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A Study on Kidney Functions in Covid - 19 Infected ICU Patients - A Retrospective Cohort

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Abstract

Early reports suggest that AKI is more common among patients withCOVID-19diseaseand associated with worse outcomes. However, AKI among hospitalized patients admitted in ICU with COVID-19 in India is not well studied. This retrospective cohort study involved a review of data from electronic health records of patients aged above 18 years with RTPCR positive COVID-19 patients admitted to ICU of the Department of Critical Care Medicine, Apollo health city, Hyderabad, Telangana from September 2020 to August 2021. We describe the incidence of stages of AKI according to KDIGO criteria in COVID-19 diabetic and non-diabetic arms. We applied one-way ANOVA Mixed Effects Model (REML) and Chi-square test to prove the relation of COVID-19 and AKI among Diabetics and Non-Diabetics at P value <0.05 at 95% CI and 80% of power of the study. Data analyzed was statistically significant for creatinine, urine output mL/Kg/hour and eGFR in diabetics and non-diabetics in COVID-19 infected ICU patients. Mortality and severity of the AKI is more in COVID-19 diabetic group. Estimation of serum creatinine, urine output and

calculation of eGFR may be a useful tool for identifying the severity of kidney injury in COVID-19 diabetic patients, helps to draw algorithms for the line of treatment in these vulnerable population and timely intervention may prevent mortality.

Keywords

Acute Kidney injury (AKI) COVID-19, creatinine, eGFR and KDIGO

Introduction

Corona virus (COVID-19) was first described in humans in December 2019 in Wuhan, China [1] and is the third coronavirus to have emerged in the last 2 decades.The pandemic COVID-19 has become a world health emergency. The individuals between 30 and 79 years of age were predominantly affected, with 81% of cases being classified as mild another 19% moderate to severe. In 2002 severe acute respiratory syndrome coronavirus (SARS-CoV) and the Middle East respiratory syndrome coronavirus (MERS-CoV) in 2012, havetoppled the world by its incidences by the global impact of SARS-CoV-2 [2].SARS-CoV-2 was declared a pandemic on March 11, 2020 by the World Health [1]. As of 10th September 2021, 3,31,74,954 infected cases have been confirmed with 4,41,768 deaths across globe, [1]. Such a large number of confirmed cases is related to the way the virus is transmitted, which is close human-to-human contact through droplets or aerosol via coughs, sneezes or talking. Infection may also occur by touching contaminated surfaces and then touching routes of transmission such as the mouth, eyes or nose [2]. The majority of the population displaying symptoms similar to the common cold, COVID-19 has also induced alveolar damage resulting in progressive respiratory failure with 6.4% fatalities. Presentation of symptoms starts form 2-14 day after exposure to virus, the symptoms include fever, cough and difficulty in breathing [3]. A severe complication of this disease is progressive respiratory failure and death may occur [3, 4]. Corona virus mainly affects the respiratory system, which in severe cases it is manifested by pneumonia, hypoxemia and acute respiratory distress syndrome. Although the main focus is on the pulmonary features, physicians must be aware of other complications that corona virus infection carries to other organs, including the kidneys [5]. In addition to cardiovascular damage, renal involvement was frequently observed in COVID-19 infected patients,varying from mild proteinuria to increase in serumcreatinine levels to acute kidney injury (AKI)and chronic renal failure. previous studies have reported varying incidences (3–15%) of AKI during illness [6,7].The potential impact of SARS-CoV-2 on the kidneys is still undetermined, but emerging evidence indicates that kidney complications are frequent in patients with comorbidity such as diabetes mellitus and hypertension [7].Disease pathogenesis includes direct viral injury, inflammation, activation of coagulation cascades and complement cascades. COVID -19 infected had mild proteinuria, haematuria, and slight elevation of creatinine, as a part of multiorgan failure [8]. Purpose of the study to find out potential markers for AKI in COVID -19 infected patients admitted in ICU, so timely interventions can prevent the further damage to kidney.Objectives of the current study were 1. Estimation of plasma levels of creatinine 2. Urine output per 24 hours and 3. Determination of eGFR to grade the kidney diseases according to KDIGO criteria in COVID-19 Patient's.

Material and Methods

Current study is a retrospective cohort in severe COVID-19 infected ICU patients from September 2020

to August 2021, 200 patients who have tested RTPCR positive with a CT cycling in time score less than≤18, severely infected, admitted in ICU were enrolled for study. Sample size was calculated by using fisher et, al formulae as population of infected patients were <10,000. Out 200 patients hospitalised 96 patients were enrolled for the study who are getting treatment in ICU.Serum creatinine levels and urine output were measured to classify them in different satages of AKIunder KDIGO AKI guidelines.

Statistical Analysis

Data presented as Mean±SD, with confidence interval of 95% at 80% power of the study. Significance levels were calculated by using one-way ANOVA Mixed effects model and chi-square test was applied for incidence of AKI, P value <0.05 was considered to be significant.

Laboratory investigations

Estimation of serum creatinine was done by turbidimetric method by using autoanalyzer make of Mindray, China with the creatinine kit supplied. Urine output was measured by using mL/kg body weight/Hour. Subjects eGFR was calculated with MSRD eGFR formulae.

Results

During the study period, 200 patients were hospitalized, aged between 40-70years. Out of these patients 96 (48%) were admitted in ICU with total hospitalization time ranged from 1 day to 30 days. Overall hospital mortality was approximately 5% from COVID diabetic group no mortality was observed in nondiabetic group (Figure 1). Out of 96 patients admitted in ICU 56 (58.3%) were diabetics and 40 (41.6%) were non-diabetics. Out of 56 patients40 (71.42%) patients satisfied the criteria of KDIGO to term them as stage 1 AKI, 10 (17.85%) were stage 2 AKI and 6 (10.71%) werestage 3 AKI were from COVID-19 diabetic group.From non-diabetic group 28 (70%) patient satisfied the criteria to be grouped them into AKI 1, 5 (12.5%) patients in AKI 2 and 2 (5%) patients satisfied to be grouped into AKI 3. Out of 96 patients admitted in ICU with COVID-19 were 68 (70.83%) of them were AKI 1, 15 (15.62%) were AKI 2 and 8 (8.33%) were AKI 3 according to KDIGO criteria (Figure 1).Laboratory assessment for creatinine values were done by using Mindray kit with turbidimetric method by using auto analyser (Mindray make) showed an increase of plasma creatinine values in the group of COVID -19 diabetic were in AKI 11.74±0.21 (CI 95% 1.670-1.810), AKI 2 3.22±0.41 (CI 95% 2.921-3.519) and AKI 3 6.22±0.64 (CI 95% 5.418- 7.022)and COVID -19 non-diabeticwereAKI 1 1.72±0.21 (CI 95% 1.640-1.810), AKI 2 3.10±0.42 (CI 95% 2.573-3.627) and AKI 3 6.05±1.06 (CI 3.480-15.58) (Table-1, Figure 2).Urine output measured in COVID-19 diabetic were0.46±0.05AKI 1, 0.48±0.04 AKI 2 and 0.23±0.08 AKI 3 and in non-diabetic group were 0.46±0.05AKI 1, 0.38±0.84 AKI 2 and 0.20±0.00AKI 3. (Table-1, Figure 3).Measured eGFR (MSRD) for diabetic group were44±7.1(CI 95% 42-47)AKI 1, 22±3 (CI 95% 20-24) AKI 2 and 10±1.4 (CI 95% 8.2-12) AKI 3, and in COVID-19 non-diabetic group were45±8.2 (CI 95% 42-48)AKI 1, 23±2.8 (CI 95% 20-25)AKI 2 and 11±2.1(CI 95% 8.6-30)AKI 3 (Table-1, Figure 4). Data was analysed by using one-way ANOVA (Mixed-effects model (REML)) showed significance at 0.0001 at 95% confidence interval, the matching effectives was found by using chi-square showed a significance level of p=0.14 (*).

Table 1- Assessment of Kidney function - COVID-19 Diabetic and Non-diabetic patients in ICU						
Parameters	COVID-19 Diabetic group			COVID-19 Non-Diabetic group		
	AKI 1	AKI 2	AKI 3	AKI 1	AKI 2	AKI 3
Creatinine (Mean±SD)	1.74±0.218*	3.22±0.41*	6.22±0.64*	1.72±0.21*	3.10±0.42*	6.05±1.06*
Urine output mL/Kg/Hour (Mean±SD)	0.46±0.05*	0.48±0.04*	0.23±0.08*	0.46±0.05*	0.38±0.84*	0.20±0.00*
eGFR	44±7.1*	22±3.0*	10±1.4*	45±8.2*	23±2.8*	11±2.1*
P Value	0.0001					
F Value	60.55					
Chi-square value	6000 (p=0.014) *indicates significance with chi-square test.					
Data presented as Mean±SD, between the groups of COVID-19 Diabetics and Non-diabetics, *indicates statically significant with chi-square test. One-way ANOVA Mixed effects model was applied to prove statistical significance (P= 0.0001*).						

Figure 1 - No of Covid-19 Patients in ICU - Diabetics and non diabetics with AKI

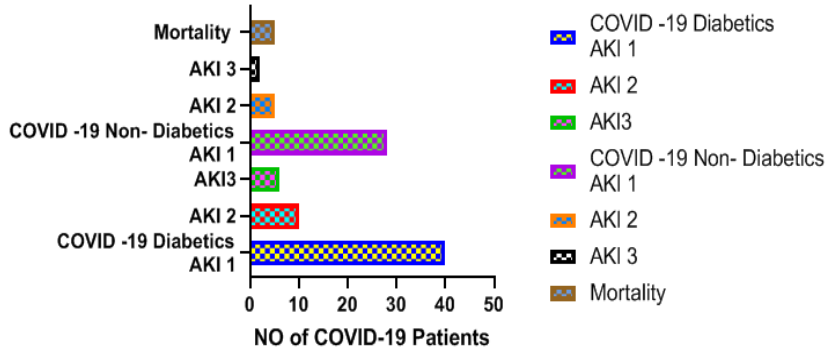


Figure 2- Levels of Creatinine in COVID-19 Diabetics and Non-diabetics with AKI-ICU patients

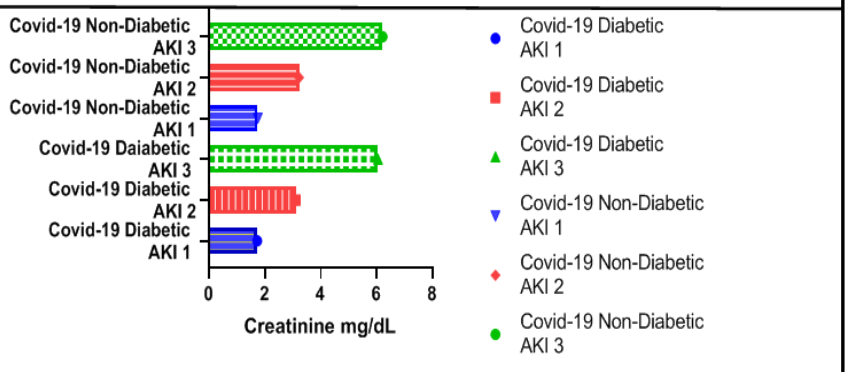


Figure 3- Urine Out put mL/Kg/Hour- in COVID 19 Diabetic and Non-diabetic ICU patients

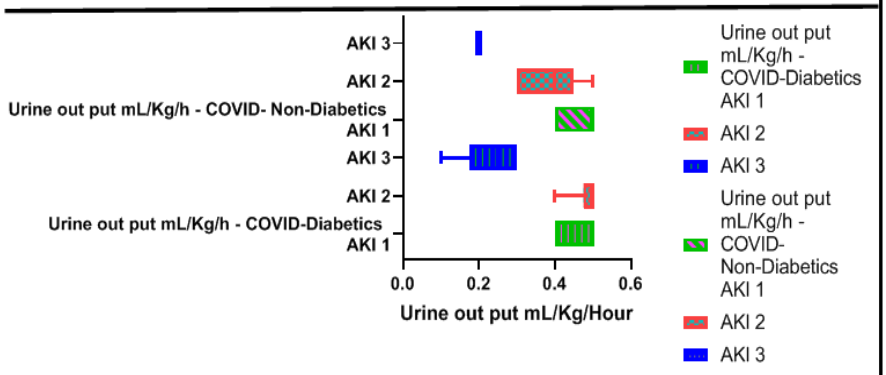
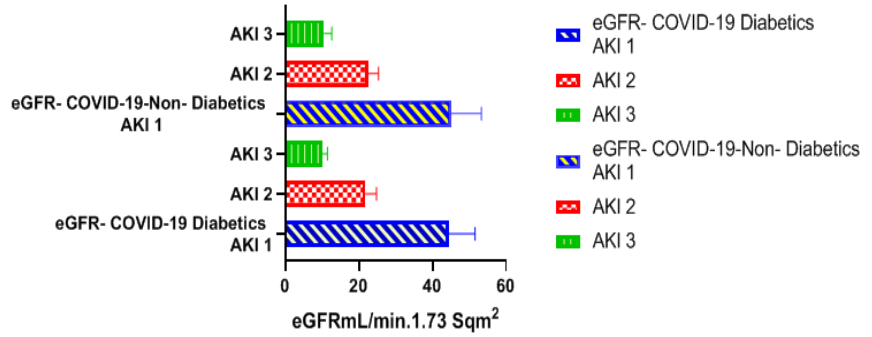


Figure 4- Values eGFR in COVID-19 Diabetic and Non diabetic ICU patients



Discussion

COVID-19 pandemic has ruined the world due to its adverse effects on human systems, the effect of this virus on human systems are not explored effectively. We tried to explore the impact of novel corona virus on kidney functions and comorbidity which may drag the patients to unknow causes of death. To achieve the objective, we decided to estimate the levels of creatinine, urine output mL/Kg/ Hour and eGFR to study the impact ofnovel corona virus on 96 ICU patients admitted in our special ICU made for it. We found the levels of creatinine increased in all type AKI whether they are diabetics or non-diabetics, there was an acceleration of kidney dysfunction in diabetic patients suffering with COVID-19 when compared to COVID-19 non-diabetic group. Studies and systematic reviews agree to our findings, have confirmed 20%-40% incidence of acute renal injury in COVID-19 patients. Data now being published shows that recovery is slower in some cases and complications requiring dialysis occur in others [3]. Lilian Caroline Goncalves de Oliveira, a co-author of the article,analyzed the role of ACE2 (Angiotensin Converting Enzyme 2) in the pathogenesis of COVID-19 [9]. Highlighted the importance of the ACE2 receptor to cell invasion by SARS-CoV-2. The interaction between the receptors and virus prevents ACE2 from performing its protective functions [9]. Recent articles quoted that the mechanism of renal involvement in COVID-19 may be

multifactorial, the virus may indirectlyinjure the kidneys by hypoxemia, systemic inflammation,shock, hypotension and renin-angiotensin system imbalance[9-20]. To prove the association,we analyzed the level of creatinine in our studies, an increased level wasobserved in both groups of COVID-19 Diabetic and Non-Diabetic group is in agreement with other studies[10-15]. The percentage of patients suffered the loss of kidney functions were categorized according to KDIGO criteria was 70.83% in AKI 1, 16.66% in AKI 2 and 8.33% in AKI 3 in accordance with previous studies [15-20].In our study we found more loss of kidney functions in COVID-19 affected diabetic group which is in agreement with other researchers [7]. There was no data published on the urine output and eGFR in COVID-19patients till now. We found an association between COVID-19 and urine output decrease of eGFR.According to KDIGO criteria increase in creatinine and decrease urine output will define the stages of acute kidney injury (AKI), we were successful to categorize COVID-19 infected diabetic and nondiabetic groups.

Conclusion

Estimation of serum creatinine, urine output and calculation of eGFR may be a useful tool for identifying the severity of kidney injury in COVID-19 diabetic patients, helps to draw algorithms for the line of treatment in these vulnerable population and timely intervention may prevent mortality. More studies are warranted with a cluster-basedsample size in COVID-19 patients.

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