EDITORIAL COMMENTARY

Pacing through a pandemic—Coping with the "tip of the iceberg"

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The coronavirus disease 2019 (COVID-19) pandemic has presented a once in a generation challenge to our health care systems worldwide. In its early phases, confusion existed about modes of transmission, levels of infection control, and risk to health care personnel. This combined with lack of resources for adequate personal protective equipment (PPE) generated high levels of anxiety for medical teams and rationing of PPE in the early phase. Advise and local guidelines were changing on an almost daily basis, with major challenges in procedural risk assessment in the absence of immediate polymerase chain reaction testing: COVID-19 positivity was assumed until proven otherwise. It is in this "febrile" atmosphere that many of us were performing electrophysiology and pacing procedures with limited information and high levels of anxiety.

By undertaking an ambitious worldwide retrospective survey of pacing procedures at this time, Tovia-Brodie, et al[1] have valiantly attempted to capture the outcomes of this early phase over the first year from March 2020 to 2021 across essentially 2 COVID-19 waves, providing important insights. They surveyed 53 centers from 13 countries (4 continents), providing data on 166 patients with active COVID-19 infection undergoing cardiovascular implantable electronic device procedures. The main indications included high grade/complete atrioventricular block (67.5% patients) or sick sinus syndrome (18.7% patients). There was a high 30-day complication rate of 13.9% and a correspondingly high 180-day mortality rate of 9.6%. One patient with a leadless system had a lethal hemorrhagic complication arising from the procedure. As expected, mortality tracked with COVID-19 severity and C-reactive protein levels ranging between 4.1% to 38.9% in mild to critical disease, respectively. Mortality also increased with anesthesiologist involvement, ranging from 7.2% to 40% in patients receiving local and general anesthesia, respectively ($P = .007$).

The use of PPE was also highly variable, ranging from routine in all procedures during the pandemic in 22% of centers to only in positive or suspected COVID-19 cases in 53.1% of centers. Surprisingly, the level of PPE, although perceived as limiting operator ability, did not translate into higher complication rates; this may reflect a type II statistical error.

The complications and mortality most likely reflect the severity of COVID-19 since C-reactive protein levels were statistically significantly linked to these outcomes. Anesthesiologist involvement was one of the strongest markers of adverse outcomes, reflecting the teams' perception of patient instability and higher procedural risks. This combined with physical difficulties in device implantation induced by PPE and the pressure to complete the procedure quickly almost certainly contributed to high implant complication rates.

The critical question is what we can learn to manage heart rhythm disorder patients in future respiratory virus pandemics. Tovia-Brodie et al demonstrated a 180-day mortality rate of 9.6%; the exact cause of death is not specified. As all patients were suffering from COVID-19 infection, it is most likely that a significant proportion died of complications of COVID-19 unrelated to their conduction disease. It was well documented that cardiovascular complications of patients hospitalized for COVID-19 include acute heart failure (in 3%–33%), cardiogenic shock (9%–17%), myocardial ischemia/infarction (0.9%–11%), venous thromboembolism (23%–27%), and arterial thrombosis secondary to viral-mediated coagulopathy.[2] This raises the question as to whether the treatment of the bradyarrhythmias with pacing would have significantly affected their prognosis, especially since 19% were implanted for sick sinus syndrome, which may have been present before COVID-19 infection or an incidental finding due to COVID-19. How many of these implants were undertaken simply as a response to intensive monitoring? In South America, virtually all were emergency high grade atrioventricular block. Did sick syndrome arrhythmias cause significant hemodynamic compromise? It could have been a marker of autonomic dysfunction due to COVID-19, which tracks with disease severity.[3] The

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differences between the United States and Europe are intriguing: in the United States, implantations were more in relatively young patients critically ill with COVID and in Europe less severe COVID-19 in the elderly in whom the team believed acute implantation was needed or at least feasible. This may indicate that the United States and Israel were quite restrictive with implantation or may also reflect how well the denominator was collected.

All these patients were implanted with permanent systems in the context of infection, which put them at risk of system-related sepsis or endocarditis; there was a device infection rate of 17%. Implanting temporary-permanent active fixation devices may have minimized this.[4] Although permanent systems are more expeditious to implant, avoiding the need for ongoing rhythm monitoring, it is yet to be determined whether they are actually a safer and more cost-effective option in this context. Leadless pacing may be a simpler approach, but given the hemorrhagic death in this series, judicious implantation technique and vascular closure must be used by experienced operators who are currently at a premium, and cost-efficacy is undoubtedly a limiting factor.

More importantly, this survey represents the "tip of the iceberg" of patients with cardiovascular disease who never reached hospital or avoided hospital for fear of COVID-19 infection despite the need for a procedure. In a British study, at the first wave's peak, there were 28,969 acute cardiovascular deaths with an excess acute cardiovascular mortality of 8%.[5] The most frequent cause of acute cardiovascular death was stroke (35.6%), followed by acute coronary syndrome (24.5%), heart failure (23.4%), pulmonary embolism (9.3%), and cardiac arrest (4.6%). This reflects New York City, which had the largest increase in ischemic heart disease deaths in the early phase of the US pandemic.[6] The COVID-19 pandemic inflated acute cardiovascular deaths, nearly half of which occurred in the community and most did not relate to COVID-19 infection, suggesting there were delays in seeking help or the result of undiagnosed COVID-19. In a separate study, cardiac service activity decreased 60%–100% compared with prepandemic levels in 8 hospitals across China, Italy, and England.[7] In China, activity remained below pre–COVID-19 levels for 2–3 months even after easing lockdown and is still reduced in Italy and England. For total cardiovascular disease, with a 10% COVID-19 prevalence, modeling predicted an estimated direct effect of 31,205 and 62,410 excess deaths in England (relative risk 1.5 and 2.0, respectively) and an indirect effect of 49,932 to 99,865 deaths. These excess non-COVID-19 deaths were preventable, as they were due to atrial fibrillation, heart failure, stroke, and myocardial infarction.

Indeed, regarding primary prevention implantable cardioverter-defibrillator (ICDs), the UK National Institute for Cardiovascular Outcomes Research reported 67% fewer ICD implantations at the peak of the first wave than a year earlier, suggesting that the vast majority of primary prevention implantations had been suspended. Alongside the individual center reports of deaths on the waiting lists for ICD implantation,[8] there was an increase in the number of patients with out-of-hospital cardiac arrest during the pandemic.

A key lesson learned from the first wave is to prioritize prognostically important electrophysiology and device procedures as per Heart Rhythm Society guidelines and ensuring these cases are performed with optimal infection control, even though the majority of the population is now vaccinated at least in Europe and the United States.[9] The challenge remains to deliver care to the substantial backlog of patients created by the first 2 waves, with increasing focus on day case high throughput delivery models. Furthermore, there is the need to be prepared for combinations of influenza and COVID-19 infection—it is critical to maintain updated plans for patient prioritization and flexible arrhythmia care delivery. In this way we can preserve life not only by vaccination and treating pneumonia but also by preventing avoidable arrhythmic and other cardiovascular disease deaths.

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