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Clinical and epidemiological analysis of COVID-19 in End-Stage Renal Disease patients undergoing maintenance hemodialysis: A study from Golestan province

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Abstract

Background: End-Stage Renal Disease (ESRD) patients under maintenance hemodialysis are at higher risk for COVID-19 and severe outcomes. This study aimed to investigate the association between ESRD patients who underwent maintenance hemodialysis at 5th Azar and Sayad Shirazi Hospital in Golestan Province in 2019 and their risk of acquiring and experiencing severe outcomes from COVID-19. Furthermore, this study aimed to provide insights into the epidemic status of COVID-19 in this specific population, contributing to better insight into the unique challenges faced by ESRD patients on hemodialysis during the pandemic.

Methods: This retrospective descriptive cross-sectional study was performed on patients who underwent maintenance hemodialysis. The diagnosis was made based on diagnostic criteria and COVID-19 PCR test. Medical information of all participants was collected. Medical information including clinical, laboratory, and radiological data as well as morbidity and mortality were collected and analyzed by experts. Statistical analysis was performed using SPSS version 21. Normality was evaluated using Shapiro-Wilk test and comparison between groups was analyzed using student T-test and Mann-Whitney U tests (P-Value < 0.05).

Results: The highest radiological view was related to the ground glass view with 46.7% and Linear Opacities with 26.7%. Most patients (86.6%) were discharged and four of them (13.4%) passed away. WBC, creatinine, and age were significantly associated with ESRD patients' mortality (P-Value < 0.05). The patients who passed away were old and had higher levels of WBC and creatinine (P-Value > 0.05). No significant difference was observed between the age and BMI of passed away and discharged patients. None of the laboratory parameters in the two groups of passed away and discharged patients with COVID-19 showed a significant difference (P-Value > 0.05). Patients with COVID-19 who had a history of diabetes and hypertension, clinical symptoms, such as cough (P-Value = 0.049), weakness, and lethargy (P-Value = 0.05), indicated a significant difference in mortality compared to the group that was discharged (P-Value < 0.05).

Conclusion: ESRD patients who underwent hemodialysis due to their underlying problems and the crowded environment of dialysis wards more than the general population are at risk of getting COVID-19.

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Highlights

What is current knowledge?

- COVID-19 disease has a severe effect on ESRD patients that is receiving chronic hemodialysis.
- In hemodialysis patients, several other diseases such as diabetes and hypertension are associated with poor outcomes due to COVID-19.

What is new here?

- Elevated WBC and creatinine levels are vital determinants of death among ESRD patients diagnosed with COVID-19.
- No association was found between CRP levels and duration of kidney dialysis in patients with COVID-19.

Introduction

The World Health Organization (WHO) officially declared COVID-19 a global pandemic in mid-June 2020 (1). Symptoms associated with COVID-19 are nonspecific, including fever (44-98% of patients), dry cough (68-76% of patients), and muscle pain (Observed in 18% of patients). Mortality rates vary, ranging from 2.3% in China to 7.2% in Italy (2,3).

In individuals affected by COVID-19, particular consideration should be given to certain demographic groups. Epidemiological investigations indicate that individuals with diabetes, hypertension, cardiovascular diseases, or those in the elderly demographic face an elevated susceptibility to contracting COVID-19, with a heightened likelihood of experiencing severe manifestations and requiring specialized care or succumbing to the disease (4,5). Patients undergoing regular dialysis maintenance are prone to an elevated risk of contracting COVID-19 and experiencing its complications (3). Epidemiological studies indicate that the kidney is an important target of COVID-19 (6). Acute kidney injury (AKI) occurs in 5-15% of cases, and the presence of COVID-19 is identified as an independent risk factor for mortality (7). Patients with Chronic Kidney Disease (CKD), those undergoing chronic replacement therapy, and kidney transplant recipients are also affected by COVID-19. Hemodialysis patients undergoing PCR dialysis may face an increased risk of COVID-19 due to potential cross-contamination in enclosed environments and abnormalities in both adaptive and innate immune systems. Furthermore, the hemodialysis patient population exhibits a higher prevalence of severe comorbidities such as cardiovascular disease, hypertension, and diabetes mellitus, all of which are linked to an elevated risk of adverse outcomes. This review is centered on exploring the clinical aspects of COVID-19 in hemodialysis patients (8).

After the binding of the SARS-CoV-2 antigen protein to angiotensin-converting enzyme 2 (ACE2) receptors, the S protein undergoes cleavage and activation by the serum family of membrane proteases (TMPRSS). This activation enables the virus to cleave the fusion peptide, facilitating its release (9). Acute kidney failure in COVID-19 may result from a synergistic effect involving both the direct cytotoxic impact of the virus and the systemic inflammatory response triggered by cytokines. This form of renal failure is particularly evident in critically ill patients, those with acute respiratory distress syndrome (ARDS), and individuals requiring intensive care unit (ICU) admission. Additional potential mechanisms contributing to acute renal failure include acute tubular necrosis (ATN) due to multiple organ failure and shock, as well as a potential pre-renal cause stemming from volume depletion associated with reduced oral intake and high fever. Factors such as drug toxicity, hemodynamic involvement, and exposure to contrast material also have the potential to play a role in this context (10).

Evaluation for acute kidney failure in COVID-19 should follow the same protocols used for other causes of acute kidney failure. Several factors can contribute to acute renal failure, including acute ischemic tubular injury, nephrotoxic acute tubular injury, or a combination of both, acute interstitial nephritis, glomerular disease, prerenal azotemia, and unspecified causes. Some factors involved in these various conditions may include hypotension, shock, atrial fibrillation, prolonged volume depletion, rhabdomyolysis, exposure to toxic agents such as vancomycin and iodinated contrast, as well as evident proteinuria (11). Additionally, the degree and severity of lung involvement can be evaluated with a CT intensity score of 25. This quantification plays an important role in modifying the treatment plan in some cases in critical patients with COVID-19.

The CT severity score reveals the actual lung involvement percentage due to the COVID-19. Briefly, CT severity score ≤ 8 indicates mild disease, CT severity score between 9 -15 means moderate disease, and CT severity score >15 reveals severe disease (12). Further, dialysis patients may be susceptible to COVID-19 and its systemic consequences due to the following reasons: 1. increased risk of transmission, 2. chronic immune system dysfunction, 3. endothelial dysfunction, 4. organ damage with reduced structural or functional reserve, and 5. prior comorbidity and increased risk of renal system dysfunction due to reduced structural organ reserve (3,10).

Considering that the effect of the COVID-19 epidemic on chronic kidney disease and end-stage kidney patients has not yet been fully determined. Considering the low immune function of uremic patients, the situation of the epidemic of COVID-19 in these patients should not be ignored. In this study, we intend to describe the frequency of COVID-19 and its characteristics in the dialysis centers of the center of Golestan Province. In this study, the epidemiological, clinical, laboratory, and radiological characteristics of these patients are investigated, and we expect that our findings will contribute to the proper management of this disease in dialysis units.

Methods

This descriptive cross-sectional study was conducted on patients undergoing maintenance hemodialysis with positive RT-PCR (Real-Time PCR) and chest CT (Computed Tomography) scan graph for COVID-19 in the hemodialysis department of 5 Azar and Sayad Shirazi Hospital in Golestan Province in 2019. After obtaining the relevant ethical permits from the academic authorities and coordinating with the officials of 5 Azar and Sayyad Shirazi Hospital to access and use the information of hospitalization records of the dialysis patients infected with COVID-19 in those centers, the required information was obtained through the patients' files and In the information registration form, which includes demographic information of patients (Age, gender, ethnicity), clinical symptoms of patients (Fever, myalgia, shortness of breath, dry cough, anorexia, weakness, and lethargy, decreased level of consciousness) and laboratory tests ((Calcium, phosphorus), sodium, potassium, CBC (Complete Blood Count), AlP (Alkaline Phosphatase), TG (Triglycerides), Chol (Cholesterol), AST (Aspartate Transferase), ALT (Alanine Transferase), Alb (Albumin), Ferritin, CRP (C-Reactive Protein) and ESR (Erythrocyte Sedimentation Rate)), patient dialysis variables (Dialysis adequacy (KT/V), duration in hours, number of sessions per week) and The radiology data (CT scan of the chest) were recorded by the operator. Dialysis adequacy usually refers to how well toxins and waste products are removed from the patient's blood, which has a major impact on their well-being. Moreover, Kt/V is a metric used to assess the effectiveness of a hemodialysis session.

Also, additionally, information regarding the underlying diseases of the patients was collected. To investigate the levels of lipids by enzymatic method, ferritin by immunoassay method and gamma counter, urinary albumin by immunoturbidometric method, and, other measurements were done in the laboratory of Sayyad Shirazi Hospital in 5 Azar. During the follow-up period, the cases of death of these patients were recorded, and the possible cause of death was suggested by the research team, based on its time, place and, clinical manifestations.

2.1. Research limitations

Access to a sufficient number of patient samples was one of the study's limitations. Another limitation of this study is the lack of follow-up on discharged patients and the lack of measuring their mortality rates. Besides, due to the high cost of inflammatory markers kits, we could not examine all of these markers in all of the patients.

2.2. Ethical consideration

This study, conducted on hemodialysis patients with COVID-19, prioritized ethical standards. Necessary permits were obtained, and collaboration with hospital officials ensured confidential use of patients' records. Patient confidentiality was strictly maintained, and informed consent was obtained when applicable. Transparency and communication were upheld to safeguard participant welfare and research integrity. The study adhered to ethical guidelines in all stages, respecting patient rights and promoting data security.

2.3. Statistical analysis

All results were analyzed using SPSS 21.0 (SPSS, Inc., Chicago, IL, USA). To determine the normality, we performed the Shapiro-Wilk test. For data analysis, we used the student T-test or Mann-Whitney U test according to the normality results. Moreover, p <0.05 was considered to indicate a statistically significant difference. In addition, we considered the conditions of the Chi-square test such as Random Sampling, as well each observation is related to one person, and no person is counted twice in the sampling.

Results

3.1. Demographic frequency of hemodialysis patients with COVID-19

Among the 198 patients undergoing hemodialysis, 30 patients have the following inclusion criteria (35 patients were not included in the study due to lack of PCR, negative PCR, lack of hospitalization, or death). The average age of the patients was 58.97 ± 11.88 years (34-83 years). Moreover, from 30 patients 16 patients (53.3%) were female and 14 (46.7%) were male. Also, it was found that most ethnicities were related to Persian ethnicity (26 participants with 86.71%), with a smaller population of Turkman (1 patient, 3.3%), Sistani (2 patients, 6.7%), and Cossack (1 patients, 3.3%). Moreover, the frequency of BMI ranges was analyzed for hemodialysis patients with COVID-19. Frequency analysis showed that 17 patients (56.6%) were in the BMI group between 18.5 and 24.9, 7 patients (23.3%) were in the BMI group between 25 and 29.5, and 6 patients (0.2%) were in the BMI group between 30 to 34.9 range. However, no patient was included in the 18.5 >BMI> 35 groups.

3.2. Proportion of underlying disease history with COVID-19

In this study, the underlying disease history of hemodialysis patients positive for COVID-19 was investigated, and the results revealed that 24 patients (76.7%) with a history of high blood pressure and 15 patients (50%) with diabetes had the highest frequency of the disease. Coronary heart disease was observed in three patients (10%) and a history of kidney transplant in one patient (3.3%).

Furthermore, the first symptoms of hemodialysis patients with COVID-19 showed that fever (80%), distress, shortness of breath (83.3%), feeling weak and lethargic (63.3%), and anorexia (33.3%) are the most common symptoms. It is noteworthy that in hemodialysis patients, cough and myalgia were observed in 10% and 33.3% of the patients, respectively. In the hemodialysis patient's examination, the PCR test was checked to determine the positive for COVID-19, also the most common radiological results were ground glass with 46.7%, followed by linear opacities with 26.7% and bilateral consolidation with 16.7%. Multilubar involvement was observed in only three patients (10%). The short-term clinical outcomes are discharge of 26 patients (86.6%) among the 30 examined patients with COVID-19, while four patients (13.4%) passed away during the course of the study.

3.3. Laboratory findings in hemodialysis patients with COVID-19

Based on the Mann-Whitney U test, white blood cell complete counts (WBC) and creatinine variables, and age were related to the mortality rate (P-Value < 0.05). So the expired patients were older and had higher WBC and creatinine values (P-Value > 0.05). However, there was no significant difference between age and BMI of expired and discharged patients. Kolmogorov-Smirnov test was used to evaluate the normality of other quantitative variables, including TG-Chol, platelet (Plt), lactate dehydrogenase (LDH), blood urea nitrogen (BUN), Ferritin, calcium, potassium, and phosphorus electrolytes, which showed P-Value >0.05. Therefore, the student T-test was used to determine the relationship between the above quantitative variables. According to the table below, no significant difference was observed in any of the mentioned laboratory variables in the two groups of expired and discharged patients with COVID-19 (P-Value >0.05). Besides, these findings suggest elevated WBC count and creatinine levels were significantly associated with mortality, while other laboratory variables showed no significant differences between recovered and expired patients. Obtained results are shown in Table 1.

Table 1. Mean and standard deviation of laboratory and demographic variables in hemodialysis patients with COVID-19

Parameters	Groups		P-value
	Recovered patients	Expired patents	
Age*	49.5±12.28	62±9.69	0.02
BMI*	25.41±2.82	28.67±6.18	0.560
WBC count*	6.85±3.87 ×10 ^{3}/µL	11.55±4.57 ×10 ^{3}/µL	0.037
Hb*	10.49±2.22×10 ^{6}/µL	9.00±1.52×10 ^{6}/µL	0.096
ALT*	35.55±28.34 IU/L	31.42±6.02 IU/L	0.188
ALP*	293.43±127.72 U/L	437.42±389.91 U/L	0.872
Alb*	3.61±0.78 gr/dl	3.34±0.69 gr/dl	0.229
ESR*	49.52±22.80 mm/hr	61.42±29.10 mm/hr	0.561
CRP*	10.76±14.65	2.65±1.18	0.288
Cr*	5.17±0.84 mg/dl	6.65±2.17 mg/dl	0.033
Na*	142.56±14.19 mEq/dl	136.57±2.57 mEq/dl	0.146
TG**	154.34±78.87 mg/dl	140.85±28.72 mg/dl	0.390
Chol**	173.04±61.22 mg/dl	180.28±42.17 mg/dl	0.671
BUN**	123.86±38.45 mg/dl	99.14±36.23 mg/dl	0.634
PLT**	265.86±94.21×10 ^{3}/µL	163.42±103.64 ×10 ^{3}/µL	0.080
LDH**	410.13±79.93 mg/dl	408.00±77.43 mg/dl	0.947
Ferritin**	329.82±168.64 ng/ml	295.71±145.82 ng/ml	0.928
Ca**	8.52±0.83 mg/dl	7.98±0.54 mg/dl	0.080
P**	4.93±1.29 mEq/dl	5.55±1.18 mEq/dl	0.211
K**	4.96±0.89 mEq/dl	4.64±1.12 mEq/dl	0.392

* Means Mann-Whitney U test and ** means student T-test.

3.4. Association of comorbidities with mortality of hemodialysis patients with COVID-19

The obtained results from Chi-square test showed that patients with COVID-19 with diabetes and high blood pressure history had a significantly increased mortality rate (P-Value < 0.05). While in patients with coronary heart disease, ESRD, polycystic kidney disease, and transplantation, we did not find any association between underlying disease with COVID-19 mortality (P-Value > 0.05). Our results revealed diabetes and hypertension were significantly associated with increased mortality, while no significant associations were found for coronary heart disease or previous kidney transplant. The results are shown in Table 2.

Table 2. Mean and standard deviation (SD) of the underlying disease of hemodialysis patients with COVID-19 based on the patient's outcome

Underlying disease	Recovered patients	Expired patients	Yes/No	P-value
T2DM*	14 (93.3%)	1 (6.7%)	No	0.031
	9 (60%)	6 (40%)	Yes	
Hypertension*	6 (57.14%)	1 (42.86%)	No	0.001
	17 (17.4%)	6 (82.6%)	Yes	
Coronary Heart Diseases*	21 (77.8%)	6 (22.2%)	No	0.666
	2 (66.7%)	1 (33.3%)	Yes	
ESRD*	23 (79.3%)	6 (20.7%)	No	0.065
	0 (0%)	1 (100%)	Yes	
Previous kidney transplant*	23 (79.3%)	6 (20.7%)	No	0.065

* Chi-square test.

3.5. Association of severe symptoms with mortality of hemodialysis patients with COVID-19

The obtained results from Chi-square test showed patients with cough complaints (P-Value = 0.049), weakness and lethargy (P-Value = 0.05) have a significant association with a higher rate of mortality in patients with COVID-19. In contrast, our results showed that other severe symptoms had no association with COVID-19 mortality rate. The results are summarized in Table 3.

Table 3. Examining the mean difference and standard deviation of initial complaints and clinical manifestations of patients with COVID-19 based on the patient's outcomes

Symptoms	Recovered patients	Expired patients	Yes/No	P-value
Fever*	4 (66.7%)	2 (33.3%)	No	0.517
	19 (79.2%)	5 (20.8%)	Yes	
Cough*	22 (81.5%)	5 (18.5%)	No	0.049
	1 (33.3%)	2 (66.7%)	Yes	
Loss of consciousness*	22 (75.9%)	7 (24.1%)	No	0.575
	1 (100%)	0 (0%)	Yes	
Pain*	15 (75%)	5 (25%)	No	0.760
	8 (80%)	2 (20%)	Yes	
Dyspnea - respiratory distress*	4 (80%)	1 (20%)	No	0.847
	19 (76%)	6 (24%)	No	
Malaise*	9 (81.8%)	2 (18.2%)	No	0.05
	14 (73.3%)	5 (26.3%)	Yes	
Anorexia*	14 (70%)	6 (30%)	No	0.222
	9 (76.7%)	1 (23.3%)	Yes	

* Chi-square test.

3.6. Correlation of CRP serum levels with hemodialysis duration in hemodialysis patients with COVID-19

In this study, our findings revealed that the serum CRP levels did not correlate with hemodialysis duration (R = 0.267, P-Value = 0.154). In contrast, the obtained results from Spearman's correlation revealed the serum CRP levels had a significant negative correlation with ESRD in hemodialysis patients with COVID-19 (R = 0.527, P-Value < 0.003). Additionally, the results from Spearman's correlation indicated that the hemodialysis duration, PCR results, and CRP serum levels had no significant correlation with any type of pulmonary involvement in ESRD patients with COVID-19, which is diagnosed by chest CT graph (P-Value < 0.05).

3.7. Hemodialysis patients with COVID-19 outcomes

CT scan results and the presence of ESRD affect the mortality and recovery status of hemodialysis patients with COVID-19. The obtained results are shown in Table 4.

Table 4. Mean and standard deviation of mortality and recovery in hemodialysis patients with COVID-19

Variables	Recovered patients	Expired patients	P-value
ESRD	2.00±0.00	1.85±0.37	0.00
PCR	1.30±0.47	1.57±0.53	0.365
CT graph	2.17±1.09	1.00±0.00	0.001
CRP	8.33±13.38	10.52±13.72	0.561

* Student T-test.

Discussion

This research aims to describe the clinical attributes and immediate repercussions experienced by a cohort of 30 chronic hemodialysis patients afflicted with COVID-19 in Gorgan province in 2019. The mean age of the participants stood at 58.97±11.88 years, signaling an elder populace in comparison to broader investigations encompassing hemodialysis patients, typically ranging between 57 and 66 years of age (3).

The short-term clinical outcomes of this study indicate that the majority of hemodialysis patients with COVID-19 were discharged (86.6%), reflecting effective acute management for most patients. However, the observed mortality rate of 13.4% underscores the severe impact of COVID-19 on this population. Bahat et al. reported a mortality rate of 20% among hemodialysis patients with COVID-19, with other studies indicating rates of 16% and 28% in groups of 37 and 25 hemodialysis patients, respectively (3,13). These rates were notably higher than the mortality rates observed in the general population, ranging from 0.8% to 1.4% (14-16). The elevated mortality in hemodialysis patients can be attributed to various factors, including concurrent diseases, chronic kidney failure, and immunosuppression induced by high uremia (17).

The clinical outcomes of this study indicate that the majority of hemodialysis patients with COVID-19 were discharged (86.6%), which indicates the effective acute management for most patients. However, the observed mortality rate of 13.4% underscores the severe impact of COVID-19 on this population. The increased susceptibility of men to the infection may be attributed to increased levels of ACE receptors, particularly in podocyte cells and proximal convoluted tubule cells that express the ACE2 and TMPRSS genes, which are the main targets of the SARS-CoV-2 virus. It is notable that kidney tissue exhibits greater ACE2 gene expression than lung tissue, with the binding affinity of SARS-CoV-2 receptors to ACE2 being 10 to 20 times higher than that of SARS-CoV-1 (9,17-19). Bwire et al. suggested that males were more susceptible to SARS-CoV-2 infection due to higher ACE2 receptor expression levels (20). Chai et al. (21) and Bwire et al. (20) provided evidence of increased ACE2 expression in male kidney tissues compared to females' kidney tissues, potentially contributing to the gender disparity in infection rates.

The strong association between diabetes and hypertension with increased mortality emphasizes the importance of managing these comorbid conditions to improve outcomes. Radiological findings and the presence of ESRD significantly impact patient outcomes, highlighting the need for alert monitoring and potentially more aggressive treatment strategies. Xiong et al. (17) 95.4% of patients had at least one comorbidity, with cardiovascular disease associated with hypertension and diabetes being the most prevalent. Fisher et al. supported these findings and identified diabetes, hypertension, coronary artery disease, and pulmonary disease as the most common comorbidities among hemodialysis patients with COVID-19 (22). Li et al.'s study highlighted the predominance of high blood pressure and diabetes in ESRD patients with COVID-19. Furthermore, Li et al. emphasized the significance of respiratory diseases as additional common comorbidities in this patient population during the COVID-19 pandemic (23).

Symptomatology and clinical presentation show that common symptoms such as fever (80%) and shortness of breath (83.3%) are prevalent, indicating the severe presentation of COVID-19 in hemodialysis patients. Significant radiological findings like ground glass opacities and bilateral consolidation further emphasize the severity of the infection. Our findings are in the same direction as Valeri et al., Fisher et al., and Xiong et al., where fever consistently emerged as the primary clinical symptom, followed by cough, fatigue, and shortness of breath in patients with COVID-19 (17,18,22). Adwan et al. corroborated these clinical observations, highlighting fever, respiratory distress, and fatigue as the most prevalent symptoms among hemodialysis patients with COVID-19 (24). On the other hand, Valeri et al. found one-sided opacity in 10% of patients in chest radiographs, with over half of the recovered patients showing multiple or one-sided infiltrations (18). Goicoechea and Ma reported a ground glass radiological appearance with bilateral and peripheral patterns in 85.7% and 64% of patients, respectively (25,26).

In our study, a comparison of clinical and laboratory data between discharged and expired hemodialysis patients with COVID-19 revealed that non-survivors tended to be older and had higher WBC and creatinine levels compared to the discharged or recovered patients. Conversely, no significant differences were noted in other laboratory parameters. Expired patients predominantly had comorbidities such as diabetes or hypertension, and their symptoms, including cough, weakness, and lethargy, significantly differed from those who recovered (27). These findings are consistent with Zhou et al. (2020) research indicating a higher mortality rate in patients with concurrent diseases like diabetes and hypertension, which are common among hemodialysis patients, thus corroborating our results (28).

Laboratory findings identify elevated WBC counts and creatinine levels as significant prognostic markers associated with mortality. The absence of significant differences in other laboratory variables suggests the need for further research to identify additional prognostic factors. In Valeri's study, a 14-day follow-up revealed that 18 patients (31%) died within 6 days of hospital admission. Expired patients exhibited higher initial values of WBC, LDH, and CRP compared to living and recovered patients (p = 0.04) (18). Ma et al. involving 230 hemodialysis patients in Wuhan, China, 15 individuals (6.25%) died from COVID-19, with cardiovascular disease, cerebrovascular disease, and hyperkalemia identified as leading causes of death (29). Laboratory findings reveal that elevated WBC counts and creatinine levels serve as significant prognostic markers associated with mortality (19). Findings from Valeri's, Yiqiong et al.'s, and Fisher's studies further support the adverse prognostic indicators identified in our research, including elevated inflammatory markers and underlying cardiovascular conditions.

This study showed a significant relationship between some demographic factors, comorbidities, symptoms, and laboratory findings with patient outcomes. For example, increased WBC count and creatinine level were identified as important prognostic markers associated with mortality. In addition, comorbidities such as diabetes and hypertension were strongly associated with increased mortality rates. These findings emphasize the importance of comprehensive patient assessment and appropriate treatment strategies to optimize outcomes in this vulnerable population.

Despite the lack of long-term follow-up data, this study provides valuable insights into the acute effects of COVID-19 on hemodialysis patients. Future research should include long-term follow-up to assess ongoing outcomes and potential complications. Additionally, larger, multicenter studies are needed to validate these findings and explore further factors influencing outcomes in this vulnerable population. Enhanced preventive measures, early interventions, and regular monitoring using CT scans and laboratory markers are crucial for managing hemodialysis patients with COVID-19.

Conclusion

In summary, this study highlights the clinical outcomes of hemodialysis patients with COVID-19. While most patients were discharged, a notable mortality rate underscores the severity of the disease. Common symptoms and significant radiological findings emphasize the acute presentation of COVID-19 in this population. Laboratory markers, especially elevated WBC counts and creatinine levels, serve as important prognostic indicators. Management of comorbid conditions like diabetes and hypertension is crucial, and the study underscores the need for vigilant monitoring and potentially more aggressive treatment strategies. Further research is warranted to validate these findings and explore additional factors affecting outcomes in hemodialysis patients with COVID-19.

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Ethical statement

Ethical approval was obtained from the Golestan University research committee, under approval number IR.GOUMS.REC.1399.377. Written informed consent was obtained from all patients or their legal guardians before their inclusion in the study. All patient data were anonymized to ensure privacy and confidentiality.

Conflicts of interest

The authors have no financial or proprietary interests in any material discussed in this article.

Author contributions

The role of each participant is as follows: S. A and M. M conceived this study and were the supervisors. S. J, and A. R. collected and analyzed the data. Also, Z. M and A. R. drafted the manuscript. All authors read and approved the final version of the manuscript.

References

1. Husain SA, Dube G, Morris H, Fernandez H, Chang JH, Kathryn Paget K, et al. Early Outcomes of Outpatient Management of Kidney Transplant Recipients with Coronavirus Disease 2019. Clin J Am Soc Nephrol. 2020:15(8):1174-8. [View at Publisher] [DOI] [PMID] [Google Scholar]
2. Aziz F, Mandelbrot D, Singh T, Parajuli S, Garg N, Mohamed M, et al. Early Report on Published Outcomes in Kidney Transplant Recipients Compared to Nontransplant Patients Infected With Coronavirus Disease 2019. Transplant Proc. 2020;52(9):2659-62. [View at Publisher] [DOI] [PMID] [Google Scholar]
3. Ajaimy M, Melamed ML. COVID-19 in Patients with Kidney Disease. Clin J Am Soc Nephrol. 2020;15(8):1087-9. [View at Publisher] [DOI] [PMID] [Google Scholar]
4. Chen N, Zhou M, Dong X, Qu J, Gong F, Han Y, et al. Epidemiological and clinical characteristics of 99 cases of 2019 novel coronavirus pneumonia in Wuhan, China: a descriptive study. Lancet. 2020;395(10223):507-13. [View at Publisher] [DOI] [PMID] [Google Scholar]
5. Lu R, Zhao X, Li J, Niu P, Yang B, Wu H, et al. Genomic characterisation and epidemiology of 2019 novel coronavirus: implications for virus origins and receptor binding. Lancet. 2020;395(10224):565-74. [View at Publisher] [DOI] [PMID] [Google Scholar]
6. Basile C, Combe C, Pizzarelli F, Covic A, Davenport A, Kanbay M, et al. Recommendations for the prevention, mitigation and containment of the emerging SARS-CoV-2 (COVID-19) pandemic in haemodialysis centres. Nephrol Dial Transplant. 2020;35(5):737-41. [View at Publisher] [DOI] [PMID] [Google Scholar]
7. Cheng Y, Luo R, Wang K, Zhang M, Wang Z, Dong L, et al. Kidney disease is associated with in-hospital death of patients with COVID-19. Kidney Int. 2020;97(5):829-38. [View at Publisher] [DOI] [PMID] [Google Scholar]
8. Yang X, Yu Y, Xu J, Shu H, Xia J, Liu H, et al. Clinical course and outcomes of critically ill patients with SARS-CoV-2 pneumonia in Wuhan, China: a single-centered, retrospective, observational study. Lancet Respir Med. 2020;8(5):475-81. [View at Publisher] [DOI] [PMID] [Google Scholar]
9. Pan XW, Xu D, Zhang H, Zhou W, Wang LH, Cui XG. Identification of a potential mechanism of acute kidney injury during the COVID-19 outbreak: a study based on single-cell transcriptome analysis. Intensive Care Med. 2020;46(6):1114-6. [View at Publisher] [DOI] [PMID] [Google Scholar]
10. Kooman JP, Sande FM van der. COVID-19 in ESRD and Acute Kidney Injury. Blood Purif. 2021;50(4-5):610-20. [View at Publisher] [DOI] [PMID] [Google Scholar]
11. Mohamed MMB, Lukitsch I, Torres-Ortiz AE, Walker JB, Varghese V, Hernandez-Arroyo CF, et al. Acute Kidney Injury Associated with Coronavirus Disease 2019 in Urban New Orleans. Kidney360. 2020;1(7):614-22. [View at Publisher] [DOI] [PMID] [Google Scholar]
12. Sharma S, Aggarwal A, Sharma RK, Patras E, Singhal A. Correlation of chest CT severity score with clinical parameters in COVID-19 pulmonary disease in a tertiary care hospital in Delhi during the pandemic period. Egypt J Radiol Nucl Med. 2022;53(1):166. [View at Publisher] [DOI] [Google Scholar]
13. Ajaimy M, Melamed ML. COVID-19 in Patients with Kidney Disease. Clin J Am Soc Nephrol. 2020;15(8):1087-9. [View at Publisher] [DOI] [PMID] [Google Scholar]
14. Wu J, Li J, Zhu G, Zhang Y, Bi Z, Yu Y, et al. Clinical features of maintenance hemodialysis patients with 2019 novel coronavirus-infected pneumonia in Wuhan, China. Clin J Am Soc Nephrol. 2020;15(8):1139-45. [View at Publisher] [DOI] [PMID] [Google Scholar]
15. Grasselli G, Z A, Zanella A, Antonelli M, Cabrini L, Castelli A, et al. Baseline characteristics and outcomes of 1591 patients infected with SARS-CoV-2 admitted to ICUs of the Lombardy Region, Italy. JAMA. 2020;323(16):1574-81. [View at Publisher] [DOI] [PMID] [Google Scholar]
16. Madjid M, Safavi-Naeini P, Solomon SD, Vardeny O. Potential effects of coronaviruses on the cardiovascular system: a review. JAMA Cardiol. 2020;5(7):831-40. [View at Publisher] [DOI] [PMID] [Google Scholar]
17. Xiong F, Tang H, Liu L, Tu C, Tian JB, Lei CT, et al. Clinical Characteristics of and Medical Interventions for COVID-19 in Hemodialysis Patients in Wuhan, China. J Am Soc Nephrol. 2020;31(7):1387-97. [View at Publisher] [DOI] [PMID] [Google Scholar]
18. Valeri AM, Robbins-Juarez SY, Stevens JS, Ahn W, Rao MK, Radhakrishnan J, et al. Presentation and Outcomes of Patients with ESKD and COVID-19. J Am Soc Nephrol. 2020;31(7):1409-15. [View at Publisher] [DOI] [PMID] [Google Scholar]
19. Kroll MK, Schloer S, Candan P, Korthals N, Wenzel C, Ihle H, et al. Importance of ACE2 for SARS-CoV-2 Infection of Kidney Cells. Biomolecules. 2023;13(3):472. [View at Publisher] [DOI] [PMID] [Google Scholar]
20. Bwire GM. Coronavirus: Why Men are More Vulnerable to Covid-19 than Women? SN Compr Clin Med. 2020;2(7):874-6. [View at Publisher] [DOI] [PMID] [Google Scholar]
21. Chai X, Hu L, Zhang Y, Han W, Lu Z, Ke A, et al. Specific ACE2 Expression in Cholangiocytes May Cause Liver Damage After 2019-nCoV Infection. bioRxiv. 2020. [View at Publisher] [DOI] [Google Scholar]
22. Fisher M, Yunes M, Mokrzycki MH, Golestaneh L, Alahiri E, Coco M. Chronic hemodialysis patients hospitalized with COVID-19-short-term outcomes in Bronx, New York. Kidney360. 2020;1(8):755-62. [View at Publisher] [DOI] [PMID] [Google Scholar]
23. Du X, Li H, Dong L, Li X, Tian M, Dong J. Clinical features of hemodialysis patients with COVID-19: a single-center retrospective study on 32 patients. Clin Exp Nephrol. 2020;24(9):829-35. [View at Publisher] [DOI] [PMID] [Google Scholar]
24. Adwan L, Al-Sadi T, Shawakha S, Al-Shami NA. Clinical outcomes of COVID-19 in hemodialysis patients. Front Med (Lausanne). 2023;10:1281594. [View at Publisher] [DOI] [PMID] [Google Scholar]
25. Goicoechea M, Cámara LAS, Macías N, Morales AM, Rojas ÁG, Bascuñana A, et al. COVID-19: clinical course and outcomes of 36 hemodialysis patients in Spain. Kidney Int. 2020;98(1):27-34. [View at Publisher] [DOI] [PMID] [Google Scholar]
26. Ma Y, Diao B, Lv X, Liang W, Zhu J, Liu L, et al. COVID-19 in hemodialysis (HD) patients: Report from one HD center in Wuhan, China. medRxiv. 2020. [View at Publisher] [DOI] [Google Scholar]

27. Zhou F, YT, Du R, Fan G, Liu Y, Liu Z, et al. Clinical course and risk factors for mortality of adult inpatients with COVID-19 in Wuhan, China: a retrospective cohort study. Lancet. 2020;395(10229):1054-62. [View at Publisher] [DOI] [PMID] [Google Scholar]
28. Keller N, Chantrel F, Krummel T, Bazin-Kara D, Faller AL, Muller C, et al. Impact of first-wave COronaVIrus disease 2019 infection in patients on haemoDIALysis in Alsace: the observational COVIDIAL study. Nephrol Dial Transplant. 2020;35(8):1338-411. [View at Publisher] [DOI] [PMID] [Google Scholar]
29. Ma Y, Diao B, Lv X, Zhu J, Chen C, Liu L, et al. Epidemiological, clinical, and immunological features of a cluster of COVID-19-contracted hemodialysis patients. Kidney Int Rep. 2020;5(8):1333-41. [View at Publisher] [DOI] [PMID] [Google Scholar]

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