COVID-19-induced myocarditis: A multicenter cardiovascular magnetic resonance study

Matthias G Friedrich[1, 2], Ria Garg[3]

[1]Departments of Cardiology and Diagnostic Radiology, McGill University Health Center, Montréal, QC, Canada
[2]Courtois CMR Research Group at the Research Institute of the McGill University Health Center, Montreal, QC, Canada
[3]Department of Internal Medicine, Geisinger Wyoming Valley Hospital, Wilkes-Barre, PA, United States

Related article
by Haberka et al.

Correspondence to:
Matthias G Friedrich, MD, PhD, Departments of Cardiology and Diagnostic Radiology, McGill University Health Center, 1001 Decarie Blvd, Montréal, QC H4A 3J1, Canada, phone: +1 514 934 1934, e-mail: matthias.friedrich@mcgill.ca

Copyright by the Author(s), 2023

DOI: 10.33963/KP.a2023.0101

Received:
April 28, 2023

Accepted:
April 28, 2023

Early publication date:
May 2, 2023

Since the onset of the COVID-19 pandemic in early 2020, several studies on its cardiovascular complications and the importance of cardiovascular magnetic resonance (CMR) in diagnosis of myocarditis have been published. "A distinct septal pattern of late gadolinium enhancement specific for COVID-19-induced myocarditis: A multicenter cardiovascular magnetic resonance study" [1] compares patients with COVID-19-related myocarditis and non-COVID-19 myocarditis, for CMR findings.

The study was a multicenter, observational study conducted in 5 centers. The authors recruited 552 COVID-19 patients prospectively and 221 patients retrospectively, as the non-COVID-19 group, between 2018 and 2019. The median time interval between acute COVID-19 disease symptoms and CMR was 12 weeks. The COVID-19 group showed a lesser extent of late gadolinium enhancement (LGE), better left ventricular systolic function, lower left ventricular end-diastolic volume (LVEDV) but a higher rate of pericarditis and septal predilection of LGE as compared to the control group. About half of the patients showed a myocarditis-like injury with only 7.5% also having myocardial edema (only 3 had myocardial edema). In those patients, the LGE areas were larger, and pericarditis was more frequent (13.6% vs. 6%; $P = 0.03$). The control group had a higher rate of myocarditis-like injury and pericardial effusion. The authors did not find any relation between the LGE extent and obesity or age.

The use of Lake Louise Criteria (LLC) as markers for myocardial inflammation is useful in patients with a clinical presentation consistent with acute myocardial inflammation [2]. But in patients without clinical evidence of myocarditis, areas with abnormal LGE may just reflect scars but not acute inflammation. Therefore, observed injuries in patients without associated edema as visualized by T2-dependent CMR may be scars or fibrosis due to other reasons, without active inflammation.

Septal fibrosis, as reported, is not specific for inflammation but, instead, is a frequent pattern in non-ischemic myocardial disease, such as dilated [3] and hypertrophic cardiomyopathy [4] and sarcoidosis [5] and can even be seen in healthy individuals [6]. Myocardium that is exposed to stress may show LV remodeling with myocyte hypertrophy and diffuse interstitial fibrosis, which may also include replacement fibrosis [7]. Therefore, such septal LGE patterns are unlikely due to inflammation and thus, in this context, should be interpreted with caution. Inflammatory injury due to viral disease is usually located in basal to mid-inferolateral regions [8], and studies in post-COVID related myocarditis have reported non-ischemic scar patterns, with some studies showing elevated T1 and T2 values [9] and others with T2 elevation only [10]. Wherever reported though, the pattern of injury was non-ischemic with the most common inferior, inferolateral, basal to mid-region scar [9, 11, 12].

One major limitation, as also pointed out by the authors, is the lack of access to T1 and T2 mapping, which was not available in all centers. In the context of COVID-related myocardial injury, mapping may be the most

accurate test for detecting myocardial inflammation and injury [9].

Pericarditis has not been a frequent finding in COVID--19 patients although in some studies [9, 13], the reported prevalence of pericardial inflammation was up to 40% [13], and most frequently it was adjacent to the lateral wall. It might be important to investigate the extent and prevalence of pericardial injury in those patients to explain the prolonged symptom duration.

COVID-19-related myocardial inflammation appears to follow similar injury patterns as in other viral diseases and, in affected patients, may reflect involvement of their vulnerable myocardial tissue. While the study by Haberka et al. [1] provides interesting results, it contradicts a large body of evidence and confirmatory studies would be needed to demonstrate that septal injury is indeed a specific marker for COVID-19 myocarditis, instead of non-specific fibrosis.

Article information

Conflict of interest: None declared.

Funding: None.

Open access: This article is available in open access under Creative Common Attribution-Non-Commercial-No Derivatives 4.0 International (CC BY-NC-ND 4.0) license, which allows downloading and sharing articles with others as long as they credit the authors and the publisher, but without permission to change them in any way or use them commercially. For commercial use, please contact the journal office at kardiologiapolska@ptkardio.pl.

REFERENCES

1. Haberka M, Rajewska-Tabor J, Wojtowicz D. A distinct septal pattern of late gadolinium enhancement specific for COVID-19-induced myocarditis: A multicenter cardiovascular magnetic resonance study. Kardiol Pol. 2023; 81(5): 463–471, doi: 10.33963/KP.a2023.0054, indexed in Pubmed: 36871296.
2. Ferreira VM, Schulz-Menger J, Holmvang G, et al. Cardiovascular Magnetic Resonance in Nonischemic Myocardial Inflammation: Expert Recommendations. J Am Coll Cardiol. 2018; 72(24): 3158–3176, doi: 10.1016/j.jacc.2018.09.072, indexed in Pubmed: 30545455.
3. Becker MAJ, Allaart CP, Zweerink A, et al. Correlation between septal midwall late gadolinium enhancement on CMR and conduction delay on ECG in patients with nonischemic dilated cardiomyopathy. Int J Cardiol Heart Vasc. 2020; 26: 100474, doi: 10.1016/j.ijcha.2020.100474, indexed in Pubmed: 32021905.
4. Ellims AH, Iles LM, Ling Lh, et al. A comprehensive evaluation of myocardial fibrosis in hypertrophic cardiomyopathy with cardiac magnetic resonance imaging: linking genotype with fibrotic phenotype. Eur Heart J Cardiovasc Imaging. 2014; 15(10): 1108–1116, doi: 10.1093/ehjci/jeu077, indexed in Pubmed: 24819852.
5. Okasha O, Kazmirczak F, Chen KHA, et al. Myocardial Involvement in Patients With Histologically Diagnosed Cardiac Sarcoidosis: A Systematic Review and Meta-Analysis of Gross Pathological Images From Autopsy or Cardiac Transplantation Cases. J Am Heart Assoc. 2019; 8(10): e011253, doi: 10.1161/JAHA.118.011253, indexed in Pubmed: 31070111.
6. Joncas S, Kolman L, Lydell C, et al. Differentiation of physiologic versus pathologic basal septal fibrosis: Proposed diagnostic criteria and associations with clinical and CMR-based markers of cardiovascular disease. J Cardiovasc Magn Reson. 2014; 16(S1), doi: 10.1186/1532-429x-16-s1-p104.
7. Hara H, Takeda N, Komuro I. Pathophysiology and therapeutic potential of cardiac fibrosis. Inflamm Regen. 2017; 37: 13, doi: 10.1186/s41232-017-0046-5, indexed in Pubmed: 29259712.
8. Friedrich MG, Sechtem U, Schulz-Menger J, et al. Cardiovascular magnetic resonance in myocarditis: A JACC White Paper. J Am Coll Cardiol. 2009; 53(17): 1475–1487, doi: 10.1016/j.jacc.2009.02.007, indexed in Pubmed: 19389557.
9. 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(11): 1265–1273, doi: 10.1001/jamacardio.2020.3557, indexed in Pubmed: 32730619.
10. Huang Lu, Zhao P, Tang D, et al. Cardiac Involvement in Patients Recovered From COVID-2019 Identified Using Magnetic Resonance Imaging. JACC Cardiovasc Imaging. 2020; 13(11): 2330–2339, doi: 10.1016/j.jcmg.2020.05.004, indexed in Pubmed: 32763118.
11. Huang Lu, Zhao P, Tang D, et al. Cardiac Involvement in Patients Recovered From COVID-2019 Identified Using Magnetic Resonance Imaging. JACC Cardiovasc Imaging. 2020; 13(11): 2330–2339, doi: 10.1016/j.jcmg.2020.05.004, indexed in Pubmed: 32763118.
12. Małek ŁA, Marczak M, Miłosz-Wieczorek B, et al. Cardiac involvement in consecutive elite athletes recovered from COVID-19: A magnetic resonance study. J Magn Reson Imaging. 2021; 53(6): 1723–1729, doi: 10.1002/jmri.27513, indexed in Pubmed: 33474768.
13. Brito D, Meester S, Yanamala N, et al. High Prevalence of Pericardial Involvement in College Student Athletes Recovering From COVID-19. JACC Cardiovasc Imaging. 2021; 14(3): 541–555, doi: 10.1016/j.jcmg.2020.10.023, indexed in Pubmed: 33223496.