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Case Report

Imaging findings in a case of myo-pericarditis associated with SARS CoV-2 disease

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ABSTRACT

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) is known to use the host protein angiotensin-converting enzyme 2 as a co-receptor to gain intracellular entry into different organs, including the heart. Cardiac involvement is one of the clinical manifestations of coronavirus disease 2019 (COVID-19) and is associated with a worse prognosis; in this setting, few cases of myo-pericarditis with complete imaging documentation have been reported. We discuss a case of a woman admitted to the emergency department with dyspnea. Nasopharyngeal swab showed positive results for SARS-CoV-2. A subsequent 12-lead electrocardiogram showed modifications of T-wave in leads V1 to V6 while blood tests revealed increased levels of troponin I. Coronary computed tomography angiography was performed, excluding hemodynamically significant coronary stenosis. Cardiac magnetic resonance (CMR) was also performed, showing findings fulfilling Lake Louise criteria for the diagnosis of acute myo-pericarditis.

To date, myocardial inflammation was recognized as connected with COVID-19 mortality. CMR is an indispensable tool for non-invasive diagnosis of this pathology; however, most clinical studies demonstrated the presence of intramyocardial edema using T1 and T2 mapping sequences. In our case, extensive intramyocardial edema was well demonstrated using TIRM sequences, with a short TI to obtain fat suppression.

<Learning objective: Coronavirus disease 2019 (COVID-19) may cause acute myo-pericarditis. Clinicians need to be aware of cardiovascular involvement during COVID-19 due to its mortality. Cardiac magnetic resonance, used in the right clinical setting, can easily diagnose myocarditis in a non-invasive way.>

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Introduction

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) is a positive-sense single-stranded RNA virus responsible for coronavirus disease 2019 (COVID-19), first identified in Wuhan in December 2019 and now spread worldwide, leading to an ongoing pandemic [1].

COVID-19 manifestations are variable, ranging from mild symptoms to severe illness and death. Patients commonly experience flu-like symptoms (headache, anosmia, dysgeusia, cough, fever, myalgia, and dyspnea) [1].

Cardiovascular involvement of COVID-19 has not been fully delineated to date [2]; few cases of myocarditis in patients with

COVID-19 have been reported, although with unclear iconography available [3, 4].

Case report

A 55-year-old white woman, without history of cardiovascular diseases, was admitted to the emergency department with dyspnea in November 2020. Nasopharyngeal swab was performed, with positive result for SARS-CoV-2 on real-time reverse transcriptase-polymerase chain reaction assay. Chest high resolution-computed tomography (CT) revealed bilateral multiple areas of pulmonary parenchymal “ground glass” and a solid area in the right upper lobe with adjacent lymphadenomegalies suggestive for lung cancer (Fig. 1); presence of pleural and pericardial effusion was also highlighted.

Due to the evidence of cardiac tamponade, evacuative pericardiocentesis was performed, draining around 700 milliliters of serous fluid.

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Fig. 1. Chest computed tomography with contrast medium revealing multiple areas of increased attenuation (ground-glass opacities and consolidation), a mass in the right hilum, and mediastinal lymphadenopathies. (A, B, C) Axial and coronal lungs' view, reconstructed with lung window. (D) Coronal lungs view reconstructed with mediastinum window.

The patient was discharged at home after two weeks of anti-inflammatory therapy, echocardiographic absence of pericardial effusion, and negativization of SARS-CoV-2 swabs.

In early December the patient was admitted to our polyclinic to undergo scheduled echocardiographic control without complaining of any symptoms; transthoracic echocardiography showed a “swinging heart” and significant circumferential pericardial effusion, most notable around right cardiac chambers (maximum 24 mm); global and segmental systolic function was preserved. Main laboratory data at admission were: D-dimer 790 ng/ml; procalcitonin 0.08 ng/ml; C-reactive protein 7.36 mg/dL; troponin I 26 pg/ml. The next day, following multidisciplinary evaluation, the patient underwent a surgical procedure of pericardial window. Histological examination of the pericardium revealed reactive hyperplasia of the mesothelium and signs of mild chronic inflammation. During hospitalization, after an exacerbation of respiratory symptoms and the finding of a new positive swab for SARS-CoV-2, she was transferred to our Covid Department. The patient was treated on admission with oxygen therapy, Methylprednisolone (max dosage: 60 mg) and broad-spectrum antibiotic therapy (vancomycin and meropenem). Due to episodes of atrial fibrillation with high ventricular response, therapy with metoprolol and low-molecular-weight-heparin was started. Furthermore, a chest CT was performed showing abundant right pleural effusion (treated with furosemide: 60 mg). On 17 December, a 12-lead electrocardiogram showed significant modifications of the T-wave in leads from V1 to V6 (Fig. 2); blood tests revealed high levels of myocyte necrosis marker (troponin I 575 pg/ml; D-dimer 1640 ng/ml; procalcitonin 0.03 ng/ml; C-reactive protein 0.68 mg/dL; B-type natriuretic peptide 50 pg/ml). A new transthoracic echocardiography was performed, showing globally hypokinetic left ventricle (LV),

akinesia of mean basal myocardial segments (mostly at the level of lateral wall), and a markedly reduced global systolic function compared to previous controls [estimated LV ejection fraction (LVEF): 34%] (Fig. 2). Coronary CT angiography (Somatom Force, Siemens, Erlangen, Germany), performed to exclude a coronaropathy, did not show hemodynamically significant coronary stenosis (Fig. 3); functional cardiac CT analysis confirmed the echocardiographic reports, except for a better global systolic function (LVEF: 52%). This discrepancy may be due to the difficult technical conditions in which the ultrasound study was performed causing an underestimation of the LVEF value, while a more objective estimation was obtained with CT.

To assess myocardial wall status, cardiac magnetic resonance (CMR) was performed (Magnetom Aera 1.5 Tesla, Siemens). CMR imaging confirmed diffuse biventricular hypokinesia, especially in mid-basal segments, and LV dysfunction (LVEF: 50%).

Short Tau Inversion Recovery sequences (STIR), in the version of Turbo Inversion Recovery Magnitude (TIRM) sequences, displayed hyperintensity of mid-basal infero-lateral wall with midwall/sub-epicardial distribution (non-ischemic pattern), extended to adjacent pericardium, suggestive for myocardial edema; at the same levels, phase-sensitive inversion recovery sequences (PSIR) acquired 10 minutes after the administration of gadolinium (gadobutrol 1.0 mmol/mL; 10 mL) showed late enhancement with an equal distribution pattern (Fig. 3).

These findings fulfilled the two main Lake Louise criteria (T1 and T2 criteria) for the diagnosis of acute myo-pericarditis.

The patient was discharged in January with a diagnosis of post-COVID myo-pericarditis and end-stage lung cancer (confirmed with endobronchial ultrasound-guided needle aspiration of the thoracic lymphadenomegaly).

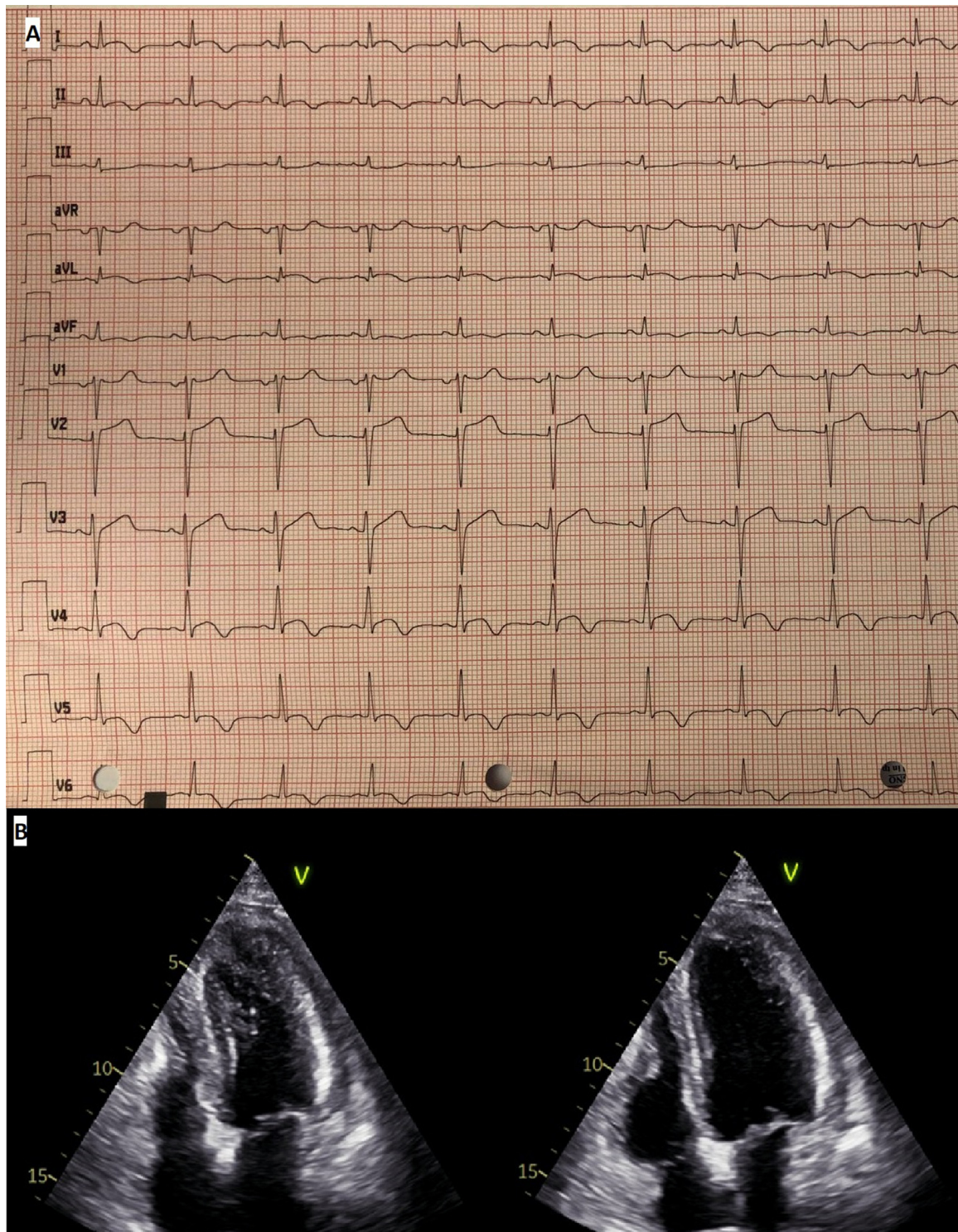


Fig. 2. (A) Electrocardiograph showing significant elevation of the ST segment in V2, V3 and V4. (B) Echocardiography during systole (left) and diastole (right) with hyperchogenicity of the mid-basal infero-lateral myocardial wall.

Discussion

We report a case of an adult female patient admitted to the emergency department with dyspnea, nasopharyngeal molecular swab with positive result for SARS-CoV-2 and related clinical and radiological findings of pneumonia and myo-pericarditis.

In December 2019, a cluster of patients with pneumonia and flu-like symptoms of unknown cause was linked to a market in Wuhan, China [1]; since then, coronavirus disease outbreak has become a global public health challenge.

Despite its typical symptoms, cardiovascular implications of COVID-19 have received less medical attention [2]. After first cases

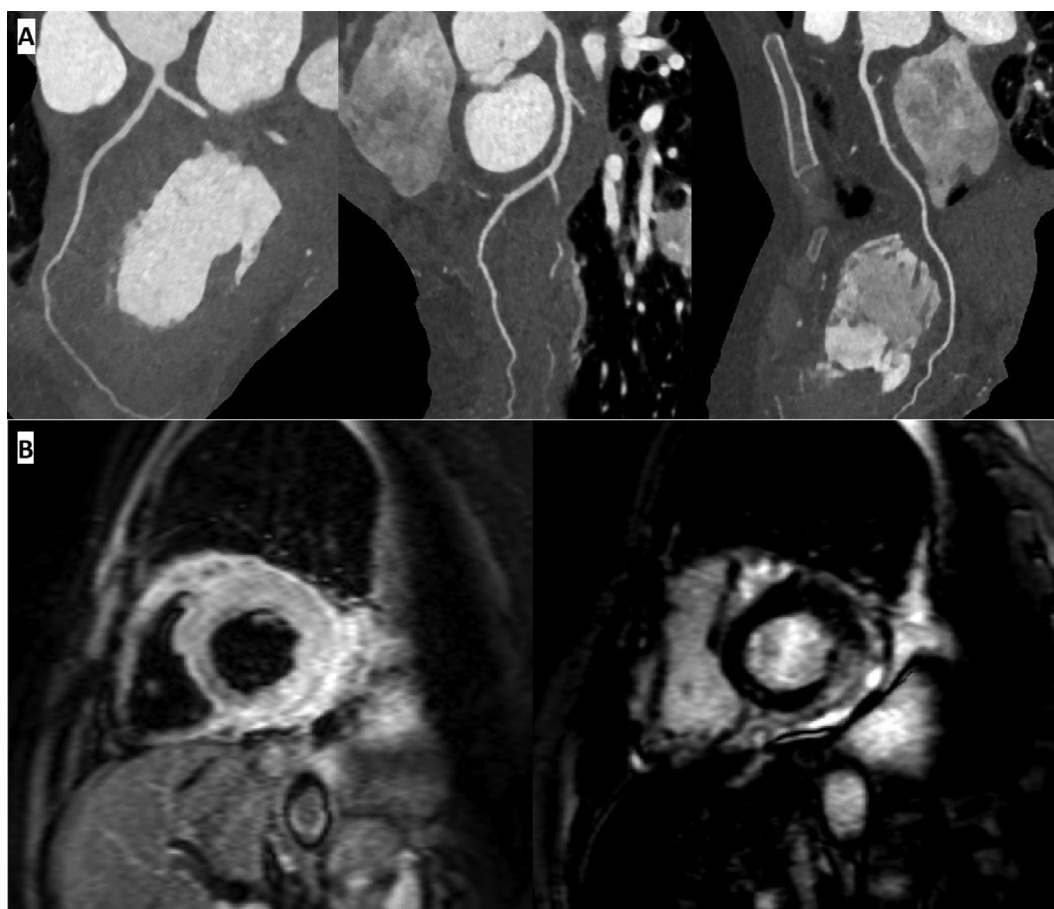


Fig. 3.

(A) Curved-planar reconstruction of coronary computed tomography angiography showing patent arteries. From left to right: left anterior descending artery, left circumflex artery, right coronary artery + posterior descending artery. (B) Cardiac magnetic resonance image short-axis view; on the left T2w short tau inversion recovery sequences showing myocardial edema of the mid-basal infero-lateral wall with a non-ischemic distribution (midwall/sub-epicardial), extended to the adjacent pericardium; on the right phase-sensitive inversion recovery sequences showing late enhancement with same pattern.

of COVID-19 related myocarditis were reported, myocardial involvement is recognized as a cause of SARS-CoV-2 death [5].

Myocarditis is an inflammatory disease of myocardium predominantly linked with several virus infections [6].

It has been widely described that SARS-CoV-2 could enter human cells binding its spike protein to the membrane protein angiotensin-converting enzyme 2 (ACE2) [2].

For this reason, it was proposed that SARS-CoV-2 could involve human heart, especially when ACE2 is upregulated, as happens in patients with a pre-existing condition of heart failure; in this case, primed CD8 T lymphocytes might migrate to cardiomyocytes causing myocardial inflammation through cell-mediated cytotoxicity [2].

The real incidence of myocarditis in COVID-19 patients is not clear, probably due to the lack of specific diagnostic modalities and an underdiagnosis of this condition.

Nevertheless, the American Heart Association scientific statement recommends early recognition and management of myocarditis for a better outcome [7].

Echocardiography can demonstrate presence of pericardial effusion; other common findings are global left ventricular systolic dysfunction, and regional wall motion abnormalities [8].

But it is also known that SARS-CoV2 disease increases the risk of acute coronary syndrome promoting vasoconstriction, plaque rupture, and microthrombi due to systemic inflammation [2];

thus, in case of increased markers levels of myocyte necrosis (e.g. troponin I) and electrocardiographic anomalies (particularly ST-segment elevation), differential diagnosis between acute myo-pericarditis and ischemic heart disease is crucial. In this clinical scenario, cardiovascular imaging plays a central role in the management of these patients, allowing non-invasive visualization of coronary tree through coronary CT angiography, eventually with a “triple rule out study” to exclude pulmonary embolism (another severe manifestation associated with SARS CoV2 disease) [2]; coronary CT is in fact a valid alternative of coronary angiography, being “a gate-keeper” in the management of troponinosis [9]. CT acquisition of heart volumes also allows an evaluation of functional parameters (as LVEF) in a better way than echocardiography, that is limited by several factors (patient habitus and compliance, presence of thoracic devices, etc.).

Furthermore, even if endomyocardial biopsy is considered the gold standard, actually CMR is a fundamental tool for an early non-invasive diagnosis of myo-pericarditis, showing the presence of interstitial edema and its extension even in COVID-19 patients with almost normal LVEF. In particular, several studies have investigated the presence of myocardial involvement using CMR [3, 4]. In most of these, myocardial edema was demonstrated using T1 and T2 mapping sequences that are most sensitive in depicting myocardial injuries, allowing diagnosis of acute myocarditis also without administration of gadolinium, as reported in Lake Louis criteria (updated in 2018) [10].

According to these, diagnosis of myocarditis is based on at least one T1-based criterion (non-ischemic late enhancement, increased myocardial T1 relaxation times, increased extracellular volume fraction) with at least one T2-based criterion (noticeable myocardial edema, global signal intensity ratio myocardium/skeletal muscle ≥ 2 , increased myocardial T2 relaxation times).

However, it is widely known that T1 and T2 mapping sequences are prone to respiratory artifacts that limited its diagnostic performances, especially in SARS-CoV2 pneumonia affected patients which struggle holding breath. Also STIR sequences, in the version of TIRM sequences, are influenced by respiratory artifacts; but the presence of a classic pathological finding in these sequences is most reliable as marker of edema, in relation to fewer cases of false positive results than mapping sequence.

This aspect makes our case report more interesting, due to the significant presence of myocardial edema demonstrated in our CMR study.

Conclusion

We reported a case of myo-pericarditis associated with COVID-19 and its radiological manifestations; clinicians should be more and more aware of cardiovascular involvement of this novel pandemic infection.

Declaration of Competing Interest

The authors declare that there is no conflict of interest.

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None.

References

- [1] Huang C, Wang Y, Li X, Ren L, Zhao J, Hu Y, Zhang L, Fan G, Xu J, Gu X, Cheng Z, Yu T, Xia J, Wei Y, Wu W, et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. *Lancet* 2020;395:497–06.
- [2] Nishiga M, Wang DW, Han Y, Lewis DB, Wu JC. COVID-19 and cardiovascular disease: from basic mechanisms to clinical perspectives. *Nat Rev Cardiol* 2020;17:543–58.
- [3] Inciardi RM, Lupi L, Zaccone G, Italia L, Raffo M, Tomasoni D, Cani DS, Cerini M, Farina D, Gavazzi E, Maroldi R, Adamo M, Ammirati E, Sinagra G, Lombardi CM, et al. Cardiac involvement in a patient with coronavirus disease 2019 (COVID-19). *JAMA Cardiol* 2020;5:819–24.
- [4] Sauer F, Dagrenat C, Couppie P, Jochum G, Leddet P. Pericardial effusion in patients with COVID-19: case series. *Eur Heart J Case Rep* 2020;4:1–7.
- [5] Ruan Q, Yang K, Wang W, Jiang L, Song J. Clinical predictors of mortality due to COVID-19 based on an analysis of data of 150 patients from Wuhan, China. *Intensive Care Med* 2020;46:846–8.
- [6] Esfandiarei M, McManus BM. Molecular biology and pathogenesis of viral myocarditis. *Ann Rev Pathol* 2008;3:127–55.
- [7] Kociol RD, Cooper LT, Fang JC, Moslehi JJ, Pang PS, Sabe MA, Shah RV, Sims DB, Thiene G, Vardeny O. American Heart Association Heart Failure and Transplantation Committee of the Council on Clinical Cardiology. Recognition and initial management of fulminant myocarditis: a scientific statement from the American Heart Association. *Circulation* 2020;141:e69–92.
- [8] Caforio AL, Pankuweit S, Arbustini E, Basso C, Gimeno-Blanes J, Felix SB, Fu M, Heliö T, Heymans S, Jahns R, Klingel K, Linhart A, Maisch B, McKenna W, Mørgensen J, et al. Current state of knowledge on aetiology, diagnosis, management, and therapy of myocarditis: a position statement of the European Society of Cardiology Working Group on Myocardial and Pericardial Diseases. *Eur Heart J* 2013;34:2636–48.
- [9] Knuuti J, Wijns W, Saraste A, Capodanno D, Barbato E, Funck-Brentano C, Prescott E, Storey RF, Deaton C, Cuisset T, Agewall S, Dickstein K, Edvardsen T, Escaned J, Gersh BJ, et al. 2019 ESC Guidelines for the diagnosis and management of chronic coronary syndromes. *Eur Heart J* 2020;41:407–77.
- [10] Ferreira VM, Schulz-Menger J, Holmvang G, Kramer CM, Carbone I, Sechtem U, Kindermann I, Gutberlet M, Cooper LT, Liu P, Friedrich MG. Cardiovascular magnetic resonance in nonischemic myocardial inflammation: expert recommendations. *J Am Coll Cardiol* 2018;72:3158–76.