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EDITORIAL COMMENT

Cardiac Arrests During the COVID-19 Pandemic



The Perfect Storm*

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Sudden cardiac death (SCD) continues to be a major public health problem in the United States. The incidence of out-of-hospital cardiac arrests (OHCAs) in the United States is approximately 350,000 per year (1-3). Coronary heart disease or other structural heart disease is responsible for SCD in most cases. Improvement in pharmacological and interventional treatments and use of implantable defibrillators (ICDs) in appropriately selected patients have changed the paradigm of the mechanisms underlying SCD. Pulseless electrical activity and asystole account for a growing percent of OHCAs and are associated with poor outcomes (3,4). The 2 general strategies to overcome this public health problem are primary prevention of SCD or improved resuscitation once OHCA has occurred.

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Identification of patients at risk for a SCD event remains challenging. Moreover, because of the different dysrhythmic mechanisms that can evolve to OHCA, it becomes even more difficult to predict the risk for SCD (5). Potential strategies to prevent poor outcomes in patients at risk for OHCA is to identify at-risk patients and initiate appropriate preventive therapies, including medications, ICDs (6), or wearable defibrillators (7). It is notable that most patients who will experience an OHCA will not have had an

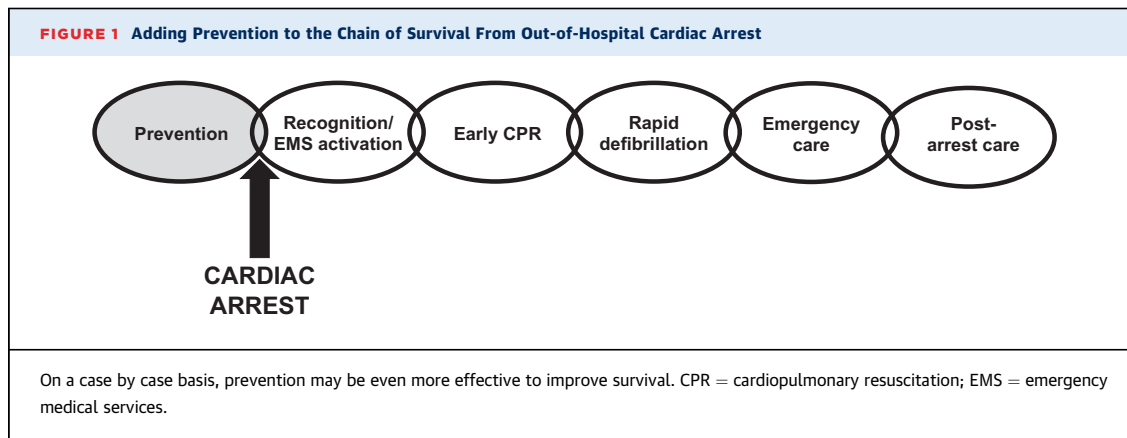
indication for an ICD, which highlights the tremendous public health impact there may be in appropriate identification and treatment of these individuals.

There has been a concerted effort to improve the out-of-hospital chain of survival (2,3). Clearly, rapid application of bystander cardiopulmonary resuscitation (CPR) and early defibrillation (for shockable rhythms) or early application of advanced cardiac life support can enhance survival (2,8). In a study of >30,000 OHCAs in Sweden, approximately 51% of whom had bystander CPR, the 30-day survival rate was 10.5% when CPR was performed before emergency medical services (EMS) arrival versus 4% when EMS arrived before CPR occurred ($p < 0.001$) (8). In the United States, based on the CARES (Cardiac Arrest Registry to Enhance Survival) dataset, the incidence of bystander-initiated CPR is approximately 40%, with a slight decline over the past 2 years (3). Survival to discharge for EMS-treated OHCA is approximately 10.4%, with no notable improvement over the past 8 years. If the first rhythm is shockable (ventricular tachycardia or ventricular fibrillation), survival is approximately 29.5%, which also has had no improvement over the past 5 years. Moreover, most (69.8%) OHCAs in adults occurred in the home setting. The location of the OHCA has implications for initial detected rhythm and outcome. OHCAs that occur in public places are more likely to have a shockable rhythm whether the arrest was witnessed by a bystander versus EMS, or whether an automatic external defibrillator (AED) was used; this resulted in a greater survival to hospital discharge (34% for arrests in public settings vs. 12% for arrests at home) (9). Similarly, the time of arrival of EMS also affects survival. One study showed survival decline by 5.2%/min for EMS arrival between 5 to 10 min and a further

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decline of 1.9%/min for arrival between 11 to 15 min after collapse (10).

During the current COVID-19 pandemic caused by the novel Corona SARS2 virus, there has been concern that patients with serious and acute cardiovascular symptoms and syndromes have been avoiding hospitals. Data from Kaiser Permanente (Oakland, California) showed that during the COVID-19 pandemic, after shelter-in-place orders were given in early March 2020, weekly incidences of acute myocardial infarction decreased by up to 48% compared with a similar period in 2019 (11). Similar studies showed decreased admission rates for myocardial infarction or unstable angina in Northern Italy (12), and the investigators posited that this might have caused increased mortality above that attributable to COVID-19 infections. Similar data from England, and other U.S. and/or European sites have also shown decreased admission rates (13,14).

In the study by Uy-Evanado et al. (15) in this issue of *JACC: Clinical Electrophysiology*, they confirmed numerically higher numbers of OHCAs with worsening survival among patients with OHCAs from March 1 to May 31, 2020 compared with the similar period in 2019. They found an increase of OHCA incidence by 23% and 25%, respectively, in 2 counties, Multnomah, Oregon and Ventura, California. This increase is certainly of clinical concern because these 2 counties were considered to have low rates of infection. In the patients from Oregon, only 0.8% of patients with OHCAs had a positive test result for COVID-19, and in the other county, there was only 1 confirmed case of COVID-19 during the study timeline. The investigators found an absolute increase of 13% of OHCAs that occurred at home (up to 76% compared with 65% in 2019; $p = 0.009$), and there was less bystander CPR by 10% (51% in 2020 vs. 61% in

2019; $p = 0.01$), lower use of AEDs, and a 1.1-min increase in EMS response ($p = 0.01$). Survival to hospital discharge decreased from 14.7% to 7.9% ($p = 0.02$) in 2020.

Other studies in areas of high COVID-19 rates also reported increases in OHCAs. In the Lombardy region of Italy, there was a 58% increase in OHCAs during the COVID-19 outbreak (16). They also noted a higher incidence of OHCAs that occurred at home or were unwitnessed, with longer time to EMS arrival and a lower percent of patients who received bystander CPR (16). In New York City, a similar observational study was conducted on patients with OHCAs during the height of their COVID-19 pandemic (March 1 to April 25, 2020) and compared with incidences in 2019 (17). They found a remarkable 3-fold increased incidence (47.5/100,000 vs. 15.9/100,000 in 2019) of OHCAs. There was an increase in asystole with an odds ratio of 3.5 and an increase of pulseless electrical activity with an odds ratio of 1.99. These data suggested the possibility of respiratory arrest, possibly COVID-19 related, as an etiological factor among many of these patients. Interestingly, in 2020, patients with OHCAs did not have higher percentages of previous cardiac and/or respiratory disease. Moreover, the percentage of bystander CPR was similar in 2020 compared with 2019.

Worse outcomes were noted in both Italy and New York with an increased COVID-19 incidence (16,17) and in areas of low COVID-19 penetrance (15). The actual incidences of OHCAs increased more in the areas with high COVID-19 penetrance (58% and 200%) compared with approximately 26% in the areas with low COVID-19 penetrance. Potential explanations included either direct COVID-19-induced cardiac injury or indirect effects due to more pronounced sheltering at home and not seeking required cardiac care due to concerns of COVID-19 exposure.

COVID-19 has created a perfect storm to increased OHCA and worsened outcomes. Because this is likely due, at least in part, to an increased number of patients who avoided care for acute coronary syndromes, and by extension, routine cardiac care, this provides supportive evidence for the impact these therapeutic approaches have for the prevention of OHCA. Although many cardiology practices shifted to a telemedicine model, this might not be sufficient to diagnose and treat at-risk patients who might require tests, including electrocardiography, echocardiography, stress testing, other cardiac testing modalities, or acute cardiac care. It is important to acknowledge that COVID-19 itself can affect the heart, and there may be acute and medium-term sequelae that may increase the prevalence of cardiovascular disease, myocardial fibrosis, and potentially, ventricular arrhythmias (18). Moreover, the shelter-in-place orders may have worsened outcomes because previous studies showed decreased outcomes that were associated with OHCA in the home compared with a public setting (9). An overburdened EMS system attending to patients with acute COVID-19 and the need for responders to don personal protective equipment may contribute to increased response times by EMS. Moreover, to the extent that bystanders were available to perform CPR, the potential or perceived risk of COVID-19 exposure might have limited or delayed CPR.

As we settle down into a new “normal” during this COVID-19 pandemic, it is incumbent on physicians, public health officials, and others to encourage patients to obtain acute, urgent, and routine cardiovascular care. It is more important than ever to encourage patients to optimize risk factors. Physical inactivity that has been exacerbated by the restrictions in place during this pandemic and weight gain during home lockdowns (19) may also increase overall risk for cardiovascular events, including OHCA. Moreover, obesity and hypertension are risk factors for morbidity and mortality associated with COVID-19, which should add

impetus to control these factors. A potential 21st century solution to low rates of bystander CPR and AED use may be the use of smartphone applications to send volunteer bystanders to sites of OHCA and to retrieve the nearest AED to enhance CPR and AED use (20).

Although the duration and severity of COVID-19 pandemic is unknown, it is certain that we will continue to have an epidemic of cardiovascular disease and associated risk factors (e.g., obesity). The insights provided by the well-established cohorts reported by Uy-Evanado et al. (15) are critical to establishing corrective responses to changing conditions (e.g., a pandemic) and to highlight the need for new public health approaches to address SCD. The report from these cohorts highlight the role of prevention, because most of the increment in OHCA was not directly related to COVID-19. Similarly, the role of resuscitation is clearly demonstrated. Ultimately, we have to link prevention to the chain of survival from OHCA (Figure 1) and evaluate whether we can substantially reduce SCD in community-based studies. Importantly, we should not lose focus of our duty to encourage patients to be compliant with proven lifestyle and pharmacological interventions, as well as hospital care for acute coronary syndromes, to improve their cardiovascular health, even during a pandemic.

AUTHOR DISCLOSURES

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