Case report

Takotsubo cardiomyopathy triggered by SARS-CoV-2 infection in a critically ill patient

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SUMMARY
COVID-19 became a global pandemic in early 2020. While well known for its pulmonary manifestations, the virus also has a number of cardiac manifestations as well. Takotsubo syndrome has scarcely been reported in patients with COVID-19, but it is possible that the cytokine storm associated with the infection can trigger Takotsubo syndrome in patients with underlying risk factors for Takotsubo (emotional distress, physical distress, history of psychiatric disorders).

BACKGROUND
COVID-19, also known as severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), which originated in China in late 2019, has spread rapidly resulting in a global pandemic. The cardiovascular complications remain under investigation. Here, we present a case of Takotsubo syndrome in a patient with COVID-19 infection.

CASE PRESENTATION
History of present illness
A 52-year-old man presented to the emergency department with shortness of breath. He was altered, febrile, tachypneic and hypoxic. Lung auscultation revealed bibasilar crackles and cardiac examination was normal. Laboratory tests were significant for an elevated C-reactive protein (276 mg/L), elevated D-dimer (3.45 μg/mL) and normal troponin I (<0.015 ng/mL). In the emergency room, he underwent endotracheal intubation due to acute hypoxic respiratory failure and altered mental status, and admitted to the intensive care unit. On the evening of hospital day 2, he became haemodynamically unstable and noted to have ST segment elevations on the telemonitor.

Medical history
The patient is a nursing home resident with history of schizophrenia, diabetes mellitus and hypertension. He was recently diagnosed with SARS-CoV-2 by reverse transcription PCR of a nasopharyngeal swab at his nursing home.

INVESTIGATIONS
ECG revealed ST segment elevations in the inferior leads (II, III, aVF; figure 1). Laboratory testing demonstrated normal levels of cardiac troponin I (<0.015 ng/L; reference range (RR) <0.045 ng/L). He underwent emergent coronary angiography due to haemodynamic instability, which revealed non-obstructive coronary arteries (figure 2) and apical ballooning on ventriculography (figures 3 and 4), consistent with Takotsubo syndrome. The estimated left ventricular (LV) ejection fraction was 45%.

DIFFERENTIAL DIAGNOSIS
The differential diagnosis includes acute inferior wall infarction, pericarditis, myocarditis, vasospasm (Prinzmetal’s syndrome) and Takotsubo syndrome.

Based on the ECG changes, acute myocardial infarction was possible. The patient had ST elevations in II, III, aVF, signalling a right coronary artery infarct. Pericarditis was possible, however, less likely given the distributional pattern of ST segment elevations, rather than a diffuse pattern. The patient never had cardiac MRI; however, myocarditis was unlikely given ventriculogram findings and negative troponin. The most likely diagnosis remains Takotsubo syndrome based on the patients apical ballooning on ventriculogram and patent coronary arteries on angiography.

TREATMENT
Treatment was started with colchicine and methylprednisolone 1 mg/kg/day given elevated serum inflammatory markers: C-reactive protein (217 mg/L; RR <3 mg/L), ferritin (1427 mg/L; RR 28–365 ng/mL), erythrocyte sedimentation rate (84 mm/hour; RR 0–20) and interleukin-6 (IL-6; 67 pg/mL; RR ≤5 pg/mL). He was also started on intravenous continuous heparin infusion for anticoagulation in the setting of his elevated D-dimer (2.40 μg/mL; RR ≤0.52) and concern for SARS-CoV-2-induced thrombophilia. On day 2, tocilizumab was administered for IL-6 inhibition based on evidence of a hyperinflammatory state and likely cytokine storm. He clinically improved and on hospital day 6, he was extubated and downgraded to a medical floor.

OUTCOME AND FOLLOW-UP
He clinically improved and on hospital day 6, he underwent endotracheal extubation and downgraded to a medical floor. The patient finished 3 days of methylprednisolone (40 mg two times per day) and remains on intravenous continuous heparin infusion for anticoagulation. His oxygen requirements decreased to 2 L/min of nasal canula with oxygen saturations between 95% and 98%.
He was eventually discharged to outpatient rehabilitation without medical symptoms.

**DISCUSSION**

COVID-19, also known as SARS-CoV-2, which originated in Wuhan, China in late 2019, has spread rapidly resulting in a global pandemic. The cardiovascular manifestations and clinical outcomes of patients with COVID-19 who develop myocardial injury during hospitalisation remain under investigation. Here, we report a case of a patient who developed Takotsubo syndrome in the setting SARS-CoV-2 infection. There were no signs of cardiac injury or myocardial involvement on presentation as demonstrated by normal ECG and absence of troponin I elevation.

Takotsubo syndrome or stress cardiomyopathy is a syndrome characterised by transient regional systolic dysfunction of the LV and ECG changes that mimic acute myocardial infarction in the absence of angiographic evidence of obstructive coronary

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**Figure 1** ECG with ST segment elevations in leads II, III and aVF, suggesting inferior wall myocardial infarction.

**Figure 2** Coronary angiogram in left anterior oblique view demonstrating patent right coronary artery.

**Figure 3** Ventriculogram during left heart catheterisation with normal diastolic filling.
It is hypothesised that SARS-CoV-2 elicits an exuberant systemic immune response with a cytokine release syndrome (CRS) characterised by elevated inflammatory markers.\(^6\)\(^7\) The presence of a surge of catecholamine levels has been reported by Staedtke et al.\(^8\) Bacterial sepsis was reported to be the most frequent cause of Takotsubo syndrome; cases of Takotsubo syndrome attributed to viral infections are rare.\(^4\) Some studies have shown an elevation in catecholamine plasma levels suggesting this disorder may be caused by diffuse catecholamine-induced microvascular spasms or direct catecholamine-mediated myocyte injury.\(^5\) It is hypothesised that SARS-CoV-2 infection complicated by Takotsubo syndrome as evident by ECG findings, normal troponin I levels, non-obstructive coronary angiogram, apical ballooning on ventriculography and absence of pericarditis or myocarditis.\(^9\)

Echocardiogram could have been useful in the diagnosis of Takotsubo syndrome in our patient; however, it was not performed. Similarly, cardiac MRI would have definitively ruled out myocarditis; however, it was not performed as the patient improved and to minimise the spread of the virus by avoiding non-essential testing. Pericarditis was unlikely given normal troponin I levels and the absence of diffuse ST segment elevations on ECG. Acute coronary syndrome was ruled out as coronary artery disease or acute plaque rupture.\(^2\)

We hypothesise that CRS triggered by COVID-19 with a subsequent rise in catecholamines may play a role in the pathogenesis of Takotsubo syndrome in patients with COVID-19 infections.

Learning points

- COVID-19 remains an ongoing global health emergency with varied clinical manifestations besides primary pulmonary symptoms.
- Caregivers must remain vigilant towards cardiac manifestations of COVID-19 syndrome as these could be potentially serious and life threatening.
- Cytokine storm induced by COVID-19 infection may play a significant role in stress cardiomyopathy.

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New disease

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