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ORIGINAL ARTICLE

AKI and Its Relation with Outcome in Patients with COVID-19

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ABSTRACT

Background: Coronavirus disease 2019 (COVID-19) is currently spreading fast around the world. The rate of acute kidney damage (AKI) in patients hospitalized with Covid-19, as well as the outcomes related with it, are unknown. The goal of this study was to see if having acute kidney damage (AKI) increased the risk of severe infection and death in COVID-19 patients. It also described the symptoms, risk factors, and outcomes of AKI in Covid-19 patients.

Material and Methods: We undertook a retrospective cohort from June 2020 and March 2021 to examine the connection between AKI and patient outcomes COVID-19.

Results: The most common comorbid condition was hypertension and diabetes followed by chronic kidney disease and ischemic heart disease. Most of the patients who required low dose oxygen with nasal prongs, face masks, or rebreathing masks were in control groups (76.2% vs. 50.6%; p <.001). More patients in AKI group needed non-invasive ventilation and invasive mechanical ventilation compared to control group (33.8% vs. 19.9%; p .001, 15.6% vs. 3.9%; p <.001 respectively. Patients in the AKI group had higher levels of C-reactive protein, lactate dehydrogenase, D-dimer, and serum. Of 145 patients who developed AKI, 29 (20%) needed hemodialysis. Of 29 patients who needed hemodialysis, 18 (62%) expired. A higher number of patients in the control group were discharged than patients in the AKI group (82.1% vs. 56.9%; p <.001). One hundred five patients were expired, with higher mortality in the AKI group (41.7% vs. 12.4%; p <.001).

Conclusion: COVID-19 patients admitted to the hospital, AKI is associated with a shockingly high fatality rate.

Keywords: chronic kidney disease, ischemic heart disease, lactate dehydrogenase.

INTRODUCTION

Coronavirus disease 2019 (COVID-19), caused by the newly identified severe acute respiratory syndrome coronavirus-2019 (SARS-CoV-2), has afflicted millions of individuals around the world as of December 2019. In addition to causing life-threatening respiratory disease, COVID-19 has been shown to affect other organs and systems [1, 2]. Acute kidney injury (AKI) has been shown to be common among critically ill patients, especially those with severe infections, and to be associated with a high mortality rate [3]. Acute kidney injury (AKI) occurs in up to 34% of patients infected with COVID-19, according to data from Europe and the United States (US) [4-5], which is greater than early China estimates of 3-5% [6]. Recent studies and renal autopsies have revealed four unique mechanisms of renal injury: hypovolemia, ARDS, cytokine storms, and direct viral invasion [7]. Acute kidney injury (AKI), proteinuria, and hematuria have all been noted in COVID-19 hospitalized patients in recent years [8]. With rates ranging from 0.5 to 50% in numerous studies conducted in numerous nations [9], AKI is one of the most severe types of renal involvement and is thought to be a predictive factor for both severity and death [9-11]. Most patients arrive with considerable insensible fluid loss because of severe pyrexia and tachypnoea [12]. These people are predisposed to pre-renal acute renal injury. Impaired gaseous exchange caused by hypercapnia reduces the kidney vasodilatory response, flow of blood, and diuresis while increasing oxygen consumption in the proximal tubule. In addition to impairing lung and kidney function, severe hypoxia also reduces renal blood flow and may stimulate the hypoxia-inducible factor system [13]. Therefore, early detection and prevention of AKI risk factors in COVID-19 patients may result in a better prognosis. In order to get trustworthy information that can inform therapeutic practice, we performed a retrospective cohort to examine the characteristics and consequences of AKI in patients with COVID-19.

MATERIAL AND METHODS

We undertook a retrospective cohort research at Dr. Ziauddin Hospital North Nazimabad, a tertiary care hospital in Karachi, Pakistan, between June 2020 and March 2021 to examine the connection between AKI and patient outcomes COVID-19.

A nasopharynx swab PCR, fast antigen assay, and radiological imaging characteristics consistent with COVID-19 pneumonia were employed to identify the infection in this research. The 2012 Kidney Disease: Improving Global Outcomes (KDIGO) guidelines defined and stage AKI. As the KDIGO criteria may underestimate AKI incidence, the manual serum creatinine readings in the past 365 days were also employed to diagnose AKI. Patients who were at least 18 years old and of either sex were eligible for participation in the study. Those with acute kidney injury, on the other hand, were the patients of attention. Dialysis patients were not allowed to participate in the research. In addition, we did not include patients whose records were missing or who died, were left in the hospital against medical advice, or required assisted ventilation on the first day of their hospitalization.

Procedure: The study was approved by the institution's Ethical Review Committee (CRC). Under the institutional policy, patients were started on the standard of care treatment, which comprised low molecular weight heparin, supplemental oxygen, and steroids. Methylprednisolone or dexamethasone was given for seven to 10 days (or until hospital discharge). Once their first symptoms appeared during the first ten days of diagnosis, patients received a 200mg loading dose of remdesivir, followed by 100mg once daily for four days. Patients with creatinine clearance less than 30 were given Remdesivir at the attending physician's discretion because there were no clear guidelines for its use. Tocilizumab was delivered subcutaneously in each thigh at 162mg or 8 mg/kg body weight intravenously, if necessary, under national guidelines.

Data Collection: The electronic medical records of all COVID-19 patients admitted have been retrieved and analyzed. Therefore, it was necessary to gather information on the patients' backgrounds, chronic illnesses, clinical characteristics, lab findings, and final treatment outcomes. In addition, the charts were examined by hand to ensure that the data they contained was accurate. Five hundred forty-nine electronic charts were analyzed, with 467 patients included and 92 removed. We excluded thirteen patients who were on dialysis. Thirty-two were excluded because they died, were left against the medical recommendation, or were placed

intubated within 24 hours of arrival. A further 33 individuals were omitted because of inadequate medical records, and fourteen patients were under 18 when evaluated. The outcome variables were recovery, the need for intensive care hospitalization, mechanical ventilation, and mortality.

Statistical Analysis: Demographics, test data, and admission status were used to compare the patients' starting points. Frequencies and percentages were computed and compared using Pearson's Chi-square or Fisher's exact tests for categorical data. The Mann-Whitney U test examined the median and interquartile range for continuous variables. Multivariate and univariate analyzes were used to calculate the results. The data were examined using IBM SPSS Version 26 to establish statistical significance, which was defined as a P-value of less than 0.05.

RESULTS

Baseline demographics are shown in table-1.

Table 1: Demographics: Abbreviations: AKI: Acute kidney injury, NP: Nasal prongs, FM: Face mask, NRM: Non-rebreather mask, NIV: Non-invasive ventilation, IMV: Invasive mechanical ventilation, SD: standard deviation, COPD: chronic obstructive pulmonary disease.

	Total	AKI N (160)	Non-AKI N (307)	P-Value
Number of patients (percentage)				
Age (mean ± SD)		61.36 (11.56)	58.41 (14.23)	.048
Gender				
Male	328	113 (70.6)	215 (70)	.491
Female	139	47 (29.4)	92 (30.0)	
Comorbidities				
Diabetes mellitus	224	95 (59.4)	129 (42.0)	<.001
Hypertension	282	114 (71.3)	168 (54.7)	<.001
Chronic kidney disease	54	36 (22.5)	18 (5.9)	<.001
Ischemic heart disease	47	25 (15.6)	22 (7.2)	.004
Oxygenation				
NP/FM/NRM	315	81 (50.6)	234 (76.2)	<.001
NIV	115	54 (33.8)	61 (19.9)	.001
IMV	37	25 (15.6)	12 (3.9)	<.001

Table 2: Baseline Blood Counts and Biochemical Markers Abbreviations: AKI: Acute kidney injury, FEU: fibrinogen-equivalent units, IQR: interquartile range.

	AKI N (160)	Non-AKI N (307)	P-Value
	Median (IQR)		
Creatinine	2.34 (1.74-4.33)	.98 (.82-1.12)	<.001
Urea	113.5 (89.25-172)	47 (31-66)	<.001
C-reactive protein (mg/L)	187.15 (90.89-324.36)	123.78 (57.35-213.7)	<.001
Lactate Dehydrogenase (U/L)	526 (330.5-768.3)	432 (313-639)	.001
D-dimer (ng/mL FEU)	3505 (1494.3-10000)	1335 (754-3219)	<.001
Ferritin (µg/L)	1302 (442-2460.5)	850 (451-1449)	<.001

There were 328 males and 139 females with no statistical significance between groups. Patients in the AKI group were older than the control group with a statistically significant p-value. The most common comorbid condition was hypertension and diabetes, with significant statistical differences between study groups (p <.001 in each group). Chronic kidney disease and ischemic heart disease were other comorbid conditions found in our study population; both had significant differences (p <.001,.004, respectively). Most of the patients who required low dose oxygen with nasal prongs, face masks, or rebreathing masks were in control groups (76.2% vs. 50.6%; p <.001). More patients in AKI group needed non-invasive ventilation and invasive mechanical ventilation compared to control group (33.8% vs. 19.9%; p .001, 15.6% vs. 3.9%; p <.001 respectively. Laboratory parameters are shown in Table-2.

Patients in the AKI group had higher levels of inflammatory markers. C-reactive protein, lactate dehydrogenase, D-dimer, and serum ferritin were significantly higher in the AKI group than in the control group. The clinical outcome of patients is shown in table-3.

Table 3: Outcome of Patients Abbreviations: AKI: Acute kidney injury, LAMA: Left against medical advice.

Clinical Outcome	Total	AKI N (160)	Non-AKI N (307)	P-Value
		Number of patients (percentage)		
Discharged	343	91 (56.9)	252 (82.1)	<.001
Expired	105	67 (41.9)	38 (12.4)	<.001
LAMA	19	2 (1.3)	17 (5.5)	.018

Renal outcomes of patients are shown in fig-I and II. Of 145 patients who developed AKI, 29 (20%) needed hemodialysis. Of 29 patients who needed hemodialysis, 18 (62%) expired.

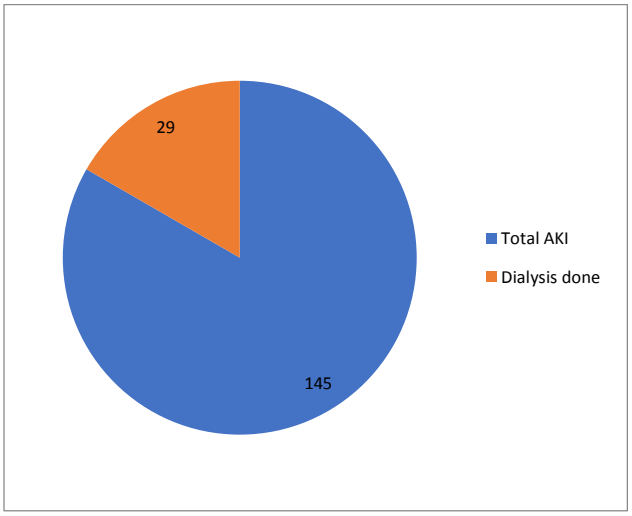

Fig-1: The number of patients having acute kidney disease requiring dialysis Abbreviation: AKI, Acute kidney injury.

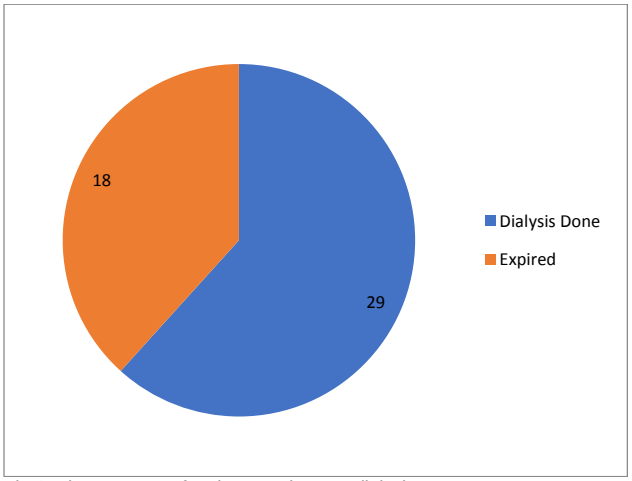

Fig-2: The outcome of patients underwent dialysis

A higher number of patients in the control group were discharged than patients in the AKI group (82.1% vs. 56.9%; p <.001). One hundred five patients were expired, with higher mortality in the AKI group (41.7% vs. 12.4%; p <.001). On

multivariate analysis table-4, hypertension, chronic kidney disease, low dose oxygen, and D-dimer were significant.

Table 4: Multivariate analysis (CI: confidence interval; NP: Nasal prongs; FM: Face mask; NRM: Non-rebreather mask; NIV: Non-invasive ventilation)

	Odds Ratio	95% CI	P-Value
Age	1.010	.995-1.024	.205
Diabetes Mellitus	1.437	.916-2.253	.114
Hypertension	1.951	1.229-3.096	.005
Chronic kidney disease	3.622	1.865-7.033	<.001
Ischemic heart disease	1.203	.601-2.408	.601
NP/FM/NRM	.294	.131-.622	.003
NIV	.593	.253-1.387	.228
C-reactive protein	1.625	.266-9.920	.599
Lactate dehydrogenase	.976	.335-2.839	.964
Ferritin	.947	.485-1.849	.872
D-Dimer	.456	.291-.714	.001

DISCUSSION

In this single-center retrospective investigation, 467 hospitalized patients with COVID-19 and AKI were examined for their features and outcomes. In these individuals, the in-hospital death rate was alarmingly high. In addition, hypertension, chronic renal disease, oxygen demand through nasal prongs/face mask/non-rebreather mask, and D-dimer were all found to be independently linked to death.

This cohort reported a 34.3% prevalence of AKI, higher than the prevalence reported in a systemic review and meta-analysis, which comprised 20 cohorts. The reported prevalence was 17%, although it ranged from 0.5 to 80.3% [14]. Clinical features and the degree of underlying illness and/or AKI were all factors in the variation in AKI prevalence among cohorts. The elevated AKI rates we found in COVID-19 individuals are comparable with large US patient series (32–46%) [12, 26, 27]. AKI was found in 39.9% of patients in a study of data from various New York hospitals (total n = 9657) [15]. Nonetheless, other early publications [16, 17], especially from China, reported far lower percentages (0–7%). A meta-analysis of 20 research from the United States and Europe found a pooled AKI incidence of 28.6% (95 percent CI 19.8–39.5), whereas 62 studies from China revealed a substantially lower 5.5 percent (95 percent CI 4.1–7.4) [10].

This cohort reported hypertension and chronic kidney disease as independent risk factors for mortality. This finding is like the results by H. Arikan et al., who wrote diabetes, chronic kidney disease, and hypertension as independent risk factors [18]. However, the frequency of chronic kidney disease was found much higher (37.6%) by H. Arikan et al. than this cohort, where we found only 11.6% of patients had CKD. CKD prevalence was considerably greater in individuals with AKI than those without AKI in a cohort of over 3000 patients with COVID-19 (17.3 percent vs. 4.4 percent, p 0.001). COVID-19-positive individuals with CKD are more likely to develop AKI [32]. CKD was found as a significant risk factor for AKI in research by Russo et al. [19], consistent with our findings in the current investigation.

In our study, we found AKI was significantly associated with mortality (41.9 vs. 12.4, p <0.001), a finding similar to findings by Jewel PD et al., who observed that patients with stage 3 AKI had a 3-fold higher risk of death than those without AKI, and that the AKI was independently associated with increased mortality at 30 days after admission, with a markedly more substantial risk with increasing severity. In addition, the link between AKI and poor prognosis has been widely documented [20] and validated in COVID-19 [16, 21].

Chan Lili et al. in their study reported that 19% of patients developing AKI required dialysis and fifty percent of them expired [15]. There findings are consistent with the findings reported by this cohort, where we found 20% patients required dialysis although with slightly higher mortality. Similarly, a research out of Ireland found that 22.2 percent of patients in the intensive care unit (ICU) required dialysis due to AKI, with a death rate of 75% [22]. High mortality in this study may be explained by the fact that, this study only included intensive care unit patients. On the contrary, according to a New York research, just 14 percent of those suffering from AKI required dialysis treatment [23].

Limitations: There were some limitations to this study. First, the survival study did not include a matched control group of patients without AKI or patients with AKI other than COVID-19 AKI. Second, we lacked the urinalysis data to determine the origin of AKI and to look for common abnormalities, such as hematuria and proteinuria, in these individuals. Third, after discharge, we could not collect any additional information. Finally, because this was an observational study, we cannot determine whether the association between exposures and results is causal.

Finally, among COVID-19 patients admitted to the hospital, AKI is associated with a shockingly high fatality rate. Patients with COVID-19 and AKI had the same risk factors linked with death as those with COVID-19, including hypertension, chronic renal illness, oxygen demand via nasal prongs/face mask/non-rebreather mask, and D-dimer.

CONCLUSION

COVID-19 patients admitted to the hospital, AKI is associated with a shockingly high fatality rate.

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