



# Rhythm blues in the time of coronavirus disease 2019 (COVID-19): how the cardiac electrophysiologist adapts to a viral pandemic in Singapore

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## Abstract

Coronavirus disease 2019 (COVID-19) is a major healthcare disaster in the modern times. Healthcare services must adapt to effectively juggle between pandemic management and maintenance of business-as-usual services so that both COVID-19 and non-COVID-19 patients receive appropriate clinical care. We share our experience of significant cardiac rhythm abnormalities seen in COVID-19 patients in Singapore, how the viral pandemic has affected the cardiac electrophysiology and pacing service in a large acute care general hospital and the steps taken to alleviate the negative impact.

**Keywords** COVID-19 · Cardiac electrophysiology · Pacemakers · Arrhythmias · Cardiac implantable electronic devices

## 1 Introduction

On 11 March 2020, the World Health Organization declared coronavirus disease 2019 (COVID-19) a pandemic. Since then, the virus has spread to every continent, with close to 2.5 million cases worldwide and more than 170,000 deaths. Singapore was one of the first few countries outside China to report confirmed cases of COVID-19. As of 21 April 2020, Singapore has a total of 9125 confirmed cases and 11 deaths [1]. Being a small city state with high population density, the COVID-19 pandemic has had a huge impact on the provision of healthcare services.

We share our experience of significant cardiac rhythm abnormalities seen in COVID-19 patients, and how the viral pandemic has affected the cardiac electrophysiology and pacing (EP) service in a large acute care general hospital in Singapore and the steps taken to mitigate the negative impact. There were several principal considerations when planning the mitigating measures. Firstly, business-as-usual cardiac

EP services must be ramped down in view of the need to conserve healthcare resources to deal with the pandemic. Secondly, exposure of healthcare professionals to suspected or confirmed COVID-19 patients should be minimized. Thirdly, measures should be implemented to ensure business continuity in the event of a staff contracting the disease. Finally, as much as possible, if the clinical need arises, patients should receive the same appropriate medical care regardless of their COVID-19 status.

## 2 Impact of COVID-19 on cardiac arrhythmias

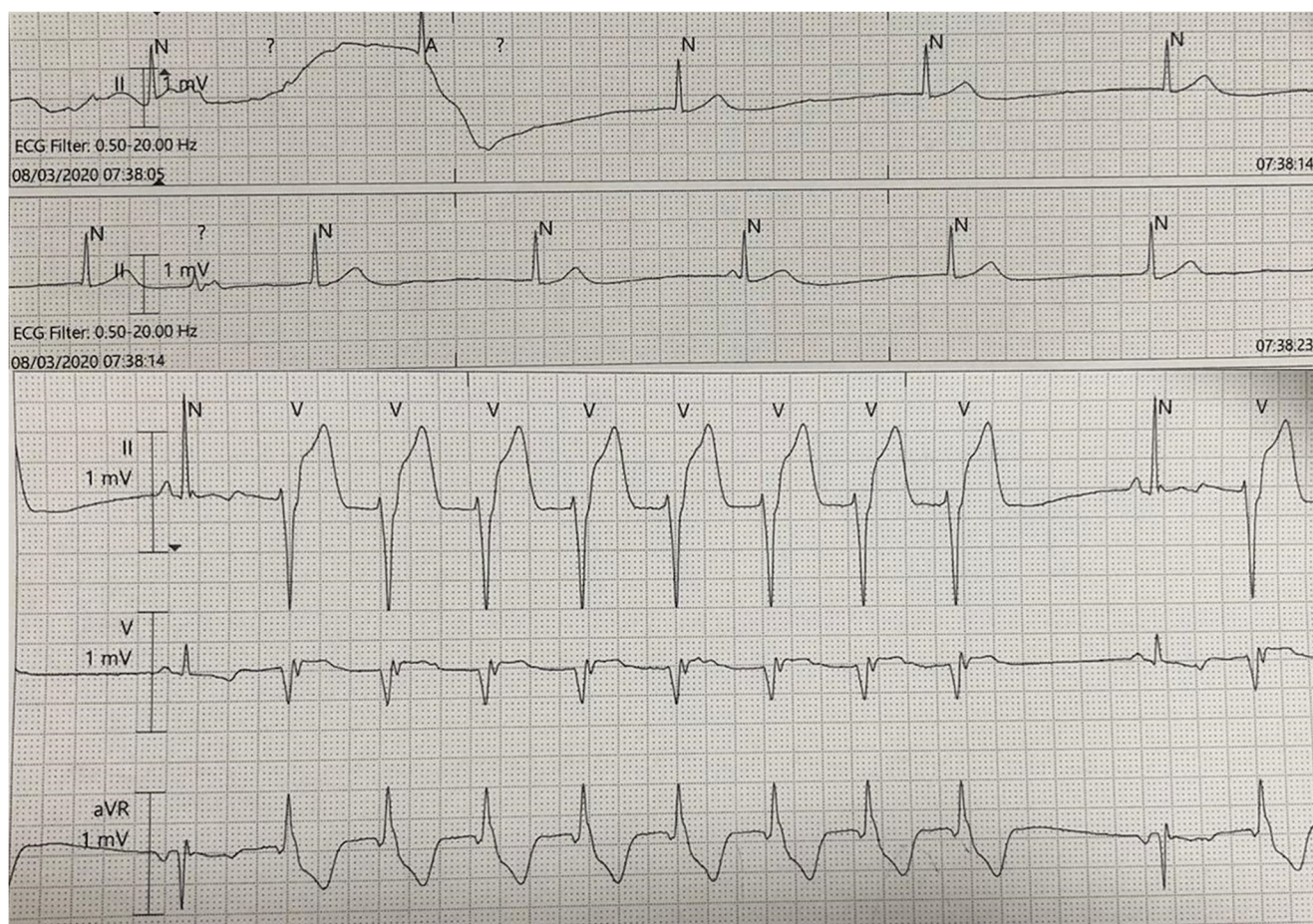
Our institution provides cardiology consult to the National Centre of Infectious Disease which has managed 2235 confirmed COVID-19 cases in Singapore until date. Thus far, there has not been any case of malignant tachy-brady arrhythmias. Only 1 case has been referred to the cardiac EP service for intermittent junctional bradycardia and non-sustained ventricular tachycardia (Fig. 1). Echocardiography revealed normal left ventricular ejection fraction and no pericardial effusion. These arrhythmias resolved spontaneously following optimization of serum electrolyte levels and resolution of hypoxia.

Consistent with the overall profile of COVID-19 cases in Singapore, 87.6% of our patients are young migrant workers, mean age of 40, with little or no comorbidity, and having

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**Fig. 1** Electrocardiography strips showing intermittent junctional bradycardia and non-sustained ventricular tachycardia in a confirmed COVID-19 patient

passed strict pre-employment medical checks before being allowed to work in Singapore. Hydroxychloroquine is not routinely recommended for treatment of COVID-19. These factors likely account for the very low incidence of significant cardiac arrhythmias in our case series. None of our patients require cardiac electrophysiology studies, catheter ablation, implantation of cardiac implantable electronic devices (CIED), or anti-arrhythmic medication. Before deciding on the choice of anti-arrhythmic medications for COVID-19 patients, it is important to evaluate their baseline QT intervals and take into account whether the patients are on macrolides, hydroxychloroquine, or other medications which may prolong the QT interval.

### 3 Healthcare manpower planning

To ensure business continuity, the cardiac EP specialists are divided into 2 teams, with clinical roles and responsibilities separate from each other. When 1 team performs CIED implants or ablations, the other team manages patients in the

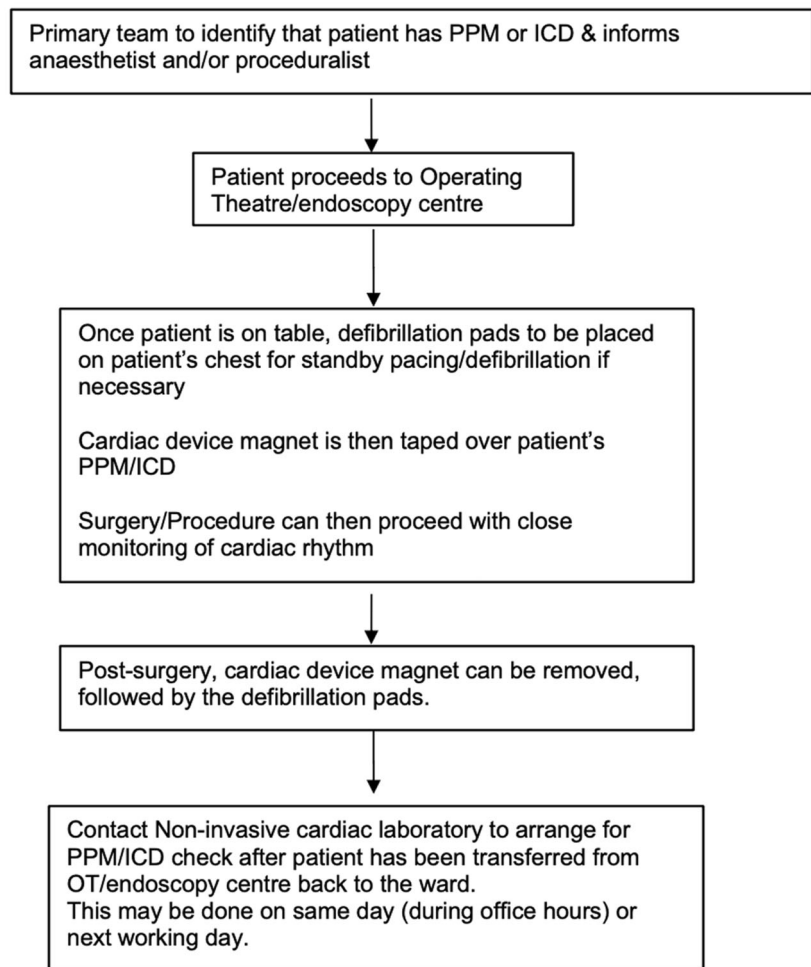
wards or clinics. The 2 teams remain segregated during and after work.

Fifteen percent of cardiac technicians are out deployed to support viral outbreak operations within the hospital. Physical segregation based on time and work areas is instituted for the remaining technicians who are rostered to perform not just CIED checks but also echocardiography scans and support cardiac ambulatory services.

With the onset of the COVID-19 pandemic, cross-institutional movement of healthcare professionals is prohibited unless under extenuating circumstances to reduce risk of community spread. This restriction is also applicable to device manufacturer representatives. During non-outbreak periods, these representatives play an important role by supporting CIED implantations, device checks, and 3-dimensional mapping. To circumvent this conundrum, negotiations were conducted with the device manufacturers at the beginning of the pandemic to assign one dedicated representative to support these services in the hospital. The identified representative will not be able to support other hospitals or clinics during the outbreak. Consequently, only selected device manufacturers with sufficient manpower are able to meet

**Fig. 2** Perioperative workflow for CIED management during COVID-19 outbreak

### Pre-operative management of patients with pacemakers (PPM) or implantable cardioverter-defibrillators (ICD) – COVID-19 Workflow



this request, resulting in a reduction in the choice of CIED brands during implantation. Three-dimensional mapping is disrupted as the device manufacturer is unable to commit one dedicated representative to support the service.

#### 4 Cardiac EP procedures and outpatient visits

Due to the decreased manpower and to free up healthcare resources for the viral pandemic, nonurgent elective cardiac EP procedures are postponed, based on individualized patient risk assessments. Cardiac EP studies requiring 3-dimensional mapping are postponed due to the absence of service representatives. Procedures are performed essentially only in patients with medically refractory tachycardias such as ventricular tachycardia storms, highly symptomatic bradycardias, and pacing dependence with CIEDs at elective replacement indicator or device end of life. This is largely in line with the

COVID-19 Practice Guidelines for Electrophysiologists by the Heart Rhythm Society COVID-19 Task Force [2].

Procedures are performed in suspect patients only after 2 nasal/throat swabs are negative for COVID-19. In confirmed cases, all personnel are required to don full personal protection equipment comprising N95 face mask, face shield, gown, and gloves.

Triaging of existing outpatients is performed to identify those whose clinic appointments may be safely postponed to reduce overall patient volume within the hospital. Home delivery of medication top-ups has been implemented for patients who require them.

The use of telemedicine is utilized to reduce unnecessary clinic visits. Referrals from primary care physicians to the cardiology clinics for abnormal electrocardiograms are reduced by remotely reviewing the electrocardiograms and patient's history through secure email or chat groups. Remote monitoring of CIEDs is actively promoted to new and existing patients so that the number of clinic visits can be minimized.

## 5 Peri-procedural CIED management

To reduce need for pre- and post-operative CIED programming, the use of cardiac magnets on CIED patients undergoing noncardiac procedures is encouraged. A workflow was created and disseminated across the hospital, to educate non-cardiologists on the efficacy and safety of cardiac magnet use (Fig. 2). Pre- and post-scan CIED programming is performed at the magnetic resonance imaging (MRI) suites to minimize movement of patients across different hospital areas. For patients with Biotronik devices, the MRI autodetect feature has proved to be useful in further reducing manual programming requirements. All these measures help to minimize exposure of cardiac technicians and device manufacturer representatives to suspected or confirmed COVID-19 patients.

## 6 Impact of COVID-19 and mitigating measures on patient volume

Our EP service typically implants 180 to 200 CIEDs and performs 60 to 80 catheter ablations, approximately 2500 to 2800 inpatient and outpatient device checks per year. CIED remote monitoring service was started in 2018 and until date, there are only 60 patients on home monitoring. CIED patients in Singapore traditionally eschew remote monitoring due to technophobia among our elderly, cost considerations, and close proximity of tertiary hospitals to their homes in view of Singapore's overall small land area.

Since the start of COVID-19 pandemic and with the introduction of mitigating measures, the total number of CIED and EP procedures has decreased to 1 to 2 cases per week. CIED interrogation volume has also dropped to 30 to 40 patients per week. On the bright side, take-up rate of CIED remote monitoring has improved, with 10 new patients recruited thus far this year. Patients have become cognizant that remote monitoring helps to reduce clinic visit frequency and allows for tele-consultation during the pandemic.

## 7 Conclusion

COVID-19 is a healthcare disaster of unprecedented proportions in the modern times. As the situation continues to evolve, healthcare services must adapt in order to effectively juggle between pandemic management and maintenance of business-as-usual services so that both COVID-19 and non-COVID-19 patients receive appropriate medical care. Cardiac EP services lend itself well to various forms of telemedicine which should be leveraged upon to reduce multiple patient exposures.

**Availability of data and material** Not applicable.

### Compliance with ethical standards

**Conflict of interest** The authors declare that they have no conflict of interest.

**Code availability** Not applicable.

## References

1. Ministry of Health Singapore COVID-19 Updates. <https://www.moh.gov.sg/covid-19>. Accessed 21 April 2020.
2. Lakkireddy DR, Chung MK, Gopinathannair R, Patton KK, Gluckman TJ, Turagam M, et al. Guidance for cardiac electrophysiology during the coronavirus (COVID-19) pandemic from the Heart Rhythm Society COVID-19 Task Force; Electrophysiology Section of the American College of Cardiology; and the Electrocardiography and Arrhythmias Committee of the Council on Clinical Cardiology, American Heart Association. *Circulation*. 2020.

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