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Outcomes for in-hospital cardiac arrest for COVID-19 patients at a rural hospital in Southern California

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ABSTRACT

Background: In-hospital cardiac arrest (IHCA) carries a high mortality and providing resuscitation to COVID-19 patients presents additional challenges for emergency physicians. Our objective was to describe outcomes of COVID-19 patients suffering IHCA at a rural hospital in Southern California.

Methods: Single-center retrospective observational study. A hospital registry of COVID-19 patients was queried for all patients who suffered IHCA and received cardiopulmonary resuscitation (CPR) between May 1st and July 31st, 2020. A manual chart review was performed to obtain patient demographics, oxygen requirement prior to cardiac arrest (CA), details of the resuscitation including presence of an emergency physician, and final disposition.

Results: Twenty-one patients were identified, most of whom were Hispanic, male, and aged 50–70. The most common medical comorbidities were diabetes and hypertension. Most patients suffered respiratory arrest, with an initial rhythm of pulseless electrical activity or asystole. Return of spontaneous circulation (ROSC) was achieved in 3/9 patients already receiving mechanical ventilation, but all 3 expired within the following 24 h. ROSC was achieved in 10/12 patients not already intubated, though most also expired within a few days. The only 2 patients who survived to discharge suffered respiratory arrest after their oxygen delivery device dislodged.

Conclusion: At a small rural hospital with limited resources and a predominantly Hispanic population, cardiac arrest in a COVID-19 patient portends an extremely poor prognosis. A better appreciation of these outcomes should help inform emergency providers and patients when discussing code status and attempts at resuscitation, particularly in resource limited settings.

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1. Introduction

The severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) pandemic has necessitated a significant reassessment of the approach to resource allocation, particularly in rural and resource-limited settings. Advances in resuscitation have seen significant improvements in survival to discharge for in-hospital cardiac arrest (IHCA) and there is slowly growing data on survivability after IHCA for patients with coronavirus disease 2019 (COVID-19) [1,2]. Initial studies in Wuhan, China demonstrated a 30-day survival rate after IHCA of 2.9% [3], while a retrospective case series of 31 IHCA early in the pandemic in New York City showed no patients survived to discharge. [4] More recent studies have shown a wide variation in survival to hospital discharge, from 0% to 12% [5–7].

In many hospital settings, emergency physicians (EPs) are expected to respond to “code blues” and assist with resuscitations for admitted patients throughout the hospital [8,9]. Furthermore, as hospitals became increasingly saturated during the pandemic, patients were routinely boarding in emergency departments (EDs) for multiple days, requiring EPs to assist when they decompensated [10,11]. Given the poor outcomes after suffering IHCA, the significant resources required to run an effective resuscitation, and concerns for contamination among code team members, it is necessary to inform EPs which patients with COVID-19 may benefit from cardiopulmonary resuscitation (CPR) [12–14]. Our goal here was to describe the characteristics and outcomes for COVID-19 patients suffering IHCA at a rural hospital in Southern California who received resuscitation from EPs.

2. Methods

This was a single-center retrospective observational study performed at [blinded]. [blinded] is a rural situated community hospital

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with a total of 120 beds and 12 licensed intensive care unit (ICU) beds. We identified patients who suffered IHCA between May 1st and July 31st, 2020. A hospital registry listing of all cardiac arrests (CAs) was queried to determine which of those patients had tested positive for COVID-19. A manual chart review was then performed to confirm CA, COVID-19 positivity, as well as to obtain patient demographics, medical comorbidities, COVID-19 specific therapies administered, oxygen requirement prior to CA, and details of the resuscitation, including the presence of an emergency physician. Our primary outcome was survival to discharge, and secondary outcomes included return of spontaneous circulation (ROSC) and cerebral performance category (CPC) score at 30 days [15]. CA was defined as the absence of a palpable pulse and/or the initiation of chest compressions. Patients were included if the first episode of CA occurred within the hospital, regardless if in the emergency department, medical surgical ward, or ICU. If a patient suffered multiple episodes of CA, only the first episode was included for analysis. All patients were identified as having SARS-CoV-2 by nasopharyngeal swab PCR (Cepheid, Biofire, or BD Max). Exclusions included age under 18 or “Do Not Attempt Resuscitation” (DNAR) code status. We also recorded the rate of survival to discharge after IHCA for non-COVID-19 patients both during this same time period and prior to the pandemic from January 1st, 2018 until April 30th, 2020. Variables were analyzed using descriptive statistics as indicated with SPSS, version 25 (SPSS, Armonk, NY). Univariate analysis was performed using Fisher’s exact test with a p value < 0.05 considered statistically significant. This study was judged exempt by our institutional review board (IRB #200558).

3. Results

Between May 1st and July 31st, 2020, 21 patients with COVID-19 suffered an IHCA and received CPR at our institution (Table 1). During this time, the hospital treated 1415 patients, of whom 497 had COVID-19. Average length of stay for COVID-19 patients was 8 days. Mortality for admitted COVID-19 patients was 16.3% (81/497). In comparison, mortality was significantly lower for admitted non-COVID-19 patients at 3.7% (34/918), $p < 0.00001$. Most of the COVID-19 patients who suffered IHCA and received attempted resuscitation were Hispanic, male, and aged 50–70. The majority also suffered from diabetes, hypertension, and obesity (Table 1).

We also analyzed the hospital day post admission on which the patient sustained CA, as well as the oxygen therapy being administered at that time (Table 2). Approximately half the patients were already intubated and on a mechanical ventilator at the time of arrest. Return of spontaneous circulation (ROSC) was achieved for 3/9 intubated patients, however all 3 arrested again and expired within the following 24 h. Most of the remainder were also receiving advanced oxygen therapy, including non-invasive ventilation (NIV), high flow nasal cannula

(HFNC), or 15 l of oxygen via a non-rebreather mask (15 L NRB). The rate of ROSC was higher among this non-intubated group (83% vs 33%), however the majority also expired within the next few days. Overall, only 2 out of 21 patients survived to discharge after IHCA, both having suffered “accidental” arrests. Patient 2 suffered a respiratory arrest after her BiPAP mask became dislodged and ROSC was achieved shortly after intubation. Patient 4 was improving in his disease course after previously receiving mechanical ventilation, when he coded after his HFNC became dislodged. ROSC was also soon achieved after intubation and he was ultimately discharged to a skilled nursing facility. In comparison, survival for non-COVID-19 patients suffering IHCA during this same time period was 33% (6/18). Survival to discharge for IHCA in patients from 1/1/2018–7/1/2020 was 31.2% (39/125), significantly higher than patients with IHCA and a diagnosis of COVID-19 ($p = 0.041$).

4. Discussion

Imperial County in Southern California had a disproportionately large burden of COVID-19 patients throughout the pandemic. From May 1st to July 31st, 2020, there were 9904 cases and 274 deaths, in a county with a population of only 198,000 (Imperial County Department of Public Health COVID-19 Dashboard). The limitation of resources was acutely felt in the region, with a shortage of ventilators and ICU beds. At our hospital, like at many other institutions, emergency physicians are expected to respond to “code blues” through the hospital, including the ICU. We believe it is important for EPs to understand the risks of providing resuscitation after IHCA for COVID-19 patients and identify which patients are most likely to benefit from that resuscitation. In this retrospective observational study, we found that most patients with COVID-19 who suffered a cardiac arrest were middle-aged Hispanic males. This likely reflects the demographics of the region, which is 80.4% Hispanic, (2010 United States Census) as well as the proximity to the Mexican border. Prior studies have shown higher rates of morbidity and mortality among minorities, particularly African Americans and Hispanics [16,17]. We also found high rates of obesity, hypertension, and diabetes among our patient cohort who suffered cardiac arrest, consistent with previously reported data [18–20].

We found the initial rhythm of arrest was pulseless electrical activity or asystole in 20/21 patients, as has been found in similar studies of IHCA of COVID-19 patients [3,4,6]. We found wide variability in the day after admission on which the CA occurred, as well as wide variability in what oxygen therapy the patient was receiving prior to arrest. Although the rate of ROSC was significantly higher among patients who were not already intubated (83% vs 33%), survival to discharge was similarly poor. Among patients who were receiving mechanical ventilation prior to arrest, those who did achieve ROSC often had recurrent cardiac arrest and ultimately expired within the following 24 h of the index cardiac arrest event. The only 2 patients who survived to discharge could both be classified as accidental arrests after their oxygen delivery dislodged.

A large burden of the COVID-19 pandemic has fallen on emergency physicians, and it is important to be aware of numerous aspects of providing care to these patients, particularly during critical illness. As more is being learned about the disease process and newer therapies become available, mortality is significantly improving [21], and there is growing literature on survivability after ICHA. However, there is still a discrepancy in patient outcomes in different resource settings. A recent study from rural Georgia showed that out of 1094 patients hospitalized for COVID-19, 63 suffered IHCA, none of whom survived to hospital discharge [5]. A large multicenter cohort study of 701 COVID-19 patients suffering IHCA in an intensive care units (ICU) setting demonstrated ROSC in 33.8% patients, but survival to discharge of only 12%, 7% with good neurologic outcome [6]. Interestingly, there was a significantly higher rate of cardiac arrest at hospitals with less than 50 ICU beds. Another recent multicenter analysis showed wide variation in outcomes after IHCA, with some hospitals demonstrating rates of survival to

Table 1
Patient characteristics ($n = 21$).

Average age – number (in years)	61
Male sex – number (%)	19 (90.5%)
Ethnicity – number (%)	
Hispanic	20 (95%)
Caucasian	1 (5%)
Characteristics of significant co-morbidities – number (%)	
Hypertension	11 (52.4%)
Diabetes mellitus	13 (61.9%)
Obesity (BMI > 30)	11 (52.4%)
Cardiovascular disease	4 (19.0%)
Chronic kidney disease	4 (19.0%)
COVID-19 specific therapies received – number (%)	
Dexamethasone	6 (28.6%)
Remdesivir	5 (23.8%)
Convalescent plasma	2 (9.5%)

Table 2
Individual patient cardiac arrest data and outcomes.

Patient Number	Age	Gender	BMI	Oxygen Requirement	Initial Rhythm	Hospital Day of Arrest	ROSC Achieved	Additional LOS	Hospital Dispo	CPC at 30 Days	Notes
1	53	M	46	intubated	asystole	10	No	X	expired	5	
2	53	F	25	NIV	PEA	8	Yes	4	transferred	1	Discharged home after 25 day stay at OSH
3	65	M	23	15 L NRB	PEA	6	Yes	4	transferred	5	Expired at OSH
4	54	M	26	HFNC	PEA	20	Yes	10	discharged	4	Discharged to nursing facility
5	39	M	61	intubated	PEA	2	Yes	0	expired	5	Recurrent CA shortly after
6	79	M	27	intubated	PEA	14	Yes	0	expired	5	Recurrent CA shortly after
7	59	M	39	NIV	PEA	6	Yes	1	expired	5	
8	40	M	31	intubated	asystole	15	No	X	expired	5	
9	68	M	41	NIV	PEA	7	No	X	expired	5	
10	39	M	33	intubated	PEA	8	No	X	expired	5	
11	87	M	27	2 L NC	PEA	8	Yes	1	expired	5	Compassionate extubation
12	37	F	50	intubated	PEA	7	No	X	expired	5	
13	37	M	57	intubated	PEA	24	No	X	expired	5	
14	59	M	42	15 L NRB	PEA	2	Yes	0	expired	5	Transitioned to comfort care
15	78	M	24	3 L NC	PEA	9	No	X	expired	5	Previously intubated, unexpected CA after initial improvement
16	53	M	47	intubated	PEA	2	Yes	0	expired	5	Recurrent CA multiple times the same day
17	67	M	33	15 L NRB	PEA	7	Yes	6	expired	5	Transitioned to comfort care
18	55	M	30	NIV	asystole	7	Yes	5	expired	5	
19	89	M	17	intubated	vfib	0	No	X	expired	5	
20	62	M	19	RA	PEA	0	Yes	0	expired	5	Recurrent CA multiple times the same day
21	79	M	27	15 L NRB	PEA	2	Yes	0	expired	5	Recurrent CA multiple times the same day

Key: BMI: body mass index; PEA: pulseless electrical activity; vfib: ventricular fibrillation; ROSC: return of spontaneous circulation; LOS: length of stay; NIV: non-invasive ventilation; NRB: non-rebreather; HFNC: high flow nasal cannula; NC: nasal cannula; RA: room air; CPC: cerebral performance category; CA: cardiac arrest; OSH: outside hospital.

discharge of up to 35.7% [7]. However, at two hospitals in New York City with the highest volume of COVID-19 patients, survival to discharge was only 5.9%.

Current guidelines try to balance protection of rescuers while still providing quality fruitful resuscitation [12]. Performing high-quality CPR requires multiple aerosol generating procedures (AGPs), including bag-mask valve ventilation and intubation [22–24]. Even for patients already undergoing mechanical ventilation, there is concern that performing compressions and manual ventilations may generate aerosols [25]. A code team typically requires the presence of a provider or multiple providers, multiple nurses, a respiratory therapist, and people to perform the compressions, each of whom is at an increased risk of exposure during a resuscitation. Furthermore, all these resources focused on a single patient detracts from attention that can be paid to all the other patients who are also suffering from critical illness. Thus, an appreciation of available hospital resources, patient factors, and family wishes should all be considered when determining which patients with COVID-19 should be offered attempts at resuscitation.

We acknowledge there are several limitations with this study. This was a single-center retrospective observational study with a small study population and reliant on the fidelity and completeness of the electronic medical record, and results may not apply at other sites. The selected time period was relatively early during the COVID-19 pandemic which may also limit the applicability of our results.

5. Conclusion

In this study at a small rural hospital with limited resources and a predominantly Hispanic population, we found low survivability after IHCA in COVID-19 patients. While more is being learned about the disease, and treatment modalities are improving, cardiac arrest portends an extremely poor prognosis. A better appreciation of these factors should help inform emergency physicians and patients when discussing code status and attempts at resuscitation.

Meetings

None.

Presentations

Accepted for presentation as an ePoster at the American Thoracic Society Conference, May 2021.

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Author contributions

AL, CAT, and RVN were involved with study concept and design. NA and AL performed data curation. RVN, GW and AL performed the formal analysis. RVN wrote the original draft and CAT, GW and AL assisted with reviewing and editing.

Declaration of Competing Interest

Dr. Wardi is supported by the National Foundation of Emergency Medicine and funding from the Gordon and Betty Moore Foundation (#GBMF9052). He has received speaker's fees from Thermo-Fisher and consulting fees from General Electric. The remaining authors have no disclosures to report.

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