics	107 (78.1%)	51 (98%)	0.00093*
Inotropes	6 (4.4%)	13 (25%)	0.00003*
Oxygen Requirement	68 (49.6%)	51 (98%)	<0.00001*
O <sub>2</sub> by NRM	21 (15.3%)	49 (94.2%)	<0.00001*
Noninvasive ventilation (NIV)	5 (3.6%)	9 (17.3%)	0.0014*
Mechanical ventilation	0 (%)	11 (21.1%)	<0.00001*

\* P value is less than 0.5.

and ground-glass opacities at admission to be significantly associated with mortality.

## Discussion

The present study looked at the outcomes of patients hospitalised with COVID-19 infection with an underlying CKD. A majority of the patients were already on maintenance haemodialysis at admission. The study population consisted of a higher proportion of males (62%); the prevalence of diabetes and hypertension were 35.2% and 83.1%, respectively. A multicentre US-based study described profile and outcomes of 419 ESKD patients (62.1% males), and the prevalence of diabetes and hypertension was 59.2% and 91.2% in that cohort.<sup>13</sup> Similar results had been reported by the ERA-EDTA registry data too.<sup>14</sup> Median age of the patients in the present study was 52 years while in the United States and European cohort it was 66 and 71.7 years, respectively. This reflects the demographic profile of India with a higher proportion of the younger population (only 6% > 65 years of age compared to 15.2% in the United States and 19.2% in the European Union).

Patients with ESKD are at an increased risk of infections, especially bacterial predominantly due to a uremic milieu that predisposes to immune dysregulation.<sup>15</sup> The annual mortality due to sepsis has been shown to be almost 50 times higher in the dialysis population compared to the general population.<sup>16</sup>

Most (84.5%) patients in the study were symptomatic for COVID-19, with 62% presenting with moderate or severe infection. Another smaller series (n = 37) from India had reported a higher number of asymptomatic and mild patients in a similar group, especially at the start of the pandemic.<sup>17</sup> However, a nationwide study from Turkey has described a higher incidence (43.9%) of severe disease among hospitalised CKD, haemodialysis and renal transplant patients.<sup>18</sup> A Korean study has also reported more severe disease in CKD5D (78.6%).<sup>19</sup>

The drugs most frequently used for the treatment of COVID-19 infection were HCQS and ivermectin. The use of azithromycin was lower as prolonged QT intervals were seen in at least 20% of patients who were co-administered HCQ. Remdesivir could be used only in a single patient as its use is contraindicated in stages 4 and 5 of CKD. Other studies too have reported similar usage of these drugs, although the evidence for the use of antiviral agents is rather scant for patients with CKD as most trials on therapy have actually excluded these patients.<sup>18–20</sup> The usage of steroids (63.8%) and LMWH (59.2%) was higher than other series possibly due to the more severe disease and patient admissions after the benefits of steroids had been published by the recovery trial (interim analysis was published in 2020).<sup>18,19,21,22</sup>

The overall mortality was 24.4%, and 20.6% of patients needed intensive care transfer with similar rates between CKD5D and CKDND (P = 0.709). During the same period, the overall mortality rate of all admitted patients (n=10,314) at our hospital was 13.72%.<sup>23</sup> High mortality rates varying between 11.6% and 31.7% among CKD population have been reported from China and later from other countries.<sup>1,8,13–15,23</sup> The mortality rates were higher in series having a larger

proportion of ESKD patients.<sup>8,24</sup> A meta-analysis (n = 38,906) on hospitalised COVID-19 patients (from US, Europe and China) showed a case fatality rate of 48% (37–63%) for CKD; deaths were more in males and those above 60 years of age.<sup>24</sup> An analysis of our deaths showed that diabetes mellitus, dyspnoea at presentation, encephalopathy and ground-glass opacities on chest radiograph were associated with a higher risk of mortality. Among survivors, the median time to RTPCR negativity was 15 days, and significant shedding was observed even after 3 weeks implying prolonged viral shedding in patients with CKD. Further, there was an earlier viral clearance for CKDND patients (12.5 vs 15 days). A similar observation has been made by another study from Korea.<sup>19</sup>

Trained manpower was a major constraint during the peak of the pandemic in many countries, and a pooling of all resources to tide the crisis appeared to be a reasonable solution. This led to our repurposing for managing a larger number of adult renal patients at our COVID-19 only facility. In the process, we pediatric nephrologists got an opportunity to broaden our horizons and felt grateful for the opportunity to serve during the pandemic. Similar experiences have been shared by other pediatric nephrology colleagues in developed parts of the world as well.<sup>25</sup> Also, we learnt that there is a need for close coordination between pediatric and adult nephrology training programs for better future preparedness.

To conclude, we learnt that the severity of COVID-19 infection was higher in patients with CKD, and so was mortality. Besides, they shed the virus for prolonged periods (>2 weeks), thus necessitating longer hospitalisation for dialysis and prevention of viral spread.

## Disclosure of competing interest

The authors have none to declare.

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