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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 ng/mL; 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%.

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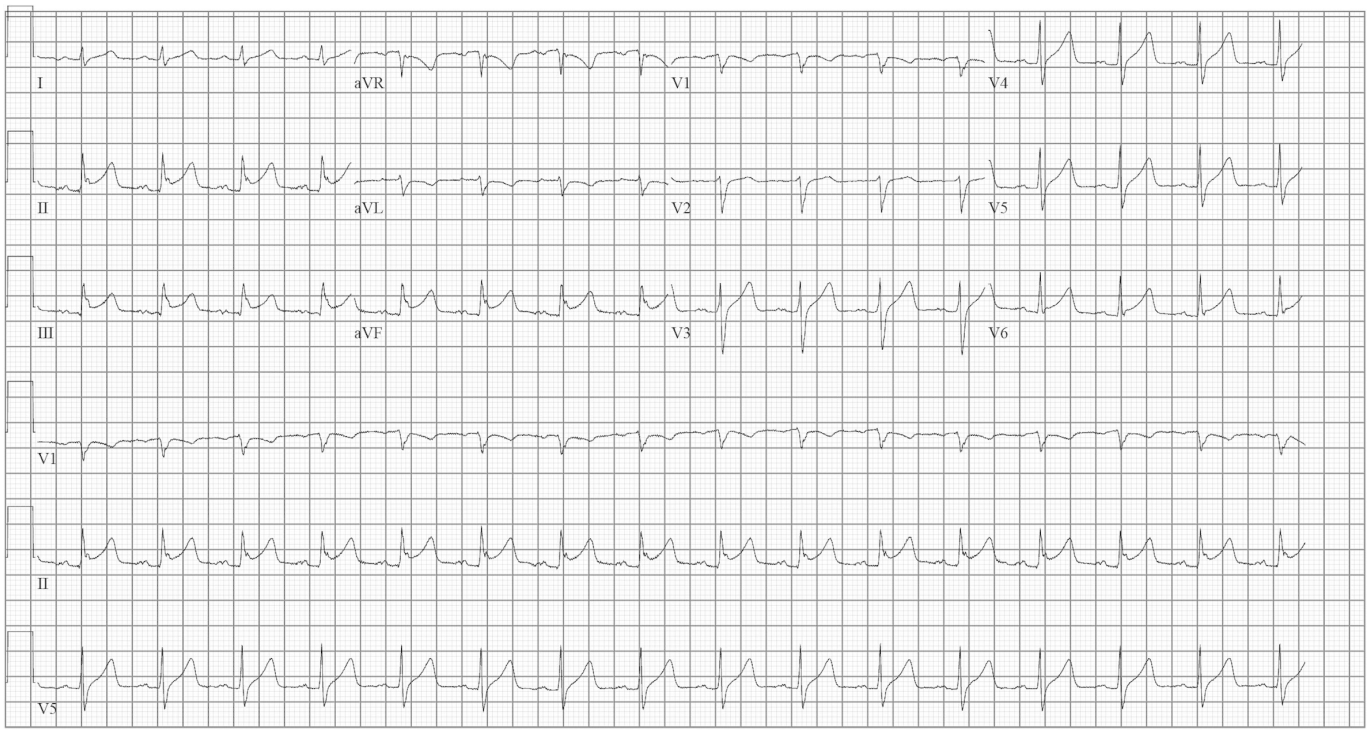

Figure 1 ECG with ST segment elevations in leads II, III and aVF, suggesting inferior wall myocardial infarction.

He was eventually discharged to outpatient rehabilitation without medical symptoms.

DISCUSSION

COVID-19, also known as SARS-CoV-2,[1] 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

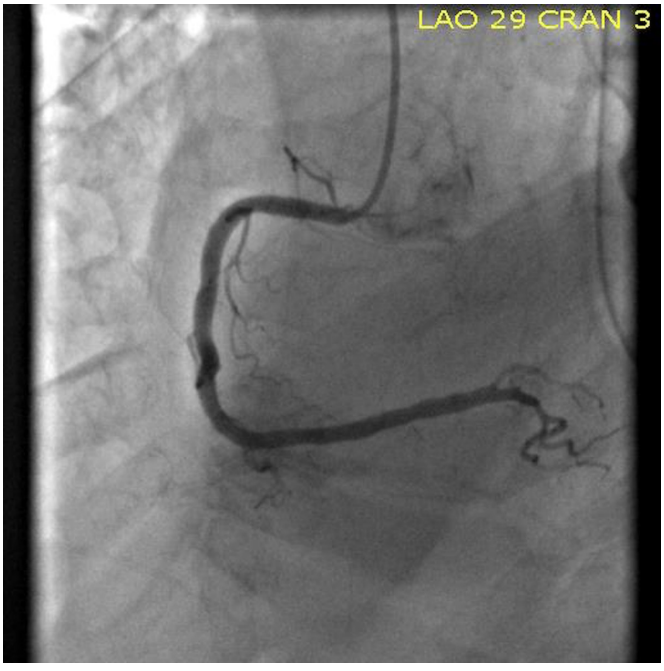

Figure 2 Coronary angiogram in left anterior oblique view demonstrating patent right coronary artery.

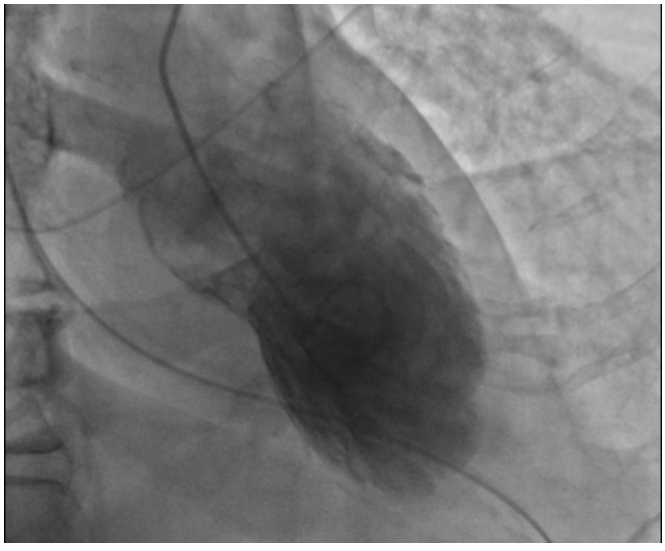

Figure 3 Ventriculogram during left heart catheterisation with normal diastolic filling.

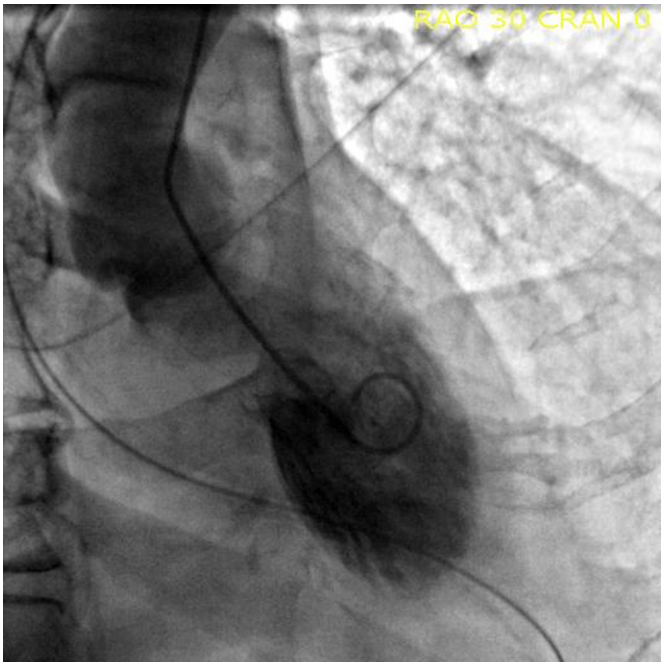

Figure 4 Ventriculogram during left heart catheterisation showing apical ballooning consistent with Takotsubo syndrome.

artery disease or acute plaque rupture.[2] There are limited data regarding precipitating factors and the pathogenesis is not well understood. Rates of neurological and psychiatric disorders were higher in patients with Takotsubo syndrome compared with patients with acute myocardial infarction in the International Takotsubo Registry Study.[3] Acute respiratory failure was found to be the most common physical trigger.[3] 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 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]; however, the details of this response are not fully explained. Our patient met the diagnostic criteria for Takotsubo syndrome as evident by ECG findings, normal troponin I levels, non-obstructive coronary angiogram, apical ballooning on ventriculography and absence of pheochromocytoma 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 angiography showed patent coronary arteries. To date, only two case reports in the literature have reported, a case of COVID-19 infection complicated by Takotsubo syndrome.[10 11] 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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REFERENCES

1 WHO. *Naming the coronavirus disease (COVID-19) and the virus that causes it*. World Health Organization, 2020.
2 Bybee KA, Kara T, Prasad A, *et al*. Systematic review: transient left ventricular apical ballooning: a syndrome that mimics ST-segment elevation myocardial infarction. *Ann Intern Med* 2004;141:858.
3 Templin C, Ghadri JR, Diekmann J, *et al*. Clinical features and outcomes of takotsubo (stress) cardiomyopathy. *N Engl J Med*.
4 Cappelletti S, Ciallella C, Aromatario M, *et al*. Takotsubo cardiomyopathy and sepsis. *Angiology* 2017;68:288–303.
5 Gianni M, Dentali F, Grandi AM, *et al*. Apical ballooning syndrome or takotsubo cardiomyopathy: a systematic review. *Eur. Heart J* 2006.
6 Huang C, Wang Y, Li X, *et al*. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. *Lancet*.
7 Mehta P, McAuley DF, Brown M, *et al*. COVID-19: consider cytokine storm syndromes and immunosuppression. *Lancet* 2020;395:1033–4.
8 Staedtke V, Bai R-Y, Kim K, *et al*. Disruption of a self-amplifying catecholamine loop reduces cytokine release syndrome. *Nature* 2018;564:273–7.
9 Scantlebury DC, Prasad A. Diagnosis of takotsubo cardiomyopathy. *Circ J* 2014.
10 Meyer P, Degrauwe S, Van DC, *et al*. Typical takotsubo syndrome triggered by SARS-CoV-2 infection. *Eur Heart J*.
11 Roca E, Lombardi C, Campana M, *et al*. Takotsubo syndrome associated with COVID-19. *Eur J Case Rep Intern Med* 2020;7:1665.