Circulation: Cardiovascular Imaging

CARDIOVASCULAR IMAGES

Reverse Takotsubo Cardiomyopathy as a Cause of Acute Chest Pain in a Young Woman Following COVID-19 Vaccination

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A healthy 30-year-old Asian woman was brought to the emergency room with sudden chest pain and cold sweat. She received the second mRNA COVID-19 vaccine shot (Pfizer, New York City) 2 days prior. The patient reported general fatigue after vaccination. ECG showed ST-segment depression on the V4-V6 leads (Figure S1A). Transthoracic Doppler echocardiography revealed akinesis at the basal portion of the left ventricle (LV) and hypercontraction at the apex (Video S1). The blood cardiac biomarkers were elevated (creatine kinase [CK], 284 IU/L, CK-MB, 18 IU/L, and cTnI [cardiac troponin I], 1008.7 pg/mL). The polymerase chain reaction test for COVID-19 was negative. Coronary computed tomography angiography showed no significant stenosis in epicardial coronary arteries or aortic dissection (Figure S1B). Furthermore, coronary computed tomography angiography depicted akinesis at the basal portion of the LV, as visualized using transthoracic Doppler echocardiography (Figure 1A and 1B, and Video S2). These findings supported our diagnosis of reverse Takotsubo cardiomyopathy (rTCM). Emergent coronary angiography confirmed no significant stenosis of the epicardial coronary arteries, while left ventriculography revealed akinesis at the basal LV and hypercontraction at the LV apex (Figure 1C and 1D and Video S3), supporting our diagnosis of rTCM. The patient experienced chest pain for several hours even after intravenous morphine, resulting in elevation of cardiac biomarkers (cTnI, 20116.6 pg/L; CK, 1297 IU/L; and CK-MB, 126 IU/L on day 2). The follow-up ECG showed QT prolongation with large positive T wave on V3-V6 leads (Figure S2). On day 3, coronary flow reserve was assessed with transthoracic Doppler echocardiography and demonstrated preserved microvascular function (mean coronary flow reserve of 3.0). Cardiac magnetic resonance images indicated delayed enhancement of the LV with basal akinesis (Figure 2A and 2B and Video S4). Additional ^{123}I-MIBG (metaiodobenzylguanidine) myocardial scintigraphy demonstrated decreased accumulation of ^{123}I-MIBG at the basal LV (day 8, Figure 3), which is compatible with LV wall motion abnormality of rTCM. The patient was managed without medical therapies, such as β-blockers or angiotensin-converting enzyme inhibitors, and discharged without any complications. The LV contraction had returned to normal range during follow-up transthoracic Doppler echocardiography examination (day 15, Video S5).

TCM is a cardiomyopathy induced by physical and emotional stress that can clinically mimic acute coronary syndrome[1,2] and myocardial infarction with nonobstructive coronary arteries. Typical TCM is characterized by an apical akinesis or hypokinesis and basal hyperkinesis of the LV that is reversible within a few weeks. rTCM is a rare variant of the TCM phenotypes (2.2%) presenting with apical hypercontraction instead of basal hypercontraction.[1] In our case, we evaluated rTCM with multiple imaging modalities. Coronary computed tomography angiography was useful for excluding obstructive coronary artery disease or aortic diseases and enabled the assessment of specific LV wall motion abnormalities. Cardiac magnetic resonance is a useful imaging technique

Key Words: chest pain ■ coronary angiography ■ COVID-19 pandemics ■ magnetic resonance imaging ■ single-photon emission-computed tomography ■ Takotsubo cardiomyopathy ■ vaccination

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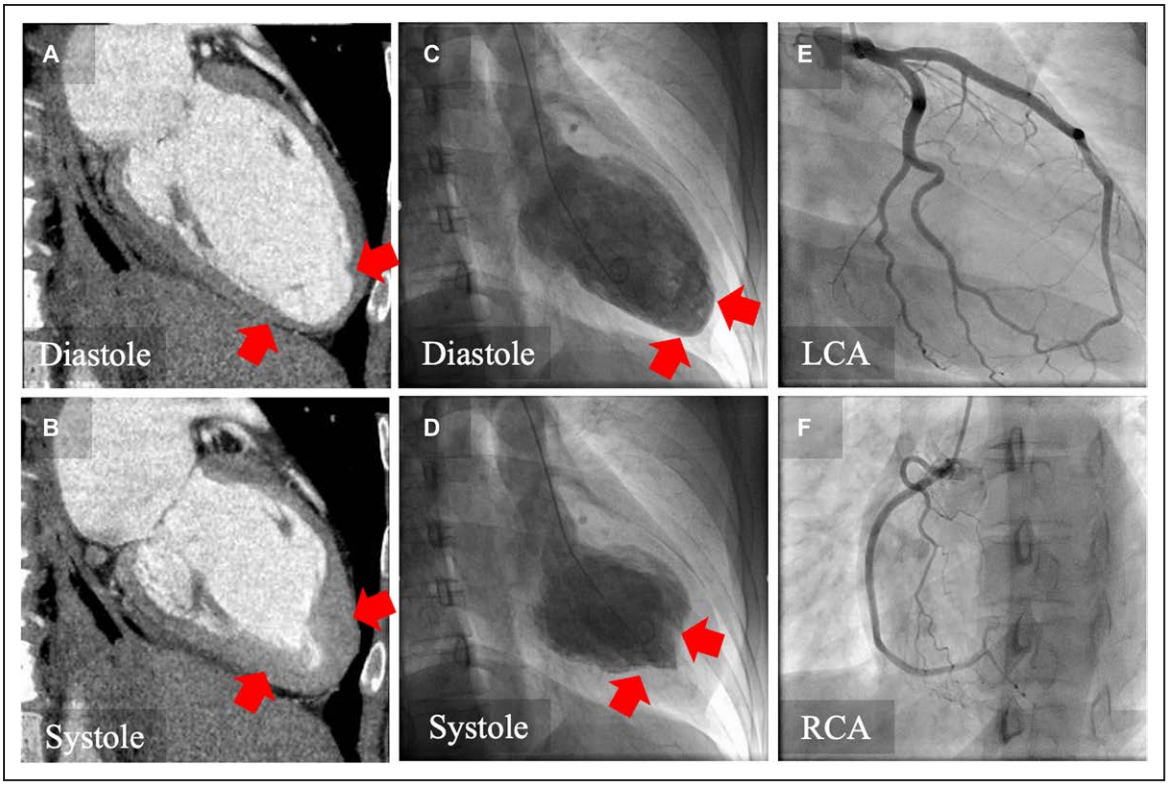

Figure 1. Computed tomography angiography (CTA) images, left ventriculography, and emergent coronary angiogram. Coronary CTA reconstruction images of the left ventricle (LV) during cardiac diastolic (**A**) and systolic phases (**B**). Coronary CTA images clearly depict basal akinesis and apical hypercontraction of the LV (**A** and **B**). Left ventriculography demonstrates basal akinesis and apical hypercontraction of the LV instead of apical ballooning (**C** and **D**, red arrows). Coronary angiogram shows no significant stenosis of the epicardial coronary arteries (**E** and **F**). LCA indicates left coronary artery; and RCA, right coronary artery.

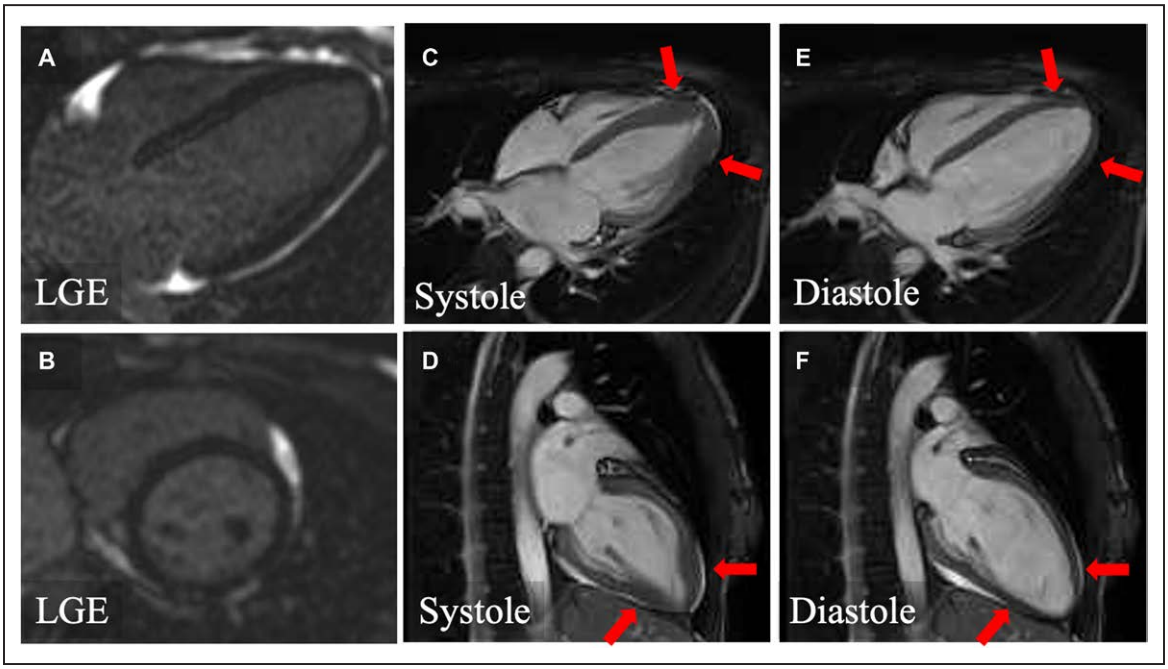

Figure 2. Cardiac magnetic resonance (CMR) images with or without late gadolinium enhancement (LGE). CMR performed on day 3 illustrates delayed enhancement of the left ventricle (LV) mid-wall (**A** and **B**). LGE illustrates the minor amounts of mid-wall LGE in the LV (**A** and **B**), which may reflect patchy myocardial fibrosis. Basal LV contraction was still impaired (**C** and **D**). Notice the akinesis of the LV basal segments as visualized during systole in the long axis (**C** and **D**). Myocardial edema was not observed in this patient.

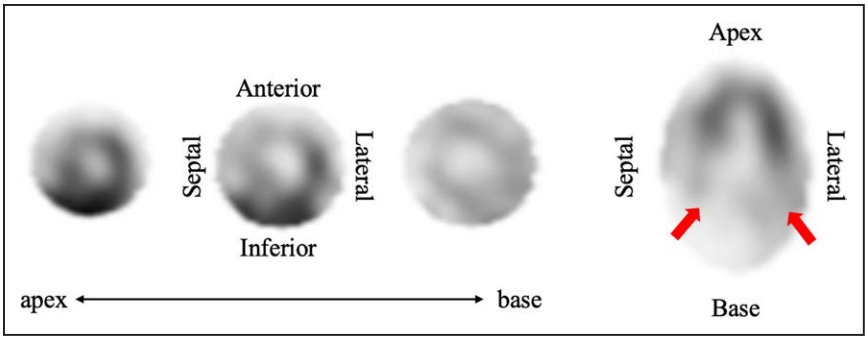

Figure 3. ^{123}I-metaiodobenzylguanidine (^{123}I-MIBG) myocardial scintigraphy. ^{123}I-MIBG myocardial scintigraphy was performed on day 8 and showed decreased accumulation of ^{123}I-MIBG in the basal left ventricle (LV). ^{123}I-MIBG was accumulated at the apex, while decreased ^{123}I-MIBG accumulation decreased at the base of the heart. These findings are consistent with those of the reverse Takotsubo cardiomyopathy.

to diagnose TCM and its variants, providing the assessment of cardiac function, visualization of regional wall motion abnormalities, and pericardial effusion.[1] It remains controversial whether minute amounts of late gadolinium enhancement, which represents fibrosis, may be present in TCM. Furthermore, T1 mapping provides the extracellular volume fraction, which is elevated in TCM indicating myocardial edema (unavailable in our case). Stress-induced catecholamine overproduction and myocardial response may be the most likely underlying mechanism of TCM. ^{123}I-MIBG uses a Single-Photon Emission-Computed Tomography tracer for a catecholamine analog to assess the presynaptic sympathetic innervation of the heart, which was confirmed in our case.[1] ^{123}I-MIBG also has the potential to assess the delayed recovery of both glucose metabolism and sympathetic innervation. These multimodality approaches can elucidate the pathophysiological mechanisms of TCM.

The disease burden of TCM has significantly risen in the era of the COVID-19 pandemic,[2,3] contributing to an increased intensive medical care. Jabri et al[3] reported that incidence of TCM during pandemic (7.8%) was significantly increased as compared with those of the prepandemic across four timelines (1.5%–1.8%). The efficacy and safety of COVID-19 vaccinations have been established to prevent pandemics. Severe side effects involving the cardiovascular system have been rarely reported.[2,4] As a result, more attention has been given to myocarditis related to COVID-19 vaccination. Although the majority of myocarditis induced by COVID-19 vaccination seems like to follow a minor course of illness,[4] the prevalence and clinical course of TCM following COVID-19 vaccinations remain largely unknown.[2] This is the first reported case of rTCM following COVID-19 vaccination in a young woman. While transthoracic Doppler echocardography, coronary angiography, and cardiac magnetic resonance are the gold-standard diagnostic tools for TCM, coronary computed tomography angiography may be useful as an alternative diagnostic tool for TCM for the differentiation of acute coronary syndrome and myocardial infarction with nonobstructive coronary arteries, especially in young women during the COVID-19 pandemic.

ARTICLE INFORMATION

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Sources of Funding

None.

Disclosures

None.

Supplemental Materials

Figures S1 and S2
Videos S1 and S5

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