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CASE REPORT

Asymptomatic COVID-19 and ST-elevation myocardial infarction in young adults: lessons learned from two similar cases

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Abstract

We present two cases of acute myocardial infarction in young patients with asymptomatic COVID-19 infection and ST-elevation myocardial infarction (STEMI), complicated by severe acute heart failure and ventricular fibrillation, resulting cardiopulmonary resuscitation and mechanical ventilatory support. Urgent primary percutaneous coronary intervention with further complex treatment was effective in both cases with critical cardiovascular state and co-morbid COVID-19 infection. This report illustrates the challenges in clinical severity of STEMI with COVID-19 infection, despite of young age and absence of clinical symptoms and chronic co-morbidities. STEMI patients with even asymptomatic COVID-19 infection may be presented with significantly higher rates of severe acute heart failure.

Keywords ST-elevation myocardial infarction; Acute heart failure; Young patients; Asymptomatic COVID-19

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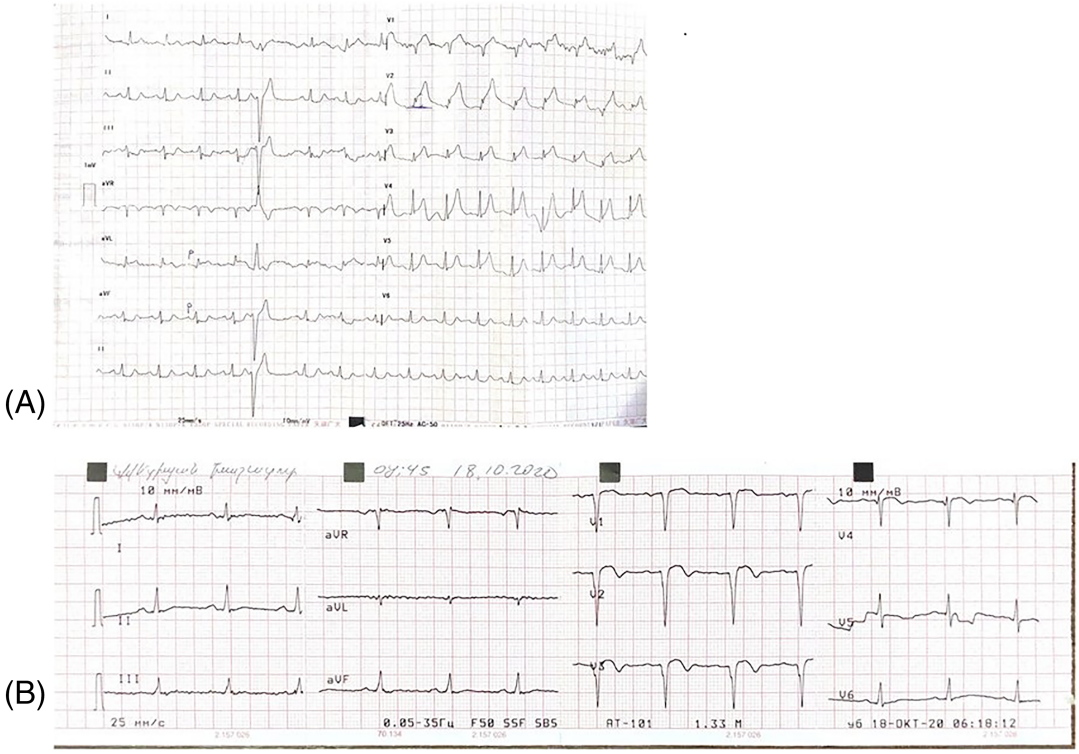
Introduction

COVID-19 caused by severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) directly and indirectly affects the cardiovascular system and predisposes to thrombotic complications. Potential mechanisms of cardiovascular injury have been identified and include direct myocardial injury from haemodynamic derangement or hypoxaemia, inflammatory myocarditis, stress cardiomyopathy, microvascular dysfunction, or thrombosis due to hypercoagulability and systemic inflammation, which may also destabilize coronary artery plaques.[1–3] COVID-19 has been shown to result in coagulation abnormalities and predisposition of patients to thrombotic disease, in both the venous and arterial circulation. This may be a secondary pathway due to inflammation, platelet activation, and endothelial dysfunction.[4–7] Coronary angiographic patterns in patients with COVID-19 and ST-elevation myocardial infarction (STEMI) may include both typical obstructive coronary arteries and angiographic normal epicardial coronary arteries.[8] We present two cases of acute myocardial infarction in young patients with asymptomatic COVID-19 infection admitted with STEMI complicated by cardiogenic shock as an initial manifestation after physical exertion.

Patient 1

A 35-year-old man was admitted to Clinic of Cardiology at University Hospital in an extremely severe state conditioned by loss of consciousness and cardiogenic shock. The patient was transferred to the hospital from gym hall, where he suddenly developed retrosternal chest pain, excessive sweating, and severe breathlessness. Ventricular fibrillation and asystole were recorded in the Emergency Department of University Hospital. Cardiopulmonary resuscitation was successful with restoration of sinus rhythm. The patient was placed on mechanical ventilation following the return of spontaneous circulation 1 h after the successful cardiopulmonary resuscitation. An electrocardiogram recorded after the restoration of sinus rhythm revealed ST-segment elevation in leads I, aVL, and V2–V4 (*Figure 1*). Subsequently urgent

Figure 1 (A) 3 mm ST-segment elevation in leads V2–V5, 1 mm ST elevation in leads I, aVL, and reciprocal ST depression in leads II, III, and aVF. (B) T-wave inversion in V2–V5 leads.



coronary angiography was performed for evaluation of the cause of cardiac arrest and revealed 90% stenosis, dissection, and subtotal thrombosis of the proximal portion of the left anterior descending artery (LAD) and 70% stenosis of middle portion of LAD (*Figure 2*). Two everolimus-eluting stents (3.0 × 28 and 2.75 × 23 mm, Xience Prime) were successfully deployed at the culprit sites. After the procedure, the patient was transferred to the intensive cardiac care unit (ICCU).

On echocardiography, septoapical and apicolateral segments were akinetic, and left ventricular ejection fraction (EF) was estimated 25–30%. Admission blood tests demonstrated high level of cardiac troponin 3.64 ng/mL (normal $<$0.014 ng/mL). Blood tests showed biological inflammatory syndrome: leucocytes 20.6 × 10^9 L (normal 4–10 × 10^9/L), C-reactive protein 21.8 mg/dL (normal $<$0.5 mg/dL), and fibrinogen 9.0 g/L (normal 2–4 g/L). Respiratory acidosis was present (pH 7.09) at admission. Although the patient had no symptoms of COVID-19 viral infection, a nasopharyngeal swab was performed as a regular hospital standard operation procedure. Polymerase chain reaction (PCR) test for COVID 19 was negative. However, antibody test revealed high level of only SARS-CoV-2 immunoglobulin M (2.044 AU/mL), which provides strong evidence of recent infection.[9] Chest computed tomography (CT) scan showed bilateral areas of ground-glass interstitial opacities in all pulmonary lobes on both sides (*Figure 3*). Despite the positive immunoglobulin M test, detailed history taken after extubation of the patient did not reveal any acute respiratory disease symptoms before STEMI.

Management

The coronary obstructions were successfully recanalized by deployment of two everolimus-eluting stents. The condition of the patient was significantly improved after successful angioplasty. Initially, the patient was hypoxic; oxygen saturation was 85% with 4–6 L/min oxygen supply. Patient's initial treatment included aspirin, clopidogrel, heparin, high-dose atorvastatin, metoprolol with additional amiodaron, and inotrope support with dopamine, which was interrupted after 4 days, when haemodynamic state improved.

Taking into consideration positive immunoglobulin M test and typical radiological pattern for COVID-19 pneumonia, decision to manage of patient as having a recent coronavirus disease, complicated by pneumonia and STEMI, was made.

In addition to the treatment of myocardial infarction, intravenous dexamethasone at 8 mg daily dose, umifenovir,

Figure 2 (A) Baseline coronary angiogram showing severe stenosis of proximal and distal portions of left descending coronary artery. (B) Coronary angiogram after angioplasty.

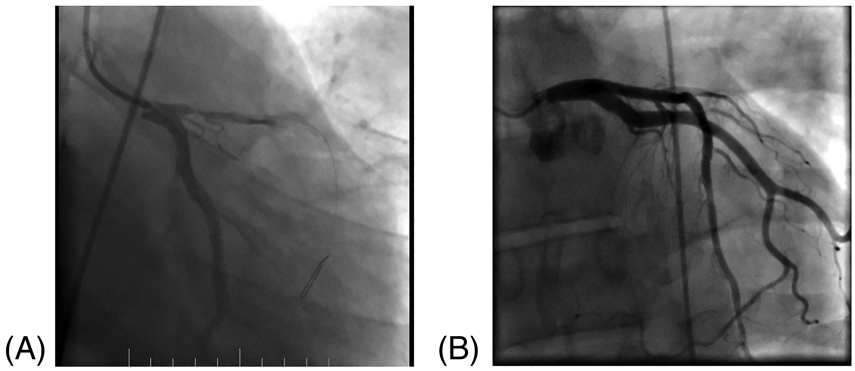


Figure 3 Computed tomography images. Computed tomography on the day of admission (A) and Day 8 of hospitalization (B). (A) Bilateral areas of ground-glass interstitial opacities at both sides of lung lobes. (B) Absorption phase.

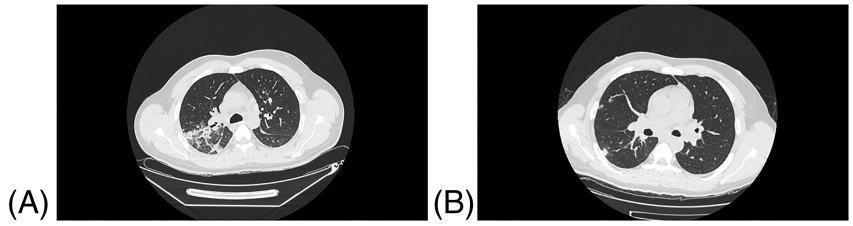
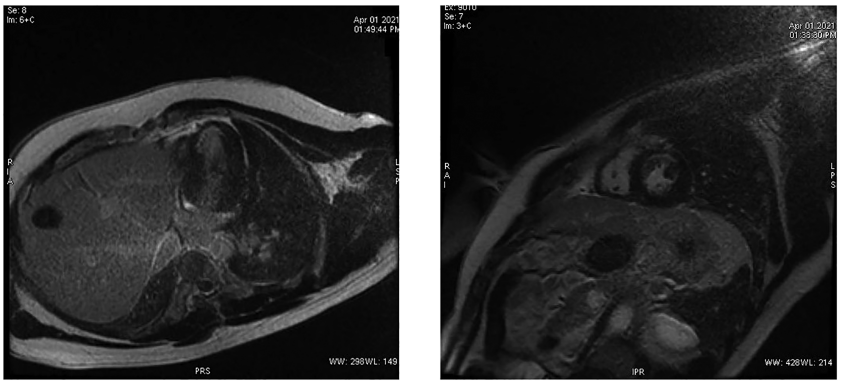


Figure 4 Cardiac magnetic resonance imaging: late gadolinium enhancement in left ventricular septoapical and anteroapical segments.



and zinc were administered. Moxifloxacin was prescribed later for the prevention of secondary in-hospital pneumonia.

Extubation was performed after 24 h of the treatment. On Day 7 of admission, the consciousness and mental state of the patient were completely restored.

Second CT, performed on Day 8 of hospitalization, revealed a radiological pattern of pneumonia in the absorption phase. Before discharge, the left ventricular EF was estimated 25% with left ventricular apical aneurysm. The patient was discharged on the 12th day with complete neurological recovery and stable cardiovascular state. After 8 weeks, cardiac magnetic resonance imaging revealed septoapical and anteroapical aneurysm with segmental dilation and EF of 52% (*Figure 4*).

Treadmill stress test with modified Bruce protocol, performed after 8 weeks, revealed high tolerance to physical

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exertion, without any ischaemic electrocardiogram changes and symptoms.

Patient 2

A 33-year-old man developed severe persistent retrosternal chest pain radiating to both arms during training in a gym hall. The complaints were accompanied by nausea, vomiting, and excessive sweating. The patient had a history of transient ischaemic attack 3 years ago. No remarkable abnormalities of neurological status were found on admission. Electrocardiogram performed on arrival showed 3 mm ST-segment elevation in anterolateral leads with reciprocal changes in the inferior leads (*Figure 5*). Echocardiography performed in the ICCU revealed hypokinesis of septoapical, midseptal, basal–septal, and apicolateral segments of the left ventricle; left ventricular EF was estimated 30–35%. Urgent coronary angiography within 1 h from hospital admission revealed total occlusion of the proximal portion of LAD (*Figure 6*). Drug-eluting stent (Xience Prime, 3.0 × 18 mm) was deployed at the culprit site. The patient was transferred to the ICCU. Three hours later, the patient experienced sustained ventricular tachycardia and loss of consciousness, absence of palpable carotid pulse, and spontaneous respiration with ventricular fibrillation detected on monitor. Subsequent resuscitation was successful with restoration of spontaneous circulation and sinus rhythm.

After the angioplasty, PCR performed on a nasopharyngeal swab was performed and showed a positive COVID-19 result. Blood tests showed leucocytosis (19.66×10^9 L), high level of C-reactive protein 4.956 mg/dL (normal $<$0.5 mg/dL), and fibrinogen 5.45 g/L (normal 2–5 g/L). High-sensitivity cardiac troponin was 7.1 ng/mL (normal $<$0.014 ng/mL).

Chest CT scan revealed widespread bilateral areas of ground-glass lesions and subpleural consolidations (*Figure 7*); 24 h Holter monitoring was performed before discharge to detect ventricular activity, which revealed only non-frequent supraventricular activity. Cardiac magnetic resonance imaging performed before the discharge showed left ventricular apical aneurysm and late gadolinium enhance-

Figure 5 Electrocardiogram performed on arrival: 3 mm ST-segment elevation in anterolateral leads with reciprocal changes in the inferior leads.

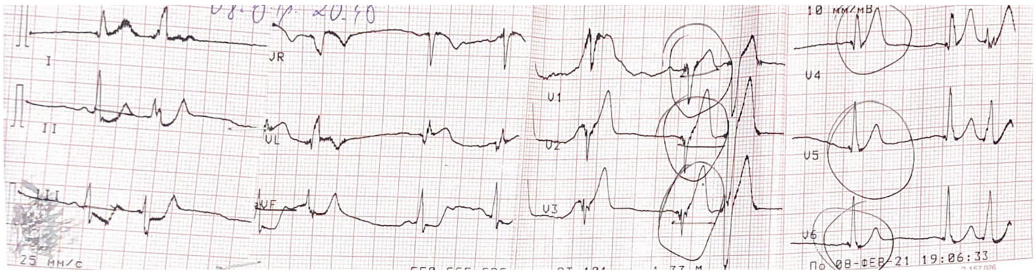


Figure 6 (A) Baseline coronary angiogram showing total occlusion of the proximal portion of the left anterior descending artery. (B) Coronary angiogram after angioplasty.

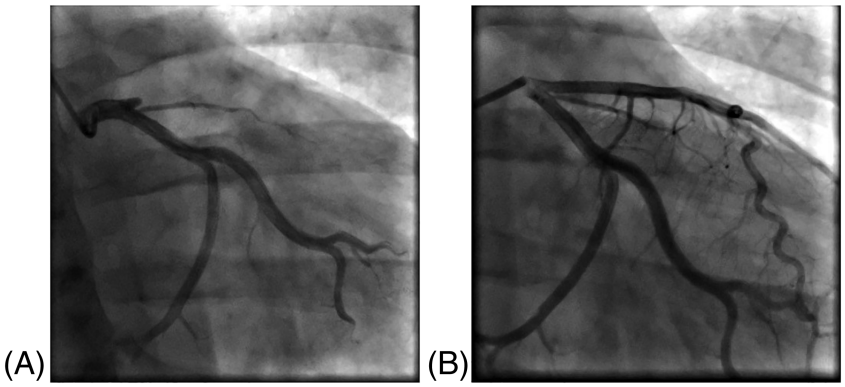


Figure 7 Computed tomography images. (A) Computed tomography on the day of admission. (B) Bilateral areas of ground-glass interstitial opacities in all lobes.

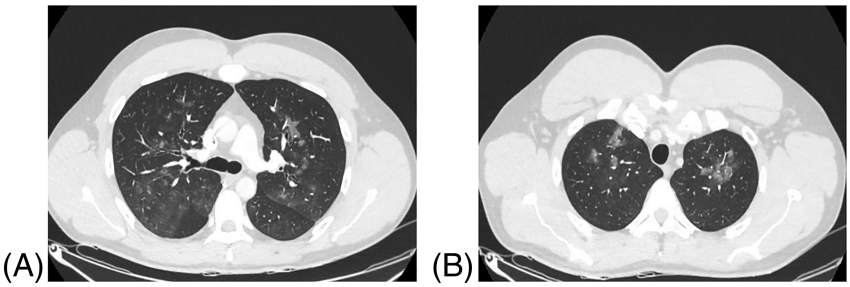
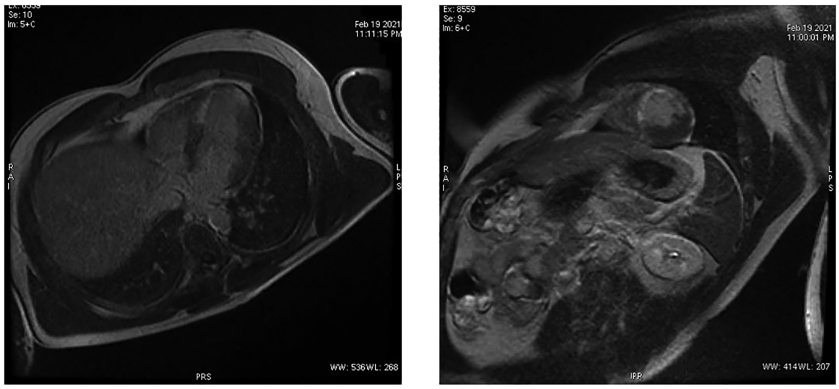


Figure 8 Magnetic resonance imaging images. Late gadolinium enhancement in left ventricular anteroapical, septoapical, midseptal, and basal–septal segments.



ment in left ventricular anteroapical, septoapical, midseptal, and basal–septal segments, and EF was estimated 42% (*Figure 8*).

Management

In addition to guideline-based pharmacological therapy of myocardial infarction, amiodaron and inotrope therapy with dopamine was administered for haemodynamic support. Dopamine was stopped on the third day, after stabilization of blood pressure. Patient was transferred to COVID-19 specialized clinic (St Gregory Illuminator Hospital) after confirmation of positive PCR test at stable haemodynamic state according to the local healthcare regulatory protocols. Additional COVID-19 treatment, including dexamethasone 12 mg daily and ceftriaxone 2.0 mg daily doses, was provided. PCR test was repeated after 15 days and came back negative.

Follow-up visits to our outpatient unit after 8 weeks and 6 months from discharge showed stable condition without any symptoms of angina, heart failure and improved EF 34% by echocardiography.

Discussion

We present two similar cases of young patients who developed STEMI without initial clinical manifestation of COVID-19 infection. Although PCR test result of the first patient was negative, our follow-up study of immunoglobulin M confirmed presence of recent asymptomatic COVID-19 infection.[9] To our knowledge, there are no reports of STEMI with type 1 myocardial infarction in young adults initially with asymptomatic COVID-19 infection, successfully treated by urgent invasive approach. In case series report of Bangalore *et al.*, STEMI patients with COVID-19 infection had heterogeneous clinical and angiographic presentations.[10] Most of presented patients had co-morbidities, such as arterial hypertension and diabetes mellitus, and mean age of patients was 63 years old.[10] Angiographic patterns in such patients may be presented by both obstructive coronary artery and frequently angiographically normal epicardial coronary arteries.[8] In ~40% of patients with COVID-19 with STEMI, a culprit lesion was not identifiable by coronary angiography.[8,11] This fact provides further evidence that multiple heterogeneous mechanisms may be associated with more severe course of STEMI, depending on thrombus grade,

thrombotic and systemic inflammatory activity, respiratory disorders, and secondary myocardial injury. High thrombotic burden in STEMI patients infected with COVID-19,[1] documented by high incidents of multiple thrombotic culprit lesions, stent thrombosis, and higher thrombus grade, was shown by several studies.[1,3,12] Enhanced immune system hyperactivity with cytokine storm may contribute to myocardial infarction clinical severity as well.[3] Apart from this, expressed left ventricular remodelling with low EF was found in such patients.

Absence of clinical criteria and respiratory symptoms for suspected COVID-19 at initial admission in our two cases may mask the presence of viral infection and increased risk of such patients despite appropriate treatment. This provides necessity of early assessment of COVID-19 infection in all STEMI patients.[10]

Preferred initial mode of reperfusion is still an issue of further debates, taking into consideration severity of inflammatory reaction and presence of respiratory failure.[13]

A recent document from the American College of Cardiology's Interventional Council and the Society of Cardiovascular Angiography and Intervention recommends weighing carefully the balance between healthcare provider exposure and patient benefit.[11] The risk of complications in STEMI and COVID-19 increases with age and co-morbidities.[14–15] However, in both clinical cases presented by us, patients were young and only one of them had history of previous stroke. Successful outcomes of these two critical patients to our opinion were conditioned by urgent primary percutaneous coronary intervention with further multidisciplinary treatment approach. These two similar cases also highlight the importance of COVID-19 diagnostic testing despite asymptomatic course of infection at initial admission to prevent disease transmission in hospital.

Conclusion

COVID-19 infection may manifest with STEMI and critical cardiovascular state even in young persons. In patients with STEMI and concomitant COVID-19 infection, there is a strong evidence of more severe clinical course of cardiac manifestations and subsequent myocardial remodelling, despite of young age and absence of co-morbidities. Regardless of age and clinical manifestation of COVID-19, these two cases support the need for determining COVID-19 status in all STEMI patients during this pandemic. Further studies are required to clarify the multiple mechanisms responsible for myocardial infarction in patients with COVID-19 infection and establish acute and long-term optimal therapy.

Learning points

i We present two unusual cases of young patients with COVID-19 infection who developed STEMI after physical activity with severe haemodynamic compromise and unstable prolonged clinical course.
ii STEMI patients with COVID-19 infection may be presented with significantly higher rates of acute heart failure despite of young age and absence of clinical symptoms of infection and co-morbidities.
iii In critical cardiovascular states of STEMI and COVID-19 resulting cardiogenic shock and ventricular fibrillation, the urgent primary percutaneous coronary intervention with further complex treatment is an effective strategy.
iv Asymptomatic patients with acute coronary syndrome may contribute to disease transmission, which suggests the need of testing of all admitted patients at pandemic periods.

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Conflict of interest

None declared.

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