Predicting In-Hospital Mortality During the COVID-19 Pandemic in Patients with Heart Failure: A Single-Center Exploratory Study

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Abstract. The aim of this study was to investigate whether exposure to the pandemic was associated with increased in-hospital mortality for health failure. We collected data from patients hospitalized between 2019 and 2020 and we assessed the likelihood of in-hospital death. Although the positive association of exposure to the COVID period with an increased in-hospital mortality is not statistically significant, this may underscore other factors that may influence mortality. Our study was designed to contribute to a better understanding of the impact of the pandemic on in-hospital mortality and to identify potential areas for intervention in patient care.

Keywords. heart failure, in-hospital mortality, COVID-19.

1. Introduction

Heart failure (HF) is a major health problem worldwide, affecting millions of people and leading to high rates of morbidity and mortality (1). HF is a major driver of healthcare costs (2), therefore, identifying predictors of mortality in patients with HF is critical to improving patient outcomes and optimizing healthcare resource allocation.

The COVID-19 pandemic has affected healthcare systems worldwide, leading to significant changes in hospital organization and patient management (3). One of the consequences of these changes is the potential impact on in-hospital mortality. The aim of this study was to investigate whether exposure to the COVID-19 pandemic was associated with increased in-hospital mortality. We hypothesized that the impact of the pandemic on healthcare systems may have influenced in-hospital mortality beyond the direct effects of the virus itself. In this study, exposure during the COVID period is intended to be exposure to the effects of the pandemic in a broad sense, including lockdown measures and organizational changes in the hospital, and not just exposure to SARS-CoV2 infection.

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Sensing (8–10) and new knowledge about materials (11–13) have brought significant innovations in health care. These have been joined by data analysis techniques, which from simple statistical analysis (14-16) used in diagnostics have evolved to support various areas of Public Health such as resource management (17,18), health care processes (19-21), and the study of hospitalization (22-24). Also on the COVID-19 topic, several studies have shown the effectiveness of these techniques (25,26). To investigate our hypothesis, we analyzed data from patients admitted to the hospital for HF before and during the pandemic: we collected data from their electronic records, then we evaluated the likelihood of in-hospital death.

2. Methods

All patients hospitalized for HF between 2019 and 2020, who were admitted through the emergency department, were included in the study. Electronic discharge records were the source of all study variables. We included hospital admissions with a diagnosis of HF and we generated APR-DRGs' Risk of Mortality (ROM) to predict the likelihood of death based on clinical factors. Death during hospitalization was chosen as the dependent variable in a Binomial Logistic Regression (BLR). The predictors were: age, sex, length of stay (LOS), ROM and COVID exposure timeframe (2019 vs 2020). A forced entry approach was used to test the model. A significance level of .05 was used for all hypothesis tests. Statistical analysis and the regression model were performed using SPSS software.

3. Results

A total of 420 cases were included in the study. 44 patients (10.5%) died during hospitalization. 167 patients (40%) were hospitalized during the pre-COVID period, and 253 patients (60%) were hospitalized during the COVID period. No patient was found to be positive for SARS-CoV2 infection during hospitalization.

Assumptions of BLR were carefully tested, including linearity of the continuous variables with respect to the logit of the dependent variable and multicollinearity among independent variables. The model was statistically significant (chi-squared: 31.988; p < .001). It explained 15.0% of the variance in hospital mortality and correctly classified 89.3% of cases. Of the five predictor variables, only three were statistically significant: age, sex and risk of mortality (Table 1). While COVID period was found to be positively associated with death, its Wald statistic was found to be non-significant.

Table 1. Logistic regression model. -2 Log Likelihood: 249.767; Cox & Snell R Square: .073; Nagelkerke R Square: .150

	B	SE	Wald	df	p	OR	95% CI for OR	
							Lower	Upper
Age	.052	.021	6.026	1	.014	1.053	1.011	1.098
LOS	-.039	.022	3.286	1	.070	.962	.922	1.003
ROM	.703	.245	8.260	1	.004	2.020	1.251	3.261
Sex	.868	.350	6.150	1	.013	2.382	1.200	4.732
COVID period	.326	.364	.803	1	.370	1.386	.679	2.827
Constant	-7.988	1.714	21.706	1	<.001	.000		

4. Discussion and Conclusions

Our study used electronic hospital records to predict mortality via clinical data. Our findings suggest that age, male sex, and ROM are significant predictors of mortality during hospitalization for HF. COVID period was positively associated with death, although the effect was not statistically significant. This weak association may underscore other factors that can influence mortality. Since none of the patients in this study tested positive for COVID, any effect recorded in this investigation during the pandemic period should be attributed to factors other than viral infection, such as internal changes in hospital organization or lockdown measures. The limitations of this study are as follows. First, the analysis was conducted at a single center and included a relatively small sample of patients for a narrow time period. Secondly, the study used variables that can be found in any hospital database, making it highly reproducible due to the capillary diffusion of clinical data collection achieved through the diffusion of electronic discharge records. Nevertheless, it is important to note that these data may not reflect all relevant clinical factors influencing mortality. Finally, the exploratory nature of this investigation necessitated the use of temporal exposure to the pandemic as a proxy for other possible mortality predictors. In conclusion, although temporal exposure to the pandemic was only weakly associated with mortality, further research is needed to better understand the complex interplay of clinical and non-clinical factors that may influence patient outcomes. More sophisticated models could be created by linking different databases, both internal and external to the hospital, moving beyond the 'silo approach' that has characterized public health databases in our country to date. The authors declare no conflicts of interest in relation to this study.

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