RESEARCH ARTICLE

Analysis of COVID-19 patients in emergency intensive care unit: Retrospective study

Harun Yildirim, Murtaza Kaya

Abstract

Objective: To investigate the role of various parameters in predicting mortality among coronavirus disease-2019 patients.

Method: The retrospective study was conducted at the Emergency Department of Evliya Çelebi Training and Research Hospital, Turkiye, and comprised medical records from November 1, 2020, to April 30, 2021, of patients aged 18 and above who were admitted to the pandemic intensive care unit. Demographic information, comorbid conditions, selected haemogram parameters and ratios, acute-phase reactants, and biochemical markers were recorded along with outcomes. Data was analysed using SPSS 20.

Results: Of the 164 patients, 91(55.5%) were males and 73(44.5%) were females. Of them 101(61.6%) died; 52(71.2%) females and 49(53.8%) males with mean age 73.98+/-11.73 years. The remaining 63(38.4%) were discharged; 42(46.2%) males and 21(28.8%) females with mean age 67.69+/-13.05 years ($p<0.05$). Lymphocyte count, C-reactive protein, ferritin, D-dimer, neutrophil-lymphocyte ratio, lymphocyte-C-reactive protein ratio, urea, sodium and potassium levels were significantly different between the groups ($p<0.05$).

Conclusion: In the monitoring of coronavirus disease-2019 patients in critical care settings, age, gender and laboratory values are the parameters that can be used for predicting mortality.

Key Words: COVID-19, Mortality prediction, Emergency medicine, Acute-phase reactants, Intensive care units.

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Introduction

In late 2019, a novel coronavirus causing a series of pneumonia cases emerged in Wuhan, a city in the Hubei province of China. This virus rapidly spread worldwide, leading to a global pandemic. Due to its similarity to the Severe Acute Respiratory Syndrome (SARS) coronavirus, it was named SARS coronavirus-2 (SARS-CoV-2), and the associated disease was termed coronavirus disease-2019 (COVID-19).[1] While COVID-19 was often mild or asymptomatic in most cases, it caused significant mortality and morbidity in some individuals.[2] Common symptoms include cough, fever, muscle aches and headache, and, less frequently, symptoms such as diarrhoea, sore throat and abnormalities in taste/smell. Pneumonia is the most common severe manifestation of the infection, characterised by fever, cough, shortness of breath, and clinical findings of bilateral infiltrations on lung imaging.[3-5] Although the majority of COVID-19 cases are mild, around 20% of infected individuals require hospitalisation for a severe illness, and approximately 5-8% may necessitate admission to an intensive care unit (ICU).[2,3,6] Over time, there has been a decrease in the rate of ICU admissions. Adherence to preventive measures against the disease, the development of new treatments, increased use of pre-intensive care non-invasive mechanical ventilation, rising vaccination rates, and changing demographic characteristics of the infected population are considered reasons for this decrease.[7,8] Patients with severe pneumonia, acute respiratory distress syndrome (ARDS), sepsis, cardiac damage, and multiorgan failure should be admitted to and treated in the ICU. Age, comorbidities, gender, socioeconomic status, high fever (>39°C), blood type, certain laboratory tests, and the type of virus are important risk factors predicting the progression to ARDS and mortality.[9,10]

The current study was planned to investigate the role of various parameters in predicting mortality among COVID-19 patients.

Materials and Methods

The retrospective study was conducted at the Emergency Department of Evliya Çelebi Training and Research Hospital, Turkiye, and comprised medical records from November 1, 2020, to April 30, 2021, of patients aged 18 and above who were admitted to the COVID-19 ICU where the patients were managed solely by emergency medicine specialists. Records of patients with missing

Department of Emergency Medicine, Kutahya Health Sciences University, Kutahya, Turkiye

Correspondence: Harun Yildirim. **Email:** harun.yildirim@ksbu.edu.tr

ORCID ID: 0000-0002-9161-263X

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data, those lost to follow-up or transferred to another hospital, trauma patients, pregnant individuals, and children were excluded.

After approval from the ethics review committee of Kutahya Health Sciences University Rectorate, Turkiye, data was retrieved from patient follow-up files and the hospital information system. The patients were stratified into two groups based on their 30-day mortality status. Parameters noted included age, gender, comorbidities, an outcomes. Laboratory values included white blood cell (WBC) count, neutrophils, lymphocytes, platelets, haemoglobin (Hb), urea, creatinine, sodium, potassium, glucose, aspartate aminotransferase (AST), alanine transferase (ALT), C-reactive protein (CRP), D-dimer, ferritin, lactate, neutrophil-lymphocyte ratio (NLR), platelet-lymphocyte ratio (PLR), lymphocyte-CRP ratio (LCR), neutrophil-platelet ratio (NPR), and polymerase chain reaction (PCR).

Data was analysed using SPSS 20. Data normality was assessed using the Kolmogorov-Smirnov test. Data was presented as mean ± standard deviation for normally distributed quantitative variables, as median with interquartile range (IQR) for non-normally distributed quantitative variables, and as frequencies and percentage for categorical variables. Normally distributed variables were compared using student's t-test, non-normally distributed quantitative variables were compared using Mann-Whitney U test, and categorical variables were compared using chi-square test. P<0.05 was considered statistically significant.

Results

Of the 218 patients admitted from the emergency department to the pandemic ICU, 164(75.2%) were included (Figure); 91(55.5%) males and 73(44.5%) female. Overall, 101(61.6%) died; 52(71.2%) females and 49(53.8%) males with mean age 73.98+/-11.73 years. The remaining 63(38.4%) were discharged; 42(46.2%) males and 21(28.8%) females with mean age 67.69+/-13.05 years (p<0.05). Comorbidities were not significantly different between the groups (p>0.05) (Table 1).

Lymphocyte count, CRP, ferritin, D-dimer, NLR, LCR, urea, sodium and potassium levels were significantly different between the groups (Table 2).

Discussion

The current study investigated the clinical outcomes of critically ill COVID-19 patients admitted to the pandemic ICU, which was established in the early stages of the pandemic.

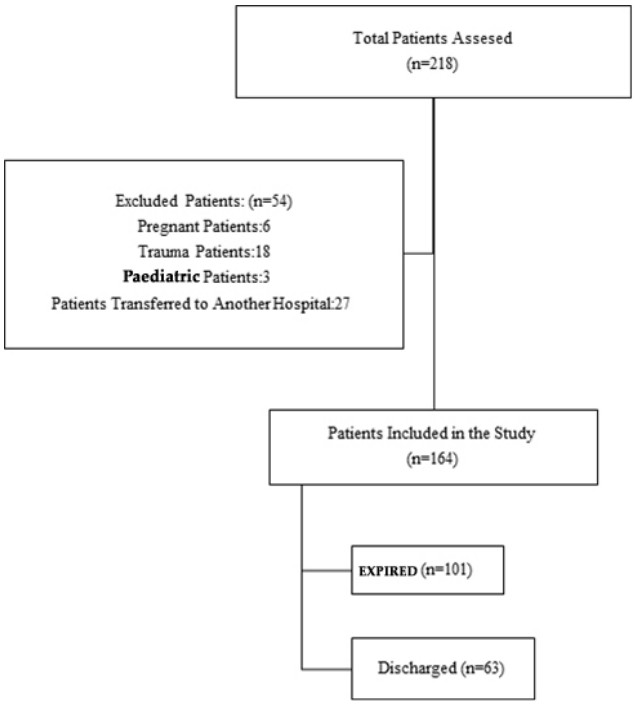

Figure: Study's flow diagram.

Table-1: The impact of demographic data and chronic diseases on mortality.

Outcome	Dead (n=101)	Discharged (n=63)	*p* Value
Gender			
Male (n=91)	71.2% (n=52)	46.2% (n=42)	0.023*
Female (n=73)	53.8% (n=49)	28.8% (n=21)	
Age	73.98±11.73	67.69±13.05	0.002**
CVD (n=23)	56.5% (n=13)	43.5% (n=10)	0.630*
HT (n=71)	59.2% (n=42)	40.8% (n=29)	0.670*
CAD (n=38)	47.4% (n=18)	52.6% (n=20)	0.050*
DM (n=56)	58.9% (n=33)	41.1% (n=23)	0.690*
Malignancy (n=10)	80% (n=8)	20% (n=2)	0.170*
CHF (n=28)	64.3% (n=18)	35.7% (n=10)	0.690*
COPD-Asthma (n=29)	62.1% (n=18)	37.9% (n=11)	0.890*
Other (n=23)	69.8% (n=16)	30.2% (n=7)	0.100*
Comorbid condition:			
YES	62.8% (n=91)	52.6% (n=10)	0.455*
NO	37.2% (n=54)	47.4% (n=9)	

* Chi-square test, **: Student's t-test.
CVD: Cardiovascular disease, HT: Hypertension, CAD: Coronary artery disease, DM: Diabetes mellitus, CHG: Congestive heart failure, COPD: Chronic obstructive pulmonary disease.

Ruchong C. et al. studied 1,590 hospitalised COVID-19 patients in China, finding higher mortality rates among the males and the elderly.[11] Jaillon S. et al. noted that women typically had stronger immune responses due to the X chromosome and sex hormones.[12] In contrast, the current study revealed a higher mortality rate in female patients, which may be linked to their older age and the

Table-2: Laboratory values and their association with mortality.

	Dead IQR (25-75)	Discharged IQR (25-75)	*p* Value
Leukocyte (10∧3/uL)	10,36 (7,46-15,37)	11,49 (8,18-16,43)	0,430*
Lymphocyte (10∧3/uL)	0,85 (0,47-1,49)	1,14 (0,72-1,80)	0,020*
Platelet (10∧3/uL)	228,00 (172,25-306,75)	238,50 (178,50-300,75)	0,390*
D-dimer (ng/ml)	3453,50 (1515,75-4281,00)	1584,50 (770,50-4183,25)	0,003*
CRP (mg/L)	147,29 59,57-214,62	43,67 17,14-151,10	0,001*
NLO	10,19 5,37-18,36	6,95 4,23-16,58	0,046*
PLO	255,05 152,50-400,37	202,72 127,14-328,95	0,089*
NPO	0,038 0,027-0,061	0,038 0,024-0,059	0,480*
LCR	0,007 0,0032-0,0213	0,0203 0,0057-01237	0,000*
Fibrinogen (mg/dl)	513,28±186,88	545,07±215,03	0,350**
Troponin-I (ng/L)	51,65 17,40-205,00	47,05 14,70-514,10	0,770*
Ferritin (ug/L)	241,50 105,00-686,00	128,00 75,00-321,00	0,040*
Lactate	2,15 1,40-4,10	2,30 1,40-2,90	0,510*
Urea (mg/dl)	77,00 46,50-104,00	55,00 35,50-82,00	0,003*
Creatinine (mg/dl)	1,37 0,96-1,92	1,12 0,97-1,59	0,090*
Sodium (mmol/L)	137 133-140	139 136-142	0,008*
Potassium (mmol/L)	4,55 4,06-5,20	4,27 3,90-4,74	0,006*
Glucose(mg/dl)	173 122,5-247,5	175 134-263	0,287*
AST (U/L)	41 28-73	35 24,5-52	0,081*
ALT (U/L)	24 16-38,5	28 15,5-42	0,489*
PCR			
Negative	%54,4	%45,6	0,098***
Pozitive	%67,1	%32,9	

*Mann-Whitney U test, ** Student's t-test, *** Chi-square test
IQR: Interqurtile range, CRP: C-reactive protein, NLO: Neutrophil-lymphocyte ratio, PLO: Platelet-lymphocyte ratio, NPO: Neutrophil-platelet ratio, LCR: Lymphocyte-CRP ratio, AST: Aspartate aminotransferase, ALT: Alanine aminotransferase, PCR: Polymerase chain reaction.

presence of comorbidities. Aisha D. et al. associated comorbidities, like obesity and hypertension, with poor COVID-19 outcomes.[13] The current study observed higher mortality in patients with comorbidities, though not statistically significant.

Literature shows that neutrophil counts serve as a predictive marker for clinical outcomes in hospitalised COVID-19 patients.[14] A meta-analysis found a strong correlation between NLR and disease severity and mortality, with patients having a high NLR experiencing more severe disease and higher mortality rates.[15] In the current study, a statistically significantly higher NLR ratio was found in deceased patients.

Kun L. et al. found that lymphocyte counts were suppressed in severe COVID-19 cases.[16] Ana Paula D. Iwamura et al. demonstrated higher CRP values in patients with severe disease[17], and elevated ferritin levels have been linked to ARDS and mortality.[10] The current study corroborated these findings, showing lower lymphocyte counts and higher CRP and ferritin levels in deceased patients, indicating their potential use in mortality prediction.

Alexander L. et al. studied 413 COVID-19 patients in the United Kingdom and found the LCR comparable to CRP in predicting mortality, with lymphocyte, neutrophil and leukocyte counts performing even better. They reported that a low LCR was associated with poor outcomes.[18] The current study also showed a significantly lower LCR ratio in the deceased patients, suggesting its utility in mortality prediction.

Coagulation disorders are common in severe COVID-19, leading to imbalances in coagulation and fibrinolysis, and platelet dysfunction due to hyper-inflammation.[19] Elevated D-dimer levels were noted in severe cases.[5] The current study found significant increases in D-dimer levels among deceased patients, supporting its role as a mortality predictor.

In COVID-19, renal dysfunction can result from multiorgan failure due to direct viral invasion, systemic inflammation, or aggressive treatments. One study found acute kidney failure in one-fourth of hospitalised patients.[20] Another study showed significant decreases in kidney function and increased creatinine levels within 24 hours of hospitalisation, linked to acute kidney injury and in-hospital mortality.[21] The current study found elevated urea and creatinine levels in deceased patients, indicating acute kidney injury, although the increase in creatinine was not statistically significant.

COVID-19 also impacts the liver and cardiovascular system. Literature reports impaired liver function tests in severe cases, with a meta-analysis indicating a 24% prevalence of liver disease.[22] The virus can cause endothelial damage and increased vascular permeability, leading to cardiovascular complications.[23] A retrospective study found myocardial damage in hospitalised patients

correlated with higher mortality, along with elevated troponin-T levels and concurrent leucocytosis, lymphopenia and neutropenia.[24] In the current study, AST and Troponin-I levels were higher in deceased patients, but differences did not reach statistical significance, possibly due to the small sample size and the prevalence of comorbidities.

Significant electrolyte disturbances, particularly hyponatraemia and hypokalaemia, are common in COVID-19, especially in severe cases. These can arise from reduced intake, gastrointestinal losses, or renal loss due to kidney damage or diuretics. Giuseppe L. et al. found lower sodium and potassium levels in severe COVID-19 compared to mild cases.[25] In the current study, the deceased patients had decreased sodium levels, consistent with the literature, while elevated potassium levels may be linked to the prevalent renal insufficiency.

The current study has limitations of being a single-centre research with a small sample size and limited number of independent variables beyond demographic characteristics and laboratory parameters.

Conclusion

The course of COVID-19, while not as severe as in the early stages of the pandemic, is observed to have increased mortality with age. Although the presence of comorbidities did not significantly increase mortality, a higher rate of death was detected. Acute-phase reactants, such as CRP and ferritin, laboratory parameters, including lymphocyte count, D-dimer, NLR and LCR, as well as biochemical parameters, such as urea, sodium and potassium values, were more significant in predicting mortality.

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HY: Concept, planning, data collection, drafting, final approval and agreement to be accountable for all aspects of the work.

MK: Data collection, analysis, interpretation, drafting, final approval and agreement to be accountable for all aspects of the work.