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Letter to the Editor

Outcomes of patients with cardiac arrest with and without COVID-19 in the United States

Cardiac arrest (CA) remains associated with very high mortality, with only one in ten patients surviving to hospital discharge [1–3]. Over the last three years, the widespread prevalence of COVID-19 infection has been associated with a significant parallel rise in the incidence of CA [1–4]. We aimed to assess (1) the incidence of COVID-19 infection in patients hospitalized with cardiac arrest and (2) the impact of concomitant COVID-19 and cardiac arrest on in-hospital mortality in the United States.

Using the national inpatient sample (NIS) database, we identified all the hospitalizations with cardiac arrest in the year 2020. Clinical characteristics and outcomes were compared between hospitalizations for cardiac arrest with and without concomitant COVID-19. Primary outcome was in-hospital mortality and secondary outcomes were cardiopulmonary resuscitation (CPR) & utilization of mechanical circulatory support. We present data on national estimates using the discharge weights provided by NIS. Categorical variables were compared using chi-square test and continuous variables using the Mann-Whitney U test. Multivariable logistic regression analysis was performed to adjust for patient and hospital characteristics. The statistical analysis was performed using SPSS version 23.0.

261,430 hospitalizations for cardiac arrest were identified of which 31,170 (11.9%) had concomitant COVID-19 infection. Patients with concomitant COVID-19 were more likely to be older, non-caucasians, obese, hypertensive, and diabetic. However, they were less likely to have a history of congestive heart failure, coronary artery disease, valvular disease, and acute myocardial infarction. Sepsis, pulmonary embolism and respiratory failure were more common in COVID-19 cohort. However, non-COVID-19 patients were more likely to have cardiogenic shock. The prevalence of shockable rhythms including ventricular tachycardia (VT) and ventricular fibrillation (VF) was significantly lower in COVID-19 patients.

In-hospital mortality was significantly higher in COVID-19 group (86.9% vs 63.0%, adjusted odds ratio (aOR): 4.1 (95% confidence interval (CI), 3.8–4.4), $p < 0.001$). CPR (aOR: 0.88 (95% CI, 0.83–0.92), $p < 0.001$) and mechanical circulatory support (aOR: 0.26 (95% CI, 0.19–0.36), $p < 0.001$) were significantly underutilized in COVID-19 cohort . Median length of stay and hospitalization charges were significantly higher in concomitant COVID-19 group.

Our study is the largest study to assess the incidence and impact of COVID-19 infection in patients with cardiac arrest. Important observations from our study are: (1) Around 12% of all CA patients admitted across the US in the pre-vaccination period had concomitant COVID-19 infection; (2) COVID-19 positive patients who suffered cardiac arrest were four times more likely to die in the hospital as compared with non-COVID-19 patients; (3) CPR and mechanical circulatory support were significantly underutilized in the COVID-19 cohort; and (4) African-americans and Hispanics were disproportionately affected with increased prevalence of concomitant COVID-19 infection.

These findings highlight the immense burden of COVID-19 infection on our society. Patients with COVID-19 who suffered a CA were more likely to have a non-shockable rhythm. Since we noted a higher incidence of pulmonary embolus (PE) and consequent respiratory failure in this population, hypoxia was probably the most common underlying mechanism behind CA in these patients. The results of our study suggests that in patients with CA and COVID-19, the care of the underlying infection is of paramount importance. Employing a protocol that utilizes a lower threshold to anticoagulate COVID-19 patients and also prioritizes the use of advanced treatment options early in the disease course for high risk patients may help in preventing a significant proportion of CA in these patients. In addition, these findings also highlight the challenges in taking care of COVID-19 patients with CA. Delays to performing chest compression due to the time needed to take appropriate precautions, hesitation from medical staff due to the concern of acquiring the infection, and the low utilization of MCS devices contribute to the suboptimal outcome noted in this group. With the possibility of further mutations and COVID surges, hospital systems should be prepared with a protocol that includes the use of automated chest compression devices, prioritizes early intubation, and also make personal protective equipment easily accessible in order to provide optimal and timely care to these patients.

The results of our study need to be interpreted within the context of the following limitations. First is the use of retrospective administrative database which utilizes ICD codes instead of adjudication. Second, we were unable to determine the timing of cardiac arrest using this database. Third, this data provides information only during the pre-vaccination period. Furthermore, due to the retrospective nature of our study, the effect of unmeasured covariates on the primary outcome cannot be assessed (Tables 1 and 2).

In this nationwide study of patients with cardiac arrest in the US, 12% were found to have concomitant COVID-19 infection. The presence of an active COVID-19 infection was associated with worse in-hospital outcomes after CA compared to those without the viral infection. Enhanced efforts are required to optimize the delivery of advanced cardiac life support (ACLS), assess for coagulopathy, and to aggressively treat the underlying infection in order to improve the outcomes of this high risk group.

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Table 1
Characteristics of patients who had cardiac arrest (CA) with and without concomitant COVID-19 infection.

Characteristics	CA with concomitant COVID-19 infection N = 31,170 (11.92%)	CA without concomitant COVID-19 infection N = 230,260 (88.08%)	*P* value
Age (Median)	67	65	<0.001
Female	39.40	42.17	<0.001
Race			<0.001
White	41.00	61.35	
Black	23.88	20.24	
Hispanic	25.30	11.06	
Coronary artery disease	24.45	32.60	<0.001
Prior myocardial infarction	4.76	6.88	<0.001
Hypertension	75.38	68.38	<0.001
Peripheral artery disease	5.05	8.82	<0.001
Diabetes mellitus	53.74	38.50	<0.001
Hyperlipidemia	41.74	36.65	<0.001
Congestive heart failure	29.48	42.89	<0.001
COPD	22.43	26.19	<0.001
Valvular disease	5.76	10.86	<0.001
End stage renal disease	10.14	10.48	0.064
STEMI	1.96	6.37	<0.001
NSTEMI	5.73	9.47	<0.001
Sepsis	38.48	28.38	<0.001
Pulmonary Embolism	5.10	3.27	<0.001
Ventricular tachycardia	9.46	13.75	<0.001
Ventricular fibrillation	6.29	12.77	<0.001
Left heart catheterization	1.36	12.21	<0.001
Percutaneous coronary intervention	0.67	6.27	<0.001
Coronary artery bypass surgery	0.03	1.37	<0.001
Acute kidney injury	63.46	51.82	<0.001
ESRD on dialysis	0.13	0.04	<0.001
Respiratory failure	72.62	66.68	<0.001
RF requiring mechanical Ventilation	53.29	51.98	<0.001
Cardiogenic Shock	2.82	6.92	<0.001

Abbreviations: CA- cardiac arrest; COPD- chronic obstructive pulmonary disease; STEMI- ST-segment elevation myocardial infarction; NSTEMI- non-ST-segment elevation myocardial infarction; ESRD- end stage renal disease; RF- respiratory failure.

Declaration of Competing Interest

The authors declare no conflicts of interest

Table 2
Outcomes of patients who had cardiac arrest (CA) with and without concomitant COVID-19 infection.

Outcomes	CA with concomitant COVID-19 infection N = 31,170 (11.92%)	CA without concomitant COVID-19 infection N = 230,260 (88.08%)	*P* value
Died	86.94	63.03	<0.001
Adjusted OR	4.10 (3.82–4.41)	Reference	<0.001
CPR	38.85	37.72	<0.001
Adjusted OR	0.88 (0.84–0.92)	Reference	<0.001
MCSD	0.67	2.89	<0.001
Adjusted OR	0.26 (0.19–0.36)	Reference	<0.001
LOS (Median)	13	8	<0.001
Total Charges (Median)	$230,839	$181,332.91	<0.001

Abbreviations: OR: odds ratio; CPR: cardiopulmonary resuscitation; MCSD: mechanical circulatory support device; LOS: length of stay.

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