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ORIGINAL ARTICLE

COVID-19

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Kidney Injury Incidence in COVID-19 Patients and Evaluation of Several Function Variables

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Abstract

Background: The clinical spectrum of SARS-CoV-2 infection includes conditions from asymptomatic and mild-moderate respiratory illnesses to catastrophic viral pneumonia with respiratory failure, septic shock, and multiple organ dysfunction. The aim of this study was to assess the prevalence of acute kidney injury (AKI) in COVID-19 patients treated at AL-Saddar Teaching Hospital (Najaf, Iraq).

Methods and Results: The study population consisted of 190 patients treated at AL-Saddar Teaching Hospital (Najaf, Iraq) between June 1 and August 20, 2022. Clinical signs, lung abnormalities, and a positive result from real-time PCR for nasopharyngeal swab samples have all been used to identify infection. Clinical and laboratory information on the patients was gathered for the investigation. A comparative analysis was conducted between patients with AKI (n=67) and without AKI (n=123). The patients without AKI frequently left the hospital in better health (80.9%), and they did not require dialysis, compared to 22.4% of those who had AKI. The percentage of patients in each group admitted to the intensive care unit (ICU) significantly differed with respect to KI: 46.3% with AKI and 15.4% without AKI (P<0.0001). Furthermore, patients with AKI had a higher rate of mortality (13.4%) than those without AKI (0.8%) (P=0.0002).

Conclusion: The results indicated that AKI is prevalent in hospitalized COVID-19 patients and is attributed to in-hospital death rates.**(International Journal of Biomedicine. 2023;13(4):296-300.)**

Keywords: COVID-19 • kidney injury • intensive care unit

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Abbreviations

AKI, acute kidney injury; **COVID-19**, coronavirus disease 2019; **CKD**, chronic kidney disease; **CRP**, C-reactive protein; **ICU**, intensive care unit; **SARS-CoV-2**, severe acute respiratory syndrome coronavirus-2.

Introduction

Globally, the coronavirus disease COVID-19 caused by SARS-CoV-2 represents a severe public health crisis. The clinical spectrum of SARS-CoV-2 infection includes conditions from asymptomatic and mild-moderate respiratory illnesses to catastrophic viral pneumonia with respiratory failure, septic shock, and multiple organ dysfunction.[1] The likelihood of a severe clinical presentation of COVID-19 is increased by advanced age, immunosuppressive medications, and underlying comorbidities such as cancer, diabetes, chronic kidney disease (CKD), cardiovascular diseases, diabetes, and chronic pulmonary illnesses.[2] The definite mechanism by which the virus enters host cells is the protein angiotensin-converting enzyme 2 (ACE2), which is abundantly present in the lungs.[3] It is important to note that acute kidney damage, proteinuria, and hematuria have all been independently associated with a higher risk of dying in COVID-19 individuals.[4,2] The steady decline in renal function in CKD alters the innate and adaptive immune systems. The loss of B lymphocytes, rapid T cell turnover, and a rise in CD4+ and

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CD8+ lymphocyte death are among these alterations, as well as a decrease in the number of dendritic cells that transmit antigens.[5] Infections account for a significant portion of mortality, particularly in patients with end-stage renal illness, and the weakened immune response is linked to increased incidence and more severe courses of infections. In addition to secondary immunodeficiency, immunological activation is seen in patients with chronic renal disease.[6] Atherosclerotic cardiovascular disease and other problems that impair the prognosis of patients with SARS-CoV-2 infection are brought on by the increased synthesis and poor clearance of pro-inflammatory cytokines, which cause systemic inflammation and oxidative stress.[7]

According to research from China, acute kidney injury (AKI) has been documented in 29% of COVID-19 patients who are severely sick or have passed away.[8] It is significant to highlight that AKI, proteinuria, and hematuria have all been independently linked to a greater risk of passing away in COVID-19 patients.[9] In addition, in a meta-analysis involving 1389 COVID-19 patients, individuals with a severe COVID-19 condition had a considerably higher frequency of underlying CKD (3.3% vs. 0.4%).[10]

The first laboratory-confirmed case of COVID-19 in Iraq was reported on February 21, 2020, and it was an Iranian citizen who entered the country before the decision to prevent travel services. Afterwards, the infection cases gradually declined. However, on June 20, 2022, and through the follow-up of the epidemiological monitoring teams of the Ministry of Health to the latest developments in the daily epidemiological situation of the coronavirus pandemic in Iraq, it was noted that there was a noticeable increase in the percentage of positive cases from total examinations, as well as an increase in the number of hospitalized cases, which means that Iraq had entered a new epidemic wave.

The aim of this study was to assess the prevalence of acute kidney injury (AKI) in COVID-19 patients treated at AL-Saddar Teaching Hospital (Najaf, Iraq)

Materials and Methods

The study population consisted of 190 patients treated at AL-Saddar Teaching Hospital (Najaf, Iraq) between June 1 and August 20, 2022.

Clinical signs, lung abnormalities, and a positive result from real-time PCR for nasopharyngeal swab samples have all been used to identify infection. Clinical and laboratory information on the patients was gathered for the investigation. The following information was gathered: age, gender, comorbidities, complete blood count, and readings for glucose, urea, creatinine, CRP, ferritin, and the CT results. A computerized chemistry analyzer and ready-to-use reagent kits were used for all biochemical assays, which were completed according to the instructions provided by the manufacturers (Mindray BS 2000M, China). Medical record system data was gathered to ensure patients' privacy, and an anonymous analysis was performed.

Statistical analysis was performed using the statistical software package SPSS version 21.0 (SPSS Inc, Armonk, NY: IBM Corp). Baseline characteristics were summarized as frequencies and percentages for categorical variables and as mean (Min-Max) for continuous variables. Group comparisons were performed using chi-square tests or, alternatively, Fisher's exact test (2-Tail) when expected cell counts were less than 5. A probability value of $P<0.05$ was considered statistically significant.

Results

Between June 1st and August 20th, 2022 (the new wave of the epidemic), 190 patients admitted to AL-Saddar Teaching Hospital/Najaf's central laboratory had a COVID-19 test performed or a test had been done previously. The clinical features of patients with COVID-19 are described in the tables below. A comparative analysis was conducted between patients with AKI (n=67) and without AKI (n=123). Table 1 showed that the patients without AKI frequently left the hospital in better health (80.9%), and they did not require dialysis, compared to 22.4% of those who had AKI. The percentage of patients in each group admitted to the intensive care unit (ICU) significantly differed with respect to AKI: 46.3% with AKI and 15.4% without AKI ($P<0.0001$). Furthermore, patients with AKI had a higher rate of mortality (13.4%) than those without AKI (0.8%) ($P=0.0002$) (Table 1).

Table 1.

Clinical features of COVID-19 patients with and without AKI.

Variables	COVID-19 patients without AKI (n=123)	COVID-19 patients with AKI (n=67)	*P*-value
	n (%)	n (%)	
Admission to the ICU	19 (15.4)	31 (46.3)	<0.0001
Dialysis	2 (1.6)	15 (22.4)	<0.0001
Recovery cases	102 (82.9)	12 (17.9)	<0.0001
Mortality	1 (0.8%)	9 (13.4)	0.0002

The manifestations of COVID-19 patients without AKI were fever (48.8%), cough (52.0%), sore throat (43.9%), labored breathing (9.8%), diarrhea (4.9%), fatigue (14.6%), and abdominal pain (3.2%). The manifestations of COVID-19 patients with different AKI rates depended on the KI intensity (Table 2). In this study, patients who developed KI had a significant relationship with hypertension (56.7%), diabetes (38.8%), chronic liver disease (23.9%), asthma (16.4%), and cancer (13.4%) (Table 3). We found the highest levels of inflammatory markers and kidney function tests in patients with AKI, including D-dimer (1944 vs. 501 mg/ml), C-reactive protein (890 vs. 358.5 mg/dl), serum creatinine (8 vs. 1.6 mg/dl), and blood urea (175.5 vs. 32.5 mg/dl), compared to patients without kidney injury (Table 4). Regarding the age groups and gender, we did not find noticeable differences by different AKI severity (Table 5)

Table 2.

Clinical symptoms considering the severity of AKI.

Symptoms	COVID-19 patients without AKI (n=123)	COVID-19 patients with AKI (n=67)		
	n (%)	Mild (n=25)	Moderate (n=22)	Severe (n=20)
		n (%)	n (%)	n (%)
Fever	60 (48.8)	18 (72.0)	18 (81.8)	13 (65.0)
		$\chi^2 = 1.534$; *P*=0.464		
Cough	64 (52.0)	21 (84.0)	19 (86.4)	18 (90.0)
		$\chi^2 = 0.345$; *P*=0.842		
Sore throat	54 (43.9)	16 (64.0)	11 (50.0)	15 (75.0)
		$\chi^2 = 2.829$; *P*=0.243		
Labored breathing	12 (9.8)	4 (16.0)	3 (13.6)	19 (95.0)
		$\chi^2 = 37.94$; *P*=0.000		
Diarrhea	6 (4.9)	1 (4.0)	1 (4.5)	4 (20.0)
		$\chi^2 = 4.17$; *P*=0.118		
Fatigue	18 (14.6)	5 (20.0)	4 (18.2)	8 (40.0)
		$\chi^2 = 3.242$; *P*=0.198		
Abdominal pain	4 (3.2)	1 (4.0)	1 (4.5)	2 (10.0)
		$\chi^2 = 0.831$; *P*=0.660		

Table 4.

Inflammatory markers in COVID-19 patients with and without AKI.

Laboratory parameters	COVID-19 patients without AKI (n=123) Mean (Min-Max)	COVID-19 patients with AKI (n=67) Mean (Min-Max)
CRP, mg/dL	358.5 (66–585)	890 (500–1280)
Blood urea, mg/dL	32.5 (18–47)	175.5 (68–215)
Serum creatinine, mg/dL	1.6 (0.9–2.2)	8 (1.8–14.1)
D-dimer, mg/mL	501 (224–778)	1944 (889–2999)
Hb, g/dL	13.2 (12.5–13.9)	11.7 (10.5–12.9)
WBCs, $\times 10^3/\mu$ L	7.2 (5.4–8.9)	10.5 (5.9–15.1)

Table 3.

The frequency of comorbidities in COVID-19 patients with and without AKI.

Comorbidities	COVID-19 patients without AKI (n=123)	COVID-19 patients with AKI (n=67)	*P*-value
	n (%)	n (%)	
Cardiac disease	28 (22.8)	19 (28.4)	0.3942
Diabetes	22 (17,9)	26 (38.8)	0.0016
Hypertension	30 (24.4)	38 (56.7)	<0.0001
Chronic liver disease	12 (9.8)	16 (23.9)	0.0090
Asthma	7 (5.7)	11 (16.4)	0.0164
Cancer	3 (2.4)	9 (13.4)	0.0029
No known chronic diseases	33 (26.8)	24 (35.8)	0.1969

Table 5.

The severity of AKI regarding the age and gender of COVID-19 patients

Age, years	COVID-19 patients with AKI (n=67)									
	Mild			Moderate			Severe			
	Female n (%)	Male n (%)	Total n (%)	Female n (%)	Male n (%)	Total n (%)	Female n (%)	Male n (%)	Total n (%)	*P*-value for "Total"
20-30	1 (6.25)	2 (22.2)	3 (12.0)	0	0	0	1 (9.1)	0	1 (5.0)	*P*=0.218
	P=0.530						*P*=1.0			
31-40	2 (12.5)	1 (11.1)	3 (12.0)	2 (16.7)	1 (10)	3 (13.6)	2 (18.2)	1 (11.1)	3 (15.0)	*P*=0.957
	P=1.0			*P*=1.0			*P*=1.0			
41-50	1 (6.25)	1 (11.1)	2 (8.0)	1 (8.3)	2 (20)	3 (13.6)	1 (9.1)	0	1 (5.0)	*P*=0.606
	P=1.0			*P*=0.571			*P*=1.0			
51-60	2 (12.5)	0	2 (8.0)	1 (8.3)	1 (10)	2 (9.1)	1 (9.1)	2 (22.2)	3 (15.0)	*P*=0.724
	P=0.520			*P*=1.0			*P*=0.566			
61-70	4 (25.0)	3 (33.3)	7 (28.0)	7 (58.3)	4 (40)	11 (50)	5 (45.5)	4 (44.4)	9 (45.0)	*P*=0.270
	P=0.673			*P*=0.670			*P*=1.0			
71-80	5 (31.2)	1 (11.1)	6 (24.0)	0	1 (10)	1 (4.5)	1 (9.1)	1 (11.1)	2 (10.0)	*P*=0.129
	P=0.364			*P*=0.454			*P*=1.0			
≥ 80	1 (6.25)	1 (11.1)	2 (8.0)	1 (8.3)	1 (10)	2 (9.1)	0	1 (11.1)	1 (5.0)	*P*=0.873
	P=1.0			*P*=1.0			*P*=0.450			
Total	16 (100)	9 (100)	25 (100)	12 (100)	10 (100)	22 (100)	11 (100)	9 (100)	20 (100)	

P=0.634 for "Total" by age/severity

Discussion

The current study evaluated the prevalence and seriousness of KI in COVID-19 patients to ascertain how it affected clinical assumptions. A total of 190 COVID-19 patients were admitted to the central laboratory at AL-Saddar Teaching Hospital/Najaf, Iraq, between June 1 and August 20, 2020. The total prevalence rate of AKI was 35.3% out of 190 COVID-19 patients. About of 46.0% were hospitalized in the ICU, compared to 15.4% patients without AKI. In addition, 22.4% of COVID-19 patients needed dialysis, and 13.4% died. According to a comprehensive evaluation of 24 publications on 4963 COVID-19 patients, the AKI incidence rate was 4.5%. The outcomes of the present investigation were much higher than in this study. Conversely, the current incidence rate is somewhat like a US report, which detected 36.6% of patients with AKI.[11] Although most patients have mild to moderate symptoms, COVID-19 is consistently associated with morbidity and mortality from respiratory failure, acute respiratory distress syndrome, and sepsis.[11] Some studies reported the variation in the prevalence rate of kidney injury among COVID-19 patients ranged from 4.7% to 74.6%.[12,13] These differences across research findings can be due to various elements, the most crucial of which are the quality of healthcare system centers, the extent of challenges of the centers, the randomized controlled trials scheme with viral diagnostics, municipal methods, unobtainable therapeutic approaches, and limiting hospital stay practices.[14]

In COVID-19 patients under the current investigation, hypertension was considerably linked to the emergence of kidney injury, and this outcome is comparable to a Chinese investigation of 394 patients. The researchers noted that hypertension markedly contributed to AKI.[15] The severity of the injury could explain the link between hypertension and AKI. Similarly, in a Chinese cohort study of 1389 patients, a history of hypertension was more prevalent among several patients who suffered from severe kidney injury than among the COVID-19 patients who did not have kidney injury.[16,17]

This study also demonstrated that D-dimer and CRP serum levels were considerably greater in AKI patients than in those who did not have AKI. Other researchers noted that CRP levels higher than 10 mg/L were directly correlated with kidney injury. In another study,[18]) they examined 555 patients retrospectively and noticed that AKI patients had greater levels of D-dimer and CRP. In patients with kidney disease, a high D-dimer level may mirror the severity of the disease, minimize its eradication by the kidneys, and stimulate agglutination. Even so, decreasing kidney function has been linked to higher levels of other thrombolytic markers, such as soluble plasmin, vimentin, factor VIII levels, globulin, and fibrin complex.[11] The connection between CRP and AKI is challenging. Following some scientific evidence CRP stimulates the signaling pathway and down-regulates RANTES (regulated upon activation, normal T cell expressed and secreted [also known as CCL5]) expression. That also plays a crucial role in attracting inflammatory cells into sites of inflammation in human kidney distal tubular cells in a dose-responsive manner.[11]

This study also identified that the females were slightly more often exposed to AKI than the males. Additionally, there were no noticeable differences between the age groups. According to a descriptive cross-sectional study of 957 patients with COVID-19 at the Chest Disease Hospital in Kashmir,[18] in the age group >60 years, the severe cases of illness were 35.74%, and the incidence of death was 10.49%. The severe cases of illness were 32.39% in males, with a mortality rate of 11.27%. The severity of the illness was found to be 33.96% in females, and the occurrence of death was 12.58%.

The lack of adequate hospital facilities and difficulty accessing the hospital during the pandemic limited the collection of other lab examinations, such as urine test results and ventilator variables. These parameters could be crucial in the validation of the current findings. As a result, the present findings require additional support. Therefore, since this study was conducted in a local hospital in Najaf City during the COVID-19 disease outbreak, the results could not be generalized to all COVID-19-infected patients in Iraq.

Conclusion

The results indicated that AKI is prevalent in hospitalized COVID-19 patients and is attributed to in-hospital death rates. Health professionals in countries of particular concern, like Iraq, must raise their understanding of kidney damage in patients suffering from severe COVID-19 and concentrate primarily on protection and citizen education actions to employ COVID-19 precautionary actions. It is suggested that similar research with more patients and other areas of the country should be implemented.

Ethical Considerations

The study protocol was reviewed and approved by the Ethics Committees of the University of Kufa and the General Organization of Teaching Hospitals, Najaf City, Iraq.

Competing Interests

The authors declare that they have no competing interests.

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