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ORIGINAL ARTICLE

Clinical Patterns of Coronavirus Disease 2019 in Different Types of Chronic Kidney Disease Patients

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Abstract

Background: **Nephrologists have been at the forefront of clinical care of patients with coronavirus disease 2019 (COVID-19) as kidney-related complications, including chronic kidney disease (CKD), glomerular disease, and severe electrolyte derangements, are frequently encountered.**

Aim: **To estimate the effect of COVID-19 viral infection on chronic kidney disease patients and to determine the clinical characteristics of the disease.**

Patients and methods: **A retrospective case study of 50 patients with CKD from stage 1 to stage 5 presented with COVID-19 infection which was confirmed by PCR at El Sheikh Zayed Al Nahyan Hospital from first of August 2021 to first of January 2022.**

Results: **Our Study Revealed that; The patient's ages was ranged from 42 to 94 years, with an average age of 65 years, BMI of the patients ranged between 28 and 39.5 kg/m^2 with an average of 33 kg/m^2, which represents obesity. Most of the patients were male 27 (54%) while; Females represent 23 (46%). The mean of comorbidities, symptoms on admission of patients, total computed tomography (CT) scan on the first day and on the last day, and the placement of oxygen therapy on the first day and on the last day were statistically significant differences. The total number of patients in stage 1, stage 2, stage 3, stage 4, and ESRD patients was 50, 12 patients cured, 24% cured, 9 patients resolved 18%, 29 patients remitted, and 58% died. of the total patients. The incidence of the disease was 29 out of 50 patients.**

Conclusion: **Mortality rate and readmission rate were clinically high significantly increased in patients with different stages of CKD.**

Keywords: Chronic kidney disease, Coronavirus disease 2019, Ground glass, Mortality, Opacity

1. Introduction

Patients with chronic kidney disease (CKD), particularly those with kidney failure receiving chronic dialysis and kidney transplant recipients (KTR), have been disproportionately affected.[1]

The global prevalence of CKD is estimated to be between 9 and 12%. CKD is the most common risk factor for death in patients with COVID-19 worldwide, and the risk increases with a higher CKD stage, with the highest risk occurring in those with kidney failure receiving replacement therapy (KFRT) and KTR.[2]

CKD is the most common risk factor for death in patients with COVID-19. In addition, the risk of COVID-19 is significantly higher in KFRT patients receiving in-center hemodialysis than in-home dialysis patients receiving telehealth care. This is probably due to the increased risk of exposure of patients receiving in-center dialysis to Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) during thrice weekly travel via group or public transportation to/from dialysis and exposure to patients and staff at the dialysis unit.[3]

Kidney impairment in hospitalized patients with SARS-CoV-2 infection is linked to increase in-

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hospital mortality and worsening clinical evolution, which raises concerns about patients with CKD.[4]

Single-center studies reporting clinical outcomes in patients with CKD and COVID-19 have reported widely variable results, and this variability is due in part to differences in patient characteristics such as age, sex, race, and comorbidities that are associated with worse outcomes.[5]

Therefore; This study purposes to estimate the effect of Covid-19 viral infection on chronic kidney disease patients and to determine clinical characteristics of disease.

2. Patients and methods

A retrospective case study for 50 patients with CKD from stage 1 to stage 5 presented with COVID-19 infection which confirmed by PCR from El Sheikh Zyed Al Nahyan Hospital.

Between August 1, 2021, and January 1, 2022, 50 adult patients with confirmed COVID-19 were admitted to Al-Sheikh Zayed Al-Nahyan Hospital, a government-selected facility for the treatment of COVID-19 patients. 50 COVID-19 adult patients with CKD were grouped together according to age, sex, BMI, and underlying conditions.

The Ethics Committee of Al-Azhar University gave their approval to the current work. In accordance with the study's retrospective design, written informed consent forms were obtained from each patient.

Patients with CKD receiving conservative treatment, those receiving regular hemodialysis for more than 6 months, and those over the age of 18 were included, while; patients with mental illnesses, children, pregnant women, non-CKD Covid 19 patients, and those with no minimum outcomes were excluded.

All patients went through; chest computed tomography (CT) scans and demographic data, CO-RADS fall into six categories. From very low risk (CO-RADS 1) to proven infection by a positive reverse transcription-polymerase chain reaction (RT-PCR) assay, Clinical Examination, categories 1 through 6 follow an increasing risk for COVID-19. All patients' clinical symptoms and outcome-related data came from electronic medical records. Investigation in a laboratory; total blood count, serum creatinine, creatinine clearance, serum urea, d dimer, and serum ferritin, as well as a chest CT scan. Progress of all available data on all admission-related dates.

Utilizing the SARS-COV-2 virus antigen Roche Diagnostic Kit, Genentech, Roche Diagnostics, Chugai Pharmaceutical Co., and MORE, Basel, Switzerland Quick and accurate chromatographic immunoassay for qualitatively detecting the human nasopharyngeal nucleocapsid antigen that is specific for SARS-CoV-2. Make three to four turns of the swab against the nasopharyngeal surface. Take 15–30 min to read the test. The person who was tested probably has SARS-CoV-2. Line C of control: demonstrates that the test is functioning properly. Line test T: observable if the SARS-CoV-2 antigen was found. Negative test outcome: Simply having control line C visible indicates that the test was successful. The test came back negative. The sample lacked any virus protein that could be identified.

Following the manufacturer's instructions, the CerTest Viasure SARS-CoV-2 Real Time PCR Detection Kit (CerTest, Biotec, Spain) was utilized for viral RNA detection. The reverse transcription and subsequent amplification of a specific target sequence were carried out in the same reaction well during the one-step real-time reverse transcription format used for the detection. Reverse transcriptase was used to transcribe the isolated RNA target, resulting in complementary DNA. The ORF1 ab and N genes for SARS-CoV-2 were then amplified with specific primers and a probe that was fluorescently labeled.

Data analysis were used IBM SPSS version 20.0 to analyze collected data and tabulated. Numbers and percentages were used to describe qualitative data. The range (minimum and maximum), mean, standard deviation, and median were used to describe quantitative data. Mean and standard deviation (SD) were presented as parametric variables; The median was used for data with minimum and maximum parametric values. There were frequencies (n) and percentages (%) for dichotomous data.

3. Results

In this study; From August 2021 to January 2022, 50 adult COVID-19-positive patients admitted to Al-sheikh zayed Al-Nahyan hospital—a government-selected facility for the treatment of COVID-19 patients—were enrolled. With nasopharyngeal samples, the SARS-CoV2 RNA of all COVID-19 patients was confirmed by reverse transcription-polymerase chain reaction, and clinical outcomes were monitored until January 2022.

50 COVID-19 adults with CKD were included in our statistically calculated and tabulated results, which were homogenized in terms of demographic, laboratory, radiographic, oxygen therapy mode, and clinical data, as well as mortality and morbidity outcomes (Tables 1–8).

4. Discussion

Worldwide, millions of people have been affected by COVID–19. Diabetes, hypertension, chronic obstructive pulmonary disease (COPD), cancer, and chronic kidney disease (CKD) were all identified as risk factors for increased mortality and severity of COVID–19 Wang and colleagues.[6]

In the current study, To determine how CKD affects COVID–19 mortality, hospitalization, incidence, admission, disease severity, and adverse outcomes, we gathered data from 50 CKD patients at various stages. We discovered that COVID–19 adverse outcomes were more common in CKD patients. This may be because patients with CKD are less likely to activate their innate and adaptive immune systems, which makes them more susceptible to infections. In the current study; there was no significant difference were observed regarding age, regarding gender and BMI.

As observed by Vindegaard and Benros,[7] study included 1000 patients; 500 CKD patients and COVID-19, and 500 COVID-19 patients without CKD demographic data were varied among patients, the percentage of male represents 73% higher than female 27%, also, BMI were ranged between 30 and 34.9 kg/m^2 of the all included patients and age range between 50 and 85 with median age 60, which is in line with our results.

Table 1. Baseline demographics and comorbidities.

Demographic data	Mean ± SD	Min–Max	Median	*P* Value
Age (Years-Old)	64.40 ± 11.03	42–94	65	0.730
BMI (kg/m^2)	32.95 ± 2.98	28–39.5	33	0.310
Sex (Male/Female)	**Percentage (*N* = %)**	**Mean ± SD**	***P* Value**	
Male	27 (54%)	25 ± 2.82	0.210	
Female	23 (46%)			
Comorbidities				
Comorbidities	**Mean ± SD**		***P* Value**	
	16.5 ± 17.20		0.007	
Comorbidities		**Percentage (*N* = %)**		
Arterial Fibrillation (AF)		5 (10%)		
Coronary Artery Bypass Graft (CABG)		4 (8%)		
Diabetes Mellitus (DM)		36 (72%)		
Hypertension (HTN)		48 (96%)		
Hypo-tension		2 (4%)		
Ischemic Heart Disease (IHD)		14 (28%)		
Past history of Glaucoma		2 (4%)		
Rheumatic Heart Disease (Rh.HD)		20 (40%)		

Bold values represent the best statistically significant results.

Table 2. Symptoms at admission.

Symptoms at admission		
Symptoms	Mean ± SD	*P* Value
	7.87 ± 10.93	0.004
Symptoms	**Percentage (*N* = %)**	
Abdominal Pain	6 (12%)	
Bone Ache	2 (4%)	
Cough	30 (60%)	
Deep Vein Thrombosis	2 (4%)	
Dehydration	1 (2%)	
Diabetic Ketoacidosis	3 (6%)	
Diarrhea	2 (4%)	
Dyspnea	23 (46%)	
Fatigue	2 (4%)	
Fever	32 (62%)	
Hypoxia	2 (4%)	
Nausea	1 (2%)	
Tachypnea	2 (4%)	
Vomiting	7 (14%)	

In the current study, the mean ± SD comorbidities of patients was 16.5 ± 17.20 with *P* value 0.007, significant differences were observed regarding-comorbidities.

According to different recent studies, CKD is among the most diffuse with simultaneous presence of more types of disease in COVID-19 patients Webster and colleagues,[8] In line with our findings.

In the current study, the mean ± SD symptoms at admission of patients was 7.87 ± 10.93 with *P* value 0.004, significant differences were observed regarding symptoms at admission.

In addition to, previous study done by Ran and colleagues,[9] reported that the effect of symptoms at admission on COVID–19 death-rate, a meta-analysis showed that symptoms of COVID-19 with CKD were associated with high-incidence of mortality rate due to the severity of COVID–19.

In the current study, there was several laboratory findings differences; The mean of total leukocytes count, creatinine, creatinine clearance, ferritin, urea and platelets count in the first day and in the last day in comparison to the normal range were significantly increased. The mean of hemoglobin and D-Dimer in the first day and in the last day in comparison to the normal range were non significantly differences.

In addition to, previous study Gong and colleagues,[10] indicated high rate of total leuckocytes, platelets, creatinine and ferritin levels than the normal ranges revealing severe-status, in addition to multi-organ injured which is consistent with our results.

However; another study Henry and Lippi,[11] indicated that D-Dimer and leukocytes count were non significant differences from the first day and after period of hospitalized.

Table 3. Clinical data among COVID-19 hospitalized patients with CKD in the first day and last day.

Clinical data			
Clinical	First day (of Admission)	Last day (of Admission)	*P* Value
	Mean ± SD		
Blood Pressure (90/60–120/80 mmHg)	40.21 ± 10.50 80/5–170/110	29.50 ± 7.05 80/50–150/90	0.040
Heart Rate (60–100 beats/Mins)	40.21 ± 15.80 61–140	87.60 ± 14.80 60–125	0.085
Temperature (36.5–37.5 °C)	37.34 ± 0.60 36.3–39.4	37.1 ± 0.53 36.2–39.5	0.052
Random Blood Sugar (</ = 140 mg/dl)	184.80 ± 86.65 92–457	189.52 ± 103.90 65–475	0.324
Blood Oxygen Saturation level (95% or more)	92.50 ± 4.40 78–100	89.96 ± 8.63 58–99	0.070

Table 4. Laboratory among COVID-19 hospitalized patients with CKD in the first day and last day.

Laboratory investigations			
Laboratory	Mean ± SD		*P* Value
	First day (of Admission)	Last day (of Admission)	
Total Leukocytes Count (4.5–11.0 × 109/L)	10.68 ± 6.67 2.4–28	12.60 ± 8.20 2.6–50.2	0.050
Hemoglobin (11.6–16.6 MmoL/l)	10.40 ± 2.30 6.4–14.8	10.108 ± 1.96 6.5–14.9	0.741
Platelets Count (125–350 × 10^9/L)	201.70 ± 85.70 44–490	175.5 ± 102.42 17–487	0.241
Creatinine (0.9–1.3 mg/dl)	4.70 ± 2.80 1.2–12.5	5.60 ± 2.70 1.3–13.5	0.064
Urea (2.1–8.5 mmoL/l)	149.80 ± 65.80 40–317	177.44 ± 93.30 55–424	0.680
Creatinine Clearance (1.49–2.33 ml/s)	29.20 ± 17.30 8.8–65	24.60 ± 17.60 8.03–72.06	0.062
Ferritin (11–336 μg/l)	689.90 ± 545.90 89–2455	625.20 ± 479.50 55–2050	0.841
D DIMER (<0.5 μg/l)	1.80 ± 1.2 0.14–4.9	2.02 ± 1.5 0.03–4.9	0.003

In the current study, computerized tomography scan were applied to differentiate the first day and last day of admission for the included patients. The mean of total CT investigation in the first day were 2.55 ± 8.3 and in the last day 2.50 ± 4.10 were non significantly differences with *P* value 0.044.

According to previous study Henry and Lippi,[11] in all admitted patients indicated higher rate in bilateral, right lung only and left lung only GGO in the first day of admission however it decrease at the last day of admission. In line with our findings.

In the current study, oxygen therapy mode depending on the severity of COVID-19 and patient needs; there are different oxygen mode were used. The mean of oxygen therapy mode in the first day

Table 5. CT Findings among COVID-19 hospitalized patients with CKD in the first day and last day.

Radiological investigations			
Computed tomography scan	First day (of Admission) Mean ± SD	Last day (of Admission) Mean ± SD	*P* Value
	2.55 ± 8.3	2.50 ± 4.10	0.044
	First Day (*N* = %)	Last Day (*N* = %)	
Acute Pulmonary edema (Acute GGO)	5 (10%)	7 (14%)	
Chronic Pneumonitis (GGO)	27 (54%)	1 (2%)	
Chronic Pneumonia Alveolar proteinosis (Chronic GGO)	3 (6%)	0	
Chronic Bronchoaveloar (GGO)	4 (8%)	0	
Chronic Eosinoph Pneumonia (GGO)	6 (12%)	0	
Normal	5 (10%)	9 (18%)	

Table 6. Oxygen therapy mode among COVID-19 hospitalized patients with CKD in the first day and last day.

Oxygen therapy mode			
O_2	First day (of Admission) Mean ± SD	Last day (of Admission) Mean ± SD	*P* Value
	2.55 ± 8.3	2.50 ± 4.10	0.0165
	1st Day (*N* = %)	Last Day (*N* = %)	
Continuous positive airway pressure	3 (6%)	7 (14%)	
Mask Bag	10 (20%)	1 (2%)	
Mechanical Ventilator	8 (16%)	21 (42%)	
Nasal 1 L	0	1 (2%)	
Nasal 2 L	2 (4%)	0	
Nasal 3 L	1 (2%)	1 (2%)	
Nasal 4 L	4 (8%)	0	
Nasal 5 L	5 (10%)	0	
Nasal 6 L	1 (2%)	0	
Nasal 10 L	1 (2%)	0	
Room Air	11 (22%)	18 (36%)	
Normal	1 (2%)	1 (2%)	

were 2.55 ± 8.3 and in the last day 2.50 ± 4.10 were significantly differences with *P* value 0.0165.

According to previous study findings Davies and Jarvis,[12] concluded that moderate certainty evidence that the oxygen therapy mode increased in patients patients with CKD other than without CKD. Out of 100 patients, 30 patients supported with mechanical ventilators from the first day to the last day of admission, however; 70 patients supported with mask bag from the last day and decreased in the last day of admission.

Table 7. Mortality and morbidity outcome.

Stages of CKD			
	Percentage (*N* = %)		
Stage 1			
Number of Patients	1 (2%)		
Resolved	0		
Partially Resolved	0		
Died	1 (2%)		
Stage 2			
Number of Patients	10 (20%)		
Resolved	4 (40%)		
Partially Resolved	2 (20%)		
Died	4 (8%)		
Stage 3			
Number of Patients	16 (32%)		
Resolved	2 (12.50%)		
Partially Resolved	3 (18.75%)		
Died	11 (68.75%)		
Stage 4			
Number of Patients	4 (8%)		
Resolved	0		
Partially Resolved	1 (25%)		
Died	3 (75%)		
ESRD			
Number of Patients	19 (38%)		
Resolved	4 (21%)		
Partially Resolved	3 (15%)		
Died	12 (64%		
Total	**Percentage (*N* = %)**	**Mean ± SD**	***P* Value**
Number of Patients	**50 (100%)**		
Resolved	12 (24%)	2.55 ± 8.3	0.262
Partially Resolved	9 (18%)	1.5 ± 1.05	**0.018**
Died	29 (58%)	6.2 ± 4.90	**0.017**

Bold values represent the best statistically significant results.

In the current study, Stages of CKD; the percentage of total stage 1 of CKD represents 1 (2%) patient of the total patients, 0% patient resolved, 0% partially resolved and 1 (2%) patient were died. The percentage of total stage 2 of CKD represents 10 (20%) patients of the total patients, 4 (40%) patient resolved, 2 (20%) patients partially resolved and 4 (40%) patient were died.

According to previous study Davies and Jarvis,[12] reported that; different stages of CKD were not the main risk factor in mortality rate, since 20 patients were died from the first stage of CKD in contrast 5 patients from fourth stage and 8 patients from third stage of CKD were died.

The total included patients of stage 1, stage 2, stage 3, stage 4 and ESRD of CKD patients were 50 patients, 12 patients 24% were resolved from the total patients with mean 2.55 ± 8.3%, *P* value 0.262 were nonsignificantly differences.

As per previous study Andersen and colleagues,[13] mentioned that; the morbidity rate were lower than mortality rate among patients with CKD.

Table 8. CKD progression.

Progression	Percentage (*N* = %)	Mean ± SD	*P* Value
Total Patients	**29 (58%)**		
CKD Progression	26 (75.5%)	10.80 ± 2.12	**0.139**
No CKD Progression	5 (14.5%)	3.20 ± 1.41	**0.020**
Days of Admission			
Days of Admission	**No. of Patients**		
1 week	10 (20%)		
13 Days	25 (25%)		
5 Days	5 (10%)		
2 Months	1 (2%)		
2 weeks	9 (18%)		

Bold values represent the best statistically significant results.

Finally, in general clinical data, laboratory findings and CT-scan examination were essential data for investigation COVID-19 patients with CKD and evaluating the risk of disease progression after infected with COVID-19. It also found that disease severity and mortality rate in COVID-19 patients with CKD possibly correlated with comorbidities and symptoms at admission. Also, observed that COVID-19 possibly represents huge role in progression in CKD stages.

4.1. Recommendation

Further studies were needed on a large scale of patients including acute and chronic kidney disease in addition to confirmed COVID-19 viral infection.

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Conflict of Interest

The authors declared that there were No conflicts of Interest.

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