https://doi.org/10.15218/zjms.2024.008

Predictors of mortality among critical COVID-19 patients admitted to the intensive care unit in the Sulaimani governorate in 2021, Iraq

Received: 26/07/2022 Accepted: 02/10/2022

Sherzad Ali Ismael [1*]

Abstract

Background and objective: There are many factors that influence mortality in critically ill patients with COVID-19 infection in the intensive care unit. The aim of this study was to investigate the risk factors that predict the mortalities of critical COVID-19 patients admitted to the intensive care unit in Sulaimani in 2021.

Methods: This is an observational retrospective study of critically ill patients with COVID-19 pneumonia admitted to the main intensive care unit of the Sulaimani government between June and December 2020. Overall baseline characteristics are presented based on the patient's survivors versus non-survivors. Mann-Whitney U test was used to compare whether there is a difference between survivors and non-survivors for the independent basic characteristics of the patients. Binary logistic regression was used to identify the predicted factors of survivors.

Results: A total of 220 patients were admitted to the intensive care unit, of whom 167 died, with a case fatality rate of 75.9%. The risk factors that predicted mortality in critical COVID-19 patients were an increasing age of more than 59 years (*P*-value = 0.008), comorbidities (*P*-value = 0.038), and a lack of use of antiviral drugs (*P*-value = 0.011). Whereas the factors significantly predicted a reduction in mortality were increasing oxygen saturation (*P*-value <0.001), systolic blood pressure (*P*-value = 0.002), non-invasive mechanical ventilation (facemask) (*P*-value = 0.001), and continuous positive airway pressure (*P*-value = 0.003).

Conclusion: The risk factors that predicted mortality in critical COVID-19 patients were increasing age, comorbidities, and a lack of use of antiviral drugs. Whereas increasing oxygen saturation, systolic blood pressure, non-invasive mechanical ventilation (facemask), and continuous positive airway pressure significantly predicted a reduction in the likelihood of death.

Keywords: COVID-19; mortality; Sulaimani; Iraq.

Introduction

The global pandemic of COVID-19 continues to have an impact on international health and healthcare delivery. To date, the World Health Organization (WHO) has recorded over 539 million cases worldwide, with the true number likely many times higher, and over 6 million confirmed deaths.[1] In February 2020, the COVID-19 pandemic was confirmed to have spread to Iraq. The mortality rate has been.[1] 08% in Iraq, with 2,334,375 confirmed cases and 25,229 deaths.[2] As of March 27, 2020, all 19 Iraqi governorates had confirmed cases, with the Iraqi Kurdistan Region accounting for 309 (26%) of those cases as of April 8, 2020.[3] COVID-19 has caused 144,463 confirmed cases and 3,178 deaths in Sulaimania since the outbreak began, accounting for 32.81% of cases and 42.65% of deaths in the Kurdistan region up to June 2022.[4] The highest number of patients in Sulaimani were male (63%),

[1] Kurdistan Board for Medical Specialties, Erbil, Iraq.
Correspondence: sherzadali71@yahoo.com

https://doi.org/10.15218/zjms.2024.008

and the age of the patients ± standard deviation (SD) was 60 ± 13.95 years old. Diabetes mellitus was the most common comorbidity among COVID-19 patients who died in Sulaimani between June and September 2020 (n = 57, 13%).[5]

The government of Sulaimani is located in the eastern-northern part of Iraq, near the Iraqi-Iranian border. It is linked to the Kurdistan region. It stands 2.895 feet above sea level. Mountains surround the governorate. Kirkuk is 140 kilometers to the east. The Dokan Dam is located 60 kilometers north of Sulaimani on the Minor Zab River. The Governorate has a population of (1.723.299) people, as well as 13 private hospitals, nearly 25 public hospitals, and 502 medical centers spread across its constituencies and districts.[6]

The emergence of coronavirus disease 2019 (COVID-19) has resulted in a high demand for intensive care services globally. However, the mortality rate of COVID-19 patients admitted to the intensive care unit (ICU) has remained high. The COVID-19 in ICU mortality is higher than that seen in ICU admissions with other viral pneumonias. Mortality from COVID-19 in the ICU was 41.6%, with evidence that this figure was decreasing as the pandemic advanced, according to an initial systematic review and meta-analysis of 24 observational studies that included 10,150 patients and were published by May 31, 2020. [7]

There are many factors that influence mortality in critically ill patients with COVID-19 infection in the ICU. Many studies have found that age, C-reactive proteins, lymphocytes at admission to the hospital, serum albumin, D-dimer, coexisting diabetes mellitus, SaO2, pulse rate, along with vasopressor requirements or renal replacement therapy.

Additionally, the factors that independently influenced mortality among critically ill COVID-19 patients were high activated partial thromboplastin time (aPTT) and international normalization ratio (INR), acidosis, and high ferritin.[8-11]

No clinical study has been conducted in the Iraqi Kurdistan Region since the beginning of the pandemic to investigate the predictors of mortality among critical COVID-19 patients admitted to the ICU.

A study analyzed different aspects of coronavirus disease (COVID-19) for patients who have coronavirus in Sulaimani to find out which aspects have an effect on patients' deaths using machine learning algorithms, but the predictive models of machine learning generally do not provide accuracy estimates for their individual predictions.[13]

Therefore, the aim of this study was to investigate the risk factors that predict the mortality rates of critical COVID-19 patients admitted to the ICU in Sulaimani in 2021.

Methods

We conducted an observational retrospective study of critically ill patients with COVID-19 pneumonia admitted to the main ICU of the Sulaimani government between June and December 2020. The ICU with 20 beds belongs to Shahid Dr. Hemn Hospital, one of the main teaching hospitals in Sulaimani, with a capacity of 164 beds and admitting about 20 patients each day.

The primary outcome of this study was ICU mortality between study periods. Mortality predictors of COVID-19 outcome were also identified using logistic regression.

The research ethics committee of the Kurdistan Board of Medical Specializations in Erbil approved the study protocol with the number 1076 on May 28, 2022.

We included all patients over 18 years old with a confirmed diagnosis of COVID-19 who had an acute infection with SARS-CoV-2 confirmed by real-time reverse transcriptase polymerase chain reaction (PCR) and were admitted to the ICU.

We collected all the data from patient files retrospectively: age, sex, temperature, heart rate, respiratory rates, systolic and diastolic blood pressure, medical history of chronic diseases, oxygen therapy types (non-invasive, invasive, and face mask),

https://doi.org/10.15218/zjms.2024.008

oxygen saturation at admission, routine blood tests (white blood and lymphocyte counts), C-reactive protein [CRP], and D-dimer), comorbidities (hypertension, diabetes mellitus, respiratory diseases, cardiovascular diseases, cerebrovascular diseases, malignancies, antibiotics, antivirals, and antifungal treatments received), duration of staying (in days) in ICU, and the patients' outcomes (not survived (died) in ICU vs discharged with survival).

Patients were treated during their hospitalization in accordance with the Iraqi Ministry of Health protocol for treating COVID-19 patients. Antiviral agents (favipiravir, remdesivir) were used in patients on supportive oxygen therapy who had radiographically confirmed severe bilateral pneumonia within 5-7 days of symptom onset. Favipiravir was given orally in two doses of 3200 mg the first day and 600 mg the following four days. Remdesivir was given intravenously, 200 mg the first day and 100 mg every 4-9 days. In patients with a moderate to severe clinical image with signs of gradual clinical deterioration or in patients with incipient or developed acute respiratory distress syndrome, corticosteroids (prednisone 0.5 mg/kg in two doses, methylprednisolone 1-2 mg/kg, and dexamethasone 6 mg/day) were used.[14]

Exclusion criteria included patients with SARS-CoV-2 who were admitted to the intensive care unit for reasons unrelated to COVID-19.

The data are checked for normality; both Kolmogorov-Smirnov and Shapiro-Wilk, as well as the Q-Q plot, showed that the data significantly deviated from a normal distribution. For this reason, non-parametric tests were used to analyze the data.

Overall baseline characteristics are presented based on the patient's survival status (survivors vs. non-survivors). Baseline independent factors likely to explain severe COVID-19 were identified. Mann-Whitney U test was used to compare whether there is a difference in the survivors based on the independent basic characteristics of the patients. For categorical data, if ≤ 20% of expected cell counts are less than 5, we used the chi -square test; if > 20% of expected cell counts are less than 5, we used Fisher's exact test. Using binary logistic regression to identify the predicted factors of survivors. We also presented the odds ratios (OR) with a two-sided 95% CI of the final models. A *P*-value ≤ 0.05 was regarded as statistically significant. For data analysis, the Statistical Package for the Social Sciences (SPSS) software version 22 was applied.

Results

A total of 220 patients were admitted to the ICU, of whom 167 died, with a case fatality rate of 75.9% in the ICU, a median age of 65.0, and a mean ± SD of 65.13 ± 12.57 years. Although males constitute the majority of non-survivors (68.3%), the difference with female non-survivors (31.7%) was statistically not significant (*P*-value = 0.290). Meanwhile, when the age (mean ± SD) of non-survivors (65.13±12.57) was compared to the age of survivors (54.38±15.16), the difference was statistically significant (*P* <0.001) (Table 1).

The comorbidity difference between survivors and non-survivors was statistically significant (*P*-value <0.001). Table 2 shows that there are significant differences between survivors and non-survivors in patients with diabetes mellitus (DM) and cardiovascular diseases (*P*-value = 0.007 and 0.047, respectively).

https://doi.org/10.15218/zjms.2024.008

Table 1 Patients' sex and age by survival status (survivors vs. non-survivors).

Characteristics		Survivors (n= 53)		Non-survivors (n=167)		All patients (n = 220)		*P*-value
		No.	%	No.	%	No.	%	
Sex	Male	32	60.4	114	68.3	146	66.4	0.290[a]
	Female	21	39.6	53	31.7	74	33.6	
	Total	53	24.1*	167	75.9*	220	100	
Age (years) Median= 65.0		**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	<0.001[c]
		54.38	15.16	65.13	12.57	62.53	13.98	

[a] Chi-square test. [C]Mann-Whitney test. *Row % was calculated

Table 2 Patients' Comorbidities by survival status (survivors vs. non-survivors).

Comorbidities		Survivors (n= 53)		Non-survivors (n=167)		All patients (n = 220)		*P*-value
		No.	%	No.	%	No.	%	
Comorbidity	Yes	33	62.3%	149	89.2%	182	82.7%	<0.001[a]
	No	20	37.7%	18	10.8%	38	17.3%	
Hypertension	Yes	26	49.1%	105	62.9%	131	59.5%	0.074[a]
	No	27	50.9%	62	37.1%	89	40.5%	
DM	Yes	14	26.4%	79	47.3%	93	42.3%	0.007[a]
	No	39	73.6%	88	52.7%	127	57.7%	
Respiratory disease	Yes	9	17.0%	42	25.1%	51	23.2%	0.220[a]
	No	44	83.0%	125	74.9%	169	76.8%	
Cardiovascular disease	Yes	11	20.8%	59	35.3%	70	31.8%	0.047[a]
	No	42	79.2%	108	64.7%	150	68.2%	
Renal disease	Yes	3	5.7%	22	13.2%	25	11.4%	0.133[a]
	No	50	94.3%	145	86.8%	195	88.6%	
Malignancy	Yes	2	3.8%	13	7.8%	15	6.8%	0.531[b]
	No	51	96.2%	154	92.2%	205	93.2%	
Cerebrovascular disease	Yes	1	1.9%	13	7.8%	14	6.4%	0.125[b]
	No	52	98.1%	154	92.2%	206	93.6%	

[a] Chi-square test. [b] Fisher's exact test.

https://doi.org/10.15218/zjms.2024.008

Patients' clinical and laboratory results are presented in Table 3.

The differences between some of the clinical and laboratory tests were found to be statistically significant, such as oxygen saturation (*P*-value <0.001), systolic BP (*P*-value <0.001), diastolic BP (*P*-value = 0.010), lymphocytes (*P*-value <0.001), CRP (*P*-value = 0.021), D-dimer (*P*-value <0.001), and duration of staying in the ICU (*P*-value= 0.002).

Table 3 Patients' clinical and laboratory results mean ± SD by survival status (survivors vs. non-survivors).

Characteristics	Survivors (n= 53)		Non-survivors (n=167)		Total (n=220)		*P*-value[c]
	Mean	SD	Mean	SD	Mean	SD	
Body temperature (C°)	37.05	1.02	36.93	0.99	36.95	1.00	0.541
Heart rate (beat/ minutes)	91.25	23.66	93.25	25.36	92.76	24.93	0.723
Respiratory rate (respiration/ minutes)	30.15	6.48	30.36	9.74	30.31	9.05	0.333
Oxygen saturation (%)	89.70	3.66	82.25	8.11	84.04	7.95	<0.001
Systolic BP (mmHg)	126.64	23.11	111.97	27.01	115.50	26.82	<0.001
Diastolic BP (mmHg)	70.66	13.30	65.34	17.86	66.62	17.00	0.010
WBC (10^9/ L)	13.60	6.45	15.32	7.11	14.90	6.98	0.083
Lymphocyte (10^9/ L)	1.30	0.81	1.29	4.49	1.29	3.93	<0.001
CRP (mg/L)	111.92	82.26	137.96	80.65	131.69	81.62	0.021
D-Dimer (ng/ ml)	1585.04	1403.45	2171.86	1366.00	2030.49	1394.75	<0.001
Duration of staying in ICU (days)	11.66	7.43	8.66	6.83	9.39	7.08	0.002

[C] Mann-Whitney test.

https://doi.org/10.15218/zjms.2024.008

Regarding the types of treatments, the patients received during their admission to the ICU, statistically significant differences were found between survivors and non-survivors. Those receiving oxygen therapy and antiviral drugs were significantly different between survivors and non-survivors (*P*-value <0.001 and *P*-value = 0.004), respectively, as shown in Table 4.

Table 4 Patients' oxygen therapy and treatment types by survival status (survivors vs. non-survivors).

Treatment types		Survivors (n= 53)		Non-survivors (n=167)		Total (n=220)		*P*– value
		No.	%	No.	%	No.	%	
Oxygen therapy	NIMV (face mask)	23	43.4%	27	16.2%	50	22.7%	<0.001[a]
	NIMV (CPAP)	27	50.9%	121	72.5%	148	67.3%	
	IMV	3	5.7%	19	11.4%	22	10.0%	
Azithromycin	Yes	14	26.4%	35	21.0%	49	22.3%	0.405 [a]
	No	39	73.6%	132	79.0%	171	77.7%	
Ceftriaxone	Yes	13	24.5%	57	34.1%	70	31.8%	0.191 [a]
	No	40	75.5%	110	65.9%	150	68.2%	
Meropenem	Yes	40	75.5%	104	62.3%	144	65.5%	0.078 [a]
	No	13	24.5%	63	37.7%	76	34.5%	
Levofloxacin	Yes	24	45.3%	81	48.5%	105	47.7%	0.683 [a]
	No	29	54.7%	86	51.5%	115	52.3%	
Corticosteroids	Yes	48	90.6%	161	96.4%	209	95.0%	0.139[b]
	No	5	9.4%	6	3.6%	11	5.0%	
Anticoagulant	Yes	52	98.1%	158	94.6%	210	95.5%	0.458 [b]
	No	1	1.9%	9	5.4%	10	4.5%	
Antifungal	Yes	30	56.6%	80	47.9%	110	50.0%	0.270[a]
	No	23	43.4%	87	52.1%	110	50.0%	
Antiviral	Favipiravir	10	18.9%	33	19.8%	43	19.5%	0.004[a]
	Remdesivir	31	58.5%	58	34.7%	89	40.5%	
	None	12	22.6%	76	45.5%	88	40.0%	

NIMV: Non-invasive Mechanical Ventilation,
IMV: Invasive Mechanical Ventilation,
CPAP: Continuous positive airway pressure.
[a] Chi-square test. [b] Fisher's exact test.

https://doi.org/10.15218/zjms.2024.008

A binary logistic regression was performed to ascertain the effects of age, oxygen saturation, systolic BP, diastolic BP, lymphocyte count, CRP, D-dimer, duration of staying in the ICU, comorbidity, DM, cardiovascular disease, oxygen therapy, and antiviral drugs on the likelihood of the survivors' patients. The logistic regression model was statistically significant ($\chi 2(8)$ = 81.072, *P* <0.001). The model explained 61.3% (NagelkerkeR2) of the variance in survivors and correctly classified 85.9% of cases.

The test statistic associated with a Receiver Operating Characteristic (ROC) analysis, signifying the statistical significance of classification, is based on the area under the curve (AUC). The ROC analysis suggests successful classification based on the predicted probability of the AUC = 0.922, *P* <0.001, Figure 1.

The results of the logistic regression to identify baseline variables possibly associated with patients' deaths are shown in Table 5. The cut-off value of the age was 59 years old; patients above 59 years old were significantly associated with an increased likelihood of death (OR 1.055 [95% CI 1.014, 1.097], *P*-value = 0.008). Furthermore, the presence of comorbidities is significantly associated with an increased likelihood of death by 3.8 times (OR 3.847 [95% CI 1.080, 13.698], *P*-value = 0.038).

Increasing oxygen saturation was significantly associated with a reduction in the likelihood of death (OR 0.764 [95% CI 0.670, 0.872], *P*-value = <0.001). Also, increased systolic BP was associated with decreased death (OR 0.960 [95% CI 0.935, 0.985], *P*-value = 0.002).

In addition, provision of non-invasive mechanical ventilation (CPAP) and invasive mechanical ventilation (IMV) both increased the likelihood of death (OR 4.884 [95% CI 2.286, 10.434],

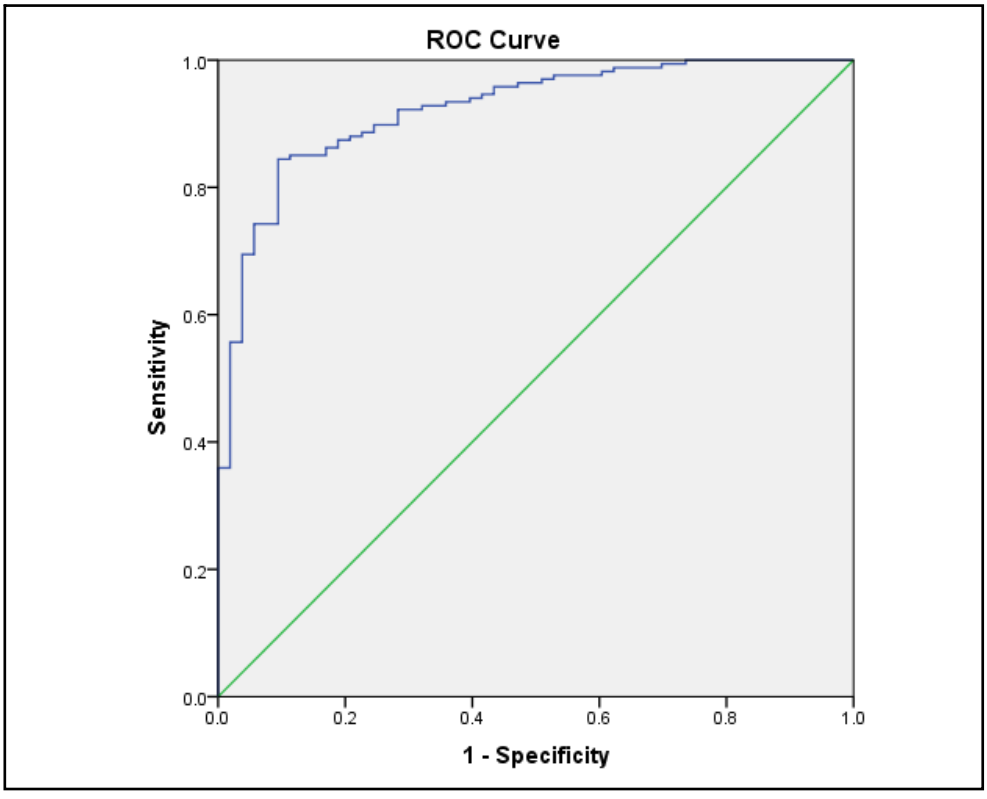

Figure 1 Receiver Operating Characteristic curve for the age of patients.

https://doi.org/10.15218/zjms.2024.008

P-value <0.001) and (OR 10.138 [95% CI 2.451, 41.936], *P*-value = 0.001), respectively. Finally, using the antiviral drug Remdesivir significantly decreased the likelihood of death (OR 0.203 [95% CI 0.089, 0.464], *P*-value <0.001).

Table 5 Logistic regression analysis of risk factors by survival status (survivors vs. non-survivors).

	B	S.E.	df	*P*-value	OR	95% C.I. for EXP(B)	
						Lower	Upper
Age (years)	0.053	0.020	1	0.008	1.055	1.014	1.097
Oxygen saturation (%)	-0.269	0.067	1	<0.001	0.764	0.670	0.872
Systolic BP (mmHg)	-0.041	0.013	1	0.002	0.960	0.935	0.985
Diastolic BP (mmHg)	0.040	0.024	1	0.095	1.041	0.993	1.091
Lymphocyte (10^9/ L)	0.015	0.050	1	0.769	1.015	0.920	1.119
CRP (mg/L)	0.001	0.003	1	0.706	1.001	0.995	1.008
D-Dimer (ng/ ml)	0.000	0.000	1	0.271	1.000	1.000	1.001
Duration of staying in ICU (days)	-0.044	0.036	1	0.218	0.957	0.892	1.026
Comorbidity	1.347	0.648	1	0.038	3.847	1.080	13.698
DM	-0.132	0.552	1	0.811	0.876	0.297	2.588
Cardiovascular disease	-0.258	0.607	1	0.671	0.773	0.235	2.540
NIMV (CPAP)	2.031	0.651	1	0.002	7.624	2.129	27.297
IMV	3.076	1.022	1	0.003	21.677	2.924	160.710
Antiviral drugs (Favipiravir)	-0.745	504	1	0.139	0.475	0.177	1.275
Antiviral drugs (Remdesivir)	-1.596	0.422	1	<0.001	0.203	0.089	0.464

NIMV: Non-invasive Mechanical Ventilation,
IMV: Invasive Mechanical Ventilation,
CPAP: Continuous positive airway pressure.

https://doi.org/10.15218/zjms.2024.008

Discussion

In this observational retrospective study of patients hospitalized with a confirmed diagnosis of critical COVID-19 in 2021 and admitted to the ICU of the Sulaimani government, we described risk factors for ICU hospitalization and death of critically ill patients with severe COVID-19. Most of the patients admitted to the ICU and the mortality from COVID-19 were male, with a median age of 65 years old and a mean ± SD of 65.13 ± 12.57 years, but only the age was statistically significant between survivors and non-survivors (*P*-value< 0.001) when regression analysis was used. The cut-off value of the age was 59 years old; patients above 59 years old were significantly associated with an increased likelihood of death (OR 1.055 [95% CI 1.014, 1.097], *P*-value = 0.008). This finding is similar to another previous study in 2020 done on patients with COVID -19 admitted to the ICU in Sulaimani5, as well as to other studies in other areas of the world focusing on patients with COVID-19.6,[8-11,15]

COVID-19 in-ICU mortality is higher than that seen with other viral pneumonias, and as the pandemic progressed, reported mortality rates dropped from more than 50% to close to 40%.[6] In our study, which covered the last six months of 2021, the majority of the patients with COVID-19 admitted to the ICU in Sulaimani have died, with a case-mortality rate of 75.9%. This mortality rate is considered high when compared to the global mortality rate from the start of the pandemic to the end of 2020 from systematic reviews, which was 41.6% (34.0%–49.7%) across international studies and (52.5–70.5%) in the Middle East and North Africa,[16] (13.2%–32.5%) in China,[18–20] 22% in Germany,[21] 28% (32% in the ICU) in the United Kingdom,[22] and 16.3%–39% in the United States,[23] and (8.7–12.9%) in Australia.[24]

This high mortality of patients in our study may be due to the stressful nature of the COVID-19 pandemic because of the large number of patients who required advanced respiratory support, such as high-flow nasal oxygen and non-invasive and invasive mechanical ventilation, and the shortages of medical support in the ICU, which is the only public ICU in Sulaimani, which receives a large number of patients parallel to the severe shortage of oxygen in hospitals.[25] In addition, the high mortality rate in the study may reflect both the severity and delay in the presentation of patients to the hospital.

In our study, the presence of at least one comorbidity was significantly different between survivors and non-survivors (*P*-value <0.001) and regarded as a predictive factor of death. These findings are similar to many previous published studies in which comorbidities were regarded as important risk factors for the death of patients admitted to the ICU.[6,7,15] In a study of patients with COVID-19 admitted to an ICU in Italy, 68% of them had at least one underlying disorder, with hypertension being the most common. Hypertension was also identified as the most common chronic disease affecting those who died in ICUs worldwide.[25,26] Furthermore, while diabetes is a poor predictor of various COVID-19 infection outcomes, regional variation is substantial and may skew overall trends.[27]

Many clinical and laboratory findings in our study were found to be significant between survivors and non-survivors. They were high oxygen saturation, raised SBP and DBP, low lymphocyte count, high CRP, high D-dimer, and a long duration of stay in the ICU. The same findings are found in many studies on patients with COVID-19 worldwide admitted to the ICU.[28-32]

During our study, we assessed the impact of treatments that were administered (antibiotics, corticosteroids, anticoagulants, antifungal therapies, and antiviral therapies) on serious COVID-19 cases. It was found that using the antiviral drug Remdesivir was a predictive factor in reducing death; no antibiotics or antiviral treatments were found to reduce the mortality of the patients. This finding is

https://doi.org/10.15218/zjms.2024.008

consistent with research findings to date suggesting that no specific therapy reduces the ICU mortality of COVID-19 patients.[7,26] Although some antiviral drugs, including Remdesivir, which is the only antiviral drug that is approved by the Food and Drug Administration (FDA) for the treatment of COVID-19, showed some favorable outcomes in some studies, they were still not recommended for the treatment of COVID-19 by many physicians.[33-36]

Regarding the patients' oxygen therapy and treatment types by survival status, it was found that oxygen therapy differs significantly between survivors and non-survivors. A logistic regression test of the variables revealed that the increasing provision of invasive mechanical ventilation was regarded as a predictive factor for death. Countries have different approaches to treating seriously ill people with severe COVID-19. Although there were fewer mortality rates for people requiring mechanical ventilation, according to recent data[23], at the beginning of the pandemic, the mortality of such patients was estimated to reach 97% due to diffuse lung injury and acute respiratory distress syndrome.[37,38]

Although this is the first clinical study to investigate the predictive factors of mortality among critical COVID-19 patients admitted to the ICU in Sulaimani City, it has many limitations.

During the COVID-19 pandemic, it was difficult for hospitals to adhere to standard guidelines and design procedures. The guidelines were developed based on previous experience with COVID-19-like conditions. Failure to fully comprehend COVID-19 remains a significant limitation, owing to the scarcity of available research results that could be used as evidence. Furthermore, it is a retrospective study with many data collected at baseline, while at the same time, many data related to the level of consciousness of the patients, which are very essential to determining the severity of the patient, were lacking. In addition, this is a single ICU study covering the patients admitted to a single ICU for a certain period of time. Although the sample size is adequate given the patients' critical illness, future multicenter, prospective studies will shed light on stronger correlations between different predictors of mortality in COVID-19 patients, paving the way for potentially useful novel therapeutic modalities.

Conclusion

According to the findings of this study, there are significant differences between ICU survivors and non-survivors in many baseline characteristics, like age, comorbidities like diabetes, CVDs, oxygen saturation, SBP, DBP, lymphocyte counts, CRP, D-dimer, length of stay in the ICU, oxygen therapy, and use of antiviral drugs. The risk factors that predicted mortality in critical COVID-19 patients were increasing age, comorbidities, and a lack of use of antiviral drugs. Whereas increasing oxygen saturation, systolic blood pressure, non-invasive mechanical ventilation (facemask), and CPAP significantly predicted a reduction in the likelihood of death admitted to Sulaimani's ICU in 2021.

Funding

Not applicable.

Competing interests

The author declare that he has no competing interests.

References

1. World Health Organization. Coronavirus disease (COVID-19) Pandemic, 2020. https://www.who.int/emergencies/diseases/novel-coronavirus-2019 (accessed 23/06/2022).
2. World Health Organization. WHO Coronavirus Disease (COVID-19) Dashboard, 2020. https://covid19.who.int/ (accessed 23/06/2022).
3. Atlas GIS and IT. Coronavirus COVID-19 GeoHub -Iraq. https://coronavirus-covid-19-iraq-atlasgis.hub.arcgis.com. (Accessed 23/06/2022).
4. Kurdistan Regional Government. COVID-19 in the Kurdistan region. https://coronavirus-covid-19-iraq-atlasgis.hub.arcgis.com (Accessed 23/06/2022).
5. Ramzi ZS. Risk Factors of Mortality among COVID-19 Patients in Sulaimaniyah City

Kurdistan Region Iraq. Am J Phytomed Clin Ther 2021; 9(8).
6. Republic of Iraq Presidency of Council of Ministers, National Investment Commission. Investment map of Iraq 2022. [Internet]. Available from: Www.investpromo.gov.iq. Accessed 24/6/2022.
7. Armstrong RA, Kane AD, Cook TM. Outcomes from intensive care in patients with COVID-19: a systematic review and meta-analysis of observational studies. Anaesthesia 2020; 75: 1340–9. DOI: 10.1111/anae.15201 (Accessed 23/06/2022).
8. Armstrong RA, Kane AD, Cook TM. Decreasing mortality rates in ICU during the COVID-19 pandemic. Anaesthesia 2020. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7436742 (Accessed 23/06/2022).
9. Alhasan KA, Shalaby MA, Temsah M-H, Aljamaan F, Shagal R, AlFaadhel T, et al. Factors that influence mortality in critically ill patients with SARS-CoV-2 Infection: A Multicenter Study in the Kingdom of Saudi Arabia. Healthcare 2021;9: 1608. DOI:10.3390/healthcare9121608 (accessed 23/06/2022).
10. Viseslav P, Slobodan K, Natasa M, Nina R, Aleksandra A, Marija M, et al. Predictors of Mortality in Critically Ill COVID-19 Patients Demanding High Oxygen Flow: A Thin Line between Inflammation, Cytokine Storm, and Coagulopathy. Oxid Med Cell Longev 2021. DOI:10.1155/2021/6648199
11. Ashraf MA, Sherafat A, Naderi Z, Sami R, Soltaninejad F, Khodadadi S, et al. Association of systemic complications with mortality in coronavirus disease of 2019: A cohort study on intensive care unit patients. J Res Med Sci 2022; 27.
12. Gopalan N, Senthil S, Prabakar NL, Senguttuvan T, Bhaskar A, Jagannathan M, et al. Predictors of mortality among hospitalized COVID-19 patients and risk score formulation for prioritizing tertiary care—An experience from South India. PLOS ONE 2022; 17(2): e0263471. DOI:10.1371/journal.pone.0263471.
13. Muhammed BT, Awlla AH, Murad SH, Ahmad SN. Prediction of CoVid-19 mortality in Iraq-Kurdistan by using Machine learning. UHD Journal of Science and Technology 2021; 5(1):66 –70. DOI:10.21928/uhdjst.v5n1y2021.pp66-70
14. Darweesh O, Abdulrazzaq GM, Al-Zidan RN, Bebane P, Merkhan M, Aldabbagh R, et al. Evaluation of the Pharmacologic Treatment of COVID-19 Pandemic in Iraq. Curr Pharmacol Rep 2021;7(4):171–8. DOI:10.1007/s40495-021-00262-9. Epub 2021. PMID: 34377628; PMCID: PMC8339216.
15. Bosnic, Zoran & Kononenko, Igor. An overview of advances in reliability estimation of individual predictions in machine learning. Intell. Data Anal 2009; 13: 385–401. DOI:10.3233/IDA-2009-
16. Martinot M, Eyriey M, Gravier S, Bonijoly T, Kayser D, Ion C, et al. Predictors of mortality, ICU hospitalization, and extrapulmonary complications in COVID-19 patients. Infectious Diseases Now 2021; 51(6):518–25. DOI:10.1016/j.idnow.2021.07.002.
17. Armstrong RA, Kane AD, Kursumovic E, Oglesby FC, Cook TM. Mortality in patients admitted to intensive care with COVID-19: an updated systematic review and meta-analysis of observational studies. Anaesthesia 2021; 76(4):537–48. DOI:10.1111/anae.15425. Epub 2021. PMID:33525063; PMCID: PMC8013495.
18. Liu J, Zhang S, Wu Z, Shang Y, Dong X, Li G, et al. Clinical outcomes of COVID-19 in Wuhan, China: a large cohort study. Ann of Intensive Care 2020; 10(1):1–21. DOI:10.1186/s13613-020-00706-3
19. 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. The lancet 2020; 395(10229):1054–62. DOI:10.1016/S0140-6736(20)30566-3.
20. Li X, Xu S, Yu M, Wang K, Tao Y, Zhou Y, et al. Risk factors for severity and mortality in adult COVID-19 inpatients in Wuhan. J Allergy Clin Immunol 2020; 146(1):110–8. DOI:10.1016/j.jaci.2020.04.006
21. Karagiannidis C, Mostert C, Hentschker C, Voshaar T, Malzahn J, Schillinger G, et al. Case characteristics, resource use, and outcomes of 10 021 patients with COVID-19 admitted to 920 German hospitals: an observational study. Lancet Respir Med 2020; 8(9):853–62. DOI:10.1016/S2213-2600(20)30316-7.
22. Docherty AB, Harrison EM, Green CA, Hardwick HE, Pius R, Norman L, et al. Features of 20 133 UK patients in hospital with covid-19 using the ISARIC WHO Clinical Characterisation Protocol: prospective observational cohort study. BMJ 2020; 369. DOI:10.1136/bmj.m1985
23. Cummings MJ, Baldwin MR, Abrams D, Jacobson SD, Meyer BJ, Balough EM, et al. Epidemiology, clinical course, and outcomes of critically ill adults with COVID-19 in New York City: a prospective cohort study. The Lancet 2020; 395(10239):1763–70. DOI:10.1016/S0140-6736(20)31189-2
24. Australian and New Zealand Intensive Care Society. Anzics core COVID-19 Report 2020. https://www.anzics.com.au/annual-reports/ (Accessed 11/12/2020).
25. World Health Organization. WHO provides support to bridge shortfall in oxygen supplies in Iraq. 2020. http://www.emro.who.int/iraq/news/who-provides-support-to-bridge-the-shortfall-in-oxygen-supplies-in-iraq.html
26. Intensive Care National Audit and Research Centre. ICNARC report on COVID-19 in critical

care 2020. https://www.icnarc.org/Our-Audit/Audits/Cmp/Reports (Accessed 29/06/2022).
27. Intensive Care National Audit and Research Centre. Case Mix Programme Summary Statistics 2018-2019. 2019. https://www.icnarc.org/OurAudit/Audits/Cmp/Reports/Summary-Statistics (accessed 24/06/2023).
28. Kastora S, Patel M, Carter B, Delibegovic M, Myint PK. Impact of diabetes on COVID-19 mortality and hospital outcomes from a global perspective: An umbrella systematic review and meta-analysis. Endocrinol Diabetes Metab 2022;5(3):e00338. DOI:10.1002/edm2.338. Epub 2022. PMID: 35441801; PMCID: PMC9094465.
29. Alnor A, Sandberg MB, Gils C, Vinholt PJ. Laboratory tests and outcome for patients with coronavirus disease 2019: a systematic review and meta-analysis. J Appl Lab Med 2020; 5(5):1038–49.
30. Zheng Z, Peng F, Xu B, Zhao J, Liu H, Peng J, et al. Risk factors of critical & mortal COVID-19 cases: A systematic literature review and meta-analysis. J Infect 2020; 81(2):e16–25. DOI:10.1016/j.jinf.2020.04.021
31. Henry BM, De Oliveira MH, Benoit S, Plebani M, Lippi G. Hematologic, biochemical and immune biomarker abnormalities associated with severe illness and mortality in coronavirus disease 2019 (COVID-19): a meta-analysis. Clin Chem Lab Med 2020; 58(7):1021–8. DOI:10.1515/cclm-2020-0369
32. Becker RC. COVID-19 update: Covid-19-associated coagulopathy. J Thromb Thrombolysis 2020; 50(1):54–67. DOI:10.1007/s11239-020-02134-3.
33. Cantini F, Goletti D, Petrone L, Najafi Fard S, Niccoli L, Foti R. Immune therapy, or antiviral therapy, or both for COVID-19: a systematic review. Drugs. 2020; 80(18):1929–46.
34. Perveen RA, Nasir M, Talha K A, Selina F, Islam MA, et al. "Systematic review on current antiviral therapy in COVID-19 pandemic." The Medical Journal of Malaysia 2020; 75(6):710–6.
35. Kim SB, Huh K, Heo JY, Joo EJ, Kim YJ, Choi WS, et al. Interim Guidelines on Antiviral Therapy for COVID-19. Infect Chemother 2020; 52(2):281–304. DOI:10.3947/ic.2020.52.2.281. Epub 2020 Apr 23. PMID: 32342676; PMCID: PMC7335642.
36. Negrut N, Codrean A, Hodisan I, Bungau S, Tit DM, Marin R, et al. "Efficiency of antiviral treatment in COVID‐19". Experimental and Therapeutic Medicine 2021; 21(6):648.
37. Richardson S, Hirsch JS, Narasimhan M, Crawford JM, McGinn T, Davidson KW, et al. Presenting Characteristics, Comorbidities, and Outcomes Among 5700 Patients Hospitalized With COVID-19 in the New York City Area. JAMA 2020. Epub 2020/04/23. pmid:32320003.
38. Wang Y, Lu X, Chen H, Chen T, Su N, Huang F, et al. Clinical Course and Outcomes of 344 Intensive Care Patients with COVID-19. Am J Respir Crit Care Med 2020. Epub 2020/04/09. pmid:32267160.