JACC: CASE REPORTS VOL. 3, NO. 4, 2021

MINI-FOCUS ISSUE: COVID-19

INTERMEDIATE

CASE REPORT: CLINICAL CASE

Intraventricular Conundrum in a SARS-CoV-2–Positive Patient With Elevated Biomarkers of Myocardial Injury

María L. Servato, MD,[a,b] Filipa X. Valente, MD,[a,b] Laura Gutiérrez García-Moreno, MD,[a,b] Guillem Casas, MD,[a,b] Rubén Fernández-Galera, MD,[a,b] Gemma Burcet, MD,[c] Gisela Teixidó-Tura, MD, PhD,[a,b] Hug Cuéllar Calabria, MD, PhD,[c] Ignacio Ferreira González, MD, PhD,[a,d] José F. Rodríguez-Palomares, MD, PhD[a,b]

ABSTRACT

We present a case of acute myocarditis with left ventricular dysfunction and intracavitary thrombosis in a 55-year-old man with severe acute respiratory syndrome coronavirus 2 infection (coronavirus disease 2019) who was admitted with bilateral atypical pneumonia. The patient was treated with anticoagulation and optimal heart failure therapy and had an improvement of left ventricular function and thrombus resolution. (**Level of Difficulty: Intermediate.**) (J Am Coll Cardiol Case Rep 2021;3:566–72) © 2021 The Authors. Published by Elsevier on behalf of the American College of Cardiology Foundation. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

HISTORY OF PRESENTATION

A 55-year-old man who tested positive for severe acute respiratory syndrome-coronavirus-2 (SARS-CoV-2) (the agent of coronavirus disease-2019 [COVID-19]) was admitted to the intensive care unit of Vall d'Hebron University Hospital, Barcelona, with a diagnosis of bilateral atypical pneumonia (**Figure 1**). Blood tests demonstrated leukopenia, elevated C-reactive protein of 12.35 mg/dl, and interleukin-6 levels of 1,946 pg/dl. High-sensitivity troponin I, D-dimer, and N-terminal pro-B-type natriuretic peptide (NT-proBNP) levels were unremarkable. Blood pressure was 144/77 mm Hg, heart rate was 84 beats/min, body temperature was 36°C, and respiration rate was 24 breaths/min. The patient required high- flow oxygen through a nasal cannula (fraction of inspired oxygen [Fio_2] 1) to maintain a peripheral oxygen saturation of 96%. However, 3 days after hospitalization, D-dimer levels increased significantly (up to 12,835 ng/ml), as did troponin I and NT-proBNP levels (4,162 ng/l and 7,460 pg/ml, respectively). He had no cardiovascular symptoms and was hemodynamically stable. A bedside echocardiogram showed a dilated left ventricle with moderate systolic dysfunction (left ventricular [LV] ejection fraction [LVEF] of 35% to 40%), global hypokinesia, and a huge multilobed,

LEARNING OBJECTIVES

- To recognize cardiovascular complications among COVID-19 patients.
- To learn the role of multimodality imaging in challenging cases.

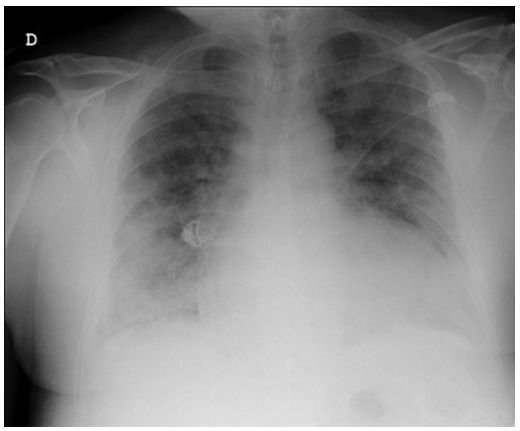
From the [a]Department of Cardiology, Vall d'Hebron University Hospital, Vall d'Hebron Research Institute, Autonomous University of Barcelona, Barcelona, Spain; [b]Center for Biomedical Investigation Cardiovascular Consortium, Madrid, Spain; [c]Radiology Service, Institute for Diagnostic Imaging, Vall d'Hebron University Hospital, Barcelona, Spain; and the [d]Center for Biomedical Investigation Epidemiology and Public Health Consortium, Madrid, Spain.

The authors attest they are in compliance with human studies committees and animal welfare regulations of the authors' institutions and Food and Drug Administration guidelines, including patient consent where appropriate. For more information, visit the Author Center.

Manuscript received October 16, 2020; revised manuscript received January 14, 2021, accepted January 22, 2021.

ISSN 2666-0849 https://doi.org/10.1016/j.jaccas.2021.01.030

FIGURE 1 Chest Radiograph on Admission



mobile, and hyperechogenic mass measuring 41 × 26 mm and attached to the apex. Right ventricular function was preserved (tricuspid annular plane systolic excursion of 22 mm and tissue Doppler systolic wave [Ś] of 12 cm/s), and there was no valve disease (**Figures 2A and 2B**, Videos 1 and 2). With these findings, anticoagulation with full-dose low-molecular-weight heparin and heart failure treatment (carvedilol and enalapril) were started.

PAST MEDICAL HISTORY

His past medical history included obesity (body mass index, 31 kg/m^2) and obstructive sleep apnea syndrome requiring continuous positive airway pressure. He had no previous cardiovascular disease.

DIFFERENTIAL DIAGNOSIS

Given the patient's clinical presentation with LV dysfunction, the differential diagnosis included ischemic cardiomyopathy, myocarditis, and decompensation of a previously unknown cardiomyopathy. Because of the presence of a huge intraventricular mass, thrombus versus intracardiac tumor was proposed.

INVESTIGATIONS

An electrocardiogram showed a previously unknown left bundle branch block (**Figure 3**). At 6 and 7 days after the echocardiogram and the start of anticoagulation, cardiac computed tomography and cardiac magnetic resonance (CMR) were performed. Computed tomography showed no coronary lesions and a dilated left ventricle with moderate systolic dysfunction (LVEF, 38%) (**Figures 4A to 4D**). No intracavitary mass was visualized. CMR revealed mildly increased diffuse wall thickness with an elevated myocardial signal intensity in the anterior middle and apical wall in balanced steady-state free precession cine sequences. In addition, short tau inversion recovery images showed mild hyperintensity of the anterior wall, with a T_2 ratio of myocardium to skeletal muscle of 2.6. Native T_1 mapping was elevated overall (native T_1 of 1,107 ms [reference values 950 to 1,050 ms]), as was the extracellular volume (29%). T_2 mapping sequences showed an elevated global T_2 value of 62 ms (65 ms in the anterior and anteroseptal wall, 55 ms in the inferior wall). Late gadolinium enhancement sequences demonstrated no foci or areas of contrast uptake; nevertheless, there was a diffuse mild hyperintensity of the middle and apical anterior wall (slow contrast washout). Overall, these findings are suggestive of diffuse myocardial edema, predominantly in the anterior wall (**Figures 5, 6A to 6C, and 7**, Videos 3 and 4). First-pass perfusion and early and late gadolinium enhancement were performed, and no intraventricular mass was observed, a finding that suggested a thrombotic origin. Because 2 complementary studies had demonstrated the absence of a mass, a second echocardiogram during hospitalization was not performed to reduce the risk of contagion for the sonographer, according to international recommendations (1). The patient did not experience any symptoms or signs suggestive of peripheral embolism.

MANAGEMENT

The patient required only high-flow oxygen (Fio_2 1) with no requirements of ventilation or hemodynamic support. He was treated with ceftriaxone, azithromycin, hydroxychloroquine, lopinavir and ritonavir in combination, and tocilizumab, according to the local protocol at the time. Anticoagulation with full-dose low-molecular-weight heparin was also prescribed, as well as complete heart failure therapy.

DISCUSSION

Severe acute respiratory syndrome associated with SARS-CoV-2 infection appears to affect the myocardium by different mechanisms (2): infection-related myocarditis, hypoxemia, and/or ischemia, and it is considered an important prognostic factor (3). Moreover, COVID-19 may be associated with a hypercoagulable state. There is evidence of a high prevalence of clinically relevant thrombosis, essentially pulmonary embolisms (16.7%), in patients with hypoxemic acute

ABBREVIATIONS AND ACRONYMS

CMR = cardiac magnetic resonance

COVID-19 = coronavirus disease-2019

Fio_2 = fraction of inspired oxygen

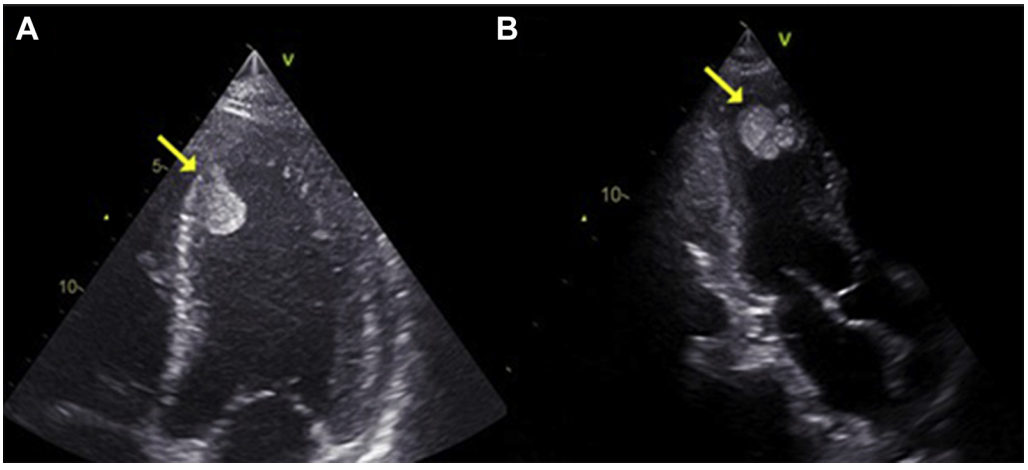
LV = left ventricular

LVEF = left ventricular ejection fraction

NT-proBNP = N-terminal pro-B-type natriuretic peptide

SARS-CoV-2 = severe acute respiratory syndrome-coronavirus-2

FIGURE 2 Bedside 2-Dimensional Echocardiography



The images show a dilated left ventricle with a huge multilobed, mobile, and hyperechogenic mass attached to the apex **(arrows).** Left ventricle in **(A)** the apical 4 chamber view and **(B)** the apical 3-chamber view.

FIGURE 3 Electrocardiogram on Admission

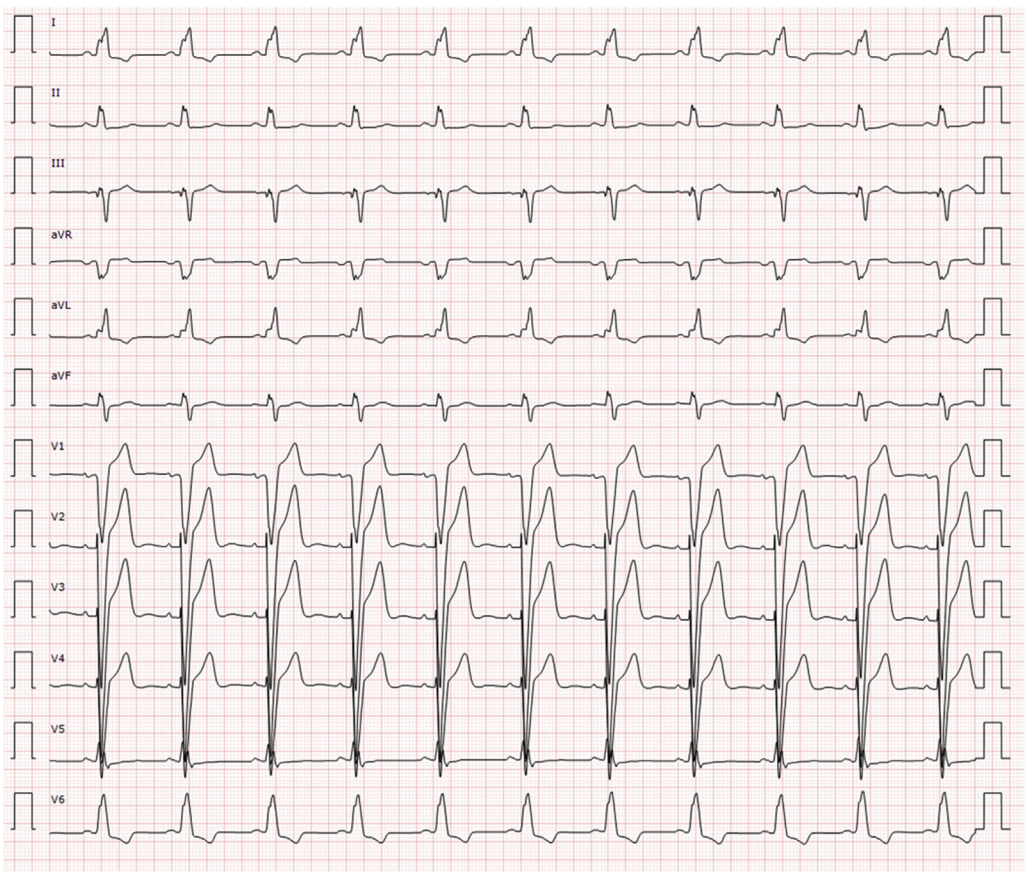
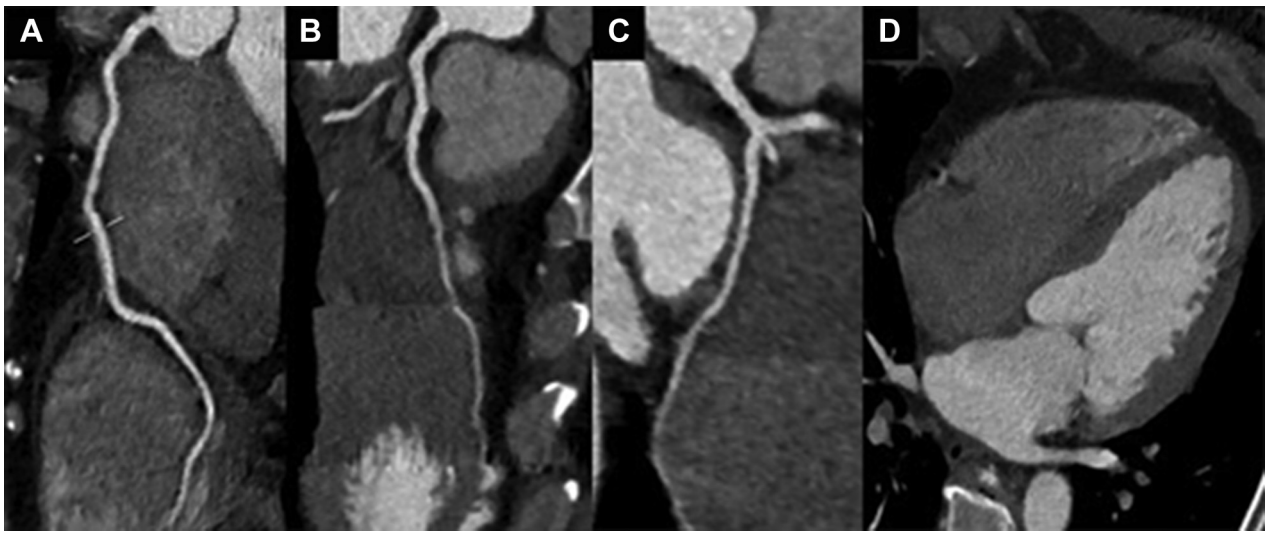


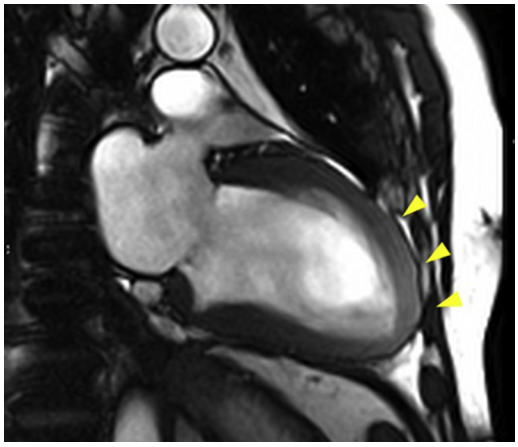
FIGURE 4 Coronary Computed Tomography Angiography



The images show no coronary stenosis in **(A)** the right coronary artery, **(B)** the left anterior descending artery, and **(C)** the circumflex artery. **(D)** No evidence of left ventricular thrombus is noted.

respiratory failure (4). Furthermore, venous and arterial thromboembolisms are emerging as among the most severe sequelae of the disease associated with poorer outcomes (5). In addition, acute coronary syndromes are noted to occur after severe acute respiratory syndrome (6).

FIGURE 5 Balanced Steady-State Free Precession Cine Images in the 2-Chamber View



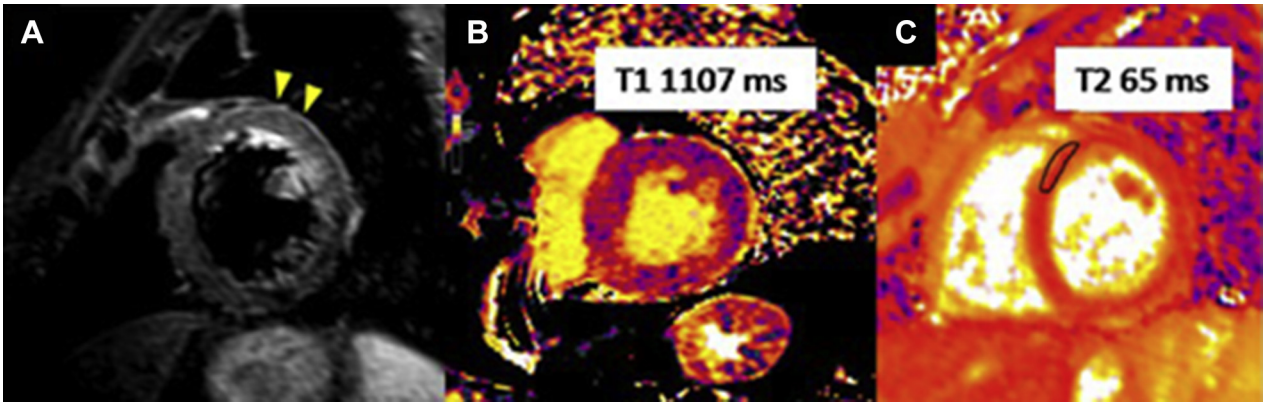
Mildly increased wall thickness and higher myocardial signal intensity in the anterior middle and apical wall **(arrowheads)**.

We report a case of myocarditis associated with COVID-19 with LV dysfunction and a large mobile LV thrombus in a young patient with no cardiovascular history. This thrombus could have resulted in severe complications without prompt diagnosis and treatment initiation. Because endomyocardial biopsy is not recommended in patients with COVID-19 and suspected myocarditis (1), and given that the patient had a good evolution, a biopsy was not performed. Moreover, recent biopsy data revealed that T_1 and T_2 increase in this population is related to myocarditis (lymphocytic infiltrates) (7).

Although the presence of elevated troponin I is frequently seen in patients with myocarditis and is usually associated with myocyte necrosis, our patient had elevated troponin but no late gadolinium enhancement. We believe that these findings can be explained by the marked myocardial inflammation and associated submillimetric and nonhomogeneous areas of necrosis (8). The lesser severity of myocardial injury also explains the overall improvement of myocardial systolic function during follow-up, whereas the expansion of the extracellular space is supported by the finding of increased native T_1 and T_2 mapping, as well as increased extracellular volume.

Echocardiography is helpful in assessing cardiac hemodynamics in the presence of chest pain, electrocardiographic changes, or biomarker elevation

FIGURE 6 Short Tau Inversion Recovery and Mapping Images



(A) Short tau inversion recovery images in the short axis with mild hyperintensity of the anterior wall **(arrowheads). (B)** T_1 mapping study shows an overall elevated native T_1 value of 1,107 ms and an extracellular volume of 29%. **(C)** T_2 mapping shows an elevated global T_2 value of 62 ms (65 ms in the anterior and anteroseptal wall, 55 ms in the inferior wall).

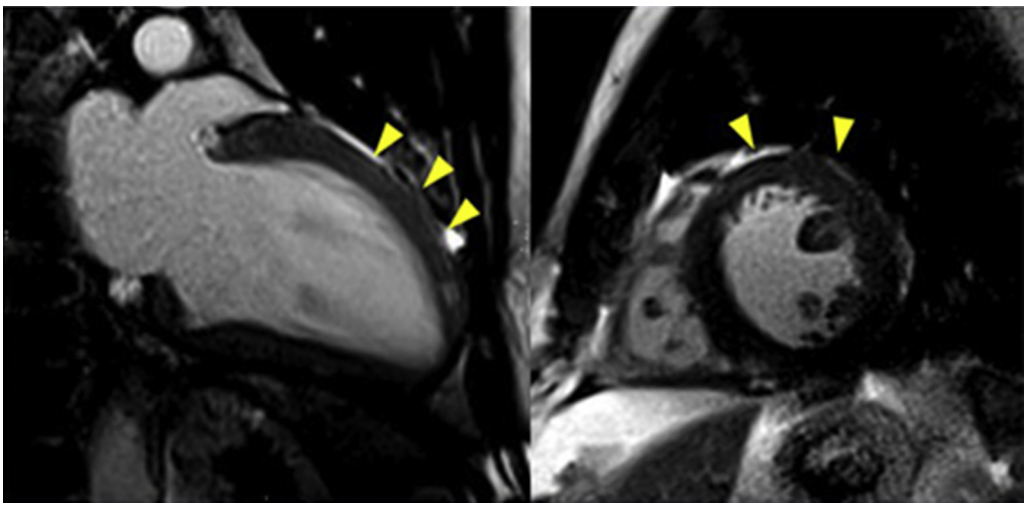
suggestive of myocardial injury, myopericarditis, or fulminant myocarditis (9), and it should be planned in patients with new onset of malignant ventricular arrhythmias not associated with a prolonged QT interval (10). As demonstrated in our case, echocardiography permitted accurate diagnosis and management.

We highlight the importance of echocardiography in patients with SARS-CoV-2 infection and elevated heart injury biomarkers, to establish a correct diagnosis, guide management, and reduce complications. To the best of our knowledge, no similar case has been published.

FOLLOW-UP

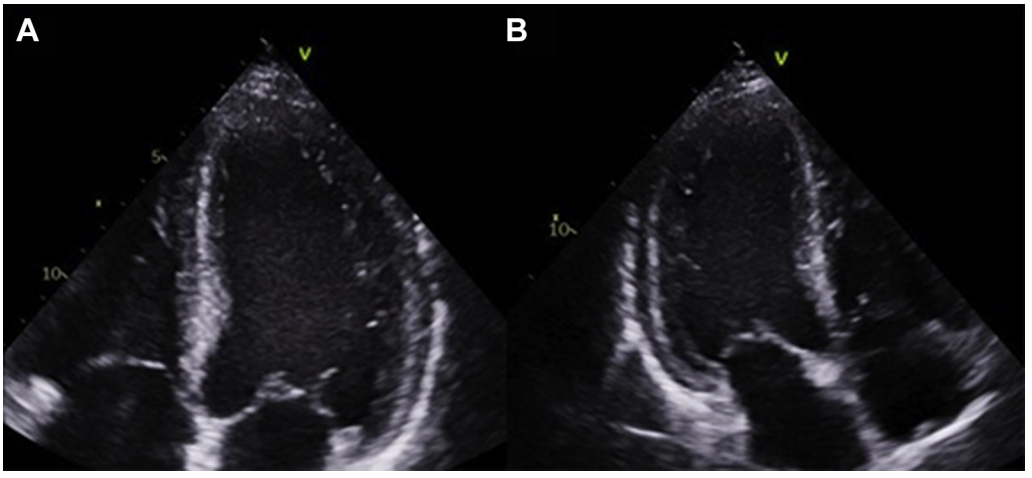
The patient was discharged in good clinical condition. He is currently receiving the following

FIGURE 7 Late Gadolinium Enhancement Images



Late gadolinium enhancement images in the 2-chamber **(left)** and mid-short-axis views **(right)** with no evidence of focal necrosis or fibrosis. Nevertheless, there is diffuse mild hyperintensity of the middle and apical anterior wall **(arrows)**.

FIGURE 8 Control Echocardiogram 2 Months After Discharge Showing Left Ventricular Function Improvement and the Absence of Intraventricular Thrombus



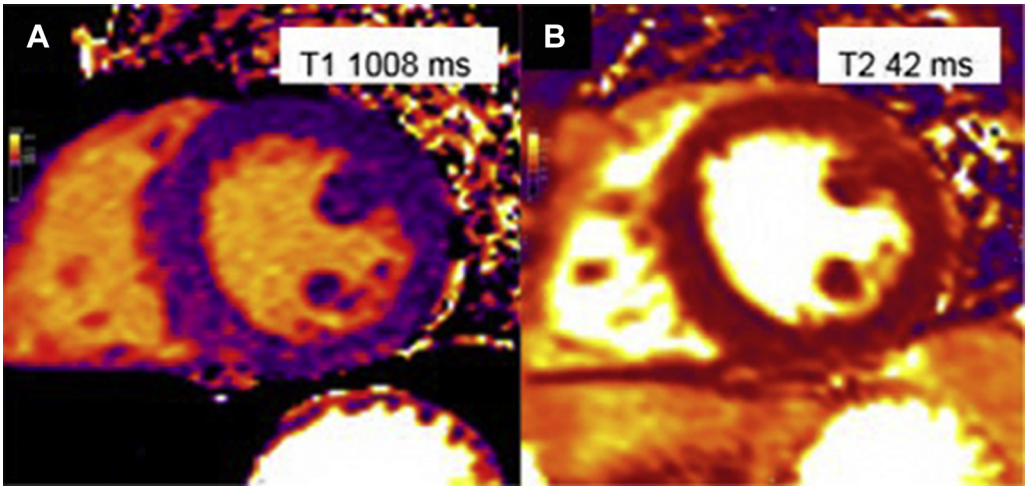
Left ventricle in **(A)** the apical 4-chamber view and **(B)** the apical 3-chamber view.

medications: carvedilol, 6.25 mg b.i.d.; enalapril, 5 mg o.d.; and acenocoumarol. Two months after discharge, he is asymptomatic, and an echocardiogram revealed improvements in contractility and ventricular function (LVEF, 50%), as well as the absence of intracavitary thrombus (**Figures 8A and 8B**, Videos 5 and 6). Moreover, control CMR showed a normalization of T_1 and T_2 values (**Figures 9A and 9B**, Videos 7 and 8).

CONCLUSIONS

This is a rare case of myocarditis with acute LV thrombosis and dysfunction in a young patient with

FIGURE 9 Control Cardiac Magnetic Resonance



The images show normalization of **(A)** T_1 and **(B)** T_2 values.

SARS-CoV-2 pneumonia. The patient had a favorable clinical evolution under anticoagulation and heart failure treatment. We highlight the importance of echocardiography in patients with SARS-CoV-2 infection and biomarker elevation suggestive of myocardial injury, to guide management and reduce complications and mortality.

FUNDING SUPPORT AND AUTHOR DISCLOSURES

The authors have reported that they have no relationships relevant to the contents of this paper to disclose.

ADDRESSES FOR CORRESPONDENCE: Dr. Jose F. Rodriguez-Palomares, Department of Cardiology, Hospital Universitari Vall d́Hebron, Paseo Vall d'Hebron 119-129, 08035 Barcelona, Spain. E-mail: jfrodriguezpalomares@gmail.com OR jfrodrig@vhebron.net. OR Dr. Ignacio Ferreira González, Department of Cardiology, Hospital Universitari Vall d́Hebron, Paseo Vall d'Hebron 119-129, 08035 Barcelona, Spain. E-mail: nachoferreira@secardiologia.es OR iferreir@vhebron.net.

REFERENCES

1. The European Society for Cardiology. ESC guidance for the diagnosis and management of CV disease during the COVID-19 pandemic. Last updated June 2020. Available at: https://www.escardio.org/Education/COVID-19-and-Cardiology/ESC-COVID-19-Guidance. Accessed February 18, 2021.

2. Xu Z, Shi L, Wang Y, et al. Pathological findings of COVID-19 associated with acute respiratory distress syndrome. Lancet Respir Med 2020;8:420–2.

3. Madjid M, Safavi-Naeini P, Solomon S, et al. Potential effects of coronaviruses on the cardiovascular system. A review. JAMA Cardiol 2020;5:831–40.

4. Helms J, Tacquard C, Severac F, et al. High risk of thrombosis in patients with severe SARS-CoV-2 infection: a multicenter prospective cohort study. Intensive Care Med 2020;46:1089–98.

5. Abou-Ismail M, Diamond A, Kapoor S, et al. The hypercoagulable state in COVID-19: incidence, pathophysiology, and management. Thromb Res 2020;194:101–15.

6. Rey J, Jiménez Valero S, Poveda Pinedo D, et al. COVID-19 and simultaneous thrombosis of two coronary arteries. Rev Esp Cardiol 2020;73:665–87.

7. Puntmann VO, Carerj ML, Wieters I, et al. Outcomes of cardiovascular magnetic resonance imaging in patients recently recovered from coronavirus disease 2019 (COVID-19). JAMA Cardiol 2020;5:1265–73.

8. Ferreira VM, Schulz-Menger J, Holmvang G, et al. Cardiovascular magnetic resonance in nonischemic myocardial inflammation: expert recommendations. J Am Coll Cardiol 2018;72:3158–76.

9. Zeng JH, Liu YX, Yuan J, et al. First case of COVID-19 complicated with fulminant myocarditis: a case report and insights. Infection 2020;48:773–7.

10. Capotosto L, Nguyen B, Ciardi M, et al. Heart, COVID-19, and echocardiography. Echocardiography 2020;37:1454–64.

KEY WORDS cardiovascular magnetic resonance (CMR), computed tomography, COVID-19, echocardiography, myocarditis, thrombus

APPENDIX For supplemental videos, please see the online version of this article.