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CASE REPORT

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Acute myocardial infarction immediately after second vaccination for coronavirus disease 2019

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Abstract

We present a serious and rare case of acute myocardial infarction soon after the administration of second vaccination for coronavirus disease 2019. Patient's culprit lesion in the right coronary artery was identified and appropriately treated using intravascular imaging. Postvaccination monitoring of patients who are at high risk of cardiovascular diseases is critical.

Rare but severe cases of acute myocardial infarction following vaccination for coronavirus disease 2019 have been reported. Physicians should consider this rare side effect as a possible differential diagnosis and appropriately manage such patients.

KEYWORDS

acute myocardial infarction, COVID-19 vaccination, optical coherence tomography, thrombus, vasa vasorum

1 | INTRODUCTION

The current outbreak of the coronavirus disease 2019 (COVID-19) has caused many severe cases of pneumonia and several kinds of complications including cardiovascular events.[1] A messenger RNA (mRNA) vaccine against COVID-19 has been in use since December 2020.[2] This vaccine prevents future infection by producing neutralizing antibodies against the SARS-COV-2 virus and has been reported to cause adverse events, including cardiovascular ones. Cardiac injury and thrombosis may be related to the systemic inflammatory response to this vaccine[3]; however, the underlying mechanisms remain unclear. Herein, we report a rare case of acute myocardial infarction shortly after the administration of COVID-19 vaccination.

2 | CASE HISTORY/EXAMINATION

A 70-year-old female patient with a history of hypertension, dyslipidemia, and diabetes mellitus presented to our emergency care center with nausea and chest pain 15 min after the administration of second dose of the Pfizer–BioNTech COVID-19 vaccine (Table 1). The patient reported no previous episodes of chest pain, dyspnea, or palpitation. Physical examination revealed peripheral cyanosis and the following vital signs: heart rate, 57 beats/min; blood pressure, 84/67 mmHg; respiratory rate, 22 breaths/min; oxygen saturation, 97% in room air; and temperature, 35.6°C. Lung and cardiac auscultation findings were normal.

TABLE 1 Clinical timeline of our case

Date	Events
First COVID-19 vaccination	−21 days
Second COVID-19 vaccination	−2 h
Symptom onset	−1 h 45 min
Triage	0 h
Recanalization	1 h
Follow-up catheterization	1 day
Percutaneous coronary intervention on LAD lesion	4 days
Discharge	13 days
No symptoms related to cardiovascular disease	6 months

Abbreviation: LAD, left anterior descending.

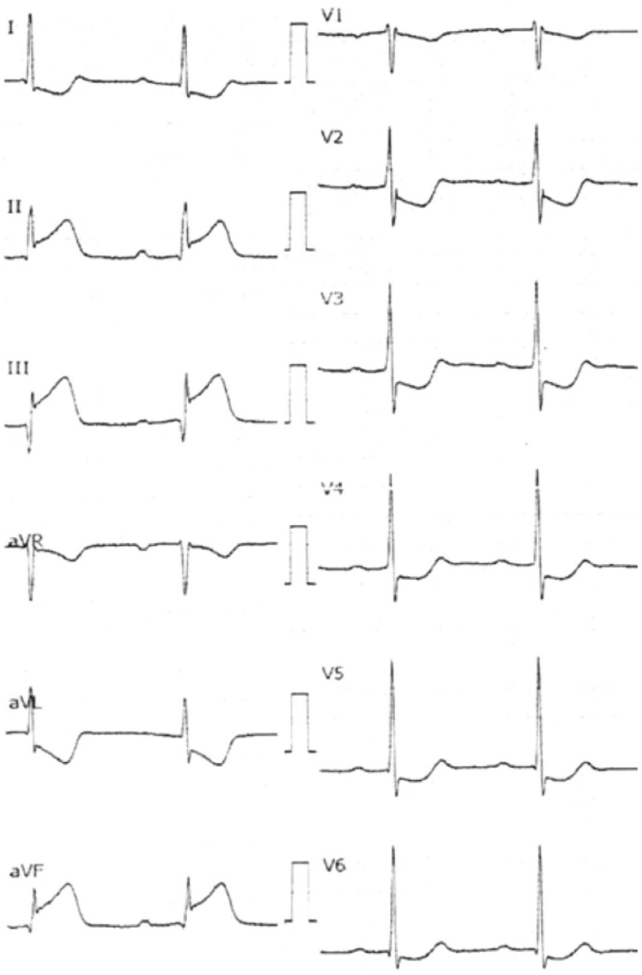

FIGURE 1 Electrocardiography shows ST-segment elevation in II, III, and aVF and a first-degree atrioventricular block.

2.1 | Differential diagnosis, investigation, and treatment

An initial electrocardiogram (Figure 1) showed ST-segment elevation in II, III, and aVF and a first-degree atrioventricular block. Transthoracic echocardiograms showed inferior wall hypokinesia. Chest radiography revealed clear bilateral lung fields. Her cardiac enzymes including inflammatory markers (white blood cell count and C-reactive protein level) were still normal, showing no acceleration of blood coagulation (D-dimer and fibrinogen).

An urgent catheter examination (Figure 2) showed total occlusion in the right coronary artery (RCA) #3 and 90% stenosis in the left anterior descending artery (LAD) #7. After catheterization, percutaneous coronary intervention was performed on the RCA lesion. A red thrombus was obtained by thrombectomy, and the occlusion was released. A new distal occlusion was found in the fourth posterolateral branch artery (#4PL) and posterior descending artery (#4PD) of the RCA (Figure 3) with residual ST-segment elevation in II, III, and aVF. Intravascular ultrasonography (IVUS) did not identify any obvious plaque rupture, whereas continuous diffuse plaques and some unstable lesions were observed (Figure 3). TIMI III blood flow was obtained, and there were large amount of blood clots and distal embolization. Therefore, we did not place a stent, but instead placed intra-aortic balloon pumping (IABP) and returned the patient to the ward.

The next day, optical coherence tomography (OCT) was performed to evaluate the unstable vessel. On coronary angiography, the #4PD/PL thrombus had disappeared (Figure 4). Thrombus and vasa vasorum in the plaque layer (Figure 4) were observed by OCT, indicating an unstable lesion. Therefore, we implanted a drug-eluting stent in the lesion where the vasa vasorum were present. IABP was discontinued after the intervention. During hospitalization, the LAD lesion was treated using percutaneous coronary intervention. The patient was on medications, including high-dose statins, for the treatment of myocardial infarction and was recovering well; she was discharged on day 13 following the Japanese Circulation Society guideline. The thrombus contained atheroma with cholesterol crystals and foam cells (Figure 5).

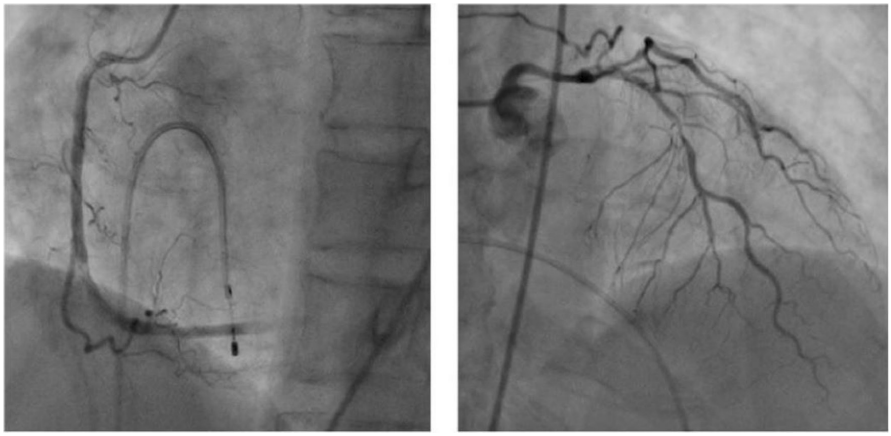

FIGURE 2 Urgent catheter examination shows total occlusion in the right coronary artery (RCA) #3 and 90% stenosis in the left anterior descending (LAD) artery #7.

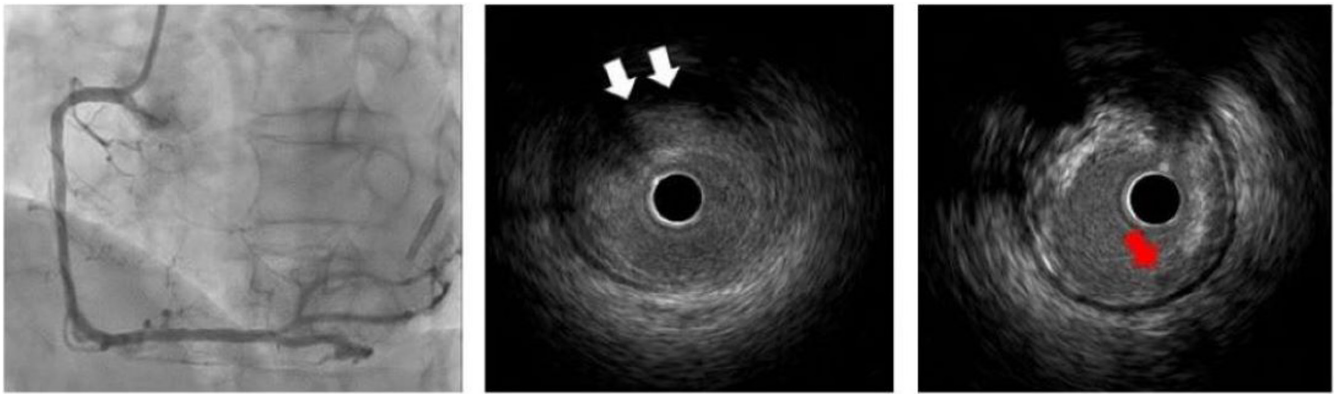

FIGURE 3 Distal occlusion in the RCA the fourth posterolateral branch artery (#4PL) and posterior descending artery (#4PD) was newly found after thrombectomy. Intravascular ultrasound likely shows thick plaques (white arrows) and thin fibrous capsules on lipid pool plaques (red arrows).

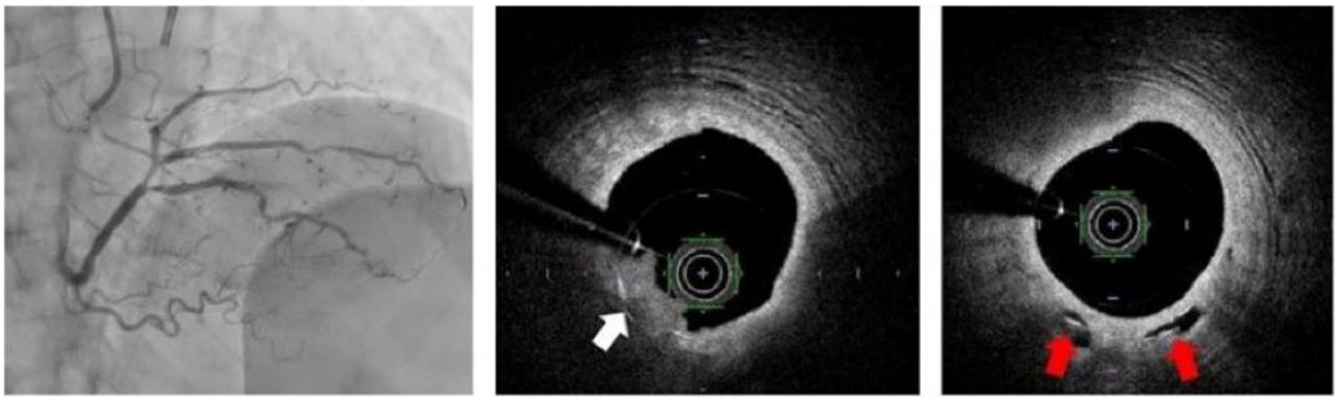

FIGURE 4 Follow-up coronary angiography is normal, including RCA #4PD/PL findings. Optical coherence tomography shows white thrombus (white arrow) and a large vasa vasorum in the plaque layer near the thrombus (red arrows).

2.2 | Outcome and follow-up

At 6-month postdischarge follow-up, the patient reported that she experienced no symptoms related to cardiovascular disease and no adverse or unanticipated events due to her medication.

3 | DISCUSSION

Centers for Disease Control and Prevention has reported various kinds of diseases as side effects following COVID-19 vaccination; anaphylaxis, Guillain–Barré syndrome, thrombosis with thrombocytopenia syndrome,

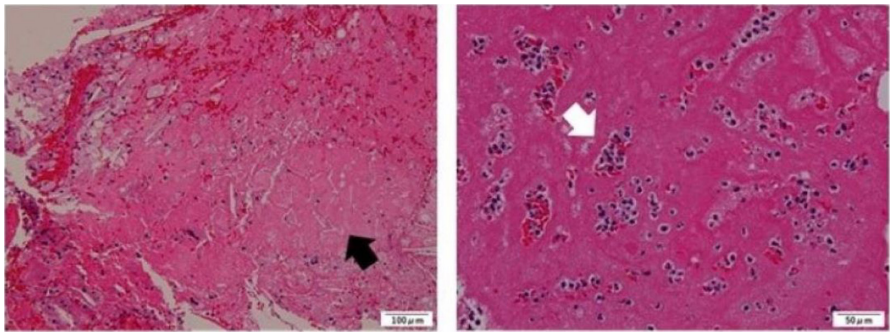

FIGURE 5 Thrombus contains atheroma rich in cholesterin crystal (black arrow) and foam cells (white arrow).

TABLE 2 Acute myocardial infarction cases that occurred within 2 h after vaccination administration

Patients	Age/sex	Coronary risks	Vaccine	Onset after vaccination	Culprit lesion
Maadarani et al.[4]	62/W	HT, DM, DL	AZD1222	1.5 h	RCA
Tajstra et al.[5]	86/M	Not listed	Pfizer–BioNTech	30 min	RCA/LAD/LCx
Boivin et al.[6]	96/W	HT	Moderna	1 h	ST elevation in inferior leads
Our case	70/W	HT, DM, DL	Pfizer–BioNTech	15 min	RCA

Abbreviations: DL, dyslipidemia; DM, diabetes mellitus; HT, hypertension; LAD, left anterior descending; LCx, left circumflex artery; M, man; RCA, right coronary artery; W, woman.

and myopericarditis, as of April 2022 (https://www.cdc.gov/). Acute coronary syndrome (ACS), as in our case, though rare, but has also been reported. However, it is still unclear how the vaccination can be associated with ACS[4–6]; coronary embolism due to severe inflammation induced by the vaccine, or coronary thrombosis mainly caused by plaque rupture.

Coronary embolism is a rare disease and is difficult to distinguish from coronary thrombosis. It has been reported to be caused occasionally in patients with arrhythmia and valvular disease.[7] Moreover, inflammatory hypercoagulation is known as a mechanism of coronary embolism.[8] It is often diagnosed by relating these conditions to embolism and by features such as fewer atherosclerosis lesions on specific angiographic images.[8] A typical thrombus is found to be platelet and fibrin rich on pathological examination.[8]

This patient had an atypical clinical history, leading to myocardial infarction shortly after vaccination. Therefore, we considered that the onset might be related to the vaccine. It was difficult to find the culprit lesion even using IVUS and OCT. However, we suspected myocardial infarction caused by plaque rupture, rather than by emboli, from the results of the pathological examination of the collected thrombus, which contained atheroma rich in cholesterin crystals and foam cells.

The vasa vasorum are small vessels that provide blood to the walls of arteries and veins. It is known that atherosclerosis facilitates the growth of vulnerable plaques and promotes neovascularization of the vasa vasorum, which predisposes plaques to rupture.[9] Treatment with a low dose of statin has little effect on the vasa vasorum, and a high dose is often needed.[10] Other medications for this condition are not known to date.

Through OCT, we discovered a rare large vasa vasorum in a thick plaque, indicating that it was unstable. These findings support the theory that plaque rupture led to the patient's ACS. Therefore, angioplasty was performed and high-dose statins were administered for these lesions.

Only three acute myocardial infarction cases have been reported to occur within 2 h after vaccination[4–6] (Table 2). Patients in all three cases had RCA lesions; this finding was similar to that in the present case report. Kounis syndrome has been reported to occur after the vaccination.[11] Around 70% of patients with Kounis syndrome show ST elevation in inferior leads on electrocardiography[12]; the reason for high probability of RCA lesion remains unknown. These myocardinal infarction cases had no allergic symptoms like rash; however, it might be suggested that the pathogenesis of acute myocardial infarct immediately after vaccination is similar to Kounis syndrome. The patient in the present case was at a high risk of ACS. We predicted that stress or an allergic reaction caused by the vaccination might have led to elevated blood pressure and vasoconstriction, which affected the vulnerable plaque and caused plaque rupture.

4 | CONCLUSION

The case we encountered is extremely rare in the following respects: ACS occurred immediately after vaccination,

the collected thrombus was evaluated pathologically and it showed large vasa vasorum, and the unknown etiology of ACS following COVID-19 vaccine was clarified to some extent. Individuals at high risk of cardiovascular disease should be carefully monitored after vaccination. Furthermore, intravascular imaging and pathological examination of the thrombus are effective for evaluating coronary lesions and clarifying the pathogenesis of ACS.

AUTHOR CONTRIBUTIONS

Atsumasa Kurozumi: directly involved in patient care. Undertook or interpreted patient investigation, and drafted the article and revised it critically for important intellectual content. Hisao Hara: drafted the article and revised it critically for important intellectual content. Ran Nagai: directly involved in patient care. Undertook or interpreted patient investigation. Yukio Hiroi: drafted the article and revised it critically for important intellectual content.

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None.

CONFLICT OF INTEREST

None.

DATA AVAILABILITY STATEMENT

Data supporting the findings of this study are available within the article. Raw data that support the findings of this study are available from the corresponding author, upon reasonable request.

CONSENT

Informed written consent was taken from the patient for publishing this report.

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