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The Effect of Estimated Glomerular Filtration Rate on Mortality in the Elderly COVID-19 Patients in the Intensive Care Unit

Yoğun Bakımda Yatan Yaşlı COVID-19 Hastalarında Tahmini Glomerüler Filtrasyon Hızının Mortaliteye Etkisi

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Abstract

Aim: Acute kidney injury (AKI) has been reported in patients with COVID-19 pneumonia and associated with higher mortality. Our study aimed to determine the relationship of eGFR during admission to the intensive care unit with mortality and clinical outcomes in the elderly COVID-19 patients.

Material and Method: This study in which the elderly patients were included was retrospectively performed in a single-center intensive care unit (ICU).

Results: A total of 152 patients including 75 female and 77 male patients were included in the study. Mean age of the patients was 74.3±7.3 years. The number of patients was 92 (60.5%) in eGFR Stage 1-2, 15 (9.9%) in Stage 3a, 26 (17.1%) in Stage 3b, and 19 (12.5%) in Stage 4-5. The rate of patients who received invasive mechanical ventilation was 40.8% and hospital mortality rate was 48.7%. According to the multivariate logistic regression analysis, eGFR, LDH, Charlson score, and duration of stay in the intensive care unit were effective on mortality. Compared to eGFR Stage 1-2 patients, the mortality risk was 4.836 times higher in Stage 3a patients, 12.233 times higher in Stage 3b patients and 10.242 times higher in Stage 4-5 patients.

Conclusion: Our results revealed that COVID-19 patients' eGFR during admission to the intensive care unit, LDH, Charlson score, and duration of stay in the intensive care unit were effective on mortality.

Keywords: COVID-19, intensive care unit, acute kidney injury, mortality

Öz

Amaç: Akut böbrek hasarı(AKI), COVID-19 pnömonisi olan hastalarda bildirilmiştir ve daha yüksek mortalite ile ilişkilidir. Çalışmamızın amacı yaşlı COVID-19 hastalarında yoğun bakıma yatıştaki eGFR ile mortalite ve klinik sonuçlar arasındaki ilişkiyi belirlemektir.

Gereç ve Yöntem: Yaşlı katılımcıların dahil edildiği bu çalışma, tek merkezli bir yoğun bakım ünitesinde (YBÜ) retrospektif olarak yapıldı.

Bulgular: Çalışmaya 75 kadın ve 77 erkek olmak üzere toplam 152 hasta dahil edildi. Hastaların yaş ortalaması 74,3±7,3 yıl idi. eGFR için Evre 1-2'deki hasta sayısı 92 (%60,5), Evre 3a'daki hasta sayısı 15 (%9,9), Evre 3b'deki hasta sayısı 26 (%17,1) ve Evre 4-5'deki hasta sayısı 19'dur (%12,5). İnvaziv mekanik ventilatör uygulanan hastalar %40,8, hastane mortalitesi %48.7 idi. Yapılan multivariate logistic regression analizine göre eGFR, LDH, Charlson skoru ve yoğun bakım yatış süresi mortalite üzerine etkili bulunmuştur. eGFR Evre 1-2'de olan hastalara göre mortalite riski Evre 3a hastalarında 4.836 kat, Evre 3b hastalarında 12.233 kat ve Evre 4-5 hastalarında 10.242 kat fazladır.

Sonuç: Bulgularımız, COVID-19 hastalarının yoğun bakım ünitesine başvuru anında eGFR, LDH, Charlson skoru ve yoğun bakım yatış süresi mortalite üzerine etkili bulunmuştur.

Anahtar Kelimeler: COVID-19, yoğun bakım ünitesi, akut böbrek hasarı, mortalite

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INTRODUCTION

Severe Acute Respiratory Syndrome Coronavirus-2 (SARS-CoV-2), commonly known as "COVID-19", was accepted as a public health emergency of international concern by the World Health Organization (WHO) on the 11th of March 2020.[1] Acute kidney injury (AKI) is one of the most common extrapulmonary complications of this disease and according to a study performed on patients hospitalized with COVID-19, AKI occurred in variable severity in 46% of these patients.[2] Pathophysiology of AKI reveals that it is a result of both direct and indirect effects of SARS-CoV-2 infection including systemic inflammatory responses, activation of Renin-Angiotensin-Aldosterone-System (RAAS), endothelial dysfunction, and coagulation.[3]

The estimated glomerular filtration rate (eGFR) is a calculation based on serum creatinine, age, race, gender, and body size and used as a measurement of kidney function.[4] It has been defined as the sign of mortality in COVID-19 patients and non-COVID-19 patients who had both acute and chronic kidney disease (CKD).[5]

Kidney failure represents a para-physiological case secondary to aging with an annual decrease of approximately 1 mL/min in GFR. Additionally, metabolic comorbidities such as diabetes mellitus and hypertension negatively affect renal function and cause a more rapid decrease in GFR.[6]

Our study aimed to determine the relationship of eGFR during admission to the intensive care unit with mortality and clinical outcomes including the duration of hospital stay and duration of stay in the intensive care unit in the elderly COVID-19 patients.

MATERIAL AND METHOD

This study was retrospectively performed in a single-center intensive care unit (ICU) between August 2020 and February 2021. Inclusion criteria of the study were as follows: being diagnosed with COVID-19 (positive SARS-CoV-2 reverse transcriptase-polymerase chain reaction (RT-PCR) test and thorax CT compatible with COVID-19 infection) and being at the age of 65 and above.

Patients under the age of 65, patients with chronic renal failure, patients with advanced malignancy, patients with hematologic malignancy, patients with acute myocardial infraction, and patients with acute ischemic or hemorrhagic stroke were excluded from the study. This study was performed in accordance with the principles of the Declaration of Helsinki and approved by the institutional ethics committee (Date: 20/12/2022, Number: 766).

Data were collected from medical records of patients. Demographic characteristics, presence of comorbidity, eGFR, troponin, WBC, lymphocyte, neutrophil, platelet count, INR, D-dimer, ferritin, lactate dehydrogenase (LDH), lactate, PaO_2/FiO_2 ratio, disease severity scores, Glasgow Coma Scale (GCS), Charlson Comorbidity Index (CCI), Sequential Organ Failure Assessment (SOFA), Acute Physiology and Chronic Health Evaluation II (APACHE II), need for Mechanical Ventilation (MV) (Invasive), number of days with ventilation, duration of hospital stay, duration of stay in the ICU, hospital mortality, and need for dialysis were recorded during admission to the intensive care unit. Patients were divided into two groups as surviving and non-surviving patients. The two groups were compared according to their demographic data, comorbidities, characteristics during admission, lab results, eGFR value, need for invasive MV, need for dialysis, duration of hospital stay, and duration of stay in the intensive care unit.

eGFR Measurement

eGFR value of the participants were obtained from their medical records. eGFR was calculated based on the Modifcation of Diet in Renal Disease (MDRD) formula.[7]

Kidney function was assessed as eGFR during admission to the intensive care unit and categorized as follows: Stage 1 and 2 (from normal kidney function to mildly decreased kidney function, eGFR ≥ 60 ml/min/1.73m²); Stage 3a (mildly to moderately decreased kidney function, eGFR ≥ 45-59 ml/min/1.73m²); Stage 3b (moderately to severely decreased kidney function, eGFR 30-44 ml/min/1.73m²); and Stage 4 and 5 (severely decreased kidney function to very severe kidney failure, eGFR 1-29 ml/min/1.73m²).[8]

Statistical Analysis

Data were assessed on IBM SPSS Statistics Standard Concurrent User V 26 (IBM Corp., Armonk, New York, USA) and MedCalc® Statistical Software version 19.6 (MedCalc Software Ltd, Ostend, Belgium) programs. Descriptive statistics were expressed as number of units (n), percentile (%), mean±standard deviation (mean±sd), median (M), minimum (min), maximum (max), and interquartile range (IQR) values. Normal distribution of data of the numerical variables was assessed with Shapiro–Wilk normality test. Normally distributed numerical data of the exitus and discharged patients according to the hospital outcomes were compared with independent samples t test and non-normally distributed numerical data were compared with Mann-Whitney U test. Comparison of the exitus and discharged patients according to the hospital outcomes was performed with Pearson's chi-square or Fisher's exact test. Performance of eGFR in predicting mortality was assessed with the Receiver Operating Characteristics (ROC) curve analysis. $p<0.05$ was accepted as the statistically significant value.

RESULTS

A total of 152 patients including 75 (49.3%) female and 77 (50.7%) male patients were included in the study. Mean age of the patients was 74.3±7.3 years and their ages ranged from 65 to 93 years. As comorbidities, 59 patients (38.8%) had diabetes, 85 (55.9%) had hypertension and 35 (23.0%) had chronic pulmonary disease. The number of patients was 92 (60.5%) in

Stage 1-2 for eGFR, 15 (9.9%) in Stage 3a, 26 (17.1%) in Stage 3b, and 19 (12.5%) in Stage 4-5. The number of patients who received invasive mechanical ventilation was 62 (40.8%) and hospital mortality rate was 48.7% (74 patients) (**Table 1**).

There was no statistical difference between the exitus and discharged patients in terms of gender, age and BMI values. For comorbidities, hypertension distributions were statistically different according to hospital outcomes. Thirty (50.8%) of patients with hypertension and 26 (38.8%) of patients without hypertension were exitus. The rate of patients who were exitus was higher among patients with hypertension than among patients without hypertension. eGFR distributions were statistically different according to hospital outcomes. Mortality rate was statistically higher in Stage 3a, Stage 3b and Stage 4-5 than in Stage 1-2. Troponin values during admission were statistically higher in exitus patients than in discharged patients. There was no statistical difference between exitus and discharged patients in terms of neutrophil and platelet values. However, N/L and INR values were statistically higher in exitus patients (**Table 2**).

Table 1: Descriptive Characteristics of Patients (N=152)

Variables	Statistics
Gender, n (%)	
Female	75 (49.3)
Male	77 (50.7)
Age, (year)	74.3±7.3 (65-93)*
BMI, (kg/m²)	27.71±4.68
Comorbidities, n (%)	
Diabetes	59 (38.8)
Hypertension	85 (55.9)
CAD	31 (20.4)
CVD	23 (15.1)
COPD	35 (23.0)
Liver Disease	4 (2.6)
Malignancy	3 (2.0)
eGFR, n (%)	
Stage 1-2	92 (60.5)
Stage 3a	15 (9.9)
Stage 3b	26 (17.1)
Stage 4-5	19 (12.5)
Troponin during admission	21.0 (32.9)
WBC	11.65 (7.11)
Lymphocyte	0.68 (0.61)
Neutrophil	10.38 (7.35)
Platelet	245.5 (144.7)
INR	1.13 (0.21)
D-Dimer	1700 (2696)
Ferritin	643 (861)
LDH	469 (272)
Lactate	1.70 (1.30)
PaO_2/FiO_2	84.0 (114.2)
GCS during admission	15 (3)
CHARLSON score	4 (2)
SOFA during admission	5 (3)
APACHE II during admission	14 (9)
Mechanical ventilation, n (%)	
Yes	90 (59.2)
No	62 (40.8)
Number of days with ventilation	7 (8)
Duration of hospital stay	15 (16)
Duration of stay in the ICU	10 (9)
Hospital outcome - ex, n (%)	74 (48.7)

Numerical data are given as mean±standard deviation or median (interquartile range) values. *(minimum-maximum) values. BMI:Body Mass Index, CAD:Coronary Artery Disease, CVD:Verebro Vascular Disease,COPD:Chronic Obstructive Pulmonary Disease; WBC: white Blood Cell, INR: International Normalized Ratio,LDH: Lactate Dehydrogenase,PaO_2/FiO_2: Ratio of Arterial Oxygen Partial Pressure to Fractional İnspired Oxygen,GCS: Glasgow Coma Score,SOFA: sequential Organ Failure Assessment, APACHE II: Acute Physiology and Chronic Health Evaluation II, ICU: Intensive Care Unit

Table 2: Comparison of Variables according to the Hospital Outcomes

	Hospital Outcome		Test Statistics	
	Exitus	Discharged	Test value	p value
Gender, n (%)			2.146	0.143†
Female	32 (42.7)	43 (57.3)		
Male	42 (54.5)	35 (45.5)		
Age, (year)	75.1±7.2	73.6±7.4	1.245	0.215&
BMI, (kg/m²)	28.09±4.9	27.34±4.37	0.979	0.329&
Comorbidities, n (%)				
Diabetes			0.181	0.671†
No	44 (47.3)	49 (52.7)		
Yes	30 (50.8)	29 (49.2)		
Hypertension			4.680	0.031†
No	26 (38.8)	41 (61.2)		
Yes	48 (56.5)	37 (43.5)		
CAD			1.372	0.242†
No	56 (46.3)	65 (53.7)		
Yes	18 (58.1)	13 (41.9)		
CVD			0.294	0.655†
No	64 (49.6)	65 (50.4)		
Yes	10 (43.5)	13 (56.5)		
Chronic Pulmonary Disease			1.302	0.335†
No	54 (46.2)	63 (53.8)		
Yes	20 (57.1)	15 (42.9)		
Liver Disease			0.003	>0.999†
No	72 (48.6)	76 (51.4)		
Yes	2 (50.0)	2 (50.0)		
Malignancy			0.289	>0.999†
No	73 (49.0)	76 (51.0)		
Yes	1 (33.3)	2 (66.7)		
eGFR, n (%)			42.103	<0.001†
Stage 1-2	26 (28.3)[a]	66 (71.7)		
Stage 3a	10 (66.7)[b]	5 (33.3)		
Stage 3b	21 (80.8)[b]	5 (19.2)		
Stage 4-5	17 (89.5)[b]	2 (10.5)		
Troponin during admission	27.0 (43.7)	17.8 (19.2)	2.768	0.006‡
WBC	11.17 (7.79)	11.89 (7.80)	0.190	0.849‡
Lymphocyte	0.64 (0.45)	0.74 (0.92)	2.038	0.042‡
Neutrophil	9.83 (7.22)	10.08 (7.62)	0.219	0.827‡
NLR	15.07 (17.02)	13.17 (12.66)	2.072	0.038
Platelet	220.0 (161.5)	252.00 (141.25)	1.301	0.193‡

%: Row percent, Numerical data are given as mean±standard deviation or median (interquartile range) values, †: Chi square test, &: Independent samples t test, ‡: Mann-Whitney U test. a and b superscripts indicate differences between categories in each column. There is no statistically significant difference between groups with the same superscripts.BMI:Body mass index, CAD:Coronary artery disease, CVD:cerebrovascular disease, eGFR:Estimated Glomerular Filtration Rate, WBC: white blood cell, NLR: Neutrophil-to-lymphocyte ratio

Ferritin, LDH, AST, procalcitonin, CHARLSON score, SOFA score during admission and APACHE scores during admission were statistically higher in exitus patients than in discharged patients. Lymphocyte, PaO_2/FiO_2 and PO_2 values and duration of hospital stay were statistically lower in exitus patients than in discharged patients. The rate of patients who were exitus was statistically higher in patients who received invasive Mechanical ventilation compared to the patients who did not receive MV. The rate of patients who were exitus was statistically higher among patients who needed dialysis compared to the patients who did not need dialysis (**Table 2**).

In single-variable comparisons performed according to hospital outcomes in **Table 2**, the variables with p<0.25 value were analyzed with multivariate binary logistic regression analysis. Backward Wald elimination method was used to determine terminal factors effective on mortality. According to **Table 3**, eGFR, LDH, Charlson score, and duration of stay in the intensive care unit were effective on mortality. Compared to eGFR Stage 1-2 patients, the mortality risk was 4.836 times higher in Stage 3a patients, 12.233 times higher in Stage 3b patients and 10.242 times higher in Stage 4-5 patients. The mortality risk increased as LDH, Charlson score and duration of stay in the intensive care unit increased. According to Hosmer-Lemeshow test, the established model provided the goodness-of-fit (p=0.417). Variables in the model revealed the mortality rate as 54.1% (**Table 3**).

Table 2: Comparison of Variables according to the Hospital Outcomes

	Hospital Outcome		Test Statistics	
	Ex	Discharged	Test value	p value
INR (continued)	1.17 (0.28)	1.08 (0.16)	3.140	0.002‡
D-Dimer	2210 (2781)	1473 (2176)	1.346	0.178‡
Ferritin	782 (1235)	511 (649)	3.197	0.001‡
LDH	557 (350)	399 (266)	3.989	<0.001‡
Lactate	1.70 (1.33)	1.50 (1.13)	1.715	0.086‡
PaO_2/FiO_2	77.2 (31.2)	150.0 (144.7)	4.633	<0.001‡
Hemoglobin	12.75 (3.15)	12.30 (2.03)	0.382	0.703‡
Fibrinogen	6440 (1880)	5700 (2930)	1.070	0.285‡
AST	39.00(26.0)	27.5 (20.2)	3.533	<0.001‡
ALT	22.0 (20.5)	22.0 (23.2)	0.680	0.497‡
GGT	41.5 (42.7)	37.5 (54.7)	0.900	0.368‡
CRP	103.5 (138.9)	86.7 (132.0)	1.513	0.130‡
Procalcitonin	0.32 (0.66)	0.16 (0.44)	3.167	0.002‡
PH	7.40 (0.13)	7.42 (0.11)	1.796	0.072‡
PaO_2	63.0 (27.5)	68.0 (20.5)	1.994	0.046‡
GCS during admission	15 (5)	15 (2)	1.410	0.159‡
CHARLSON score	5 (3)	4 (3)	3.762	<0.001‡
SOFA during admission	6 (4)	4 (1.2)	5.355	<0.001‡
APACHE II during admission	16 (12)	12 (6.2)	4.342	<0.001‡
Mechanical Ventilation, n (%)				
No	18 (20.0)	72 (80.0)	72.668	<0.001†
Yes	56 (90.3)	6 (9.7)		
Number of Days with Ventilation	7 (8)	7 (16)	0.066	0.957‡
Need for Dialysis, n (%)				
No	61 (44.9)	75 (55.1)	7.513	0.008†
Yes	11 (84.6)	2 (15.4)		
Duration of hospital stay	13.0 (15.5)	17.5 (16.2)	1.992	0.046‡
Duration of stay in the ICU	10.0 (12.5)	9.5 (8.5)	1.372	0.170‡

%: Row percent, Numerical data are given as mean±standard deviation or median (interquartile range) values, †: Chi square test, &: Independent samples t test, ‡: Mann-Whitney U test.INR: International Normalized Ratio, LDH: Lactate dehydrogenase, PaO_2/FiO_2: Ratio of arterial oxygen partial pressure to fractional inspired oxygen, AST: aspartate aminotransferase, ALT: alanine aminotransferase, GGT:Gama Glutamil Transferaz, CRP: C-reactive protein, GCS: Glasgow coma score, SOFA: sequential organ failure assessment, APACHE II: Acute Physiology and Chronic Health Evaluation II, ICU: Intensive Care Unit;

Table 3: Assessment of factors affecting mortality with Multivariate Binary Logistic Analysis

	Regression Coefficients						
	β	Standard Error	Wald statistics	p	Exp(β)	95% Confidence Interval for exp(β)	
						Lower Bound	Upper Bound
Constant	-5.988	1.230	23.713	<0.001	0.003		
eGFR							
Stage 1-2	Ref						
Stage 3a	1.576	0.737	4.569	0.033	4.836	1.140	20.517
Stage 3b	2.504	0.768	10.633	0.001	12.233	2.716	55.107
Stage 4-5	2.327	0.959	5.884	0.015	10.242	1.563	67.115
LDH	0.005	0.001	11.984	0.001	1.005	1.002	1.008
Charlson score	0.358	0.156	5.260	0.022	1.431	1.053	1.943
Duration of stay in ICU	0.096	0.033	8.516	0.004	1.101	1.032	1.175

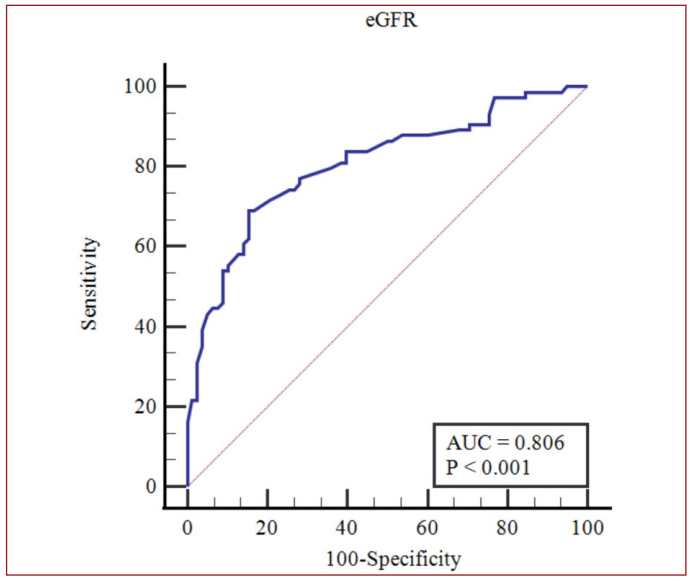
Variables in the model: gender, age, hypertension, CAD, eGFR, Troponin during admission, lymphocyte, platelet, INR, D_dimer, ferritin, LDH, Lactate, PaO_2/FiO_2, glucose, CRP, procalcitonin, PH, PO_2, GCS_ during admission, CHARLSON_score, SOFA_ during admission, APACHE_ during admission, Mech. vent, duration of hospital stay, duration of stay in ICU, need for dialysis. Model Statistics: Hosmer and Lemeshow Test $\chi2$=8.166; p=0.417; Nagelkerke R2=0.541 Elimination Method: Backward Wald. eGFR:Estimated Glomerular Filtration Rate, LDH: Lactate dehydrogenase, ICU: Intensive Care Unit

When the performance of eGFR in predicting mortality was assessed by ROC Curve Analysis, it had 68.9% sensitivity and 84.6% specificity when eGFR was ≤60.0 in predicting mortality (**Table 4**, **Graph 1**).

Table 4: Assessment of the performance of eGFR in predicting mortality with ROC Curve Analysis

	AUC (95.0% CI)	p	Cutoff	Sensitivity (95.0% CI)	Specificity (95.0% CI)
eGFR	0.806 (0.734-0.865)	<0.001	≤60.0	68.9 (57.1-79.2)	84.6 (74.7-91.8)

AUC: Area under the curve, CI: Confidence interval, eGFR:Estimated Glomerular Filtration Rate



Graph 1: ROC curve for eGFR in predicting mortality

DISCUSSION

In a study including 152 patients above the age of 65 who were followed up with severe COVID-19 in the intensive care unit of a tertiary care hospital, hospital mortality rate was 48.7% and eGFR was <60 ml/min/1.73m² in 39.5% of the patients. Most of the previous studies used a paired comparison to compare Stage 1-2 with Stage 3a, 3b, 4 and 5 and revealed the relationship between eGFR and mortality.[9,10] A more detailed classification was performed in our study.

In our study, mortality rate was higher among patients with hypertension. In addition, ferritin, LDH, AST, procalcitonin, Charlson score, SOFA score during admission, and APACHE score during admission were higher and lymphocyte and PaO_2/ FiO_2 ratio were lower in patients who were exitus. In an international multicenter study including a total of 758 adult COVID-19 patients, 8.5% of the patients had chronic renal failure history and kidney dysfunction was reported in 30% of the patients during admission (eGFR < 60 mL/min/1.73m²). It was reported in the multivariate analysis that age, hypertension, renal dysfunction, oxygen saturation<92%, and high LDH during admission independently predicted all-cause mortality, which is similar to the findings in our study.[9]

In our study, mortality rate was higher in patients who needed invasive MV and dialysis. In a multi-center retrospective study performed on critical COVID-19 patients, 85.1% of 1286 patients had AKI and kidney replacement therapy was used in 9.8% of them. Advanced age, obesity, higher APACHE II score, and use of mechanical ventilation in the 1st day of intensive care unit stay were associated with the increasing risk of AKI. All AKI stages were associated with ICU mortality in the multivariate analysis.[11] In our study, logistic regression analysis revealed that eGFR, LDH, Charlson score, and duration of stay in the intensive care unit were effective on mortality and compared to eGFR Stage 1-2 patients, the mortality risk was 4.836 times higher in Stage 3a patients, 12.233 times higher in Stage 3b patients and 10.242 times higher in Stage 4-5 patients. The mortality risk increased as LDH, Charlson score and duration of stay in the intensive care unit increased.

Pathophysiology of AKI in critical COVID-19 is multifactorial. Acute tubular injury is the most common histologic finding; however, collapsing glomerulopathy and thrombotic microangiopathy were observed in this population. Other rare findings such as anti-neutrophil cytoplasmic antibody vasculitis, anti-glomerular basement membrane disease and podocytopathies were also reported.[12-14] As well as endothelial dysfunction, complement activation and local and systemic inflammatory responses may also play role. Renal tropism of SARS-CoV-2 with direct invasion of kidney is recommended, but it is controversial.[15] In critical COVID-19, indirect factors such as presence of hypoxemia, hypotension, hypo or hypervolemia and also use of high positive end expiratory pressure mechanical ventilation or high inspiration pressure and nephrotoxic drugs may also have contribution.[12,14]

In a study performed by Aukland et al. on 361 COVID-19 patients in Norway, AKI was detected during admission to the intensive care unit in 32.0% of patients. Age, acute circulatory failure during admission to hospital and AKI during admission to ICU were reported as determinants of both 30-day and 90-day mortality.[16] In systematic review and meta-analysis of 54 studies, AKI occurred in about 30% of the patients who were hospitalized with COVID-19, the course of >45% of patients who needed intensive care became complicated and 1 out of 5 patients who were admitted to the intensive care unit received kidney replacement therapy.[17]

In a study by Fisher et al., the incidence of acute kidney injury was compared in patients who were hospitalized with COVID-19 and without COVID-19 and the incidence of acute kidney injury was found higher in COVID-19 patients compared to the control group (56.9% vs. 25.1% respectively).[18] In a meta-analysis by Fabrizi et al., the incidence rate of acute kidney injury in patients with severe COVID-19 was 53% (95% CI: 42.7-63.3%).[19] Similar results were found in the meta-analysis by Hansrivijit et al.. They reported that the incidence of acute kidney injury was higher in critical patients compared to the other COVID-19 patients (7.3% vs. 19.9%).[20]

Chan et al. found in their study that in-hospital mortality rate was 50% in COVID-19 patients with acute kidney injury and 8% in those without acute kidney injury.[2] Lin et al. revealed in their meta-analysis that acute kidney injury in patients who were hospitalized with COVID-19 was associated with a significant increase in the mortality risk.[21] Similar results were found in the study performed by Fisher et al. on 3,345 patients with COVID-19. According to their study, mortality rate was significantly higher in patients with COVID-19 and acute kidney injury compared to the patients who were hospitalized with COVID-19 (33.7% vs. 9.3% respectively).[18] In the meta-analysis of 142 studies performed by Fu et al. on 49,048 patients who were hospitalized with COVID-19, a significant increase was observed in mortality risk in patients with accompanying acute kidney injury.[22] In our study, when eGFR was evaluated by ROC Curve Analysis, it had 68.9% sensitivity and 84.6% specificity when eGFR was ≤60.0 in predicting mortality.

A total of 152 patients who were admitted to the intensive care unit were included in this retrospectively performed single-center study, which limits the study to be generalized. Only electronic health record systems were used to define AKI in this study. AKI was classified using only eGFR for main analysis, not the urinary criteria, which may have caused AKI rate to seem lower. In addition, we did not have the data of patients after their discharge. Therefore, we could not assess the effects of COVID-19 on long-term survival and kidney function.

CONCLUSION

Our data revealed that COVID-19 patients' eGFR value during admission to the intensive care unit, LDH, Charlson score and duration of stay in the intensive care unit were effective on mortality. Therefore, clinicians in developing countries should increase their awareness on kidney disease in severe COVID-19 patients and focus on increasing primary prevention and population training in order to use preventive measures against COVID-19. It is also recommended to perform further similar studies with larger sample size.

ETHICAL DECLARATIONS

Ethics Committee Approval: The study was carried out with the permission of Kayseri City Training and Research Hospital Clinical Researches Ethics Committee (Date: 20/12/2022, Number: 766).

Informed Consent: All patients signed the free and informed consent form.

Referee Evaluation Process: Externally peer-reviewed.

Conflict of Interest Statement: The authors have no conflicts of interest to declare.

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