

Original Article

Impact of COVID-19 pandemic on cardiac electronic device implantations in Northwestern Greece

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Abstract: The coronavirus disease 2019 (COVID-19) pandemic seems to have a significant impact on cardiovascular-related hospital visits and admissions. The effect of the ongoing pandemic on the cardiac implantable electronic device (CIED) procedures is less well studied. We recorded and compared the rates of de novo implantations and replacements of CIEDs performed by two experienced implanters in our referral center between years 2019 and 2020, as well as the periods of lockdowns in 2020 to the corresponding periods of the previous year. Our data indicate a significant decrease in CIEDs de novo implantations during the COVID-19 pandemic (year 2020) even though the replacements were increased. Both de novo implantations and replacements were markedly declined during the first lockdown period while no significant change was observed during the second lockdown period. However, urgent pacemaker implantations did not change significantly between 2020 and 2019 during these periods. Of note, in our study the total number of de novo pacemaker and CRT implantations did not change significantly between 2019 and 2020 while ICD and ILR procedures dropped significantly.

Keywords: Cardiac implantable electronic devices, pacemakers, implantable cardioverter defibrillators, COVID-19, pandemic

Introduction

The ongoing corona virus disease 2019 (COVID-19) pandemic has a significant impact on health care systems worldwide while it seems to affect patients' and physicians' attitudes. In the setting of increased health care costs, imperative need of resources, and risk of hospital contamination/spread, a substantial decline in the recorded cardiovascular hospital visits, hospitalizations, and related interventional procedures has been reported [1-3].

Regarding cardiac electronic devices (CIEDs) implantation procedures during COVID-19 pandemic there are limited published data indicating remarkable reductions compared to the pre-pandemic era, especially during the first wave of the outbreak [4-10]. Indeed, data on CIEDs implantation rates during the COVID-19 pandemic are sparse and limited only to 3 countries (Italy, Spain, and Peru) and most of the available data refer only to pacemakers [4-10]. Also, there are no clear data regarding

the differential effect of sequential lockdowns on CIEDs implantations while most of the published studies provide relative data only for the first wave of COVID-19. Moreover, there are no relative data from Greece, a country that faced milder waves of the COVID-19 outbreak compared to most of the other European countries.

Patients and methods

In this retrospective observational study, we recorded the rates of CIEDs implantation and replacement in consecutive adult patients comparing the year 2019 to the year 2020, as well as the procedures performed during the two time periods of the national lockdowns imposed in 2020 as well as the corresponding periods in 2019. In our hospital we do not perform procedures in pediatric and adolescent patients. Regarding the adult patients who underwent CIED procedures no exclusion criteria were applied for the present analysis. During the periods of lockdown, travel restrictions between adjacent counties had been imposed. The CIED

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Table 1. CIEDs implantations and replacements in 2019

| Time Period | Pacemakers | ICDs | CRTs | ILRs | CIEDs replacements |
|------------------------------------|------------|------|------|------|--------------------|
| 1/1/19-22/3/19 | 70 | 17 | 4 | 5 | 12 |
| 23/3/19-18/5/19 (First lockdown) | 56 | 16 | 5 | 4 | 14 |
| 19/5/19-28/10/19 | 146 | 27 | 5 | 7 | 32 |
| 7/11/19-31/12/19 (Second lockdown) | 50 | 12 | 3 | 3 | 12 |

CIEDs, cardiac implantable electronic devices.

Table 2. CIEDs implantations and replacements in 2020

| Time Period | Pacemakers | ICDs | CRTs | ILRs | CIEDs replacements |
|------------------------------------|------------|------|------|------|--------------------|
| 1/1/20-22/3/20 | 65 | 9 | 7 | 2 | 23 |
| 23/3/20-18/5/20 (First lockdown) | 34 | 6 | 2 | 0 | 8 |
| 19/5/20-28/10/20 | 168 | 20 | 8 | 4 | 53 |
| 7/11/20-31/12/20 (Second lockdown) | 52 | 15 | 1 | 0 | 9 |

CIEDs, cardiac implantable electronic devices.

procedures that recorded were performed by two experienced implanters (P.K. and A.B.) in the University Hospital of Ioannina, a high-volume tertiary center which is the sole referral center for CIEDs implantation in the isolated area of Northwestern Greece, covering a population of nearly half a million inhabitants. The CIED related operations were retrieved and counted from a special logbook that is filled in the electrophysiology laboratory after each procedure. Given that our study was a simple retrospective observational study using data from our archive, and not a clinical trial, no approval was needed from the Hospital's Ethics Committee.

The COVID-19 pandemic caused by the SARS-CoV-2 strain spread to Greece from 26 February 2020 onwards. The first emergency measures to tackle the pandemic began on 28 February 2020 locally in the affected areas and resulted in a nationwide market close and travel restrictions on 23 March 2020. Thus, the first national lockdown lasted from this time point until 18 May 2020. On November 5th, 2020, the Greek prime minister announced a new global travel restriction for the whole country that came into force from Saturday 7 November 2020 (second national lockdown).

Statistical analysis

Continuous parameters are presented as median values [25th-75th percentile] and categorical variables as numbers or percentages. No spe-

cific statistical analysis was performed since the data provided simply compare implantation rates between time periods and describe variations as number or percentages.

Results

We did not observe a significant reduction in the total CIED procedure rates since 500 (patients' median age: 77 [72-82] years, 56% men) were performed in 2019 while 486 (patients' median age: 76 [70-82], 54% men) were performed in 2020. The specific procedures that were performed in years 2019 and 2020 are presented in **Tables 1** and **2**, respectively. In total, de novo CIEDs implantations were reduced in 2020 while replacements were increased. Specifically, de novo pacemaker and cardiac resynchronization therapy (CRT) system implantation rates did not change significantly during the year of COVID-19 pandemic. However, implantable cardioverter defibrillator (ICD) implantation rates declined by 31%, and implantable loop recorder (ILR) implantation rates by 68%. On the other hand, CIEDs replacement procedures increased by 33%. Notably, a dramatic decrease of 48% in CIED de novo implantations and replacements were observed during the first lockdown period in 2020 compared to the corresponding period in 2019 (50 vs 95 procedures, respectively). However, urgent pacemaker implantations did not change significantly between 2020 and 2019 during this period (44 vs 46 procedures, respectively). Moreover, no significant altera-

tion was observed during the second lockdown period compared to the corresponding period of the previous year.

Discussion

Our data indicate a significant decrease in the rates of CIEDs de novo implantations during the COVID-19 pandemic (year 2020), even though the replacements were increased. In specific, this decrease was mainly driven by the reduction in ICDs and ILRs implantation rates while pacemaker and CRT system implantation rates did not change significantly. Of note, both de novo implantations and replacements were markedly declined during the first period of strict restrictions (first lockdown) while no significant change was observed during the second lockdown period. In specific, a 48% decrease in these procedures was evident compared to the corresponding period of the previous year. In keeping with these results, data obtained from Greek Hospital registries indicate that the first lockdown had a much more dramatic effect on emergency hospital visits and admissions for acute coronary syndromes compared to the second lockdown, despite the low incidence of COVID-19 cases in Greece during the first wave of the outbreak [3].

Our observations are in accordance with other reports from Italy, Peru, Spain, and Catalonia comparing years 2019 and 2020 [4-6, 8-10]. Indeed, a significant reduction in elective CIEDs procedures had been consistently demonstrated [4, 10]. Specifically, in the Northern Italy where a dramatic COVID-19 first wave occurred, a 50% reduction in the number of elective CIED implantations was noted in the period March-April 2020 compared to previous years [4]. Remarkably, we did not observe a significant change in urgent pacemaker implantation rates during the first lockdown period. However, there are inconsistent data regarding the impact of COVID-19 outbreak on urgent pacemaker implantations since two studies from Italy [4, 5] and one from Peru [6] suggest a significant decrease while two others Italian registries [7, 9] indicate no change in the emergency CIED procedures. Of note, a 28% decrease in urgent pacemaker implantation was observed during the 6 weeks before and after 21st of February 2020 in the Veneto region of Italy where a massive eruption of COVID-19 cases

appeared [5]. Data from a single center in Peru indicate a dramatic decrease of de novo pacemaker implantations in the order of 70-80% during the first outbreak (March-April 2020), including procedures for urgent conditions such as complete and high-grade atrioventricular block [6]. However, a very small study with less than 100 elderly patients from Italy showed no difference in urgent pacemaker implantations during the period March-April 2020 compared to the same time period in 2019 [7]. In the same line, data from Southern Italy indicate a 50% decrease in elective CIED procedures in the period from March 10th to May 4th, 2020, compared to the same time frame in 2019 [9]. Moreover, this study showed a marked decrease in pacemaker, ICD, and CRT de novo implantations but a small increase in pacemaker and ICD replacements [9]. Remarkably, emergency pacemaker implantations were not affected [9]. A relative study from Spain demonstrated a 35% total decrease in pacemaker implantations but implantations in urgent cases such as patients with syncope and/or severe bradycardic abnormalities were not significantly affected during the first wave of COVID-19 [8]. Very recent data from Catalonia indicate a 54% decrease in pacemaker implantations, a 65% decrease in ICD implantations, and a 35% decrease in CRT implantations from 16th of March 2020 until 30th of April 2020 compared to the immediate pre-COVID 19 period (1st February 2020 to 15th March 2020) [10].

Altogether the above data suggest that differences in the reported rates of CIED implantations during the COVID19 era are subjected to variations in health care systems, local but also ethnic restriction measures as well as the perceived fear for infection/transmission during the various phases of the disease. During the first outbreak/lockdown period, the widespread fear of contagion among patients and physicians, the stricter restrictive measures regarding transportations, and the health authorities' warnings suggesting social distancing and avoiding hospital visits for non-urgent situations led to a unanimous decrease in all scheduled medical interventional procedures including CIED implantation. Patients with urgent or emergent conduction disorders being severely symptomatic would ultimately visit the hospital to receive the appropriate therapy. This is probably the reason why universally there was no

decrease in urgent/emergent CIED implantation rates event during the first lockdown phase of COVID19 pandemic. In our center, the most obvious decreased in CIED implantation during the first lockdown was in ICD/CRT devices. These devices apply mostly to heart failure patients followed in specialized Heart Failure outpatient clinics that were not working during this period and patients were advised to avoid hospital visits except for urgent decompensations. Although one might suggest that these patients would be rescheduled later in this year this was not the case in ICD recipients; the number of ICDs during 2020 was significantly lower than 2019. The management of heart failure patients during the pandemic era seems to be severely impaired despite several efforts on various telemonitoring services and continuing concerns are raised including the adverse effect on ICD implantations. On the other hand, despite the temporary decline during the first lockdown, patients with bradycardic problems and highly symptomatic heart failure were implanted a CIED during 2020 at a later time. Indeed, the last months of 2020 during the second wave of COVID19 disease and the second lockdown, in our hospital there was no significant change in CIED implantation rates compared to the previous year. Potential explanations include the improved preparation and performance of the health care system over time, reduced concerns and fear of patients and referring physicians based on the widespread awareness of the disease and potential management/prevention measures as well as the implementation of local or ethnic protocols for the management of various conditions during the COVID19 era. During the second lockdown in our center there was actually no change in the workflow of outpatient departments of Heart Failure or Arrhythmia and Rhythm Device. However, this should be considered as a local phenomenon since countries and local societies with a high burden of the COVID19 disease could not offer equal services.

Conclusion

It is evident that during the first wave of COVID-19 pandemic (February 2020-April 2020) a marked decrease of hospital visits and admissions due to acute coronary syndromes, stroke, and heart failure decompensation was noted [1-3]. The same seems to be true regarding CIEDs implantation and replacement proce-

dures, although emergency pacemaker implantations were not significantly affected in many centers [4-10]. Our study adds to the existing literature showing that that ICD and ILR implantations were particularly affected by the pandemic. Moreover, the first lockdown had a more dramatic effect on CIEDs implantation rates. This decline in CIED de novo implantations may have a significant impact on the cardiovascular outcomes especially in heart disease patients needing ICDs. Given that COVID-19 pandemic is ongoing, governments and health care providers should take measures to avoid adverse long-term health and social impact in cardiovascular disease patients.

Disclosure of conflict of interest

None.

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