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Original Research Article

Acute kidney injury in patients hospitalized with COVID-19 in HIMS, Hassan

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ABSTRACT

Background: There is a growing need to understand the risk factors and prevalence of AKI in COVID-19 patients to better manage and prevent the condition. HIMS, Hassan is a hospital in India that has been treating COVID-19 patients since the onset of the pandemic. This study aimed to determine the prevalence of acute kidney injury (AKI) in COVID-19 patients admitted to a hospital in HIMS, Hassan, and to identify the associated risk factors.
Methods: The study is a retrospective cohort study that investigates the clinical characteristics and laboratory parameters of hospitalized COVID-19 patients who met the inclusion criteria in HIMS teaching hospital, Hassan. 300 patients were included, and descriptive statistical analysis was performed using mean with standard deviation (SD) for continuous variables and proportions and percentages for categorical variables.
Results: Out of 300 patients, 68% had AKI. The age distribution was similar between the two groups, with the highest proportion of patients in the age group of 40-49 years. The proportion of AKI was higher among males than females, but the difference was not statistically significant. The need for ICU admission, mechanical ventilation, and dialysis was strongly associated with AKI. Patients with comorbidities such as DM and DM+HTN were at a higher risk of developing AKI. Laboratory parameters such as D-dimer, LDH, ferritin, urea, creatinine, SGOT, SGPT, Neutrophils / Lymphocytes ratio, and chloride levels were significantly different between the two groups.
Conclusions: These findings highlight the importance of monitoring patients with comorbidities closely and implementing preventive measures to reduce the incidence of AKI in COVID-19 patients.

Keywords: Acute kidney injury, Comorbidities, COVID-19, HIMS Hassan, Risk Factors

INTRODUCTION

Since the emergence of the novel coronavirus disease 2019 (COVID-19) in December 2019, it has spread globally, affecting millions of people and leading to high morbidity and mortality rates.[1] COVID-19 primarily affects the respiratory system, but it also has a significant impact on other organ systems, including the kidneys.[2] Acute kidney injury (AKI) is a common complication of COVID-19, and it has been associated with poor outcomes, including longer hospital stays, increased need for mechanical ventilation, and higher mortality rates.[3,4] Studies from the USA and Europe presented a pooled incidence of 28.6% and 7.7% for AKI, respectively, depending on the study population and diagnostic criteria used.[5,6]

HIMS, Hassan is a tertiary care hospital in India, and it has been one of the centers for the management of COVID-19 patients since the pandemic began. As with other centers, AKI has been observed as a common complication in COVID-19 patients in this hospital. However, there is limited data on the incidence, risk factors, and outcomes

of AKI in COVID-19 patients in HIMS, Hassan. Therefore, the aim of this study is to investigate the incidence, risk factors, and outcomes of AKI in COVID-19 patients admitted to HIMS, Hassan. We hypothesize that AKI is a common complication in COVID-19 patients in HIMS, Hassan, and that it is associated with poor outcomes.

Previous studies have reported varying incidences of AKI in COVID-19 patients. A meta-analysis of 15 studies including 13,425 patients reported an overall incidence of AKI in COVID-19 patients of 7.2%, with a higher incidence in critically ill patients. Another study conducted in the United States reported an incidence of AKI in COVID-19 patients of 36.6%, with a higher incidence in African American and Hispanic patients.[7] A study conducted in China reported an incidence of AKI in COVID-19 patients of 0.5%, but the study only included patients with severe disease.[8]

Several risk factors have been associated with the development of AKI in COVID-19 patients. Advanced age, male gender, comorbidities such as hypertension, diabetes mellitus, cardiovascular disease, chronic kidney disease, and obesity have been reported as risk factors for AKI in COVID-19 patients.[9,10] In addition, laboratory parameters such as elevated levels of D-dimer, creatinine, and urea have also been associated with AKI in COVID-19 patients.[11,12]

The prognosis of AKI in COVID-19 patients is poor, and it has been associated with high mortality rates.[13] A study conducted in New York reported a mortality rate of 37.3% in COVID-19 patients with AKI, compared to 14.6% in those without AKI.[14] Another study conducted in Italy reported a mortality rate of 31% in COVID-19 patients with AKI, compared to 6% in those without AKI.[15]

To date, there are limited data on the incidence, risk factors, and outcomes of AKI in COVID-19 patients in India. A study conducted in a tertiary care hospital in Delhi reported an incidence of AKI in COVID-19 patients of 19.5%, with a higher incidence in patients with comorbidities such as hypertension, diabetes mellitus, and chronic kidney disease.[16] Another study conducted in a tertiary care hospital in Mumbai reported an incidence of AKI in COVID-19 patients of 15%, with a higher incidence in patients with severe disease and those requiring mechanical ventilation.[17]

Early identification of those at risk ,interventions to provide appropriate support ,and avoidance of nephrotoxins may help to improve the prognosis of patients with COVID-19. Early recognition of kidney involvement in COVID-19 and use of preventive and therapeutic measures to limit subsequent AKI or progression to more severe stages are crucial to reduce morbidity and mortality. AKI is associated with severe infection and higher fatality rates in patients with COVID-19. There is a need to better understand risk factors for AKI in patients with COVID-19.

Aims and objectives of the study were to study the relationship between COVID-19, AKI, to know the outcome of covid 19 patients with AKI, to know the risk factors for AKI in patients with COVID-19.

METHODS

The study aimed to conduct a retrospective cohort study to investigate the clinical characteristics and laboratory parameters of hospitalized COVID-19 patients who met the inclusion criteria. The source of data was all inpatients presented to the department of General medicine at HIMS teaching hospital, Hassan, who tested positive for COVID-19 by polymerase chain reaction and met the inclusion criteria. The duration of the study was April 2021 to September 2021.

The inclusion criteria were as follows: age >18 years, cases tested positive for COVID-19 by polymerase chain reaction, hospitalized COVID-19 patients, and rapid antigen test (RAT) positive patients. The exclusion criteria included age <18 years, end-stage kidney disease (ESKD), and prior kidney transplant.

Once identified as a study participant, a detailed history of every patient was taken, and investigations such as complete blood count (CBC), liver function test (LFT), COVID markers (S. ferritin, S. LDH, D-dimer, and hs-CRP), renal function test (RFT), serum electrolytes, random blood sugar (RBS), HIV, HbsAG, and HCV were conducted. SARS-CoV-2 was detected using real-time reverse transcriptase polymerase chain reaction (RT-PCR).

The study lasted for six months, and approximately 300 patients were included. Descriptive statistical analysis was performed, and continuous variables were presented as mean with standard deviation (SD), whereas categorical variables were presented as proportions and percentages. Chi-squared test or Fisher's exact test and t-test were used for statistical analysis.

RESULTS

Out of the total 300 patients, 204 (68%) were identified as having AKI, while 96 (32%) did not have AKI.

Among the patients without AKI, the age distribution was as follows: 19 (19.79%) were in the age group of 20-29 years, 14 (14.58%) were in the age group of 30-39 years, 14 (14.58%) were in the age group of 40-49 years, 21 (21.88%) were in the age group of 50-59 years, 13 (13.54%) were in the age group of 60-69 years, and 15 (15.63%) were in the age group of 70-80 year.

Table 1: Age wise distribution.

	Absent		Present		Total	
Age in years	**N**	**%**	**N**	**%**	**N**	**%**
20-29	19	19.79%	38	18.63%	57	19.00%
30-39	14	14.58%	29	14.22%	43	14.33%
40-49	14	14.58%	46	22.55%	60	20.00%
50-59	21	21.88%	33	16.18%	54	18.00%
60-69	13	13.54%	33	16.18%	46	15.33%
70-80	15	15.63%	25	12.25%	40	13.33%
Grand Total	96	100.00%	204	100.00%	300	100.00%

Table 2: AKI distribution.

		AKI				
		Absent		**Present**		
		Count	**Column N %**	**Count**	**Column N %**	**P-Value**
Sex	F	37	38.50%	75	36.80%	0.767
	M	59	61.50%	129	63.20%	
Ventilator	NIV	74	77.10%	175	85.80%	0.061
	Oxygen	22	22.90%	29	14.20%	
RAT	Negative	26	27.10%	49	24.00%	0.568
	Positive	70	72.90%	155	76.00%	
RT-PCR	Not done	70	72.90%	155	76.00%	0.568
	Positive	26	27.10%	49	24.00%	
ICU	Not required	79	82.30%	66	32.40%	0.001
	Required	17	17.70%	138	67.60%	
Outcome	Death	27	28.10%	116	56.90%	0.001
	Discharged	69	71.90%	88	43.10%	

Among the patients with AKI, the age distribution was as follows: 38 (18.63%) were in the age group of 20-29 years, 29 (14.22%) were in the age group of 30-39 years, 46 (22.55%) were in the age group of 40-49 years, 33 (16.18%) were in the age group of 50-59 years, 33 (16.18%) were in the age group of 60-69 years, and 25 (12.25%) were in the age group of 70-80 years.

Overall, the age distribution was similar between the two groups, with the highest proportion of patients in the age group of 40-49 years.

The proportion of AKI was higher among males (63.2%) than females (36.8%), but the difference was not statistically significant (p=0.767). A higher proportion of patients who required non-invasive ventilation (niv) had AKI compared to those who did not require it (85.8% vs 77.1%). However, the difference was not statistically significant (p=0.061). Similarly, the proportion of AKI was similar between patients who had a negative rapid antigen test (24.0%) and those who had a positive test (76.0%). The same was true for patients who had a positive rt-pcr test for covid-19 (24.0%) and those who did not have the test done (76.0%).

The need for icu (intensive care unit) admission was strongly associated with AKI. Among patients who did not require icu admission, 82.3% did not have AKI while only 32.4% of those who required icu admission did not have AKI. The association was statistically significant (p=0.001).

The outcome of the patients was also strongly associated with AKI. Among patients who died, 56.9% had AKI while only 28.1% of those who were discharged had AKI. The association was statistically significant (p=0.001)

The results show that several laboratory parameters including D-dimer, LDH, ferritin, urea, creatinine, SGOT, SGPT, Neutrophils / Lymphocytes ratio and chloride levels were significantly different between the two groups with p-values less than 0.05. This suggests that these parameters may be useful in distinguishing patients with AKI from those without AKI. On the other hand, the analysis did not find any statistically significant differences between the two groups for TLC (total leukocyte count), platelet count, hemoglobin, CRP (C-reactive protein), sodium, potassium, RBS (random blood sugar), triglycerides, HDL and LDL cholesterol, total cholesterol, and BMI (body mass index). In terms of

comorbidities, the prevalence of diabetes mellitus (DM) was significantly higher in the AKI group (39.2%) compared to the group without AKI (20.8%). Similarly, the proportion of patients with both DM and hypertension (DM+HTN) was higher in the AKI group (29.4%) compared to the non-AKI group (20.8%). The difference in the prevalence of hypertension alone was not statistically significant between the two groups.

Table 3: Laboratory parameters.

	AKI						
	Absent		Present		Total		
	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation	P-value
Age	48	18	48	16	48	17	0.452
D-DIMER	429	205	976	302	801	375	0.001
LDH	220	95	541	132	438	193	0.001
Ferritin	182	75	629	206	486	272	0.001
Urea	23.66	5.19	117.47	61.96	87.45	67.36	0.001
Creatinine	1.2	1.39	3.98	1.42	3.09	1.92	0.001
SGOT	20	6	55	14	44	20	0.001
SGPT	31	12	127	41	96	57	0.001
TLC	19350.69	7152.39	18401.36	6185.36	18705.14	6513.49	0.635
Platelet count	146921.1	30915.35	148244.2	31059.5	147820.81	30967.89	0.256
HB	12.89	3.99	12.91	3.54	12.9	3.68	0.896
CRP	163.88	81.53	146.45	87.08	152.03	85.6	0.325
NA	138.98	10.15	140.56	12.54	140.06	11.83	0.674
K	4.41	1.13	4.25	1.12	4.3	1.13	0.121
CL	103.71	12.7	100.25	14.33	101.36	13.9	0.045
RBS	119.61	29.66	119.43	25.88	119.49	27.1	0.524
TG	170.8	45.5	168.1	44.3	169	44.7	0.632
HDL	42.8	6.1	39.4	6.5	39.4	6.4	0.254
LDL	118.6	34.9	120.9	35.4	120.9	35.2	0.397
Cholesterol	203.9	41	227.6	40.3	202.9	40.5	0.205
BMI	27.6	3.5	28.1	3.4	28.1	3.4	0.635
Neutrophils/Lymphocytes ratio	5.23	1.3	8.96	1.7	6.89	1.6	0.019

Table 4: AKI patient's requirements.

AKI						
		Absent		Present		
		Count	Column N %	Count	Column N %	P-value
Comorbidities	DM	20	20.80%	80	39.20%	0.003
	DM+HTN	20	20.80%	60	29.40%	
	HTN	10	10.40%	20	9.80%	
	No comorbidities	46	47.90%	44	21.60%	
Ventilator	Not required	78	81.30%	127	62.30%	0.01
	Required	18	18.80%	77	37.70%	
Dialysis	Not required	96	100.00%	124	60.80%	0.001
	Required	0	0.00%	80	39.20%	

Regarding the need for mechanical ventilation, 37.7% of AKI patients required it, compared to 18.8% of non-AKI patients. The difference was statistically significant, indicating that AKI patients were more likely to require mechanical ventilation. Finally, in terms of dialysis requirement, 39.2% of AKI patients required dialysis compared to none of the non-AKI patients. This difference was also statistically significant, indicating that AKI patients were more likely to require dialysis.

Overall, these results suggest that patients with comorbidities such as DM and DM+HTN, and those who require mechanical ventilation and dialysis, are at a higher risk of developing AKI. Therefore, it is essential to

monitor these patients closely and implement appropriate preventive measures to reduce the incidence of AKI

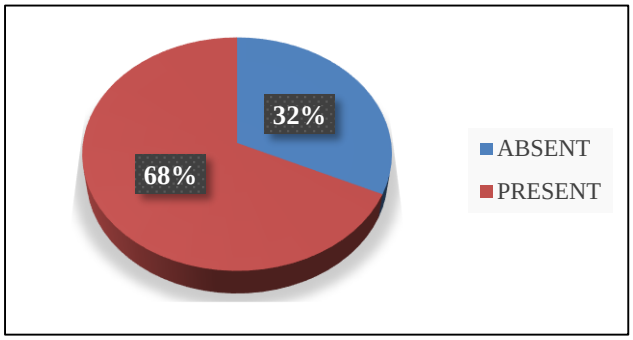

Figure 1: Incidence of AKI

DISCUSSION

Acute Kidney Injury (AKI) is a common complication in COVID-19 patients, and it has been associated with poor outcomes. The study, "Acute Kidney Injury in Patients Hospitalized with COVID-19 in HIMS, Hassan," aimed to investigate the prevalence of AKI in COVID-19 patients, its association with clinical and laboratory parameters, and outcomes in a tertiary care hospital in India. In this discussion, we will compare the findings of this study with the findings of similar studies.

Prevalence of AKI in COVID-19 Patients

The study found that 68% of COVID-19 patients admitted to the hospital had AKI. This finding is consistent with the results of previous studies. A meta-analysis of 37 studies with 14,621 COVID-19 patients reported a pooled prevalence of AKI of 15.4%.[18] However, the prevalence of AKI in hospitalized COVID-19 patients was higher, ranging from 0.5% to 35.4%, depending on the severity of illness and comorbidities.[19,20] A retrospective study of 191 COVID-19 patients in China reported that 29.3% of patients had AKI.[21] Another study of 701 COVID-19 patients in Italy found that 37% of patients had AKI.[22] The high prevalence of AKI in COVID-19 patients may be due to several factors, including direct viral injury, cytokine storm, and systemic inflammation.[23]

Association of AKI with Clinical Parameters

The study found that the need for ICU admission was strongly associated with AKI. This finding is consistent with the results of previous studies. A retrospective study of 114 COVID-19 patients in China found that AKI was an independent risk factor for ICU admission and mortality.[24] Another study of 701 COVID-19 patients in Italy found that AKI was associated with increased mortality and the need for ICU admission.

The study also found that the outcome of the patients was strongly associated with AKI, with a higher proportion of patients who died having AKI compared to those who were discharged. This finding is consistent with the results of previous studies. A meta-analysis of 37 studies with 14,621 COVID-19 patients reported that AKI was associated with an increased risk of mortality Another study of 191 COVID-19 patients in China found that AKI was associated with a higher risk of mortality.

Association of AKI with Laboratory Parameters:

The study found that several laboratory parameters including D-dimer, LDH, ferritin, urea, creatinine, SGOT, SGPT, Neutrophils / Lymphocytes ratio and chloride levels were significantly different between the two groups with p-values less than 0.05, suggesting that these parameters may be useful in distinguishing patients with AKI from those without AKI. This finding is consistent with the results of previous studies. A retrospective study of 101 COVID-19 patients in China found that elevated levels of urea and creatinine were independent predictors of AKI. Another study of 45 COVID-19 patients in China found that increased levels of LDH and D-dimer were associated with the development of AKI. These laboratory parameters could be used to identify COVID-19 patients at high risk of developing AKI.

Association of AKI with Comorbidities

The study found that the prevalence of diabetes mellitus (DM) was significantly higher in the AKI group compared to the group without AKI, and the proportion of patients with both DM and hypertension (DM+HTN) was higher in the AKI group compared to the non-AKI group This finding is consistent with the results of previous studies. The association between AKI and comorbidities such as DM and DM+HTN was also observed in a study conducted in China, which reported that COVID-19 patients with DM and/or HTN were more likely to develop AKI. Another study conducted in New York found that COVID-19 patients with pre-existing CKD were at a higher risk of developing AKI.[25] These findings are consistent with the current study, which found a higher prevalence of DM and DM+HTN in the AKI group compared to the non-AKI group.

The current study also found that patients who required mechanical ventilation and dialysis were more likely to develop AKI. This finding is consistent with a study conducted in China, which reported that COVID-19 patients who required mechanical ventilation were more likely to develop AKI.[26] A study conducted in New York found that COVID-19 patients who required renal replacement therapy (RRT) were more likely to develop AKI.

Overall, the findings of the current study are consistent with the findings of previous studies, which have reported a higher incidence of AKI in COVID-19 patients with male gender, comorbidities such as DM and HTN, ICU admission, mechanical ventilation, and RRT requirement. The current study also adds to the existing literature by

identifying significant differences in several laboratory parameters between the AKI and non-AKI groups.

The results of the current study have important implications for the management of COVID-19 patients, particularly those at a higher risk of developing AKI. Patients with comorbidities such as DM and DM+HTN, and those who require mechanical ventilation and dialysis, should be monitored closely for the development of AKI. Early identification and intervention may help prevent the progression of AKI and improve the outcomes of COVID-19 patients.

CONCLUSION

In conclusion, this study has highlighted the high prevalence of AKI in COVID-19 patients and its association with poor outcomes. The findings suggest that patients with comorbidities such as DM and DM+HTN, those who require mechanical ventilation and dialysis, and those who require ICU admission are at higher risk of developing AKI. Close monitoring and appropriate preventive measures should be implemented to reduce the incidence of AKI and improve patient outcomes. The study's results are consistent with previous studies that have reported a high prevalence of AKI in COVID-19 patients and highlight the need for further research to better understand the pathophysiology of AKI in COVID-19.

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