Implantable-cardioverter defibrillators and COVID-19: A complicated relationship

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The ongoing coronavirus pandemic has left a profound impact on humanity, unveiling the insidious nature of the virus whose influence extends beyond the upper respiratory tract. Cardiovascular disorders, including cardiac arrhythmias, are recognized as common extrapulmonary manifestations of coronavirus disease 2019 (COVID-19). Cardiac arrhythmias, such as atrial fibrillation and ventricular tachycardia, are prevalent among COVID-19 patients. Furthermore, the pandemic has also been linked to a sharp increase in out-of-hospital cardiac arrests, but the specifics of the cause of cardiac arrest and associated arrhythmias remain unclear.

Patients with implantable cardioverter-defibrillators (ICD), who are inherently predisposed to ventricular tachyarrhythmias due to underlying structural or electrical heart disease, became a focal point of study during the pandemic. That research aimed to discover the arrhythmic mechanisms underlying cardiac arrests. However, despite the heightened vulnerability to severe SARS-CoV-2 infection in these patients, the frequency of ICD therapies has been surprisingly variable (Figure 1).

Exploring the data from various studies provides a kaleidoscopic view of ICD therapies during the pandemic. Adabag et al. [1] reported a significant increase in ICD therapies in New York City, Boston, and New Orleans, focusing on the zip codes with the highest prevalence of COVID-19 in the USA during the first phase of the pandemic. However, using

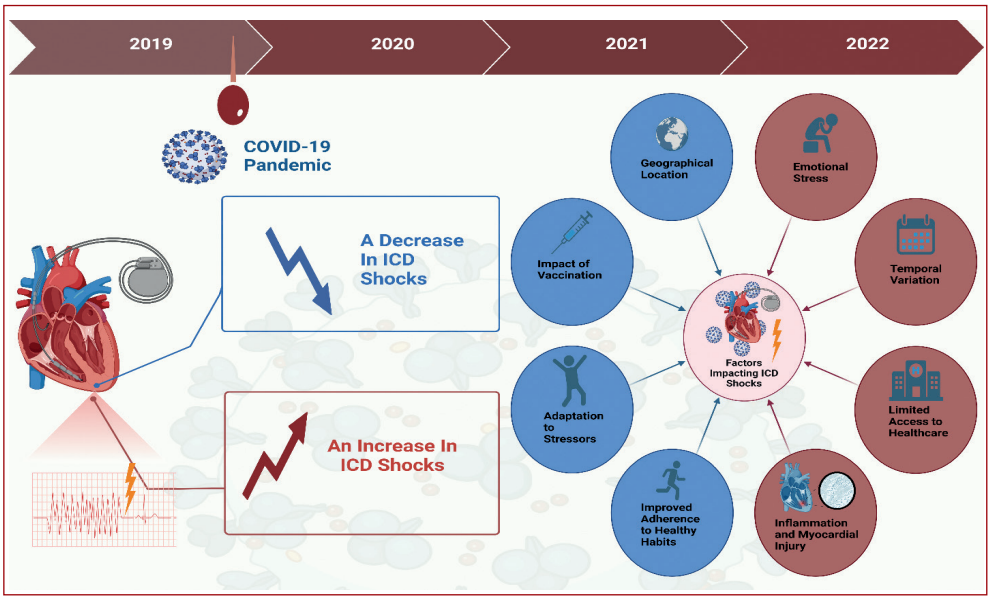

Figure 1. Central figure

state-level data from a wide region in the USA, O'Shea et al. [2] reported a 32% decrease in ICD shocks. In studies from 3 separate regions in Italy, Malanchini et al. [3], Sassone et al. [4], and Zorzi et al. [5] reported no change in ventricular arrhythmia burden and ICD therapies during the COVID-19 pandemic, disputing a higher incidence of cardiac arrests in the same period in Italy. However, Ducceschi et al. [6] reported an increase in both ventricular and atrial tachyarrhythmias during the pandemic in the Campania region of Italy. In Germany, Hauck et al. [7] reported no change in cardiac arrhythmias in ICD patients enrolled in a clinic, but Rath et al. [8] reported an increase in cardiac arrhythmias in ICD patients during the second wave of the COVID-19 pandemic. In a multi-center study from France, Galand et al. [9] noted a significant increase in ICD therapy with anti-tachycardia pacing during the initial weeks of the pandemic, coinciding with heightened emotional stress, but observed a subsequent significant decrease in ICD therapies after the lockdown. In Poland, Tajstra et al. [10] reported no change in appropriate ICD therapies during the pandemic but inappropriate therapies, delivered for atrial tachyarrhythmias, occurred less frequently.

These disparate results may arise from each study focusing on a different aspect of the pandemic's influence on people. While the patients infected with SARS-CoV-2 may have a greater likelihood of arrhythmias, others may have been protected due to lockdowns. While the patients who had to delay necessary medical care may have suffered adverse consequences, those who avoided the physical and emotional stressors of work may have had more favorable outcomes. Thus, these varied outcomes underscore the intricate relationship between COVID-19 and ICD interventions. Notably, prior studies lacked information on patients' COVID-19 status. A comprehensive analysis involving a large group of patients with and without ICD therapy is necessary to determine the true association of COVID-19 with ICD shocks.

In this issue of the journal, Biel et al. [11] report the outcomes of patients presenting to the hospital with ICD shocks in the COVID-19 era, providing data elucidating part of this puzzle. They note that the number of hospital admissions for ICD shocks during the pandemic was similar to the pre-pandemic era. However, only 11% of the patients hospitalized during the pandemic had COVID-19, which does not appear to be a sufficient proportion to alter the overall hospitalization rate. The authors acknowledge as a limitation that there may have been patients with ICD shocks who were not hospitalized due to reluctance to go to the emergency department. Biel et al. [11] also report a higher mortality rate among patients who had COVID-19. This is not a surprise, given that high-risk study population. Furthermore, the patients with COVID-19 had a higher likelihood of ICD discharges in the hospital compared to those without COVID-19. Although the sample size of this subgroup is small, this observation suggests a positive association between potentially lethal ventricular arrhythmias and COVID-19.

Indeed, the current body of evidence supports the hypothesis that COVID-19 may trigger cardiac arrhythmias. However, this potential is not exclusive to COVID-19. Existing data also highlight a higher incidence of sudden cardiac death, cardiac arrhythmias, and ICD shocks during the influenza season. The potential mechanism of cardiac arrhythmias triggered by upper respiratory tract viral infections includes cytokine activation, viral myocarditis, hypercoagulability, and adrenergic activation as well as secondary factors such as hypoxemia, dehydration, electrolyte abnormalities, drug toxicities, and inability to take cardiac medications.

Despite significant progress in the field, sudden cardiac death (SCD) remains a major cause of death in the general population [12]. While left ventricular structural abnormalities associated with SCD have been identified, we cannot predict most SCD cases, and ICDs may not be beneficial in certain patient groups [13–15]. In addition to the abnormal myocardial substrate, there also appears to be a seemingly random component in SCD prediction that has puzzled investigators for a long time. This "random" component might involve transient SCD triggers, which are so elusive that they are undetectable by the time the healthcare team arrives on the scene. Wearable and implantable devices as well as machine-learning algorithms may help investigators identify some of these transient triggers for cardiac arrhythmias and SCD. The pandemic has taught us those viral infections of the upper respiratory tract, including COVID-19, may just be one of them.

Article information

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REFERENCES

1. Adabag S, Zimmerman P, Black A, et al. Implantable cardioverter-defibrillator shocks during COVID-19 outbreak. J Am Heart Assoc. 2021; 10(11): e019708, doi: 10.1161/JAHA.120.019708, indexed in Pubmed: 34044586.
2. O'Shea CJ, Thomas G, Middeldorp ME, et al. Ventricular arrhythmia burden during the coronavirus disease 2019 (COVID-19) pandemic. Eur Heart J. 2021; 42(5): 520–528, doi: 10.1093/eurheartj/ehaa893, indexed in Pubmed: 33321517.
3. Malanchini G, Ferrari P, Leidi C, et al. Ventricular arrhythmias among patients with implantable cardioverter-defibrillator during the COVID-19 pandemic. J Arrhythm. 2021; 37(2): 407–413, doi: 10.1002/joa3.12518, indexed in Pubmed: 33821178.
4. Sassone B, Virzì S, Bertini M, et al. Impact of the COVID-19 lockdown on the arrhythmic burden of patients with implantable cardioverter-defibrillators. Pacing Clin Electrophysiol. 2021; 44(6): 1033–1038, doi: 10.1111/pace.14280, indexed in Pubmed: 34022067.

5. Zorzi A, Mattesi G, Frigo AC, et al. Impact of coronavirus disease 19 outbreak on arrhythmic events and mortality among implantable cardioverter defibrillator patients followed up by remote monitoring: a single center study from the Veneto region of Italy. J Cardiovasc Med (Hagerstown). 2022; 23(8): 546–550, doi: 10.2459/JCM.0000000000001348, indexed in Pubmed: 35905001.
6. Ducceschi V, de Divitiis M, Bianchi V, et al. Effects of COVID-19 lockdown on arrhythmias in patients with implantable cardioverter-defibrillators in southern Italy. J Arrhythm. 2022; 38(3): 439–445, doi: 10.1002/joa3.12713, indexed in Pubmed: 35785398.
7. Hauck C, Schober A, Schober A, et al. Ventricular arrhythmia burden in patients with implantable cardioverter defibrillator and remote patient monitoring during different time intervals of the COVID-19 pandemic. Eur J Med Res. 2022; 27(1): 234, doi: 10.1186/s40001-022-00867-w, indexed in Pubmed: 36348435.
8. Rath B, Doldi F, Willy K, et al. Ventricular arrhythmia burden in ICD patients during the second wave of the COVID-19 pandemic. Clin Res Cardiol. 2023, doi: 10.1007/s00392-023-02320-2, indexed in Pubmed: 37902845.
9. Galand V, Hwang E, Gandjbakhch E, et al. Impact of COVID-19 on the incidence of cardiac arrhythmias in implantable cardioverter defibrillator recipients followed by remote monitoring. Arch Cardiovasc Dis. 2021; 114(5): 407–414, doi: 10.1016/j.acvd.2021.02.005, indexed in Pubmed: 34088625.
10. Tajstra M, Wojtaszczyk A, Sterliński M, et al. Patients with heart failure and an implanted cardioverter-defibrillator during the coronavirus disease 2019 pandemic: insights from a multicenter registry in Poland. Kardiol Pol. 2021; 79(5): 562–565, doi: 10.33963/KP.15918, indexed in Pubmed: 34125930.
11. Biel B, Skoczyński P, Hrymniak B, et al. Outcomes of patients with implanted cardioverter-defibrillators admitted to the Emergency Department due to electrical shock during the pre-pandemic and COVID-19 pandemic era. Pol Heart J. 2024; 82(2): 156–165, doi: 10.33963/v.kp.98604, indexed in Pubmed: 38230463.
12. Adabag S, Hodgson L, Garcia S, et al. Outcomes of sudden cardiac arrest in a state-wide integrated resuscitation program: Results from the Minnesota Resuscitation Consortium. Resuscitation. 2017; 110: 95–100, doi: 10.1016/j.resuscitation.2016.10.029, indexed in Pubmed: 27865744.
13. Konety SH, Koene RJ, Norby FL, et al. Echocardiographic predictors of sudden cardiac death: the atherosclerosis risk in communities study and cardiovascular health study. Circ Cardiovasc Imaging. 2016; 9(8), e004431, doi: 10.1161/CIRCIMAGING.115.004431, indexed in Pubmed: 27496550.
14. Anantha Narayanan M, Vakil K, Reddy YN, et al. Efficacy of implantable cardioverter-defibrillator therapy in patients with nonischemic cardiomyopathy: a systematic review and meta-analysis of randomized controlled trials. JACC Clin Electrophysiol. 2017; 3(9): 962–970, doi: 10.1016/j.jacep.2017.02.006, indexed in Pubmed: 29759721.
15. Maheshwari A, Norby FL, Soliman EZ, et al. Relation of prolonged P-wave duration to risk of sudden cardiac death in the general population (from the atherosclerosis risk in communities study). Am J Cardiol. 2017; 119(9): 1302–1306, doi: 10.1016/j.amjcard.2017.01.012, indexed in Pubmed: 28267962.