Circulation: Cardiovascular Quality and Outcomes

DATA REPORT

Survival After In-Hospital Cardiac Arrest in Critically Ill Patients

Implications for COVID-19 Outbreak?

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For the American Heart Association Get With The Guidelines–Resuscitation Investigators

The coronavirus disease 2019 (COVID-19) outbreak is placing a considerable strain on US healthcare systems by requiring both significant acute resources and endangering healthcare team members through airborne infection.[1] Many US healthcare systems are now considering how to treat patients with COVID-19 who suffer cardiac arrest based on a presumption of poor survival after resuscitation in patients with COVID-19.[2] However, empirical data on cardiac arrest survival in COVID-19 from the United States are not available at the moment. To inform this debate, we report survival data following cardiopulmonary resuscitation in a cohort of critically ill patients with pneumonia or sepsis who were receiving mechanical ventilation in an intensive care unit (ICU) at the time of arrest.

Using Get With The Guidelines–Resuscitation, a US registry of in-hospital cardiac arrest patients,[3] we identified all adult patients (age 18 years and older) who underwent cardiopulmonary resuscitation for an index in-hospital cardiac arrest event. To simulate our study cohort as closely as possible to the COVID-19 population, we restricted our cohort to 5690 patients hospitalized in an ICU with a diagnosis of pneumonia or sepsis during the hospitalization and who were receiving mechanical ventilation at the time of arrest during 2014 to 2018. The study outcomes included survival to discharge, survival with a cerebral performance category (CPC) score of 1 (none to mild neurological disability), and survival with a CPC of 1 or 2 (no worse than moderate disability). We examined the above survival outcomes overall and stratified by patient age (categorized as <50, 50–59, 60–69, 70–79, and ≥80 years), initial rhythm (asystole or pulseless electrical activity [PEA] versus ventricular fibrillation or pulseless ventricular tachycardia) and whether patients were receiving intravenous vasopressors at the time of arrest. All analyses were carried out using SAS. The study was reviewed by Saint Luke's Hospital's Mid America Heart Institute Institutional Review Board, which waived the requirement for informed consent. Because of the sensitive nature of the data collected for this study, requests to access the dataset from qualified researchers trained in human subject confidentiality protocols may be sent to Get With The Guidelines–Resuscitation (GWTGResuscitationResearch@heart.org).

The median age was 65 years. All patients were located in an ICU and were receiving mechanical ventilation at the time of arrest. The initial cardiac arrest rhythm was asystole or PEA in a majority (87%) of patients and more than half (57%) were also receiving intravenous vasopressors at the time of arrest. The overall rate of survival to discharge was 12.5%. Rate of survival with CPC of 1 or 2 was 9.2% and survival with CPC of 1 was 6.2%.

The Table includes rates of overall survival, survival with a CPC of 1 or 2, and survival with a CPC of 1 across categories of age-group, initial rhythm, and need for vasopressors. Older age, initial rhythm of asystole or PEA, and use of vasopressors

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Key Words: cardiac arrest ■ COVID-19 ■ intensive care unit ■ pneumonia ■ sepsis

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Table. Rates of Survival to Discharge, Survival With a CPC of 1 or 2, and Survival With a CPC of 1 by Age-Group, Cardiac Arrest Rhythm, and Vasopressor Status

	Asystole/PEA		VF/Pulseless VT	
Age Group	All Patients	Patients on Vasopressors	All Patients	Patients on Vasopressors
<50 y				
N	980	562	111	67
Survival to discharge	16.8%	10.1%	26.1%	17.9%
Survival with a CPC of 1 or 2*	12.9%	8.3%	22.0%	15.9%
Survival with a CPC of 1†	9.9%	6.3%	16.5%	11.9%
50–59 y				
N	945	533	163	103
Survival to discharge	12.1%	5.1%	26.4%	23.3%
Survival with a CPC of 1 or 2*	8.9%	3.4%	19.6%	18.6%
Survival with a CPC of 1†	6.3%	2.7%	14.5%	15.5%
60–69 y				
N	1305	773	198	107
Survival to discharge	11.1%	5.6%	20.7%	15.0%
Survival with a CPC of 1 or 2*	8.2%	4.0%	14.3%	12.3%
Survival with a CPC of 1†	4.8%	2.4%	9.3%	6.8%
70–79 y				
N	1110	645	169	103
Survival to discharge	8.6%	4.8%	20.1%	13.6%
Survival with a CPC of 1 or 2*	6.0%	3.0%	14.7%	12.5%
Survival with a CPC of 1†	3.6%	2.1%	10.1%	7.9%
≥80 y				
N	629	332	80	47
Survival to discharge	6.0%	3.9%	15.0%	10.6%
Survival with a CPC of 1 or 2*	3.7%	2.7%	6.8%	6.4%
Survival with a CPC of 1†	1.7%	1.2%	5.5%	6.4%

CPC indicates cerebral performance category; PEA, pulseless electrical activity; VF, ventricular fibrillation; and VT, ventricular tachycardia.

*To address missing data on CPC scores, rates of survival with CPC of 1 or 2 were calculated by determining the proportion of survivors with CPC of 1 or 2 among all survivors with available CPC data and multiplying that proportion by the overall survival rate.

† Similarly, rates of survival with CPC of 1 were calculated by determining the proportion of survivors with CPC of 1 among all survivors with available CPC data and multiplying that proportion by the overall survival rate.

were associated with worse survival outcomes. In patients ≥80 years old with asystole or PEA on mechanical ventilation, the overall rate of survival was 6%, and survival with CPC of 1 or 2 was 3.7%. Survival with CPC of 1 in that group was 1.7%. Among all patients with asystole or PEA who were also receiving vasopressors (n=2845, 50% of the cohort), <10% of patients were discharged with a CPC of 1 or 2 and <7% were discharged with a CPC of 1, across all age groups. The corresponding rates of survival with a CPC of 1 or 2, and CPC of 1 were 2.7% and 1.2% in the ≥80 years age group with asystole/PEA and on vasopressors. Similar patterns of survival by age and vasopressor use were noted in patients with ventricular fibrillation or pulseless ventricular tachycardia, although the overall rates were higher compared with patients with asystole or PEA. In patients <50 years of age, with ventricular fibrillation or pulseless ventricular tachycardia who were not on vasopressors, overall survival was 26.1%, survival with a CPC of 1 or 2 was 22.0%, and survival with CPC of 1 was 16.5%.

We think that these data can help inform discussions among patients, providers, and hospital leaders regarding resuscitation policies and goals of care in the context of the COVID-19 pandemic, which is posing unprecedented challenges to the US healthcare system. The limited supply of ICU beds, mechanical ventilators, and personal protective equipment is already placing a tremendous strain on health systems. That notwithstanding, a recent article in the *Washington Post* noted that some hospitals are already considering universal do-not-resuscitation orders in patients with confirmed COVID-19 potentially overriding wishes of patients and their families for resuscitation.[2] Furthermore, a recent discussion in the *BMJ* highlighted similar challenges in

how to perform resuscitation effectively under these circumstances.[4]

Although empirical data regarding resuscitation outcomes in patients with COVID-19 from the United States are not available at the moment, a recent study from Wuhan, China found an overall survival of 2.9% in 136 patients with COVID-19 who underwent cardiopulmonary resuscitation for in-hospital cardiac arrest.[5] However, extrapolation of these findings to the United States needs to be done with caution. First, in-hospital cardiac arrest survival in China before the COVID-19 pandemic are important for context. A 2016 study from Beijing that included 1292 patients with in-hospital cardiac arrest from 12 hospitals found an overall survival of 9.1%,[6] which is much lower compared with a median survival of ≈25% in the US. Second, it is possible that the poor survival in patients with COVID-19 reported in the study from Wuhan are in part, because the hospital was severely overwhelmed with patients with COVID-19 and struggled to provide ICU care and ventilatory support for many severely ill patients (83% of patients included in the study had a cardiac arrest on the wards).

Until empirical data on cardiac arrest survival for COVID-19 patients in the United States become available, we think that our study findings can help inform the debate about resuscitation care for patients with COVID-19 in the United States. While we found low overall rates of survival and neurological outcomes in a cohort of selected ICU patients that would be most similar to critically ill patients with COVID-19, large heterogeneity in survival outcomes based on patient, cardiac arrest, and treatment variables was still present. The probability of survival without severe neurological disability (CPC of 1 or 2) ranged from <3% to over 22% across key patient subgroups, while survival with none to mild disability (CPC of 1) ranged from ≈1% to 16.5%. Such large variation in survival rates suggest that a blanket prescription of do-not-resuscitate orders in patients with COVID-19 may be unwarranted. Such a blanket policy also ignores the fact that early experience of the pandemic in the United States reveals that a large proportion of patients with COVID-19 are <50 years of age and otherwise healthy.[7] Cardiac arrest in such patients will likely have a different prognosis. Moreover, while asystole or PEA may be more common rhythms in the event of a cardiac arrest in patients with COVID-19 due to the associated hypoxia and respiratory failure, patients may also develop ventricular arrhythmias due to associated myocarditis, and QTc prolongation (eg, due to treatments like hydroxychloroquine), which may be reversible. We think that absent survival data for resuscitation in COVID-19 patients, clinicians could use data on survival presented here to engage patients and families in meaningful conversations regarding the likelihood of survival in the event of a cardiac arrest based on age, presenting rhythm, and illness severity.

Our findings should be interpreted carefully. Although we selected our cohort to be as closely representative of patients with COVID-19 as possible (ie, patients with pneumonia or sepsis on ventilatory support in an ICU at the time of arrest), the survival rates reported here represent a best-case scenario. It is possible that patients with COVID-19 who arrest are sicker and may therefore experience lower survival. Moreover, resuscitation care in patients with COVID-19 in healthcare settings is likely to be delayed due to the need for donning personal protective equipment, which may lead to worse survival in patients with COVID-19. Second, the definition of pneumonia and sepsis used in this study is based on documentation in the medical record, which may differ from other criteria (eg, diagnosis codes) used for identifying similar patients. Third, data on CPC scores were missing in 25.8% of all survivors, which was similar across patient subgroups. Therefore, calculations of neurological outcomes were based on the proportion of survivors with CPC 1 or CPC 1 and 2 among those with documented CPC scores. Finally, it is likely that hospitals participating in Get With The Guidelines–Resuscitation are motivated for improving resuscitation care quality and their experience may not be representative of nonparticipating hospitals.

In conclusion, we found that in a cohort of critically ill patients on mechanical ventilation, survival outcomes following in-hospital resuscitation were not uniformly poor. These data may help guide discussions between patients, providers, and hospital leaders in discussing appropriate use of resuscitation for patients with COVID-19.

ARTICLE INFORMATION

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