Research Article

ACUTE KIDNEY INJURY IN PATIENTS PRESENTING WITH SEVERE COVID-19 - A DESCRIPTIVE STUDY

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ABSTRACT

The Corona Virus Disease (COVID-19) was reported for the first time in 2019 as acute respiratory syndrome. However, its effects on other systems also became evident. Acute kidney injury (AKI) is the typical manifestation of renal involvement, reported in several cases; nevertheless, there is a lack of consensus regarding AKI manifestations of COVID-19. Therefore, this study was designed to determine the frequency of AKI in Pakistani patients presenting with severe COVID-19. It was a descriptive cross-sectional study conducted at the Department of Nephrology, Liaquat University of Medical and Health Sciences, Jamshoro, over a period of six months from 1 January 2022 to 30 June 2022. A total of 113 patients were included, who fulfilled pre-defined inclusion criteria. Acute renal injury was assessed using acute kidney injury based on the 2012 KIGDO AKI criteria. The mean age of our study's participants was 45.72 years, and of the 113 participants, 49 (43.4%) were male and 64 (56.6%) were female patients. Twenty-eight (24.8%) had diabetes, and thirty-four (30.1%) were hypertensive. 59 (52.2%) patients were found to have AKI. Age, gender, diabetes, hypertension and the severity of COVID-19 did not show any significant association with AKI. Acute kidney injury was found in a considerable number of COVID-19 patients. Therefore, close monitoring of patients must be done in all patients with regular follow-up.

Key Words: Acute kidney injury; COVID-19, Pneumonia Severity, Epidemiology, SARS COV-2

INTRODUCTION

Novel Coronavirus 2019 is a member of the Human Coronavirus (HCoVs) family, which emerged in 2019 and became a global pandemic involving the whole world, including low-income nations[1]. Pakistan was also not an exception to the spread of the virus [2]. Although most patients have good prognosis, the elderly, patients with diabetes mellitus, cardiovascular diseases, obesity, hypertension, chronic respiratory diseases, and cancer, had the worst outcomes [3-4]. Although the COVID-19 infection primarily affects the respiratory system, kidney involvement has also been observed [5]. Acute kidney injury (AKI), with acute tubular necrosis (ATN) as a histo-pathological alteration, is most frequently associated kidney disease with COVID-19 infection. Sepsis, cytokine storm syndrome, hypoxia, dehydration, rhabdomyolysis, and nephrotoxic drugs are the leading causes of AKI [6-7]. Mechanical ventilation is more frequently required in AKI patients[8]. More than two-thirds of the AKI episodes that occurred while the patients were hospitalized reportedly started after they became critically ill[9-10].

According to Kwok Hong Chu et al., AKI complication arises in 6.7% of SARS patients, and those who develop it had high mortality, at a rate of 91.7% [11, 12]. Xu et al. further confirmed and found that 39% of patients who had COVID-19 had also suffered from AKI [13]. As a result, clinical approaches to preventing and managing COVID-19 patients must consider the possibility of multi-organ impairment.

Prompt diagnosis and management of AKI in COVID-19 can slow its progression and help to reduce morbidity and mortality. [14].

In COVID-19 patients, the development of AKI is a critical prognostic factor for survival; however, unlike other known prognostic markers, AKI may be cured with interventions. Furthermore, according to the preliminary data, the incidence of AKI in patients with COVID-19 ranged from 5% to 29%, with significant heterogeneity in different centres, presumably because of demographically diverse populations and risk factors for AKI [14-16]. This may have some influence on virus variants. However, it is unclear how much COVID-19 increases the risk of AKI in a severe COVID-19 infection. According to several findings in a small number of individuals, SARS-CoV-2 may directly affect kidneys. COVID-19 showed considerable morbidity and mortality in Pakistan, but limited data is available to suggest a pattern of AKI and associated factors. Thus, this study evaluated the pattern of AKI and its association with age, gender, diabetes, hypertension and severity of COVID-19.

METHODS

It was a descriptive cross-sectional study conducted for six months (from 1 January 2022 to 30 June 2022) at the Department of Nephrology, Liaquat University of Medical and Health Sciences, Jamshoro, Pakistan. A total of 113 patients who met inclusion criteria, such as age between 20 to 60 years, either gender and patients presenting with severe COVID-19 for more than 12 hours, were included in the study. The following criteria determined the severity of the COVID-19 patients: a positive qRT-PCR with the presence of at least one or more of the following findings: 1) Respiratory frequency > 30 breaths per minute on clinical examination; 2) $SaO2 \leq 93\%$ on room air measured on a pulse oximeter; 3) ratio of arterial partial pressure of oxygen to fraction of inspired oxygen ($PaO2/FiO2 < 300$ measured on ABG; and 4) lung infiltrates on a CT scan > 50%. Patients presenting with malaria, dengue, or typhoid, and those with a history of sepsis, congestive cardiac failure, COPD, chronic kidney disease, stroke, contrast-induced nephropathy, hepatitis B, C, and HIV, and those taking nephrotoxic drugs such as aminoglycosides and NSAIDS, were excluded from the study. For sample selection, a non-probability consecutive sampling method was adopted.

This study was initiated after receiving an approval letter from the Research Ethics Committee of Liaquat University of Medical and Health Science Jamshoro (Notification No. LUMHS/REC/-245, Dated December 17, 2021). Informed written consent was taken from all enrolled patients before data collection. A brief history from the patient was taken about demographic information at the time of enrollment.

Patients were labelled with acute kidney injury based on the 2012 KIGDO AKI criteria that included any of the following: a) rise in serum creatinine of >0.3 mg/dl in 48 hours from the baseline, b) Rise in serum creatinine >1.5 times in the past seven days from the baseline c) Decrease in urine output to 0.5 ml/kg/hour for six hours by noting the urine output from the 24-hour urine output charts.

Statistical Methods

Statistical Package for Social Sciences (SPSS Version 22) was used to analyze the data; the mean and standard deviation were calculated for continuous variables, including age and duration of severe COVID-19. The frequency and percentages of categorical variables such as gender, type II diabetes, hypertension, and acute kidney injury (yes/no) were calculated. Age, gender, type II diabetes, duration of severe COVID-19 infection, and hypertension were stratified to determine their impact on the outcome variable. Post-stratification chi-square test was applied to correlate AKI, and a p-value of 0.05 was regarded as statistically significant.

RESULTS

The mean age of our study population was 45.72 years, and of the 113 participants, 49 (43.4%) were male and 64 (56.6%) were female. Twenty-five (22.1%) patients were between 20-40 years, whereas 88 (77.9%) were between 41-60 years of age. Twenty-eight (24.8%) had diabetes, and 38 (30.1%) were hypertensive.

A total of 38 (33.6%) patients had severe COVID-19 for less than 24 hours, while 75 (66.4%) had severe COVID-19 for more than 24 hours. Acute kidney injury was found in 59 (52.2%) patients. Age stratification concerning AKI found that 13 (52%) patients were between the ages of 20 and 40, whereas 46 (52.3%) were between the ages of 41 and 60 (p-value =0.98, Figure 1). Gender stratification found that 46.9% of male patients, while 36 (56.2%) of females developed acute renal injury (p-value =0.32, Figure 2). Diabetes mellitus type II was found in 12 individuals (42.9%) developing AKI, which was not significantly higher than in non-diabetics (p-value = 0.25, Figure 3). A total of 17 (50%) hypertensives developed AKI, and 42 (53.2%) patients were without a history of hypertension (p-value=0.75, Figure 4). The duration of the severity of symptoms also did not show any significant influence on the development of AKI (p-value= 0.64, Figure 5).

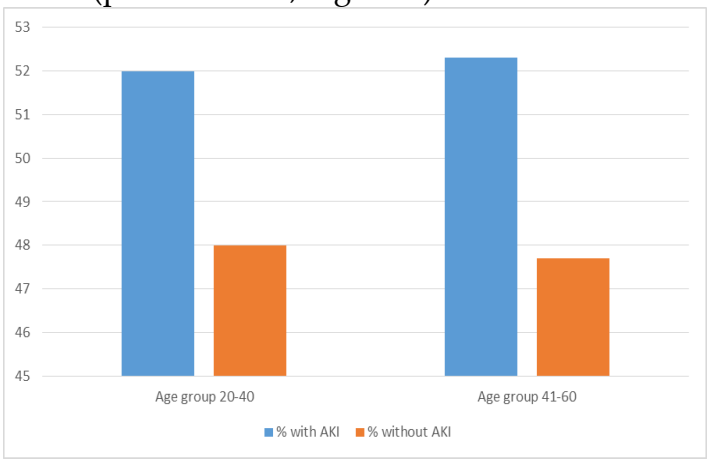

Figure 1. Association of age with development of Acute Kidney Injury in COVID-19 patients

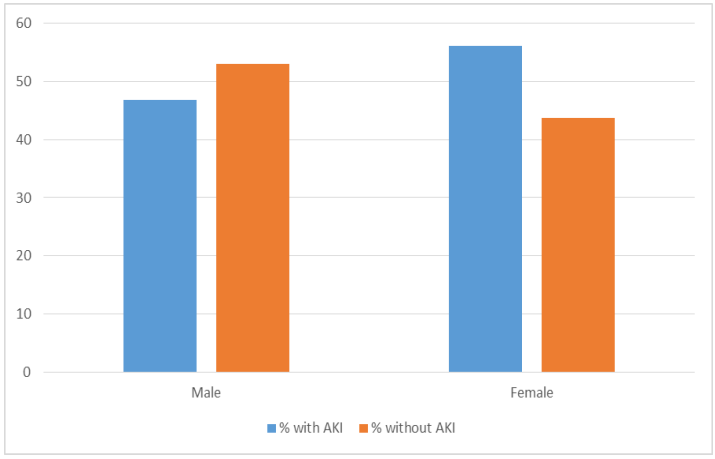

Figure 2. Association of gender with development of Acute Kidney Injury in COVID-19 patients

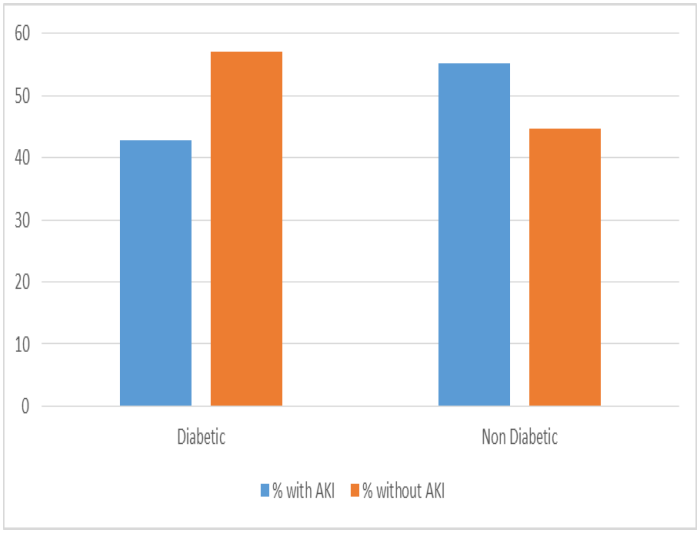

Figure 3. Association of Diabetes Mellitus with development of Acute Kidney Injury in COVID-19 patients

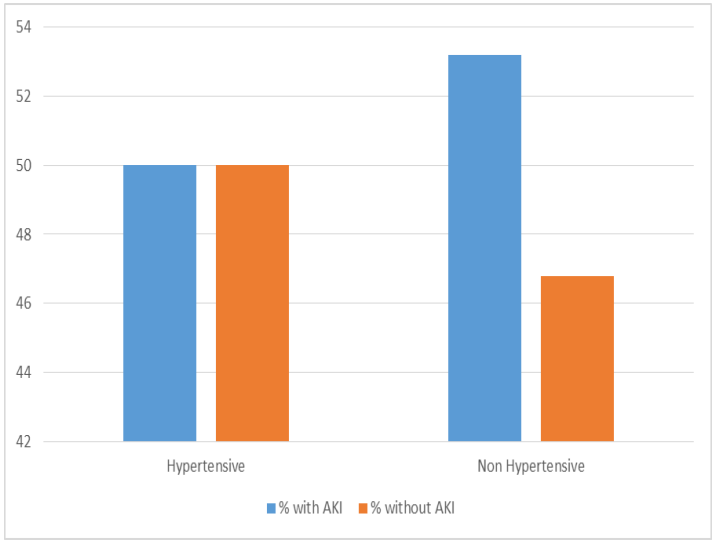

Figure 4. Association of Hypertension with development of Acute Kidney Injury in COVID-19 patients

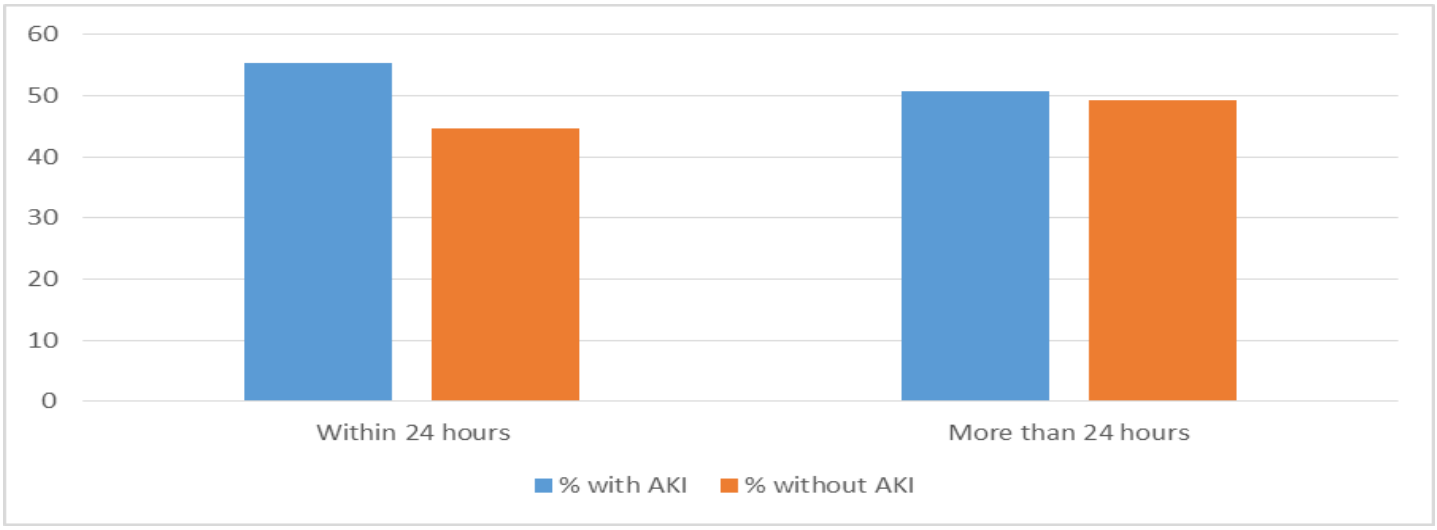

Figure 5. Association of duration of severe symptoms with development of Acute Kidney Injury in COVID-19 patients

DISCUSSION

The COVID-19 infection pandemic is a multidimensional problem with far-reaching healthcare and economic consequences. The "severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2)" was initially identified in Wuhan, a city in China, at the end of 2019 as a cluster of lower respiratory tract infection cases of unknown origin. Since then, the coronavirus illness pandemic has spread quickly around the world, causing the World Health Organization (WHO) to call the outbreak a global public health emergency [17-19]. The clinical symptoms of SARS-CoV-2 infection appear diverse, including the majority as asymptomatic carriers of mild viral upper respiratory tract illness and severe pneumonia with respiratory failure and death. Although diffuse alveolar injury is the most prominent manifestation of COVID-19, other organ systems must also be considered. Numerous studies on the incidence of AKI in COVID-19 have reported varied rates of occurrence, which may be related to the variance in severity and baseline conditions of the patients included in the studies[20]. Acute kidney Injury is unquestionably prevalent in COVID-19[20]. Of the 113 individuals included in our analysis, 59 (52.2%) developed AKI. According to Paul D. Jewell et al., 487 (39%) of the 1248 patients in the study had AKI [21]. A systemic review of 60 studies by Rupesh Raina et al. found that the incidence of AKI among COVID-19 patients was 19.45%; overall patient mortality for COVID-19 was estimated to be 17.71%, whereas patient mortality for AKI was higher at 54.24%[22]. In the elderly age group, diabetes and hypertension were considered as poor prognostic factors in COVID-19 patients, though they did not show any significant association with the development of AKI. Thus, AKI can be regarded as an independent factor that needs further exploration.

Kidney injury can be multifactorial, including damage caused by direct injury by the virus or the impact of the body's immune response against the virus. Also, there might be some influence of aggressive therapy in severe cases. However, these questions warrant further exploration. Our study includes patients from a single centre; the variant of COVID-19 was not assessed, which could have influenced it. The smaller sample size is considered a limitation; thus, more extensive cohort studies with the evaluation of the long-term impact of AKI on survival and overall clinical outcome are required to be done.

CONCLUSION

A considerable number of COVID-19 patients develop acute renal injury, which is regardless of age, diabetes and hypertension, which are known as poor prognostic factors. Thus, further, more extensive cohort studies are required to explore its associated factors and long-term clinical impact.

Ethical consideration: This study was approved by local Research Ethics committee of Liaquat University of Medical and Health Science Jamshoro.

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Conflict of interest: Authors declare no conflict of Interest

REFERENCES

1. Guo Y, Cao Q, Hong Z, Tan Y, Chen S, Jin H, et al. The origin, transmission and clinical therapies on coronavirus disease 2019 (COVID-19) outbreak–an update on the status. Military Med Res. 2020;7(1):1–10.
2. Khalid A, Ali S. COVID-19 and its challenges for the healthcare system in Pakistan. Asian Bioeth Rev. 2020 Aug 13:1-14.
3. Zhou F, Yu T, 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.
4. Huang C, Wang Y, Li X, Ren L, Zhao J, Hu Y, et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. Lancet. 2020;395(10223):497–06.
5. Legrand M, Bell S, Forni L, Joannidis M, Koyner JL, Liu K, et al. Pathophysiology of COVID-19-associated acute kidney injury. Nat Rev Nephrol. 2021;17(11):751–64
6. 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.
7. Alberici F, Delbarba E, Manenti C, Econimo L, Valerio F, Pola A, et al. Management of patients on dialysis and with kidney transplant during SARS-CoV-2 (COVID-19) pandemic in Brescia, Italy. Kidney Int Rep 2020; 5(5):580-5.
8. Kolhe NV, Fluck RJ, Selby NM, Taal MW. Acute kidney injury associated with COVID-19: a retrospective cohort study. PLoS Med. 2020; 17(10):e1003406.
9. Ronco C, Reis T. Kidney involvement in COVID-19 and rationale for extracorporeal therapies. Nat Rev Nephrol 2020;16(6):308-10.
10. Zheng X, Zhao Y, Yang L. Acute Kidney Injury in COVID-19: The Chinese experience. Semin Nephrol. 2020 Sep; 40(5):430-42.
11. Chu KH, Tsang WK, Tang CS, Lam MF, Lai FM, To KF et al. Acute renal impairment in coronavirus-associated severe acute respiratory syndrome. Kidney Int. 2005;67(2):698–05.
12. Pacciarini F, Ghezzi S, Canducci F, Sims A, Sampaolo M, Ferioli E et al. Persistent replication of severe acute respiratory syndrome coronavirus in human tubular kidney cells selects for adaptive mutations in the membrane protein. J. Virol. 2008;82(11):5137–44.
13. Xu J, Xie J, Du B, Tong Z, Qiu H, Bagshaw SM. Clinical characteristics and outcomes of patients with severe COVID-19 induced acute kidney injury. J Intensive Care Med 2021;36(3):319–26.
14. Ahmed AR, Ebad CA, Stoneman S, Satti MM, Conlon PJ. Kidney injury in COVID-19. World Journal of Nephrology. 2020 Nov 29;9(2):18–32.
15. Guan WJ, Ni ZY, Hu Y, Liang WH, Ou CQ, He JX, et al. Clinical characteristics of Coronavirus Disease 2019 in China. N Engl J Med. 2020;382(18):1708–20.

16. 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.
17. Sohrabi C, Alsafi Z, O'Neill N, Khan M, Kerwan A, Al-Jabir A, et al. World Health Organization declares global emergency: a review of the 2019 novel coronavirus (COVID-19). Int J Surg. 2020;76:71–6.
18. Shanmugaraj B, Malla A, Phoolcharoen W. Emergence of novel coronavirus 2019-nCoV: need for rapid vaccine and biologics development. Pathogens. 2020;9(2):148.
19. Ribeiro DE, Oliveira-Giacomelli Á, Glaser T, Arnaud-Sampaio VF, Andrejew R, Dieckmann L, et al. Hyperactivation of P2X7 receptors as a culprit of COVID-19 neuropathology. Mol Psychiatry. 2021;26(4):1044–59.
20. Qian J-Y, Wang B, Lv L-L, Liu B-C. Pathogenesis of acute kidney injury in Coronavirus Disease 2019. Front Physiol. 2021;12:586589.
21. Jewell PD, Bramham K, Galloway J, Post F, Norton S, Teo J, Fisher R, Saha R, Hutchings S, Hopkins P, Smith P. COVID-19-related acute kidney injury; incidence, risk factors and outcomes in a large UK cohort. BMC nephrology. 2021 Dec;22(1):1-2.
22. Raina R, Mahajan ZA, Vasistha P, Chakraborty R, Mukunda K, Tibrewal A, Neyra JA. Incidence and Outcomes of Acute Kidney Injury in COVID-19: A Systematic Review. Blood Purif. 2021 Jun 15:1-14.