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Clinical Courses and Outcomes of COVID-19 in Patients Undergoing Chronic Hemodialysis and Peritoneal Dialysis in Northeast Thailand

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Abstract

Background: End-stage renal disease (ESRD) is one of the risk factors for infection, morbidity, and mortality in SARS-CoV-2. This study was aimed to evaluate the prevalence, clinical courses, and outcomes of patients undergoing chronic hemodialysis (HD) and peritoneal dialysis (PD). **Materials and Methods**: This was a retrospective study of ESRD patients admitted to Sakon Nakhon Hospital between October 2020 and September 2022. Data were analyzed for the incidence, demographic characteristics, clinical outcomes, laboratory tests, and mortality rates of the HD and PD patients who tested positive for COVID-19. **Results:** There were 73 ESRD patients (mean age 58.7 years, male 50.7%), who were positive for COVID-19 infection, of which 76.7% were on HD and 23.3% in the PD program. Hypertension (89.0%) and diabetes (54.8%) were more frequent comorbid conditions. Compared to the route of transmission, the HD group was more from hospital transmission ($P = 0.03$), while home transmission was more common in the PD group ($P = 0.003$). Serum potassium ($P = 0.008$) and albumin ($P = 0.0005$) were more in HD than PD, but bicarbonate ($P = 0.01$) was less. There was no significant in severity ($P = 0.88$) and mortality ($P = 0.55$) between both groups. Seven (9.6%) patients died. Risk factors compared between survivor and non-survivor groups significantly were serum albumin <3.5 g/dL ($P = 0.008$) and vaccination <2 shots ($P = 0.04$). Risk factor associated mortality in COVID-19 patients ongoing dialysis was low serum albumin <3.5 g/dL ([OR] 11.22, 95%, [CI] 1.27–98.91, $P = 0.029$). **Conclusion**: ESRD patients undergoing HD or PD were susceptible to COVID-19 infection. A comparison between the standard deviation and PD was found, but there was no significant difference in the clinical course and outcome of treatment in both groups.

Keywords: Coronavirus 2019, Dialysis, End-stage renal disease

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Introduction

On the health-care system and the global economy, the coronavirus 2019 (COVID-19) outbreak had a significant impact. The body of evidence is mounting that COVID-19 is especially dangerous for patients receiving peritoneal and chronic dialysis,[1,2] with many studies indicating death rates above 20%.[3-5] Despite the fact that infection rates among dialysis patients frequently follow regional patterns, COVID-19 is more common in these patients than in the general population, most likely as a result of increased testing, symptom screening, the requirement for medical care, sharing of public transportation, or familial contact at home.[6,7] Patients having in-center hemodialysis (HD) are significantly at risk for COVID-19 problems. Frequent visits to the dialysis facility and combining patients with advanced age and comorbidities create an environment where COVID-19 transmission and the resulting morbidity and mortality are highly likely.[8,9] Compared to HD, peritoneal dialysis (PD) can be carried out at home, and patients can avoid complications by having a family visit the PD facility or having dialysate mailed to their homes, which may lower the chance of COVID-19 infection.[10,11] Home dialysis may likely shield patients from COVID-19-related morbidity and mortality because the risk of COVID-19 is lower with it than with in-center dialysis.[12]

Because there are not enough research comparing the clinical results and COVID-19 prevalence between patients with PD and those who have in-center HD. The purpose of this study is to identify the differences between the two groups.

Materials and Methods

This study is retrospective and descriptive. Between October 2020 and September 2022, we located the medical records of COVID-19 patients receiving HD (in-hospital) and PD in a dialysis unit at Sakon Nakhon Hospital in northeast Thailand. SARS-CoV-2 reverse-transcription polymerase chain reaction testing using nasopharyngeal swab samples was used to establish the presence of COVID-19 in all cases. All patients who reported illness symptoms or close encounters with COVID-19 underwent testing. The incidence, demographics, clinical results, laboratory tests, severity, mortality rate, and associated risk factors of HD and PD patients who tested positive for COVID-19 were examined in the data.

Statistical Analysis

Quantitative variables are presented as means ± standard deviation, while categorical variables are presented as frequencies (percentage). For between-group comparison, the χ^2 test and Fisher

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exact test were used for categorical variables, and the Student's t-test (data with a normal distribution) or the Mann– Whitney test (data with a non-normal distribution) was used for continuous variables. In an exploratory analysis, univariable predictors of death were examined using logistic regression. Data analyses were performed using SPSS Version 19. $P < 0.05$ values are considered statistically significant.

Results

During the 24-month epidemic, 73 dialysis patients had a COVID-19 diagnosis, of which 56 (76.7%) were on HD and 17 (23.3%) were on PD. According to Table 1, the sample's overall mean age was 58.712.8 years, and 50.7% of the participants were men. The average time spent on dialysis was 3.2-2.7 years. Diabetes 40 (54.8%) and hypertension 65 (89.0%) were the comorbidities that were most commonly present. Epidemiological analysis revealed that 46.6% of patients had contact during in the hospital, 27.4% at home, and 13.7% during public transport; however, 10.9% were unaware of any close contact. In the comparison between the HD and PD groups, HD patients were more likely to contact the hospital (41.1% vs. 5.5%; $P = 0.03$), but PD patients were more likely to transmit at home (5.5% vs. 8.2%; $P = 0.003$). There were 46 cases of vaccination, with the majority of patients receiving 2 injections (63.0%). The most common symptoms were coughing (56.2%), fever (45.2%), and dyspnea (41.1%). Serum potassium was higher in the HD group than the PD group (4.3 ± 0.8 vs. 3.6 ± 0.9 mEq/l; $P = 0.008$) and albumin was higher in the HD group than the PD group (3.6 ± 0.4 vs. 2.9 ± 0.7 g/dL; $P = 0.0005$), but serum bicarbonate was less substantially different (20.8 ± 4.3 vs. 23.6 ± 4.4 mEq/l; $P = 0.01$). [Table 2] 16.4% of patients had severe hypotension, 58.9% were receiving oxygen therapy, and 31.3% were on a mechanical ventilator. The mean hospital stay for patients was 10.7 ± 6.7 days, with a 31.3% admission rate to the intensive care unit (ICU). There was no discernible difference between the HD and PD groups regarding the mortality rate (8.2% vs. 1.4%; $P = 0.55$), which was 9.6%. [Table 3] For comparison between non-survivors and survivors, related risk factors were examined. Two risk factors were identified as having a considerable negative impact on non-survivors more than on survivors. They were <2 injections of vaccination and serum albumin <3.5 g/dL ($P = 0.008$ and $P = 0.04$, respectively). [Table 4] The evaluation of parameters related to COVID-19-related deaths was done by an exploratory logistic regression analysis. [Table 5] Low serum albumin was only significantly associated with the relative risk of COVID-19-related death ([OR] 11.22, 95%, [CI] 1.27–98.91, $P = 0.029$) [Table 5].

Table 1: Demographic characteristic of patients

Characteristics	*Total (n=73)*	*HD (n=56)*	*PD (n=17)*	*P-value*
Age (years)	58.7±12.8	59.6±12.9	55.5±11.9	0.13
<60 years	38 (52.1)	28 (38.3)	10 (13.8)	0.52
≥60 years	35 (47.9)	28 (38.3)	7 (9.6)	0.52
Gender				
Male	37 (50.7)	31 (42.5)	6 (8.2)	0.15
Female	36 (49.3)	25 (34.2)	11 (15.1)	0.15
Dialysis duration (years)	3.2±2.7	2.9±2.6	4.1±2.8	0.26
Comorbidity				
Cardiovascular disease	13 (17.8)	11 (15.1)	2 (2.7)	0.46
Hypertension	65 (89.0)	51 (69.9)	14 (19.1)	0.31
Diabetes mellitus	40 (54.8)	28 (38.4)	12 (16.4)	0.14
Cerebrovascular disease	5 (6.8)	5 (100)	0 (0)	0.20
Transmission				
Public	20 (27.4)	13 (17.8)	7 (9.6)	0.15
At home	10 (13.8)	4 (5.5)	6 (8.2)	0.003*
Hospital	34 (46.6)	30 (41.1)	4 (5.5)	0.03*
Unknown	8 (10.9)	8 (10.9)	0 (0)	0.10
Vaccination (shots)				
None	16 (21.9)	14 (19.1)	2 (2.7)	0.25
1	2 (2.7)	0 (0)	2 (2.7)	0.009*
2	46 (63.0)	35 (47.9)	11 (15.1)	0.87
3	9 (12.3)	8 (10.9)	1 (1.4)	0.36

*P<0.05 is considered statistically significant. HD: Hemodialysis, PD: Peritoneal dialysis

Discussion

The incidence of COVID-19 in our investigation was lower in the PD group than in the HD group, as was to be expected and in agreement with earlier studies.[13,14] The HD group was unable to follow the advice to stay in isolation; hence, 17.8% and 41.1% reported coming into contact with COVID-19 in the dialysis center and on public transit, respectively. The COVID-19 infection transmitted from the hospital was more substantial in HD than PD. It was presumably brought on by more people sharing public transportation and a crowded hospital dialysis unit. While family members and caregivers were the primary sources of transmission for PD patients. Therefore, PD patients had higher in-home transmission than HD patients. One key issue that had been promoted by the government was the importance of vaccination in preventing infection, but many individuals did not want to get the injection due to concerns about the vaccine's quality and potential adverse effects. Then, it became clear that 21.9% of people choose not to get vaccinated and just receive one or two shots, which was insufficient to lessen the spread and severity of this illness.[15,16]

We discovered that the majority of patients (90.4%) showed at least one symptom. Whereas only a minor portion (9.6%) showed no symptoms, this resulted in a number of tests for the detection of COVID-19 infection. There was a significant difference in the mean of albumin and potassium in serum when laboratory results from HD and PD patients were compared. However, it could frequently be identified when compared even in patients who were not infected. PD increased the likelihood of protein and potassium loss during dialysis more than HD. Moreover, half of the patients required oxygen therapy as part of their course of treatment, it was discovered. This was brought on by dyspnea and hypoxia symptoms, particularly in older individuals with comorbid conditions. A ventilator was required for about 13–16% of patients because their symptoms, such as hypotension and abrupt respiratory failure, were so severe. The majority of them underwent additional care in the ICU, where there was a significant risk of death. In contrast to prior research (16.2–62%), we discovered that the death rate following treatment was 9.6%.[17,18] In addition, there was no discernible difference between HD and PD in terms of treatment variables such as oxygen therapy, the use of mechanical ventilation, hospitalization, ICU admission, and mortality rate. It found no significant changes in the rates of morbidity and mortality between the HD and PD groups with COVID-19, similar to one study.[19] Contrary to some previous studies, this one discovered that PD had a greater mortality rate.[20,21]

We evaluated the literature to identify risk variables that predict death.[22,23] Then, the effects of the aforementioned variables

Table 2: Symptoms and laboratory findings of patients

Characteristics	*Total (n=73)*	*HD (n=56)*	*PD (n=17)*	*P-value*
Symptoms (n [%])				
Fever	33 (45.2)	23 (31.5)	10 (13.8)	0.19
Cough	41 (56.2)	31 (42.5)	10 (13.8)	0.80
Dyspnea	30 (41.1)	24 (32.9)	6 (8.2)	0.58
Myalgia	5 (6.8)	4 (5.5)	1 (1.4)	0.86
No symptom	7 (9.6)	6 (8.2)	1 (1.4)	0.55
Hypotension	12 (16.4)	9 (12.3)	3 (4.1)	0.88
Laboratory findings				
Hemoglobin (g/dL)	8.7±2.0	8.7±1.9	8.9±2.2	0.31
Leukocytes (/mm^3)	7,248±3,031.8	7,027±2,755.8	7,977.1±3,709.6	0.40
Lymphocytes (/mm^3)	18.9±11.2	19.0±11.6	18.8±9.8	0.42
Neutrophils (/mm^3)	69.5±14.5	69.3±14.8	70.1±13.5	0.44
C-reactive protein (mg/dL)	36.6±49.7	27.4±34.7	49.4±70.5	0.23
Albumin (g/dL)	3.4±0.6	3.6±0.4	2.9±0.7	0.0005*
Serum Na^+ (mEq/l)	135.1±5.7	135.6±5.6	133.3±5.5	0.37
Serum K^+ (mEq/l)	4.2±0.9	4.3±0.8	3.6±0.9	0.008*
Serum HCO_3 (mmol/l)	21.5±4.5	20.8±4.3	23.6±4.4	0.01*

*P<0.05 is considered statistically significant. HD: Hemodialysis, PD: Peritoneal dialysis

Table 3: Treatment and outcome of patients

Characteristics	*Total (n=73)*	*HD (n=56)*	*PD (n=17)*	*P-value*
Oxygen therapy	43 (58.9)	32 (43.8)	11 (15.1)	0.58
Mechanical ventilation	10 (13.7)	8 (10.9)	2 (2.7)	0.79
Hospitalization (days)	10.7±6.7	11.2±7.0	9.3±5.2	0.17
ICU admission (n [%])	10 (13.7)	8 (10.9)	2 (2.7)	0.79
Death (n [%])	7 (9.6)	6 (8.2)	1 (1.4)	0.55

*P<0.05 is considered statistically significant. HD: Hemodialysis, PD: Peritoneal dialysis, ICU: Intensive care unit

Table 4: Characteristics stratified by survivors and non-survivors

Characteristics	*Total (n=73)*	*Survivor (n=66)*	*Non-survivor (n=7)*	*P-value*
Age≥60 years	35 (47.9)	30 (41.1)	5 (6.8)	0.23
Male gender	37 (50.7)	34 (46.6)	3 (4.1)	1.00
Vaccination <2 shots	18 (24.6)	14 (19.1)	4 (5.5)	0.04*
Hemoglobin <7 g/dL	18 (24.6)	16 (21.9)	2 (2.7)	0.80
Albumin <3.5 g/dL	29 (39.7)	23 (31.5)	6 (8.2)	0.008*
Diabetes	40 (54.8)	35 (47.9)	5 (6.8)	0.43
Hypertension	65 (89.0)	60 (82.2)	5 (6.8)	0.12
Cardiovascular disease	13 (17.8)	11 (15.1)	2 (2.7)	0.32
Hemodialysis	56 (76.7)	51 (69.9)	5 (6.8)	0.73
Peritoneal dialysis	17 (23.3)	15 (20.5)	2 (2.7)	0.73

*P<0.05 is considered statistically significant

Table 5: Risk factors associated with mortality

Risk factor	*Odds ratio*	*95% confidence interval*	*P-value*
Age ≥60 years	3.00	0.54–16.59	0.208
Male gender	0.71	0.15–3.40	0.664
Vaccination <2 shots	2.55	0.51–12.68	0.25
Hemoglobin <7 g/dL	1.25	0.22–7.08	0.80
Albumin <3.5 g/dL	11.22	1.27–98.91	0.029*
Hypertension	0.25	0.04–1.58	0.140
Diabetes	2.21	0.40–12.24	0.362
Cardiovascular disease	2.00	0.34–11.66	0.441
Hemodialysis	0.74	0.13–4.18	0.735
Peritoneal dialysis	1.36	0.24–7.73	0.729

*P<0.05 is considered statistically significant

on survivors and non-survivors were compared. Only two risk factors – inadequate immunization and low serum albumin – were shown to be significantly associated with mortality. In contrast to earlier research, this one mentioned elderly age and male gender as risk factors.[24] Furthermore, using logistic regression analysis, we discovered important risk factors linked to death. Only one contributing factor to COVID-19-related deaths in dialysis patients was low serum albumin levels.

The relatively small sample size, observational design, low testing rates for COVID-19 in PD patients, and potential undertesting of asymptomatic patients are all limitations of this study.

Conclusion

During the pandemic, patients with HD and PD experienced significantly increased incidence, morbidity, and fatality rates from COVID-19. However, the clinical outcomes and courses for both the PD and HD groups were equally poor.

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