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Acute myocarditis associated with COVID-19 infection

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Title: ACUTE MYOCARDITIS ASSOCIATED WITH COVID-19 INFECTION

Running Title: MYOCARDITIS ASSOCIATED WITH COVID-19

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## ACUTE MYOCARDITIS ASSOCIATED WITH COVID-19 INFECTION

### Abstract

We present the case of a 20-year-old male patient without previous history of cardiovascular disease who was admitted to our hospital with a new onset febrile sensation and chest pain. Chest computed tomography revealed a subpleural consolidation with a halo of ground-glass opacification. Blood tests revealed elevated levels of markers of myocyte necrosis (troponin I and creatine kinase-MB). Nasopharyngeal swab was positive for COVID-19. Cardiac MRI showed myocardial edema and late gadolinium enhancement compatible with myocarditis associated with COVID-19 infection. This case showed that acute myocarditis can be the initial presentation of patients with COVID-19 infection.

### Introduction

Coronavirus disease 2019 (COVID-19) has been declared a world-wide public health emergency. There is limited published data concerning cardiovascular presentations in the wake of viral epidemics [1]. Acute or fulminant myocarditis as well as heart failure have been reported with Middle East respiratory syndrome coronavirus and could be expected to occur with SARS-CoV-2, given the similar pathogenicity [2]. Previous severe acute respiratory syndrome (SARS) beta-coronavirus infections could be associated with tachyarrhythmias and signs and symptoms of heart failure [3]. The current report describes a case of myocarditis in a patient affected by COVID-19.

### Case Report

A 20-year-old male patient without previous history of cardiovascular disease admitted to our hospital with a new onset febrile sensation and chest pain during the COVID-19 outbreak. On arrival to the emergency department, physical examination revealed blood pressure of 146/63 mmHg, heart rate of 111 beats per minute, oxygen saturation of 97%, and body temperature of 39 °C. The posteroanterior chest radiograph revealed a focal consolidation on the upper

zone of left lung (Figure 1A). A chest computed tomography (CT) revealed a subpleural consolidation containing air bronchogram with a halo of ground-glass opacification in the left upper lobe (Figure 1B). Troponin I level was 0.572 ng/mL (<0.045 ng/mL), creatine kinase–MB level was 9.08 µg/L (<5 µg/L), N-terminal pro-B-type natriuretic peptide (NT-proBNP) level was 127 ng/L (<125 ng/L), and C-reactive protein level was 0.0812 g/L (0.005 g/L). Blood cell counts show a haemoglobin concentration of 15.3 g/dL, a platelet count of  $203 \times 10^9$  per L, and a leucocyte count of  $6.74 \times 10^9$  per L (neutrophils 71%, lymphocytes 21%, monocytes 8%, and no eosinophils or basophils 0%). Nasopharyngeal swab was positive for COVID-19. Hydroxychloroquine, azithromycin, ceftriaxone, tigecycline, favipiravir, and colchicine were started. On the first day after hospital admission, there was a further increase in levels of Troponin I (7.621 ng/mL), creatine kinase–MB (21.92 µg/L), and NT-proBNP (1525 ng/L), with a gradually reduction to normal range during the following days. The patient was recovered and was discharged to home on day 7. One week later, a cardiac magnetic resonance imaging (MRI) was performed. Left ventricular function, volumes, and mass were in normal range (ejection fraction 64%, stroke volume 62.2 mL, end-diastolic volume 97 mL, end-systolic volume 34.8 mL, mass 128 g) (Video 1). T2 short tau inversion recovery (STIR) sequence revealed a subepicardial high signal intensity in the mid posterolateral wall of the left ventricle which suggests myocardial wall edema (Figure 2A). Cardiac MRI showed subepicardial late gadolinium enhancement of the posterolateral wall in the mid ventricle-suggestive of myocarditis at 5 and 10 minutes after contrast administration, respectively (Figure 2B, Figure 2C). The myocardial edema and pattern of late gadolinium enhancement were compatible with the Lake Louise criterias for the diagnosis of acute myocarditis [4]. Myocarditis combined with COVID-19 was confirmed by clinical presentation, elevated levels of markers of myocyte necrosis, and cardiac MRI.

## Discussion

Herein, we present a patient without a known history of cardiovascular disease admitted to the hospital with COVID-19 pneumonia and acute myocarditis. The current case presentation shows that cardiac involvement may occur with COVID-19 pneumonia. Although the clinical manifestations of COVID-19 are dominated by respiratory symptoms, some patients have severe cardiovascular damage [5]. Virus infection has been widely described as one of the most common infectious causes of myocarditis [6, 7]. As with other coronaviruses, SARS-CoV-2 can elicit the release of multiple cytokines and chemokines that can lead to myocardial inflammation. Direct viral infection of the myocardium is another possible causal pathway of myocardial damage. In some patients with or without preexisting cardiovascular disease, COVID-19 associated myocardial injury could represent myocarditis [2]. However, less is known about the cardiac involvement as a complication of SARS-CoV-2 infection. Suspected myocarditis is one of the most frequent indications for cardiac MRI scanning [8, 9]. Cardiac MRI allows for targeting several features of myocarditis inflammatory hyperemia and edema, necrosis/scar, and contractile dysfunction can all be visualized [8]. There were a few cases described myocarditis with COVID-19. Cardiac MRIs of these cases showed diffuse myocardial wall edema and decreased LV ejection fraction [6, 10]. However, cardiac MRI of this patient revealed focal myocardial wall edema with normal left ventricular function and volumes. In our patient, increases of markers of myocyte necrosis, the cardiac MRI findings showing focal edema, and the late gadolinium enhancement are compatible with an acute myocarditis.

In conclusion, it should be kept in mind that COVID-19 associated myocardial injury could represent myocarditis. This is one of the first reported cases of myocarditis associated with COVID-19 infection.

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### Figure Legends

Figure 1. Note that an opacity (arrow) in left lung at posteroanterior chest radiograph (A). Chest computed tomography (CT) reveals a consolidation containing air bronchogram with a halo sign in the left upper lobe and a subpleural localization (B).

Figure 2. Short tau inversion recovery (STIR) sequence in short-axis view (A) reveals a subepicardial high signal intensity in the posterolateral wall of the left ventricle which suggests myocardial wall edema (arrow). Phase-sensitive inversion recovery (PSIR) sequence in short-axis view shows subepicardial late gadolinium enhancement of the posterolateral wall in the mid ventricle at 5 (B) and 10 (C) minutes after contrast administration (arrowheads).

Video 1. 1.5-Tesla steady-state free precession (SSFP) cine cardiac magnetic resonance imaging in 4-chamber view shows normal left ventricular wall motion.