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Assessment of All-Cause Mortality and Need For Mechanical Ventilation Among COVID-19 Patients Taking Corticosteroids In The Intensive Care Unit

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Abstract

Background: Hospital admission due to the coronavirus disease of 2019 (COVID-19) is high, imposing several challenges for patient management during intensive care unit (ICU) stay.

Objectives: This communication explores the association between all-cause mortality, the need for mechanical ventilation, and the general characteristics of COVID-19 patients taking corticosteroids in the ICU.

Methods: A cross-sectional study was performed over three months in a tertiary care hospital in Lebanon. Two clinical pharmacists used a uniform form to collect data from patients' medical charts.

Results: Higher all-cause mortality was noted among critical cases, those with dyslipidemia, and those with abnormal glucose levels on admission and discharge. Women, those with abnormal glucose and creatinine levels, and critically-ill patients needed more mechanical ventilation than others.

Conclusion: Taking into account these associations can help doctors in a better assessment of cases to be admitted to the ICU.

Keywords: Intensive care unit; corticosteroids; COVID-19 patients; all-cause mortality; mechanical ventilation

Introduction

Background

Hospital admission due to the coronavirus disease of 2019 (COVID-19) is high, imposing several challenges for patient management during intensive care unit (ICU) stay **[1]**. Patients admitted to the ICU for COVID-19 had an increased mortality risk and required mechanical ventilation to manage their respiratory distress **[2]**. This risk is shown to be higher than usually seen in ICU admissions with other viral cases of pneumonia **[3]**. Changes in laboratory parameters **[4]**, age, and admission to ICU are the main reported predictors of that risk **[5]**.

In Lebanon, like in other countries, patients were prioritized, and few could access the ICU based on doctors' evaluations **[6]**, creating ethical dilemmas for frontline workers. Understanding the characteristics of patients admitted to the ICU can help better assess cases. Therefore, this communication explores the association between all-cause mortality, the need for mechanical ventilation, and the general characteristics of COVID-19 patients taking corticosteroids in the ICU.

Methods

Study design

A cross-sectional study was performed over three months (May-July 2021) targeting adult COVID-19 patients admitted to the ICU. They were included if they received corticosteroid medication as part of their treatment. Two clinical pharmacists used a uniform form to collect data from patients' medical charts. The research protocol and data collection tool were reviewed and approved by the hospital's institutional review board (See supplementary materials; reference: CRU329). Data were wholly anonymous and non-identifiable. A different researcher performed data coding and analysis.

Data collection

Data completion took an average of 10 minutes per patient and was updated based on their status. The sex, age, height, weight, and smoking status of the patients were collected. The results of the glucose level, oxygen saturation, blood pressure, creatinine, and the C-reactive protein (CRP) were registered on admission and at discharge. Patients were then classified as critical (septic shock,

sepsis, mechanical ventilation, or vasopressor therapy), severe (Oxygen saturation ≤ 90 %, respiratory rate > 30 breaths/min or the existence of signs of severe respiratory distress), and non-severe cases (absence of any signs of harsh or critical COVID-19) **[7]**. The medical history of the patients was also recorded.

Statistical analysis

Statistical analyses were performed using Statistical Package for Social Sciences (SPSS Inc, Chicago, Illinois) Version 27. The age of the patients is presented using means and standard deviations. In contrast, categorical variables are presented using frequencies and percentages. Bivariate analyses were conducted by taking (i) all-cause mortality and (ii) the need for mechanical ventilation as the independent variable and the general information about the patients and their medical history as dependent variables. Chi-square/Fisher exact tests were used to compare percentages between associate categorical variables. A p-value was considered statistically significant if less than 0.05.

Findings

The sample included 123 patients (61.8 % men and 38.2 % women) with a mean age of 69.2 (13.8) years and a mean of 6.9 (3.6) days of ICU stay. They were classified as non-severe (48.0 %), severe (28.4 %), and critical (23.6 %) cases. Most patients had two or more (62.0 %) comorbidities, and only 16.8 % were smokers. 25 patients (20.3 %) died, and 34 (27.6 %) needed mechanical ventilation. The reported causes of death were heart failure (N=7), septic shock (N=7), respiratory failure (N=4), and pulmonary embolism (N=2), and five patients had an unknown cause. **Table 1** presents the association between all-cause mortality, the need for mechanical ventilation, and the characteristics of the patients. All-cause mortality was significantly higher among critical cases (75.9 %), those having dyslipidemia (41.7 %), and patients with glucose levels >126 mg/dL on admission and at discharge. Women (38.3 %) needed more than men (21.1 %) mechanical ventilation in the ICU (p=0.038). The need for mechanical ventilation was also noted among patients with glucose levels >126 mg/dL on admission (37.8 %) and at discharge (35.1 %), creatinine levels > 1.5 mg/dL at admission (39.5 %) or dismissal (43.6 %), and significantly increased with the severity of cases (p < 0.001). Furthermore, 75.0 % of patients with chronic kidney disease needed mechanical ventilation (p=0.002). Patients with SPO2 > 90 % at discharge were those with higher all-cause mortality (34.8 %) and requiring ventilation (43.5 %).

Table 1: Association between all-cause mortality, need for mechanical ventilation, and the general characteristics and the medical history of the patients.

		All-cause mortality (N=25)		**Mechanical ventilation** (N=34)	
General characteristics of the patients		**Frequency (%)**	**p-value**	**Frequency (%)**	**p-value**
Sex	Man	15 (19.7 %)	0.837	16 (21.1 %)	**0.038**
	Woman	10 (21.3 %)		18 (38.3 %)	
Age (years)	**Mean ±SD**	69.2 ±13.8			
	18-60	3 (9.7 %)		5 (16.1 %)	
	61-70	5 (22.7 %)	0.231	6 (27.3 %)	0.222
	More than 70	17 (24.3 %)		23 (32.9 %)	
The glucose level on admission	< 126 mg/dL	5 (11.4 %)	**0.005**	6 (13.6 %)	**0.023**
	> 126 mg/dL	14 (37.8 %)		13 (35.1 %)	
The glucose level at discharge	< 126 mg/dL	4 (10.3 %)	**0.018**	3 (7.7 %)	**0.007**
(last test)	> 126 mg/dL	15 (33.3 %)		15 (33.3 %)	
The oxygen saturation on admission (SPO2 %)	< 90 %	--	0.343	3 (42.9 %)	0.409
	> 90 %	25 (22.5 %)		31 (27.9 %)	
The oxygen saturation at discharge	< 90 %	6 (9.0 %)	**< 0.001**	12 (17.9 %)	**0.003**
(last test)	> 90 %	16 (34.8 %)		20 (43.5 %)	
Blood pressure on admission	< 139/89 mm Hg	16 (19.8 %)	0.962	20 (24.7 %)	0.418
(mmHg)	> 139/89 mm Hg	6 (19.4 %)		10 (32.3 %)	
Blood pressure at discharge	< 139/89 mm Hg	13 (15.3 %)	0.121	21 (24.7 %)	0.398
(last test)	> 139/89 mm Hg	7 (29.2 %)		8 (33.3 %)	
Creatinine level on admission	< 1.5 mg/dL	13 (17.3 %)	0.284	16 (21.3 %)	**0.034**
(mg/dL)	> 1.5 mg/dL	11 (25.6 %)		17 (39.5 %)	
Creatinine level at discharge	< 1.5 mg/dL	14 (17.9 %)	0.202	16 (20.5 %)	**0.009**

(last test)	> 1.5 mg/dL	11 (28.2 %)		17 (43.6 %)	
CRP level on admission	< 3.0 mg/L	1 (50.0 %)	0.375	1 (50.0 %)	0.481
(mg/L)	> 3.0 mg/L	23 (20.4 %)		31 (27.4 %)	
CRP level at discharge	< 3.0 mg/L	5 (19.2 %)	0.975	5 (19.2 %)	0.314
(last test)	> 3.0 mg/L	16 (19.5 %)		24 (29.3 %)	
Smoking status	Non-smoker	22 (22.0 %)	0.763	28 (28.0 %)	0.784
	Smoker	3 (15.0 %)		5 (25.0 %)	
Severity of cases	Non-severe	2 (3.4 %)		4 (6.8 %)	
	Severe	1 (2.9 %)	**< 0.001**	10 (28.6 %)	**< 0.001**
	Critical	22 (75.9 %)		20 (69.0 %)	
Medical history		**Frequency (%)**	**p-value**	**Frequency (%)**	**p-value**
Number of comorbidities	None	4 (17.4 %)	0.576	7 (30.4 %)	0.212
	One	5 (21.7 %)		5 (21.7 %)	
	Two	7 (15.6 %)		9 (20.0 %)	
	More than two	9 (28.1 %)		13 (40.6 %)	
Hypertension		16 (19.3 %)	0.677	20 (24.1 %)	0.205
Diabetes		7 (16.3 %)	0.414	12 (27.9 %)	0.962
Coronary artery disease		7 (17.9 %)	0.655	13 (33.3 %)	0.336
Dyslipidemia		5 (41.7 %)	**0.053**	6 (50.0 %)	0.068
Heart failure		1 (10.0 %)	0.685	2 (20.0 %)	0.725
Chronic kidney disease		2 (25.0 %)	0.664	6 (75.0 %)	**0.002**

Results are given in terms of frequency (percentage) or Mean ± Standard Deviation

Discussion

This communication explored the association between all-cause mortality, the need for mechanical ventilation, and the general characteristics of COVID-19 patients admitted to the ICU. The sample included more men than women, in agreement with previous research showing a higher risk for men to be critically-ill and hospitalized **[8]**. Patients with glucose levels >126 mg/dL and critically-ill ones had higher all-cause mortality risks than others. This finding was also reported in the literature, where the severity of cases and glycemic variability were associated with a higher mortality risk **[9]**. Women needed more mechanical ventilation than men in contrast with a previous report **[10]**, which may be explained by the fact that women in this study were older and had more comorbidities than men, reported to be predictors of mechanical ventilation use **[10]**. This use was significantly higher among patients having abnormal laboratory parameters. A result previously revealed **[1]**, namely high creatinine levels. A recent meta-analysis reported 2.84 times poorer outcomes in those with elevated creatinine **[11]** and, therefore, can be used as one of the predictors of mechanical ventilation use. Most patients with chronic kidney disease required mechanical ventilation in coherence with a retrospective study performed in a similar setting in Jordan **[12]**. Remarkably, these outcomes were reported in patients with normal oxygen saturation at discharge, possibly due to continuous ICU surveillance and ventilation use.

This study has limitations related to the inclusion of patients from one hospital, which might affect the generalizability of the results to other settings. Data were collected from the medical charts, which could have included missing information. However, it can provide additional information regarding the outcomes of COVID-19 in the ICU by considering the associations above.

Conclusion

Hospital outcomes among COVID-19 patients admitted to the ICU varied with their characteristics. Abnormal glucose levels at admission and discharge and the severity of cases were associated with higher risks of all-cause mortality and the need for mechanical ventilation. Abnormal creatinine levels and chronic kidney disease were also correlated with the need for mechanical ventilation. In future investigations, these factors should be considered to allow informed decision-making for admitting and managing ICU patients with COVID-19.

List of abbreviations

COVID-19: Coronavirus Disease of 2019

ICU: Intensive Care Unit

CRP: C-reactive protein

SPSS: Statistical Package for Social Sciences

SPO2: Oxygen Saturation

Declarations

Ethics approval and consent to participate

The study protocol, questionnaire, and consent form were reviewed and approved by the institutional review board of Ain Wazein Medical Village on October 13th, 2021 (reference: CRU329).

Consent for publication: Not applicable

Availability of data and materials: Not applicable

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Authors' contributions

SA: Conceptualization, data curation, methodology, Writing-review, and editing.

GH: Conceptualization, formal analysis, Validation, and Writing-original draft.

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