

The Effects of SARS-CoV-2 Infection on Renal Function in Patients with Hemodialysis

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ABSTRACT

Objective: This study aims to demonstrate the impact of "SARS-CoV-2" infection on renal function in patients who have undergone hemodialysis in the past.

Methodology: Telomerase Reverse Polymerase Chain Reaction in Real Time (RT-Real time PCR) To verify "SARS CoV-2" infection, RT-PCR was used, moreover pre and post urea and creatinine tests were confirmed by COBAS INTEGRA ® 400 plus analyzer was automated qualitative assays rapidly detected Creatinine, urea, and diabetes Mellitus levels.

Results: The mean of pre-creatinine levels was 7.3336. The post-creatinine levels (11.8276) significantly increased after "SARS-CoV-2" infection with a P-value of 0.001. The mean of pre-urea levels was 163.6724. The post-urea levels (213.706897) significantly increased after "SARS-CoV-2" infection with a P-value of 0.001.

Conclusion: SARS-CoV-2 infection in patients with pre-existing hemodialysis leads to increasing kidney dysfunction with or without comorbidities (diabetes mellitus and hypertension). Moreover, the old patients with pre-existing hemodialysis are found to be at higher risk of renal dysfunction during "SARS-CoV-2" infection than the younger groups.

Keywords: SARS-CoV-2, Hemodialysis, Urea, Creatinine, Renal dysfunction

INTRODUCTION

A new challenge to healthcare systems has been posed by a new strain of coronavirus called "SARS-CoV-2" which was detected for the first time in China and Eastern Countries and spread to Europe and the United States, causing a major global pandemic¹⁻⁴. Epithelial cells of several organs, such as the lung, intestine, blood vessels, and kidney, express angiotensin-converting enzyme 2 (ACE2), is used by SARS-CoV-2 to attach to its target cells and begin attacking them⁵⁻⁷. The intensity, symptoms, and organ involvement of the clinical presentation vary greatly, ranging from asymptomatic to multi-organ failure. One of the key organs affected, which indicates a connection to COVID-19, is the kidney. Acute kidney damage (AKI) among hospital inpatients, specifically in those who require management in the intensive care unit (ICU)⁸⁻¹⁰.

Combinable diseases are very easy to transmit to patients with hemodialysis (HD) and peritoneal dialysis (PD). Patients receiving HD receive their treatment at the dialysis unit multiple times per week, where they also interact with the medical staff and other patients. Additionally, individuals on dialysis frequently have a significant load of co-morbidities among others, "a high prevalence of diabetes and cardiovascular disease" and they have become immunocompromised in the last phase of a renal disease¹¹⁻¹³. The prevalence of COVID-19 and consequently the death rate is high in dialysis patients mainly

because they suffer from malnutrition, older age, cardiovascular disease, diabetes, lung disease, and immunosuppression as well as the hardship that they go through for dialysis treatment^{14,15}. According to data, "SARS-CoV2" infection can result in acute renal injury (AKI). Serum creatinine (SCr) elevation, various degrees of proteinuria and hematuria in addition to renal fibrosis, are some of the hallmarks of renal dysfunction that have been clarified by a number of clinical results. Clinical phenotypes' findings often disagree with one another¹⁶⁻¹⁹. However, the "SARS-CoV-2"-induced clinical indications of renal dysfunction are hardly ever known. Furthermore, the clinical relevance of renal impairment brought on by SARS-CoV-2 and its stage of recovery are still unknown²⁰⁻²².

Patients in this study underwent renal hemodialysis, and "SARS-CoV-2" infection was detected using RT PCR. Pre-creatinine and pre-urea testing were performed on the patients to evaluate their renal function, and post-infection test was conducted to examine the impact of the SARS-CoV-2 infection on kidney function. Examination of the creatinine and urea levels was done while age, hypertension, and diabetes were taken into account^{23,24}.

METHODOLOGY

Study Design and Participants: This study has targeted 58 patients

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who had the hemodialysis and were also diagnosed with "SARS-CoV-2" infection through RT-PCR assay, and they periodically visited the Hemodialysis center in Imam Hussein Medical City of Holy Karbala Province in the period between 1st April and 1st May 2021. The patients were further classified into three groups: Hypertension, Diabetes mellitus, and normal. The pre and post (before and after SARS-CoV-2 infection) creatinine and urea levels were taken for each patient involved in this study. The data was collected through extracted demographic information (age and gender) and laboratory tests from electronic medical records during the hospital stay.

Creatinine, and Urea Test Assay: The tests were done according to the manufacturer's instruction in COBAS INTEGRA® 400 plus analyzer was automated qualitative assays rapidly detected Creatinine, urea, and diabetes Mellitus levels.

Statistical Analysis: The data preparation and calculations were done by Microsoft Excel 2016. SPSS software, version 26 was used for performing the statistical analysis. The demographic data Given the patients' clinical features were processed using descriptive statistic tests. The statistical analysis of urea and creatinine was performed using T independent samples test and Pearson Correlation. The significance of the statistical value was determined to be $P < 0.05$.

RESULTS

Pre-creatinine levels had an average of 7.3336 and a standard deviation of 7.3336, whereas post-creatinine levels had an average of 11.8276 and a standard deviation of 3.19296. As demonstrated in Table 2, the post-creatinine levels dramatically rose following "SARS-CoV-2" infection with a P- value of 0.001. In comparison to the mean post-urea levels, which were 213.706897 with a standard deviation of 53.687206,

Table 1: Patient demographics and clinical details of those with SARS-CoV-2 infection who have renal failure

Characteristics	Frequency and percentage	
Gender	Male	33(55.9%)
	Female	25 (42.4%)
Age		48.91 ± 9.5
PCR test	Positive	58 (100%)
	Negative	0 (0.0%)
Diabetes Mellitus DM	Diabetic Patients	14(23.7%)
	Non-diabetic patients	44(74.3%)
Hypertension	Yes	18(30.5%)
	No	40(67.8%)

Table 2: Patients with kidney failure and SARS-CoV-2 infection underwent pre- and post-renal function tests

	Pre_test		Post_test		t	P_value
	Mean	Std. Deviation	Mean	Std. Deviation		
Creatinine test	7.3336	7.3336	11.827	3.19296	-18.068115	0.001
urea test	163.6724	48.268	213.706	53.687206	-12.887708	0.001

T-test (independent t-test or pair t-test) Std: standard deviation

Table 3: The correlations between age and creatinine & urea level after SARS-CoV-2 infection in patients with kidney failure

Independent variable	Statistics	post creatinine test	post urea test
AGE	Pearson_ Correlation	0.540**	0.406**
	Sig_ (2-tailed)	0.001	0.002

** . Correlation is significant at the 0.01 level (p-value).

Table 4: Diabetes Mellitus and hypertension in relation to creatinine and urea levels

Group Statistics	Independent Samples T-Test					
Kidney function tests	Diabetic (DM)	Mean	Std. Deviation	t	df	P-value
post creatinine test	DM	12.400	2.2576			
	Non-DM	11.645	3.4399	0.767	56	0.446
post urea test	DM	224.357	57.9026	0.850	56	0.399
	Normal DM	210.318	52.5210	0.808	20.277	0.429
Kidney function tests	Hypertension (HTN)	Mean	Std. Deviation	t	df	P-value
	HTN	11.611	2.8061	-0.344	56	0.732
post creatinine test	Non- HTN	11.925	3.3818	-0.369	39.188	0.714
	HTN	221.278	61.6802	0.717	56	0.476
post urea test	Non-HTN	210.300	50.1588	0.663	27.560	0.513

the mean pre-urea levels were 163.6724 with a standard deviation of 48.268397. As indicated in Table 2, the post-urea levels dramatically rose following "SARS-CoV-2" infection with a P-value of 0.001.

The correlation between creatinine level after SARS-CoV-2 infection in patients with hemodialysis and age has shown that post creatinine level significantly increases with age with a P-Value of $0.00 < 0.05$ as shown in Table 3. Moreover, the correlation between urea level after "SARS-CoV-2" infection and age indicate that post-urea level has significantly increased with age with a P-Value of $0.02 < 0.05$ as shown in Table 3.

As shown in Table 4, of 58 patients, 14 had Diabetes Mellitus DM and there was no significant evidence for the presence of a relationship between DM and creatinine and urea level after "SARs-CoV-2" infection with a P-Value of $0.44 > 0.05$ and $0.42 > 0.05$ respectively. Furthermore, 18 patients had hypertension and there was no significant evidence for the presence of a relationship between hypertension and creatinine and urea level after "SARs-CoV-2" infection with a P-Value of $0.73 > 0.05$ and $0.47 > 0.05$ respectively.

DISCUSSION

This study reported that post creatinine level and post urea level in patients with hemodialysis significantly increased with P-Values of $0.001 < 0.05$ after SARS-CoV-2 infection. This is similar to the procedure of another study where blood urea nitrogen and plasma creatinine were evaluated after SARS-CoV-2 infection⁸. Angiotensin-converting enzyme 2 is present in human kidney cells, making them a special target for SARS-CoV-2 infection, according to recent clinical observations (ACE2) COV-2 SARS receptor²³⁻²⁵. Numerous studies have revealed that people with chronic kidney disease (CKD) are more likely to have acute kidney injury (AKI) when exposed to SARS-CoV-2 than people without CKD. This can be influenced by a number of variables, such as the possibility of volume depletion due to decreased hydration intake and increased gastrointestinal fluid loss as a result of diarrhea, as well as the use of NSAIDs for headaches and myalgias. According to a recent large prospective study, having kidney illness at the time of admission was linked to an increased risk of developing AKI and a higher fatality rate while being treated in a hospital for SARS-CoV-2 infection^{26,27}.

In this study, there was significant evidence suggesting the presence of a positive relationship between aging and increase in the urea and creatinine levels after "SARs CoV-2" infection, and this may be due to physiological and functional changes in kidney with aging. According to data from another study, aging can lead to decreased renal reserve, altered tubular management of creatinine, decreased sodium reabsorption, and vascular dysautonomia^{28,29}.

In this study there was no significant evidence suggesting the presence of a relationship between the increase of the creatinine and urea level with diabetic daises in hemodialysis patients infected with "SARS-CoV-2". Furthermore, there was no significant relationship between the increase of the creatinine and urea level with hypertension in hemodialysis patients infected with "SARS-CoV-2" have hypertension. This may be indicating that "SARS-CoV-2" infection has an essential role in the increase of creatinine and urea levels in hemodialysis patients without the effect of comorbidities (diabetes mellitus and hypertension).

CONCLUSION

In conclusion, SARS-CoV-2 infection causes renal dysfunction to worsen in patients who are already receiving hemodialysis,

whether or not there are comorbidities (diabetes mellitus and hypertension). Moreover, the old patients with hemodialysis are at higher risk of renal dysfunction during "SARS-CoV-2" infection than younger groups.

RECOMMENDATION

Study the relationship between SARS-COV-2 infected on patient with hemodialysis and stroke.

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Competing Interest: None

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