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Case Report

Covid-19-Induced Myocarditis

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Abstract

We present the case of a young man, who had a history of COVID-19 pneumonia and with the following chest pain. The diagnosis of acute myocarditis was eventually confirmed by cardiac magnetic resonance imaging. The diagnosis of acute myocarditis is frequently empiric and is made on the basis of the clinical presentation, electrocardiographic changes, elevated cardiac enzymest. To date, the only widely available method for the diagnosis of myocarditis is myocardial biopsy. This procedure, although very specific, has limited sensitivity and substantial procedural morbidity and mortality rates.

Keywords: *Chest Pain; Covid-19; Coronary Angiography; Magnetic Resonance Imaging; Myocardial Infarction; Myocarditis*

Introduction

Common cardiac complications for COVID-19 are hypotension, myocarditis, arrhythmias, and sudden cardiac death (SCD). Electrocardiographic changes, systolic left ventricle (LV) dysfunction and elevated troponin levels were detected during diagnosis [1,2]. Myocardial damage and elevated levels of inflammatory biomarkers were likely associated with viral myocarditis and ischemia [3].

The receptor through which SARS-CoV-2 enters cells to initiate infection is ACE2 [4,5]. ACE2 is a multifunctional protein. Its main physiological role is the enzymatic conversion of angiotensin (Ang) II to Ang- (1-7) and Ang I to Ang- (1-9), which are protective peptides of the cardiovascular system (CVS) [6]. In the context of COVID-19, however, ACE2 is a receptor for the coronavirus [7]. Binding of the SARS-CoV-2 spike protein to ACE2 facilitates entry of the virus into alveolar lung epithelial cells, where it is expressed through cell surface-associated transmembrane protein serine 2 (TMPRSS2) processes [8]. In the host cell cytoplasm, the RNA of the viral genome is released and replicated, resulting in newly genomic RNA, processed into virion vesicles, which fuse with the cell membrane to release the virus. SARS-CoV-2 is predominantly spread through the respiratory tract by droplets, respiratory secretions and direct contact. In addition to the lungs, ACE2 is expressed in the human heart, vessels, and gastrointestinal tract [9,10].

Although COVID-19 is primarily a respiratory disease, many patients develop associated cardiovascular diseases (CVD) including pulmonary hypertension, severe cardiac arrhythmias and myocarditis [11]. Being secondary to the lung disease these associated diseases increase the risk of cardiac death in acute presentation of respiratory pathology, especially for patients with pre-existing cardiac insufficiency. CVD may also become a major phenomenon, through pathophysiologic role of RAAS/ACE2 in the cardiovascular system and the fact that particularly ACE2 is expressed in the human heart [12].

Myocarditis occurs in patients with COVID-19 within a few days after the onset of fever. This is indication of myocardial damage caused by a viral infection. Mechanisms of SARS-CoV-2-induced myocardial damage may be related to ACE2 receptivity in the heart and coronary vessels [11,13]. Respiratory failure and hypoxia in COVID-19 can also lead to myocardial damage and immune mechanisms of myocardial inflammation. As an example, cardiac damage leads to activation of innate immune response with release of proinflammatory cytokines, as well as activation of autoimmune adaptive mechanisms by molecular mimicry.

Clinical experience and experimental data indicate that > 7.5% of myocardial cells have positive expression of ACE 2 receptors, the 42 targeted through which SARS-CoV-2 adheres to human cells, suggest that myocarditis can be caused by COVID-19. This diagnosis should be considered as s potential cause of cardiogenic shock [11,14].

No specific ECG changes in patients with SARS-CoV-2 infection have been described so far. Therefore, we have to admit that the overall minimum level of myocardial damage associated with infection does not have characteristic ECG manifestations in the majority of patients, although ST-segment elevation in the setting of myocarditis was described in the study of Inciardi RM., *et al* [13].

A marked increase of Troponin I concentration (e.g. > 5 times the normal value) may indicate the presence of cardiogenic effects of COVID-19 significant respiratory deficiency, tachycardia, systemic hypoxemia, myocarditis, Takotsubo syndrome or myocardial infarction type 1(TIMI) caused by COVID-19 [15,16]. In the absence of symptoms or ECG changes suggestive of TIMI, echocardiography should be considered to diagnose the underlying cause. Patients with symptoms and ECG changes suggestive of TIMI should be treated according to ESC guidelines, regardless of COVID-19 status [17,18].

Mechanisms and risk factors for myocarditis associated with SARS-CoV-2 are unclear. Recently, a high viral load was detected in 4 patients who subsequently developed fulminant myocarditis [19]. One published case described a 38-year-old man with chest pain, hypotension, bilateral pneumonia with pleural effusion and ST-segment elevation, but with normal results of computer tomography (CT) angiography of coronary arteries [20]. Echocardiography demonstrated dilatation and 2 mm pericardial effusion. Troponin I and BNP levels were markedly high. The patient was successfully cured after taking high doses of parenteral glucocorticoids anti-inflammatory therapy and immunoglobulins, in order with other therapeutic interventions. We would like to present a clinical case of the development of covid-associated myocarditis.

Case Report

In present case, on 20.05.2020 a 36-year-old man had a burning retrosternal pain without radiation of the arm or neck, shortness of breath and palpitations. He had a history of COVID-19 pneumonia and had been discharged 2 weeks before. Patient was admitted to the Myocardial infarction care unit Oleksandrivska Kyiv City Clinical Hospital with repeated retrosternal pain and palpitation lasted more than 6 hours. He has had history of hypertension and type II diabetes since 2016. Does not receive regular medications. Clinical examination showed that patient's blood pressure was 160/120 mmHg and heart rate was 110 bpm. First and second heart sounds were normal without any audible murmurs, rubs or gallops. He had moist rales across the entire surface of the lungs.

There were no significant changes in red blood cell (RBC), white blood cell (WBC), or platelet counts. On biochemical profile there was an increased level of ALT - 74,8 U/L, AST - 55,0 U/L, C-reactive protein (CRP) - 9,4 mg/L, increased level of troponin up to 5,65 ng/ml, D-Dimer -was normal.

Echocardiographic findings: dilated heart chambers, ejection fraction was reduced (25,0%), deficiency of mitral valve, tricuspidal and pulmonary artery valves, pericardial effusion up to 150 ml, diffuse hypokinesis.

The ECG dated 20.05.20 (Picture 1) showed sinus tachycardia with a heart rate of 101 beats per minute. Insignificant elevation up to 1 mm of the ST-segment in V1-V3, negative T wave in V5-V6, slightly negative T-wave in I and II.

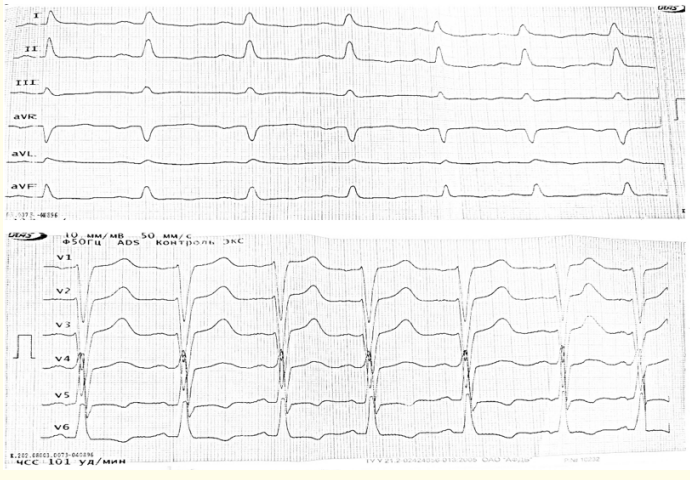

Figure 1: *ECG from 20.05.20.*

In the dynamics on 24.05.20 (Picture 2), there were a deterioration in ECG data - negative T in I, II, aVL, aVF, ST elevation up to 2 mm in V1-V2, depression up to 2 mm in V5-V6.

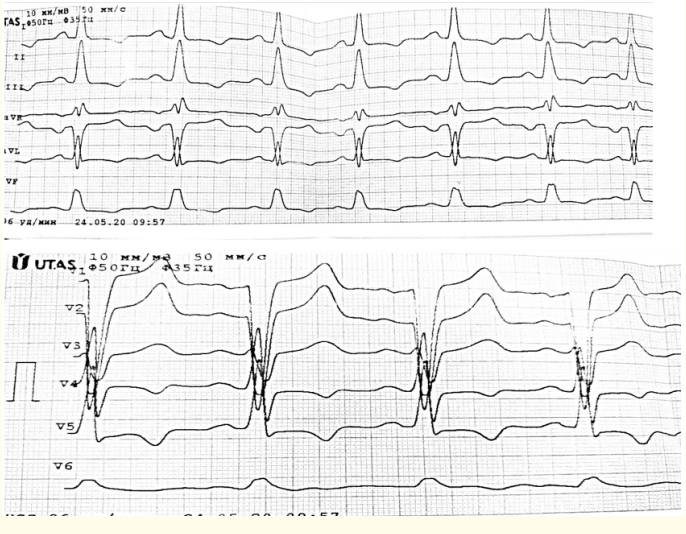

Figure 2: *ECG from 24.05.20.*

Coronary angiography was performed due to discordant changes in the ST segment, in order to exclude acute ischemic myocardial injury, which showed no hemodynamically significant stenoses of coronary arteries.

Cardiac MRI was the decisive test for the diagnosis. It showed evidence of myocarditis (diffuse), active inflammatory process, small pericardial effusion, decreased overall LV contractility and cavity dilatation.

Multidetector spiral CT of the thoracic cavity organs revealed right-sided polysegmental subpleural areas of ground-glass opacities, bilateral hydrothorax, small hydropericardium.

As a result, patient was diagnosed with acute COVID-19 induced myocarditis. The treatment consisted of Torasemide 10 mg in the morning once daily, Carvedilol 25 mg twice daily, Ramipril 5 mgE daily, Eplerenone 50 mg daily, Meloxicam 7,5 mg twice daily, Rivaroxaban 20 mg daily.

On discharge the patient had no complains, was in good condition and mood. He was recommended to continue taking medicines, avoid intensive physical activity, to be followed up by his family doctor with a cardiologist.

Discussion and Conclusion

The main causes of complications of COVID-19 are systemic and microvascular inflammation that lead to thrombosis. Arterial thrombosis most often leads to myocardial infarction and stroke, myo- and pericarditis [3]. The difficulty in diagnosing between myocarditis and myocardial infarction is caused by the similarity of clinical manifestation (pain syndrome), presence of increased markers of myocardial damage (troponin I) in both cases that also complicate decision making for the treatment of the patient. Initial changes in ST segment, as a consequence of microthrombosis of myocardial vessels are represented by concordant ST elevation in all leads in myocarditis and discordant ST elevation in the infarct-dependent zone and depression in the opposite leads in myocardial infarction. Another important differential criterion is the presence of local zones of hypo- or akinesia in echocardiography, that are more common for ischemic myocardial damage. Given the lack of indications for myocardial biopsy in COVID-associated diseases, the «gold standard» for a crucial step in diagnosis is cardiac MRI, in which finding areas of inflammatory rather than ischemic myocardial damage ultimately helps in diagnosis.

In our clinical case, we present the differential diagnosis between acute myocarditis and myocardial infarction using cardiac MRI in patient during post-COVID period, who suffers from pain syndrome and has discordant changes of ST segment.

A fundamental difference in the treatment of COVID-associated myocarditis is for mandatory administration of oral anticoagulants, regardless of the presence or absence of severe heart failure, enlargement of the heart chambers (as in treatment of other forms of myocarditis), taking into account the pathogenesis. Other groups of drugs (β-blockers, ACE inhibitors, diuretics) remain common.

In our clinical case, the criterion for diagnosis was MRI, which should be used in COVID-associated myocardial diseases [21-31].

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