

## Post-COVID Tachycardia Syndrome: Could It Be Myocarditis? A Case Report of a Patient Treated with Ivabradine

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### Abstract

This report illustrates a case of acute myocarditis in a patient who was recently hospitalized for COVID-19. Myocarditis was suspected based on the presence of tachycardia, the only abnormality present on physical examination, as well as high levels of B-type natriuretic peptide. The diagnosis was confirmed with cardiac magnetic resonance image, which showed the presence of late enhancement, predominantly subepicardial, in the inferolateral and inferior walls of the left ventricle. The patient did not meet any of the criteria for endomyocardial biopsy (progressive heart failure, severe cardiac dysfunction, ventricular arrhythmias, atrioventricular blocks). Therefore, the treatment was focused on heart rate control. Beta-blocker is the first option for rate control, but the patient had a contraindication. Thus, ivabradine, a selective heart rate reducer was used. This drug has been poorly studied in the context of post-COVID-19 syndromes, and the present case suggests a benefit for heart rate control in patients with post-COVID-19 tachycardia syndrome.

### Introduction

Coronavirus disease (COVID-19) was identified at the end of 2019 in China and spread across the world as a pandemic that lasted 2 years. In the most severe forms, it presents as severe respiratory distress syndrome and atypical pneumonia.<sup>1</sup> The disease may have systemic repercussions and can affect the cardiovascular system. The damage caused by COVID-19 to the cardiovascular system is likely multifactorial. It can result from an imbalance between high metabolic demand and low myocardial reserve, aggression caused by exacerbated inflammation as a result of the production of inflammatory cytokines, and thrombogenesis. It can also occur due to direct cardiac injury by the virus.<sup>2</sup>

The cardiovascular manifestations of COVID-19 are multiple and can present as myocarditis, acute coronary syndrome, cardiac arrhythmias, heart failure (HF) with

systolic or diastolic dysfunction, cardiogenic shock, and even sudden death.<sup>2-4</sup>

Some patients experience symptoms that persist after an acute case of COVID-19, which can last for months, a condition known as long COVID. Post-COVID-19 cardiovascular symptoms include chest pain, dyspnea, fatigue, and tachycardia. Post-COVID-19 tachycardia can have numerous causes, one of which is myocarditis.<sup>5</sup> In this scenario, heart rate control is usually achieved with beta-blockers, but, in cases of failure or contraindication, medications such as ivabradine could be an alternative. However, the use of ivabradine in this condition is poorly studied.

In this report, we present the case of a patient who had COVID-19 and developed fatigue and tachycardia 3 months after hospital discharge, in whom heart rate control was achieved with the use of ivabradine.

### Case Report

A 30-year-old woman presented to the cardiologist office with the complaint of palpitations and heart acceleration despite being at rest. Three months before the current presentation, she had been hospitalized for 7 days for moderately severe COVID-19. During this hospitalization she was treated with supplemental oxygen therapy due to low oxygen saturation. She had a past history of hypertension and bronchial asthma. At the time of consultation, the patient was using losartan 50 mg twice daily and a combination of budesonide and formoterol (12/400 mg, inhalation route) once a day. On physical examination, the cardiovascular system was normal, except for a resting heart rate of 110 bpm.

The electrocardiogram showed a sinus rhythm, with heart rate of 111 bpm, and repolarization abnormalities in the anterior wall (Figure 1). Laboratory tests showed an erythrocyte sedimentation rate of 16 mm in the first hour (reference value: up to 20 mm), high sensitivity C-reactive protein of 37.19 mg/L (reference value: up to 10 mg/L), D-dimer of 93 ng/mL (reference value: < 500 ng/mL), B-type natriuretic peptide of 171 pg/mL (reference: < 35 pg/mL), and high-sensitivity troponin I was 2.5 ng/L (reference: < 38.6 ng/L). The hemogram test was normal, including normal values of hemoglobin, hematocrit, and white blood count. The blood levels of electrolytes and glucose were normal, as were the results of kidney function tests. Urinalysis results were normal.

The chest X-ray showed normal cardiac size and normal lung transparency. The echocardiogram showed normal left ventricular (LV) systolic function, with LV ejection fraction of

### Keywords

Post-Acute COVID-19 Syndrome; Myocarditis; Heart Injuries; Tachycardia; Ivabradine

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69%, LV end-diastolic diameter of 48.8 mm, and LV end-systolic diameter of 29.7 mm. The left atrium diameter and the LV septum and free wall thickness were normal (Figure 2).

The patient underwent 24-hour Holter monitoring which demonstrated a mean heart rate of 98 bpm, minimum heart rate of 58 bpm, and maximum heart rate of 185 bpm (Figure 3). Low-incidence supraventricular ectopic activity was observed during the 24 hours (one isolated supraventricular extrasystole; one episode of paired supraventricular extrasystole; one episode of non-sustained atrial tachycardia, with 28 consecutive complexes and heart rate of 126 bpm). No ventricular ectopic activity was observed. Cardiac magnetic resonance imaging (MRI) showed the presence of late enhancement, predominantly subepicardial, in the inferolateral and inferior walls of the LV (Figure 4). Cardiac cavities had normal sizes, and LV systolic function was preserved. Based on the MRI results, the diagnosis of acute myocarditis was made.

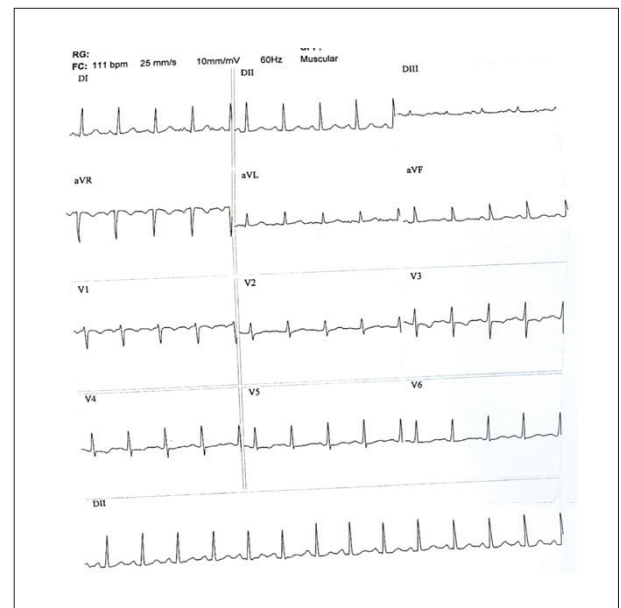
Since the patient did not have overt HF or ventricular arrhythmias, and LV systolic function was preserved, endomyocardial biopsy was not performed, and no HF medication was necessary. Treatment was aimed at controlling the heart rate. The patient could not tolerate beta-blockers due to bronchial asthma. Ivabradine was started at a dose of 5 mg twice daily. One month later, resting heart rate was 85 bpm. Ivabradine dose was increased to 7.5 mg twice daily. One month later, resting heart rate dropped to 70 bpm, and the patient complaint of palpitation disappeared.

Three months after ivabradine initiation, C-reactive protein and B-type natriuretic peptide values were normal. During 2 years of follow-up, no complications were observed. The patient is currently asymptomatic, and cardiovascular examination is normal. The patient is still on ivabradine, and resting heart rate at last visit was 74 bpm.

## Discussion

Patients who have been affected by moderate or severe COVID-19 may present symptoms for up to 3 months after the acute episode, a period considered as convalescence of the disease. However, some patients persist with symptoms beyond this period, a condition known as long COVID or post-acute COVID-19 syndrome (PACS).<sup>5</sup> The pathophysiology of this condition is still unknown, but it is believed to be due to an autoimmune mechanism and also to chronic endothelial dysfunction.<sup>5</sup> Prolonged damage to the cardiovascular system is probably multifactorial and may involve, in addition to autoimmune mechanisms, inflammation.<sup>5</sup>

The symptoms presented in long COVID are diverse and may include fatigue, chest pain, effort intolerance, cognitive disorders, fever, headache, loss of smell and taste, and tachycardia. The latter is a frequent finding and can be found in 25% to 50% of cases within 3 months of the acute episode and in up to 9% at 6 months.<sup>5</sup> In a recent publication, a group of researchers suggested the term "post COVID-19 tachycardia syndrome" (PCTS) for patients with persistent tachycardia after a COVID-19 episode.<sup>5</sup> The possible etiologies behind PCTS include a range of



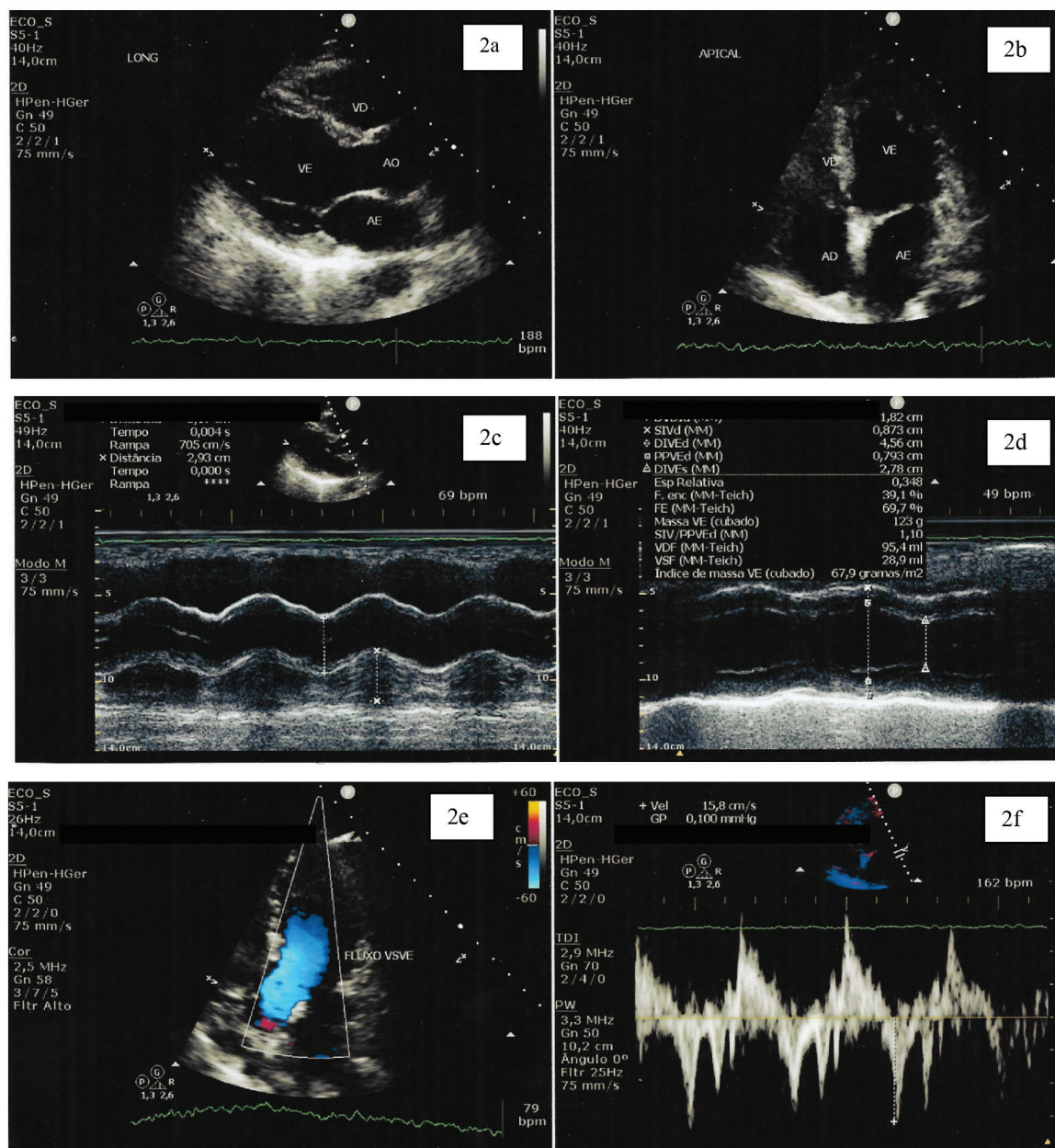
**Figure 1** – Baseline electrocardiogram, showing sinus tachycardia (heart rate of 111 bpm) and changes in ventricular repolarization in the anterior wall.

different situations, such as anemia, myocarditis, HF, and dysautonomic states that occur with inappropriate sinus tachycardia or postural orthostatic tachycardia syndrome (POTS).<sup>5</sup> In our case, the patient had a resting heart rate usually above 90 bpm, which at times reached 185 bpm in the context of myocarditis.

Cases of post-COVID-19 acute myocarditis have been described in the literature, with variable presentations, ranging from cases with only tachycardia and preserved LV systolic function to cases with LV systolic dysfunction and severe HF.<sup>4,6,7</sup> Biomarkers may be altered, especially natriuretic peptides, and they can be used as screening tests for a post-COVID-19 cardiological complication.<sup>8</sup> Troponin may be elevated in acute cases, but may be normal in cases with longer evolution.<sup>8,9</sup> In the present case, C-reactive protein and B-type natriuretic peptide remained elevated, but troponin was normal, probably because it was taken more than 3 months after the acute phase of COVID-19. When myocarditis is suspected, cardiac MRI is the first-line imaging test, with a typical finding of late enhancement in the inferolateral region of the LV, without compromising the subendocardium, as in our case.<sup>8,9</sup> Endomyocardial biopsy should be reserved for cases of LV dysfunction and HF that do not respond to treatment or in the presence of ventricular arrhythmias or atrioventricular blocks.<sup>9</sup> In our case, LV systolic function was preserved, and biopsy was not indicated.

The management of tachycardia in myocarditis is usually achieved with beta-blockers.<sup>8,9</sup> In our case, the patient could not tolerate beta-blockers, and heart rate control was achieved with ivabradine, a selective heart rate reducer, which acts by inhibiting the *If* channels of the sinus node. Ivabradine has been shown to reduce outcomes in patients with elevated heart rate in the

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**Figure 2** – Two-dimensional echocardiogram with color Doppler within normal limits for age, sex, and biotype.

setting of HF with reduced ejection fraction,<sup>10</sup> but its use in long COVID is poorly studied. There are reports on post-COVID POTS;<sup>11</sup> however, few cases of patients with post-COVID myocarditis have been found in the literature. Our report demonstrates that ivabradine is a good option for controlling heart rate in this situation.

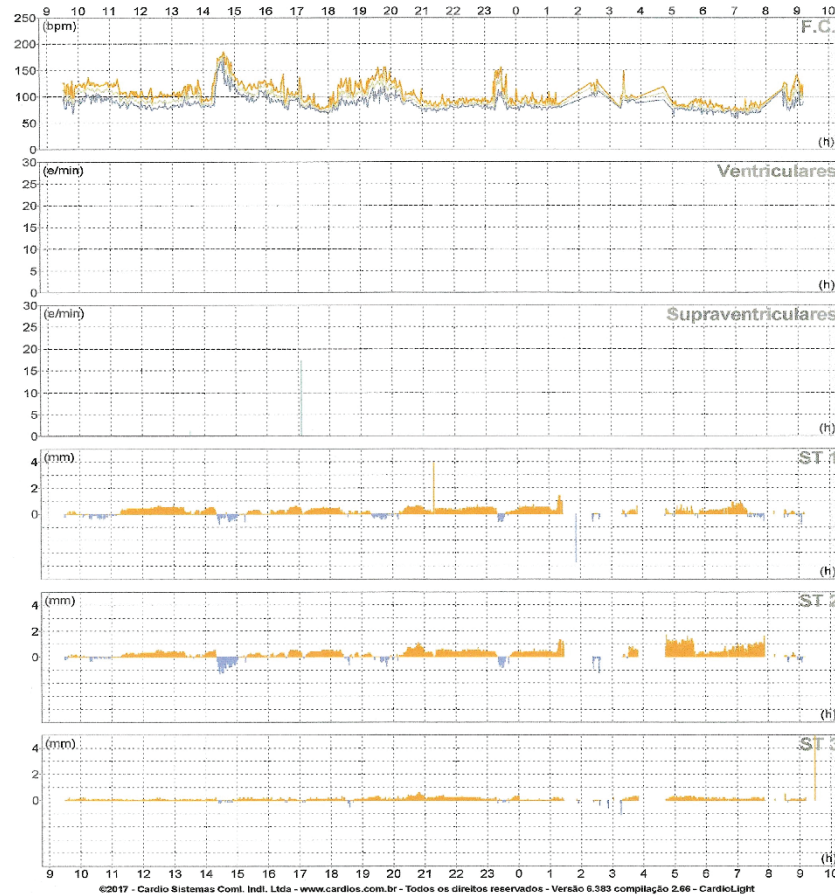
In conclusion, we have presented the case of a patient with post-COVID myocarditis, which presented as resting tachycardia 3 months after a hospitalization for COVID-19. The patient's symptoms and tachycardia were successfully treated with the use of ivabradine.

## Author Contributions

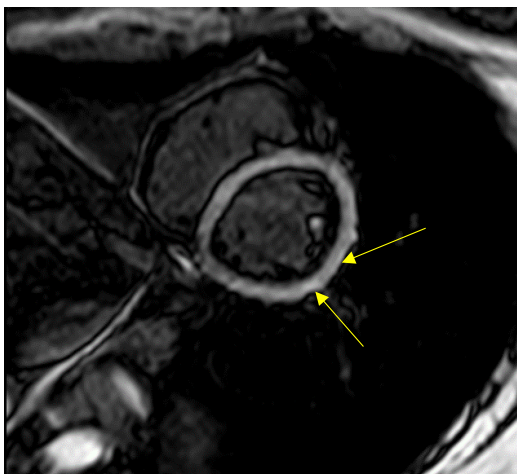
Conception and design of the research: Villacorta H; Acquisition of data: Souza DG; Analysis and interpretation of the data and Writing of the manuscript: Souza DG, Villacorta H; Critical revision of the manuscript for important intellectual content: Tinoco VA, Faial LCM, Villacorta H.

## Potential conflict of interest

No potential conflict of interest relevant to this article was reported.



**Figure 3** – 4-hour Holter monitoring showing an average heart rate of 98 bpm, with an episode of 185 bpm at 2:40 p.m.



**Figure 4** – Cardiac magnetic resonance imaging showing the presence of late enhancement, predominantly subepicardial, in the inferolateral and inferior walls of the left ventricle.

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There were no external funding sources for this study.

## Study association

This study is not associated with any thesis or dissertation work.

## Ethics approval and consent to participate

This study was approved by the Ethics Committee of the Hospital Universitário Antônio Pedro under the protocol number CAAE 33852720.1.0000.5239. All the procedures in this study were in accordance with the 1975 Helsinki Declaration, updated in 2013. Informed consent was obtained from all participants included in the study.

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