

Impact of the COVID-19 lockdown in urgent pacemaker implantations: A cross-sectional study

Diogo de Almeida Fernandes MD¹  | Rúben Cadete MD² | Natália António MD, PhD^{1,2} | Miguel Ventura MD¹ | João Cristóvão MD¹ | Luís Elvas MD¹ | Lino Gonçalves MD, PhD^{1,2}

¹Department of Cardiology, Coimbra Hospital and University Centre (CHUC), Coimbra, Portugal

²Faculty of Medicine, University of Coimbra, Coimbra, Portugal

Correspondence

Diogo de Almeida Fernandes, Serviço de Cardiologia, Centro Hospitalar e Universitário de Coimbra, Praceta Professor Mota Pinto, 3004-561 Coimbra, Portugal.
Email: almeidafernandes.diogo@gmail.com

Abstract

Aims: The COVID-19 pandemic resulted in a decrease in patients' follow-up and interventions with cardiovascular disease. In Portugal, the consequences on emergent pacemaker implantation rates are largely unknown. We sought to analyze the impact of the COVID-19 pandemic on emergent pacemaker implantation rate and patient profile.

Methods: We retrospectively reviewed the clinical profile of the 180 patients who had pacemakers implanted in our hospital in an emergent setting from March 18, 2020, to May 17, 2020 ("lockdown") and May 19 to July 17, 2020 ("postlockdown"). This data was then directly compared to the homologous periods from the year before.

Results: Urgent pacemaker implantation rates during "lockdown" was lower than its homologous period (-23.7%), and cases in "postlockdown" were significantly increased (+106.9% vs. "lockdown"; +13.2% vs. May–July 2019).

When comparing "lockdown" and "postlockdown," there was a tendency for a higher number of temporary pacemaker use ($p = .076$). Patients during "lockdown" were 7.57 times more likely to present with hypotension/shock (odds ratio 7.57; $p = .013$). We also noted a higher tendency for hypotension on presentation during "lockdown" ($p = .054$) in comparison to 2019. In comparison to its homologous 2019 period, "postlockdown" saw more patients presenting with bradycardia ($p = .026$). No patients were admitted to the emergency department during "lockdown" for anomalies detected on ambulatory tests.

Conclusion: Our data show that the COVID-19 pandemic had a real impact on urgent pacemaker implantation. Patients with bradyarrhythmias are at particular risk for severe complications and should seek medical care regardless of the pandemic.

KEYWORDS

atrioventricular block, bradycardia, COVID-19, emergency, pacemaker

Diogo de Almeida Fernandes and Rúben Cadete contributed equally to the work and are co-first authors.

This is an open access article under the terms of the Creative Commons Attribution-NonCommercial License, which permits use, distribution and reproduction in any medium, provided the original work is properly cited and is not used for commercial purposes.

© 2021 The Authors. *Journal of Arrhythmia* published by John Wiley & Sons Australia, Ltd on behalf of Japanese Heart Rhythm Society.

1 | INTRODUCTION

On March 11, 2020, the World Health Organization declared that COVID-19 could be considered a pandemic.¹ The first case of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection in Portugal was reported on the 2nd of March² and the first 4 months of the pandemic were directly responsible for a total of 48.077 confirmed cases and a total of 1.682 "direct" deaths.³

In the early stages of the pandemic, the population was cautioned by the government and health authorities to avoid nonurgent visits to the emergency department.

Compared to the year of 2019, reports reveal the months of March and May of 2020 saw a reduction of programmed surgical activity of 58%, a reduction of visits to the Emergency Department of 44%, and a reduction of first-time outpatient hospital appointments of 40%.² This significant decrease in admissions included not only nonurgent patients but also severe cases who refrained from seeking medical attention because of fear.

Untreated atrioventricular (AV) block and symptomatic sinus node disease can result in heart failure secondary to low cardiac output and sudden cardiac death because of asystole or bradycardia-triggered ventricular tachyarrhythmias. In this situation, there is clear scientific evidence that pacing prevents the recurrence of syncope and improves survival.⁴ Although formal randomized controlled trials do not exist, natural history of severe bradyarrhythmias and pacing comes from old observational research conducted at the beginning of the Pacemaker era. This data continues to form the basis of the current guidelines.⁴

To this day, the impact of the first wave of the pandemic and the "lockdown" on patient care is still not fully known. Within the complex scenario presented, no data is available on the changes of care in the field of arrhythmology in Portugal, either regarding the period of "lockdown" or the so-called "2nd Phase" (post-COVID-19 recovery phase) that started around the beginning of May 2020. Our study aimed to analyze the impact of the pandemic on urgent pacemaker implantations.

2 | METHODS

2.1 | Study design and patient selection

This study is a retrospective observational design conducted at the *Centro Hospitalar e Universitário de Coimbra* (CHUC).

We selected the patients admitted to the Emergency Room who had cardiac pacemaker implantation in the periods of interest at CHUC.

Four time periods were considered: (1) the first "lockdown" in Portugal (March 18, 2020 to May 17, 2020); (2) the following

2 months of "postlockdown" (May 18, 2020 to July 17, 2020), and (3) and (4) the corresponding periods from 2019, respectively. A total of 180 cases met these criteria:

- Patients with indication for other types of device therapy (implantable cardioverter defibrillator or cardiac resynchronization therapy) were excluded.
- Number of COVID-19 daily cases were obtained from the daily bulletins of *Direção Geral de Saúde* (the public agency responsible for the public health efforts in Portugal).⁵

2.2 | Data collection

The following information was retrieved for every patient: demographic characteristics (age and gender), type of intervention (cardiac pacemaker insertion or reintervention), presentation upon arrival (main symptoms, asystole, hypotension, and cardiac arrest), temporary pacing necessity, underlying condition requiring the intervention, relevant past medical history and medication.

Hypotension was defined as systolic arterial pressure <90 mmHg and diastolic values <60 mmHg at admission.

2.3 | Data analysis

Categorical variables are presented as frequencies and percentages, and continuous variables as means and standard deviations if normally distributed, or medians and interquartile ranges for variables with skewed distributions. Bivariate analysis was performed by using χ^2 test and odds ratio (OR) for categorical variables and *t* test for continuous variables. All reported *p* values are two-tailed with a values inferior to .05 indicating statistical significance. Analysis was performed with the use of IBM® SPSS® 26.

3 | RESULTS

A total of 180 patients were enrolled. During "lockdown", a total of 29 patients were seen, during the "postlockdown" phase 60 patients, and from March through May 2019 and May through July 2019, 38 and 53, respectively (Figures 1 and 2). The number of patients during "lockdown" was lower than the homologous period (-23.7%). Cases in "postlockdown" increased significantly (+106.9% vs. "lockdown"; +13.2% vs. May-July 2019).

Baseline characteristics and comparison between the different periods are presented in Tables 1-3. The mean age of patients was 80.72 ± 7.92 in "lockdown", 79.08 ± 11.94 in "postlockdown", 80.58 ± 10.16 from March-May 2019, and 81.57 ± 9.23 from May-July 2019. There was no difference among groups regarding age and gender (*p* > .05).

FIGURE 1 Number of pacemaker interventions in the four studied time periods

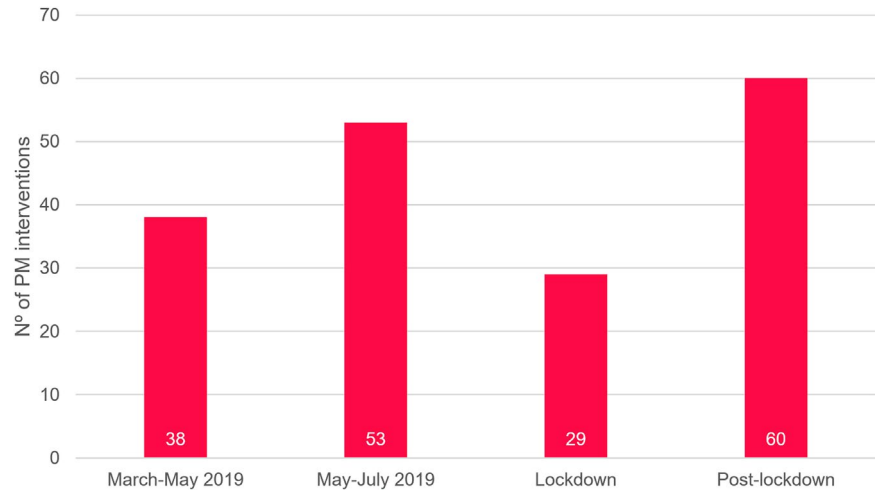
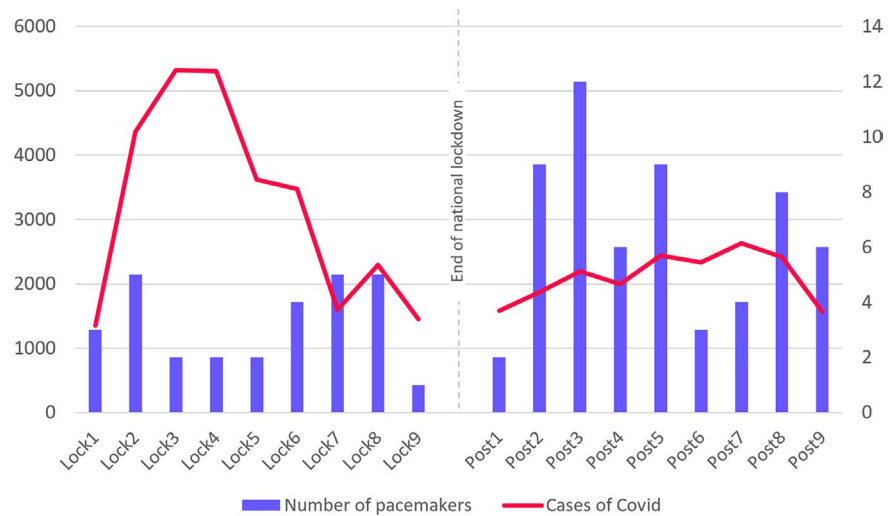


FIGURE 2 Number of pacemaker interventions per week in our Center and number of new SARS-CoV2 cases per week in Portugal, during the lockdown and postlockdown periods



Also of note, no patients were admitted to the emergency room during “lockdown” because of abnormal Holter, electrocardiogram, or ILR reading results.

3.1 | Comparison between “lockdown” and “postlockdown” periods

As already mentioned, the number of cases was significantly higher in “postlockdown” than in “lockdown” (+106.9%) (Figures 1 and 2). There was also a tendency for a higher number of temporary pacemakers used in the “postlockdown” period ($p = .076$) (Figure 3).

Patients admitted during “lockdown” were 7.57 times more likely to present with hypotension (OR 7.57; $p = .013$) than in “postlockdown” (Figure 3).

In terms of past medical history and medication, there was no significant difference between patients submitted to emergent pacemaker implantation during “lockdown” and “postlockdown” periods (Table 1).

3.2 | Comparison between “lockdown” and the homologous period of 2019

As mentioned before, the number of cases in “lockdown” was lower than the homologous period of the year before (−23.7%) (Figure 1). There was also a tendency for patients to have hypotension more frequently at presentation ($p = .054$) (Figure 3).

No significant difference was detected for past medical history. In terms of medication, there were significantly more patients who were on statins ($p = .014$) and a tendency for more patients being treated with a renin-angiotensin-aldosterone system (RAAS) inhibitor ($p = .054$) (Table 2).

3.3 | Comparison between “postlockdown” and the homologous period of 2019

The number of cases in “postlockdown” was higher than the homologous period in 2019 (+13.2%) (Figure 1).

TABLE 1 "Lockdown" versus "Postlockdown"

Characteristics	"Lockdown" (N = 29)	"Postlockdown" (N = 60)	p Value
Age—years	80.72 ± 7.92	79.08 ± 11.94	
Female sex—no. (%)	13 (44.8%)	23 (38.3%)	.558
Pacemaker implantation—no. (%)	29 (100%)	59 (98.3%)	
Pacemaker reintervention—no. (%)	–	1 (1.7%)	
Indication for PM implantation—no. (%)			.362
1st degree AV block	–	1 (1.7%)	
2nd degree AV block	7 (24.1%)	9 (15%)	
Complete AV block	10 (34.5%)	30 (50%)	
Bifascicular block	–	1 (1.7%)	
Trifascicular block	1 (3.4%)	3 (5%)	
Atrial fibrillation and bradycardia	8 (27.6%)	9 (15%)	
Sick Sinus Syndrome	–	4 (6.7%)	
Tachycardia-bradycardia syndrome	3 (10.3%)	2 (3.3%)	
Lead displacement	–	1 (1.7%)	
Main symptom—no. (%)			.257
Bradycardia	4 (13.8%)	10 (16.7%)	
Uncompensated HF	7 (24.1%)	12 (20%)	
Syncope or Lipothymia	18 (62.1%)	29 (48.3%)	
Medical test anomaly ^a	–	2 (3.3%)	
Cardiorespiratory arrest—no. (%)	–	1 (1.7%)	.484
Asystole—no. (%)	–	1 (1.7%)	.484
Temporary pacing necessity—no. (%)	1 (3.4%)	10 (16.7%)	.076
Hypotension at presentation—no. (%)	6 (20.7%)	2 (3.3%)	.013
Medical history—no. (%)			
Myocardial infarction	2 (6.9%)	4 (6.7%)	.968
Percutaneous coronary intervention	3 (10.3%)	2 (3.3%)	.178
Heart valve disease ^b	3 (10.3%)	5 (8.3%)	.756
Cardiac surgery ^c	1 (3.4%)	2 (3.3%)	.978
Atrial fibrillation	8 (27.6%)	17 (28.3%)	.941
Sick sinus syndrome	–	1 (1.7%)	.484
Chronic heart failure	3 (10.3%)	10 (16.7%)	.429
Hypothyroidism	2 (6.9%)	7 (11.7%)	.484
Type 2 diabetes mellitus	12 (41.4%)	26 (43.3%)	.861
Hypertension	26 (89.7%)	45 (75%)	.107
Dyslipidemia	19 (65.5%)	38 (63.3%)	.841
Stroke	3 (10.3%)	5 (8.3%)	.756
Medication—no. (%)			
Statin	19 (65.5%)	24 (40%)	.070
RAAS inhibitor	23 (79.3%)	36 (60%)	.086
Spironolactone	1 (3.4%)	8 (13.3%)	.141
Beta blocker	7 (24.1%)	14 (23.3%)	.966
CCB	11 (37.9%)	15 (25%)	.227
Class I or class III AR	1 (3.4%)	4 (6.7%)	.526
Digoxin	1 (3.4%)	1 (1.7%)	.604

^aIncludes electrocardiogram, Holter and implanted loop recorder anomalies.

^bOnly moderate to severe valvular disease was considered.

^cIncludes coronary artery bypass grafting and valve replacement surgery.

TABLE 2 “Lockdown” versus March–May 2019

Characteristics	“Lockdown” (N = 29)	March–May 2019 (N = 38)	p Value
Age—years	80.72 ± 7.92	80.58 ± 10.16	
Female sex—no. (%)	13 (44.8%)	24 (63.2%)	.135
Pacemaker implantation—no. (%)	29 (100%)	37 (97.4%)	
Pacemaker reintervention—no. (%)	–	1 (2.6%)	
Indication for PM implantation—no. (%)			.270
1st degree AV block	–	–	
2nd degree AV block	7 (24.1%)	2 (5.3%)	
Complete AV block	10 (34.5%)	18 (47.4%)	
Bifascicular block	–	1 (2.6%)	
Trifascicular block	1 (3.4%)	1 (2.6%)	
Atrial fibrillation and bradycardia	8 (27.6%)	8 (21.1%)	
Sick sinus syndrome	–	1 (2.6%)	
Tachycardia-bradycardia syndrome	3 (10.3%)	7 (18.4%)	
Lead displacement	–	–	
Main symptom—no. (%)			.479
Bradycardia	4 (13.8%)	8 (21.1%)	
Uncompensated HF	7 (24.1%)	6 (15.8%)	
Syncope or lipothymia	18 (62.1%)	21 (55.3%)	
Medical test anomaly ^a	–	2 (5.3%)	
PM battery exhaustion	–	1 (2.6%)	
Cardiorespiratory arrest—no. (%)	–	–	
Asystole—no. (%)	–	–	
Temporary pacing necessity—no. (%)	1 (3.4%)	2 (5.3%)	.722
Hypotension at presentation—no. (%)	6 (20.7%)	2 (5.3%)	.054
Medical history—no. (%)			
Myocardial infarction	2 (6.9%)	–	
Percutaneous coronary intervention	3 (10.3%)	1 (2.6%)	.197
Heart valve disease ^b	3 (10.3%)	1 (2.6%)	.197
Cardiac surgery ^c	1 (3.4%)	1 (2.6%)	.861
Atrial fibrillation	8 (27.6%)	12 (31.6%)	.671
Atrial flutter	–	2 (5.3%)	
Sick sinus syndrome	–	3 (7.9%)	
Chronic heart failure	3 (10.3%)	8 (21.1%)	.222
Hypothyroidism	2 (6.9%)	4 (10.5%)	.583
Type 2 diabetes mellitus	12 (41.4%)	9 (23.7%)	.140
Hypertension	26 (89.7%)	32 (84.2%)	.695
Dyslipidemia	19 (65.5%)	17 (44.7%)	.113
Stroke	3 (10.3%)	2 (5.3%)	.452
Medication—no. (%)			
Statin	19 (65.5%)	13 (34.2%)	.014
RAAS inhibitor	23 (79.3%)	21 (55.3%)	.054
Spironolactone	1 (3.4%)	3 (7.9%)	.431
Beta blocker	7 (24.1%)	8 (21.1%)	.809
CCB	11 (37.9%)	9 (23.7%)	.233
Class I or class III AR	1 (3.4%)	4 (10.5%)	.262
Digoxin	1 (3.4%)	–	.255

^aIncludes detected ECG, Holter and ILR anomalies.^bOnly moderate to severe valvular disease were considered.^cIncludes coronary artery bypass grafting and valve replacement surgery.

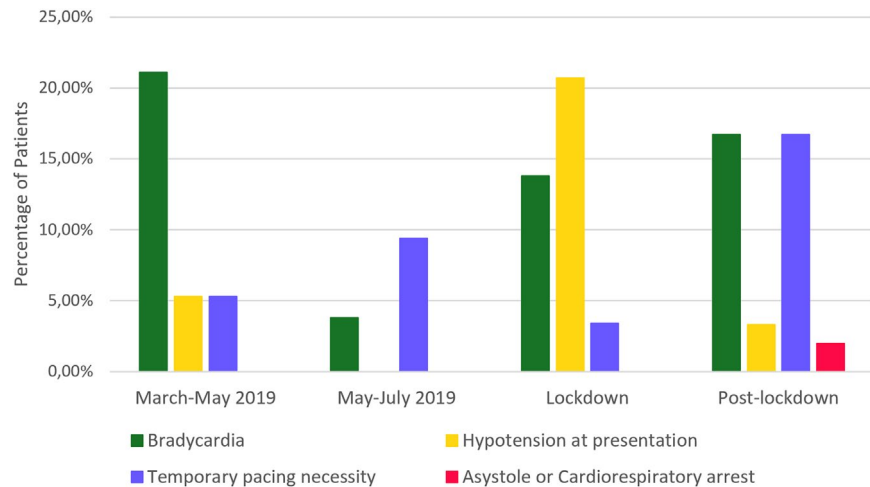
TABLE 3 "Postlockdown" versus May–July 2019

Characteristics	Postlockdown (N = 60)	May–July 2019 (N = 53)	p Value
Age—years	79.08 ± 11.94	81.57 ± 9.23	
Female sex—no. (%)	23 (38.3%)	21 (39.6%)	.888
Pacemaker implantation—no. (%)	59 (98.3%)	51 (96.2%)	
Pacemaker reintervention—no. (%)	1 (1.7%)	2 (3.8%)	
Indication for PM Implantation—no. (%)			.505
1st degree AV block	1 (1.7%)	—	
2nd degree AV block	9 (15%)	4 (7.5%)	
Complete AV block	30 (50%)	24 (45.3%)	
Bifascicular block	1 (1.7%)	—	
Trifascicular block	3 (5%)	5 (9.4%)	
Atrial fibrillation and bradycardia	9 (15%)	9 (17%)	
Sick sinus syndrome	4 (6.7%)	6 (11.3%)	
Tachycardia-bradycardia syndrome	2 (3.3%)	3 (5.7%)	
Lead displacement	1 (1.7%)	—	
Non-functioning pacemaker	—	2 (3.8%)	
Main symptom—no. (%)			.017
Bradycardia	10 (16.7%)	2 (3.8%)	.026
Uncompensated HF	12 (20%)	10 (18.9%)	.495
Syncope or lipothymia	29 (48.3%)	28 (52.8%)	.633
Medical test anomaly ^a	2 (3.3%)	10 (18.9%)	.007
Cardiorespiratory arrest—no. (%)	1 (1.7%)	—	
Asystole—no. (%)	1 (1.7%)	—	
Temporary pacing necessity—no. (%)	10 (16.7%)	5 (9.4%)	.258
Hypotension at presentation—no. (%)	2 (3.3%)	—	
Medical history—no. (%)			
Myocardial infarction	4 (6.7%)	5 (9.4%)	.588
Percutaneous coronary intervention	2 (3.3%)	1 (1.9%)	.633
Heart valve disease ^b	5 (8.3%)	6 (11.3%)	.593
Cardiac surgery ^c	2 (3.3%)	6 (11.3%)	.099
Atrial fibrillation	17 (28.3%)	22 (41.5%)	.141
Atrial flutter	—	1 (1.9%)	
Sick sinus syndrome	1 (1.7%)	2 (3.8%)	.487
Chronic heart failure	10 (16.7%)	10 (18.9%)	.760
Hypothyroidism	7 (11.7%)	6 (11.3%)	.954
Type 2 diabetes mellitus	26 (43.3%)	18 (34%)	.308
Hypertension	45 (75%)	48 (90.6%)	.030
Dyslipidemia	38 (63.3%)	31 (58.5%)	.598
Stroke	5 (8.3%)	—	
Medication—no. (%)			
Statin	24 (40%)	26 (49.1%)	.397
RAAS inhibitor	36 (60%)	36 (67.9%)	.366
Spironolactone	8 (13.3%)	4 (7.5%)	.321
Beta blocker	14 (23.3%)	17 (32.1%)	.294
CCB	15 (25%)	20 (37.7%)	.140
Class I or class III AR	4 (6.7%)	3 (5.7%)	.827
Digoxin	1 (1.7%)	2 (3.8%)	.486

^aIncludes detected ECG, Holter and ILR anomalies.

^bOnly moderate to severe valvular disease were considered.

^cIncludes coronary artery bypass grafting and valve replacement surgery.

FIGURE 3 Patient presentation, in the four time periods

Bradycardia was significantly more frequent at presentation in “postlockdown” compared to the same period in 2019 ($p = .026$) (Figure 3). In terms of past medical history, the homologous period of 2019 had significantly more history of hypertension ($p = .030$). No other significant differences in comorbidity proportion were found (Table 3).

4 | DISCUSSION

In this retrospective observational study involving patients who underwent urgent pacemaker implantation and who were admitted from the Emergency Department, there was a significant change in the number of interventions during “lockdown” and during “postlockdown” period. Even though urgent care was guaranteed during “lockdown”, there was a 24% total decrease in the number of urgent pacemaker implantations compared to the homologous period of 2019 and a subsequent significant increase in the implantation rates during the “postlockdown” period. This result reflects the impact of the pandemic on programmed interventions in arrhythmology and strengthens prior reports that the recommendation to limit hospital admissions to the ER, combined with the fear of patients being infected in the hospital, had an impact on urgent/emergent admissions and interventions. The same phenomenon seems to have occurred in other countries that adopted similar measures.^{6–8} Compared to the homologous period of 2019, we also noted patients who came to the ER during “lockdown” were significantly more likely to be on statins and had a tendency for being treated more frequently with a RAAS inhibitor. We hypothesize this may signify that people who had a known cardiovascular (CV) condition were more likely to value their symptoms and go to the ER.

Previous studies showed substantial reductions in hospitalizations because of other emergent CV conditions such as myocardial infarction and acute heart failure during the early phase of the pandemic.^{9,10} This drop is more probably explained by fear regarding the risk of contagion than by a change in the incidence of these diseases.

Similarly, it is not expected that the incidence of emergent bradyarrhythmias changed during the pandemic. Therefore, it is more likely that the fear of contagion might justify the significant reduction of urgent pacemaker implantation rates during the “lockdown” and the “rebound” effect during the “postlockdown” period.

We found a tendency for an increase in hypotension at presentation in the “lockdown” period compared to the corresponding period of 2019. This suggests that patients with mild symptoms tended to wait and only sought medical assessment when more severe conditions arose. This delay in treatment could explain the higher proportion of bradycardia at presentation in the “postlockdown” phase by comparison with the homologous period of 2019.

No asymptomatic patients presenting with an electrocardiogram (ECG), Holter, or implantable loop recorder (ILR) abnormalities were admitted during “lockdown”. As suggested in previous studies,⁷ the pandemic might also have had an impact on the organization of care, with disruption of ambulatory activity and fewer complementary exams performed. This may have led to a further delay in the management of patients with mild bradyarrhythmias and consequently greater severity at presentation.

Our work showed a tendency for a higher number of temporary pacemaker implantations during the “postlockdown” compared to the “lockdown” period. This observation leads us to speculate that less invasive procedures were performed not only because of the lower patient affluence to the emergency department but also because of fear from hospital staff and more stringent in-hospital safety measures.⁹

Our study has some limitations. First, it was unicentric. As such sample size was relatively small and our findings must be interpreted with caution as they may not accurately reflect the impact of the COVID-19 pandemic on the activities of all Portuguese centers. Secondly, impact on mortality was not evaluated, even though our study shows an increase in some variables such as hypotension and bradycardia and no decrease in other gravity related variables such as syncope and complete AV block. Finally, as this was an observational study, no demonstration of causality can be drawn from this study.

5 | CONCLUSIONS

To sum up, the first wave of the COVID-19 pandemic had a significant impact on urgent pacemaker implantation with a significant reduction during the “lockdown” period, followed by a “rebound” increase during the “postlockdown” period. Moreover, the clinical presentation of patients requiring urgent pacemaker implantation was generally more severe during “lockdown” and “postlockdown”. Efforts must be made to raise awareness regarding the importance of early symptoms of bradyarrhythmias, so that patients continue to seek appropriate medical care when appropriate.

ACKNOWLEDGMENTS

None to declare.

CONFLICT OF INTEREST

Authors declare no conflict of interest for this article.

DISCLOSURE

The protocol for this research project has been approved by a suitably constituted Ethics Committee of the institution and it conforms to the provisions of the Declaration of Helsinki. Committee of Centro Hospitalar e Universitário de Coimbra, Approval No. OBS. SF.63/2021. Consent from patients was waived because of the design of the study.

ORCID

Diogo de Almeida Fernandes  <https://orcid.org/0000-0003-4388-7011>

REFERENCES

1. WHO Director-General's opening remarks at the media briefing on COVID-19—11 March 2020 [internet]. World Health organization [11 Mar 2020; cited 15 Mar 2021]. Available from: <https://www.who.int/director-general/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19---11-march-2020>

2. Relatório No. 5/2020 – OAC: COVID-19 – Impacto na atividade e no acesso ao SNS [internet]. Portugal: Tribunal de Contas [May 2020; cited 5 Mar 2021]. Available from: <https://www.tcontas.pt/pt-pt/ProdutosTC/Relatorios/relatorios-oac/Documents/2020/relatorio-oac-2020-05.pdf>
3. Relatório de Situação DGS COVID-19 17/07/2020 [internet]. Direção Geral de Saúde [updated 17 Jul 2020; cited 5 Mar 2021]. Available from: https://covid19.min-saude.pt/wp-content/uploads/2020/07/137_DGS_boletim_20200717.pdf
4. Brignole M, Auricchio A, Baron-Esquivias G, Bordachar P, Boriani G, Breithardt OA, et al. 2013 ESC Guidelines on cardiac pacing and cardiac resynchronization therapy. *Eur Heart J*. 2013;34(29):2281–329.
5. Relatório de Situação DGS COVID-19 18/03/2020 – 17/05/2020 [internet]. Direção Geral de Saúde [cited 5 Mar 2021]. Available from: <https://covid19.min-saude.pt/relatorio-de-situacao/>
6. Migliore F, Zorzi A, Gregori D, Del Monte A, Falzone PV, Verlato R, et al. Urgent pacemaker implantation rates in the Veneto region of Italy after the covid-19 outbreak. *Circ Arrhythmia Electrophysiol*. 2020;13(6):576–8.
7. Boriani G, Palmisano P, Guerra F, Bertini M, Zanotto G, Lavallo C, et al. Impact of COVID-19 pandemic on the clinical activities related to arrhythmias and electrophysiology in Italy: results of a survey promoted by AIAC (Italian Association of Arrhythmology and Cardiac Pacing). *Intern Emerg Med*. 2020;15(8):1445–56.
8. Mathew S, Fraebel C, Johnson V, Abdelgwad S, Schneider N, Müller P, et al. Cardiac arrhythmias in patients with SARS-CoV-2 infection and effects of the lockdown on invasive rhythmological therapy. *Herzschrittmacherther Elektrophysiol*. 2021;32(1):108–13.
9. Garcia S, Albaghdadi MS, Meraj PM, Schmidt C, Garberich R, Jaffer FA, et al. Reduction in ST-segment elevation cardiac catheterization laboratory activations in the United States during COVID-19 pandemic. *J Am Coll Cardiol*. 2020;75(22):2871–2.
10. De Rosa S, Spaccarotella C, Basso C, Calabrò MP, Curcio A, Filardi PP, et al. Reduction of hospitalizations for myocardial infarction in Italy in the COVID-19 era. *Eur Heart J*. 2020;41(22):2083–8.

How to cite this article: de Almeida Fernandes D, Cadete R, António N, Ventura M, Cristóvão J, Elvas L, et al. Impact of the COVID-19 lockdown in urgent pacemaker implantations: A cross-sectional study. *J Arrhythmia*. 2022;38:137–144. <https://doi.org/10.1002/joa3.12658>