Case Report

Takotsubo Syndrome in a Critical COVID-19 Patient: Electrocardiographic and Echocardiographic Evolution

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Background

By resembling a Japanese traditional octopus trap, i.e. a takotsubo, Hikaru Sato described the first case of "Takotsubo cardiomyopathy" in a patient without coronary stenosis and end-systolic left ventricular apical ballooning on a cardiac left ventriculography.[1] Takotsubo syndrome (TTS) is a clinical syndrome characterized by an acute and transient left ventricular systolic dysfunction related to an emotional or physical stressful event.[2] COVID-19 is a recognized trigger for TTS, with the possible explanations being the enormous emotional stress caused by the pandemic and the entire spectrum of myocardial damage associated with SARS-COV-2.[3]

Case description

An 88-year-old female, fully vaccinated against COVID-19, was admitted to our hospital due to significant dyspnea and signs of inadequate perfusion. Her initial diagnosis was pneumonia due to COVID-19. She had no history of chronic illnesses.

Since her arrival, her blood pressure was 84/45mmHg, her heart rate 96, and her oxygen saturation 88%. Her 12-lead electrocardiogram showed deep T-wave inversion in leads V1-V6, DII, DIII, and aVF, as well as a QTc interval of 689ms (Figure 1A). In the laboratory analysis, troponin I was 1.67 ng/mL (reference range <0.03 ng/mL); the brain natriuretic peptide was 1,254.5 pg/mL (reference range 0-100mg/mL); and D-dimer was 1,236 ng/mL (reference range <500 ng/mL). The transthoracic echocardiogram (ECG) also showed an akinesia of the mid segments and dyskinesia of the apex and apical segments of the left ventricle (Video 1, Figure 1 C-D); left ventricular ejection fraction was 37%. An urgent coronary angiography demonstrated an absence of significant obstructive coronary artery disease (Figure 2 A-D). However, non-significant stenosis of the proximal right coronary artery, mid left-anterior descending, and distal circumflex were found (bystander non-obstructive coronary artery disease). A left ventriculography showed the characteristic apical ballooning of TTS (Video 2, Figure 2 E-F).

The patient was administered a high oxygen flow, dexamethasone, enoxaparin, and intravenous noradrenaline. In the following days, she presented a gradual worsening of her pulmonary function, but her family refused invasive mechanical ventilation. Her follow-up electrocardiogram, 5 days later, showed a nearly 50% depth reduction on T-wave inversion in leads V1-V6, as compared to her initial ECG (Figure 1B). Control ECG demonstrated hypokinesia of the mid and apical segments of the left ventricle, with a left ventricular ejection fraction of 40% (Video 3). The patient progressed to multiorgan failure and died 11 days after admission.

Discussion

The case presented in this article supports the correlation between TTS and COVID-19. An overactive immune response due to a cytokine storm, a surge in the sympathetic nervous system, and the development of micro-vascular dysfunction are the pathophysiological connections between COVID-19 and TTS.[4] QTc interval has been described to be longer in patients with TTS than in myocardial infarction and represents 1 on the InterTak diagnostic score.[2,5] Additionally, four stages of the temporal ECG evolution have been described in TTS, with stage 1 being a transient ST segment elevation, stage 2 being an initial T-wave inversion over days 1-3, stage 3 being a transient improvement of T-wave inversion on days 2-6, and stage 4 being a normalization of the T-waves noted by the second week's onset of symptoms.[6] In line with these, this patient's ECG showed a deep T-wave inversion in leads V1-V6, DII, DIII, and aVF, as well as a QTc interval of 689ms. On day 5 after the diagnosis, a nearly 50% depth reduction in the T-wave inversion in leads V1-V6 and a QTc interval of 460ms were correlated with an improvement in the mild contractility of the mid and apical segments of the left ventricle. Along with ST-segment elevation, T-wave inversions and a prolonged QTc interval, complete atrioventricular block, ventricular bigeminy, and sinus tachycardia have been described in TTS related to COVID-19.[7]

Keywords

COVID-19; Echocardiography; Takotsubo Cardiomyopathy

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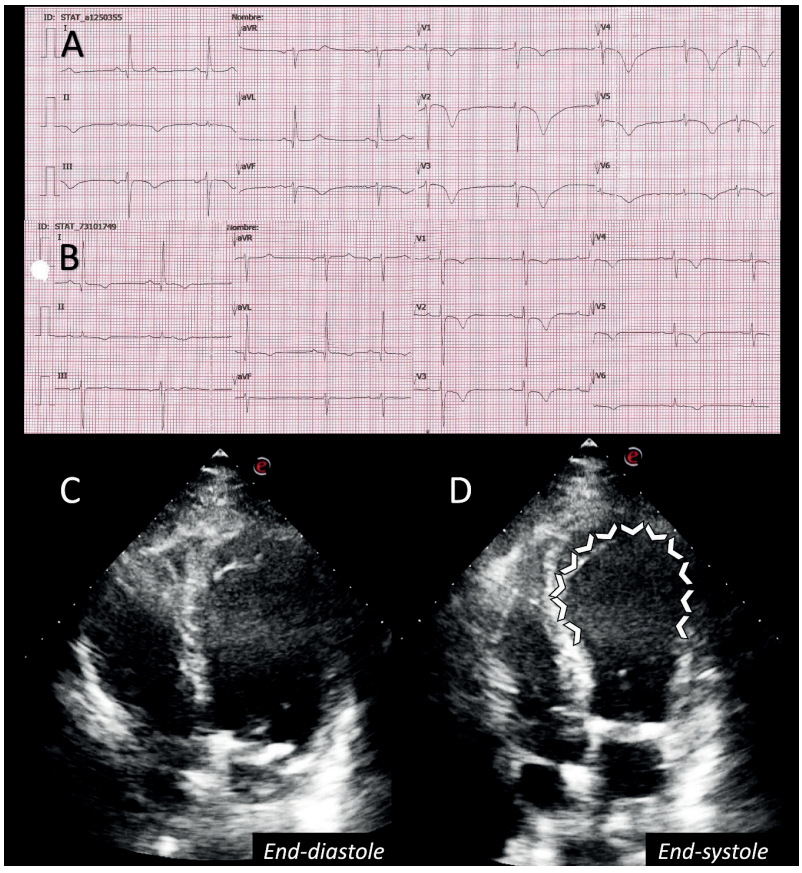
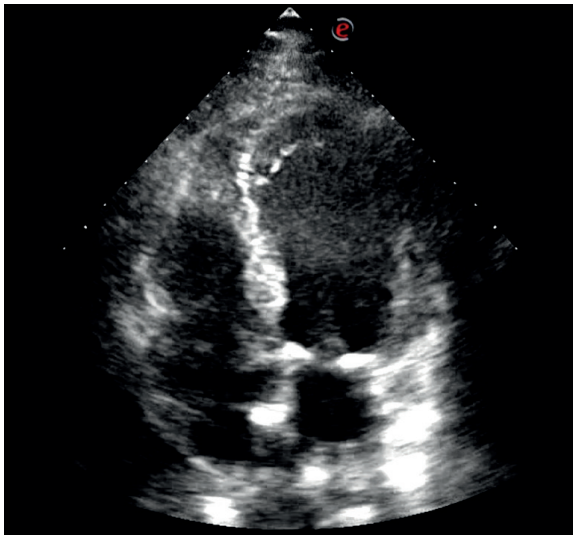


Figure 1 – *A) Initial electrocardiogram showing deep T-wave inversion in leads V1-V6, DII, DIII, and aVF, as well as a corrected QTc interval of 689ms; B) electrocardiogram after 5 days demonstrated a nearly 50% depth reduction in T-wave inversion in leads V1-V6; C) end-diastole; and D) end-systole, apical 4 chamber view demonstrating akinesia of the mid segments and dyskinesia of the apex and apical segments of the left ventricle.*



Video 1 – *http://abcimaging.org/supplementary-material/2024/3702/2024-0014_RC_Video_1.mp4*

Conclusion

This case supports COVID-19 as a trigger for TTS and demonstrates its temporal electrocardiographic and echocardiographic evolution. Initial deep T-wave inversions and the prolonged QTc interval were partially resolved on day 5 after the onset of symptoms and correlates with a mild improvement in the contractility of the mid and apical segments of the left ventricle in echocardiographic exams.

Author Contributions

Conception and design of the research, acquisition of data, analysis and interpretation of the data, writing of the manuscript and critical revision of the manuscript for intellectual content: Arroyo-Rodríguez C, Hernández-Parra A.

Potential Conflict of Interest

No potential conflict of interest relevant to this article was reported.

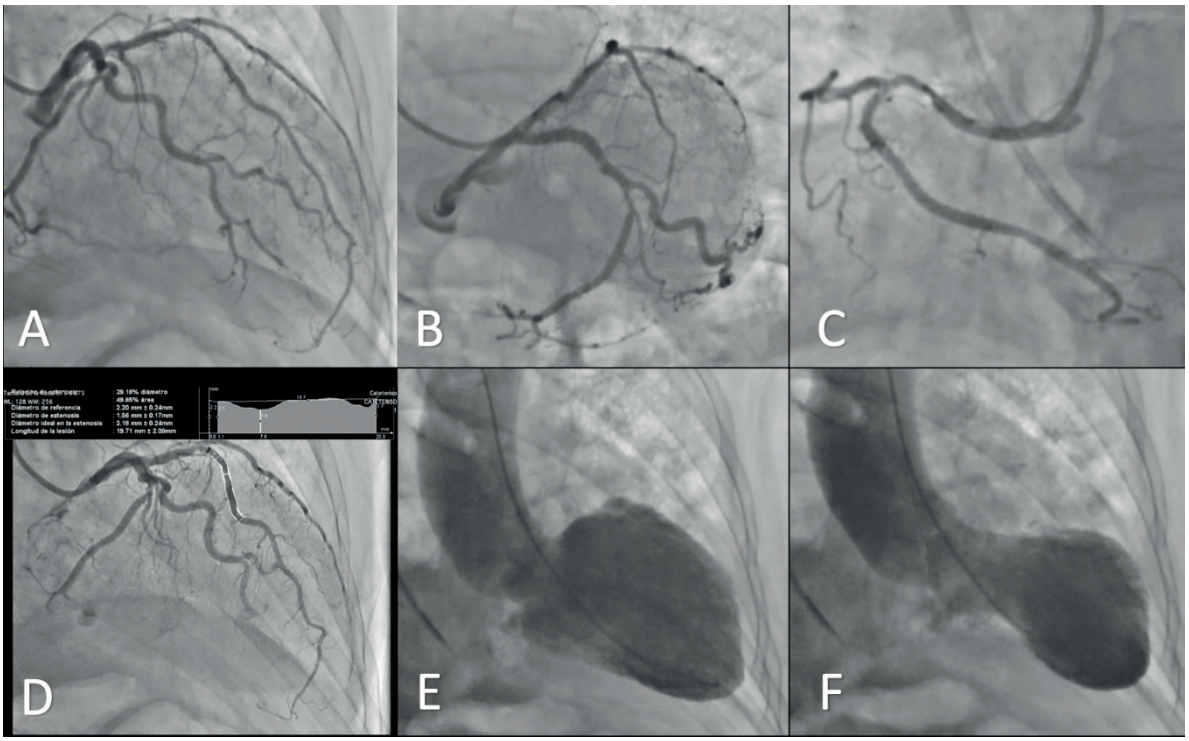
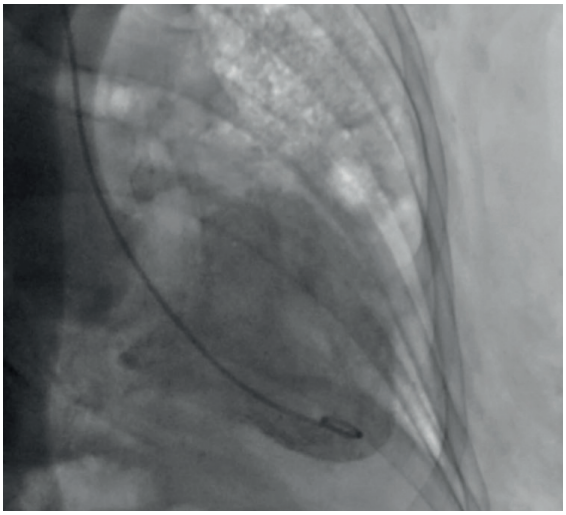


Figure 2 – *A-D) coronary angiography demonstrating absence of significant obstructive coronary artery disease; E-F) left ventriculography showing the characteristic apical ballooning of TTS.*



Video 2 – *http://abcimaging.org/supplementary-material/2024/3702/2024-0014_RC_Video_2.mp4*

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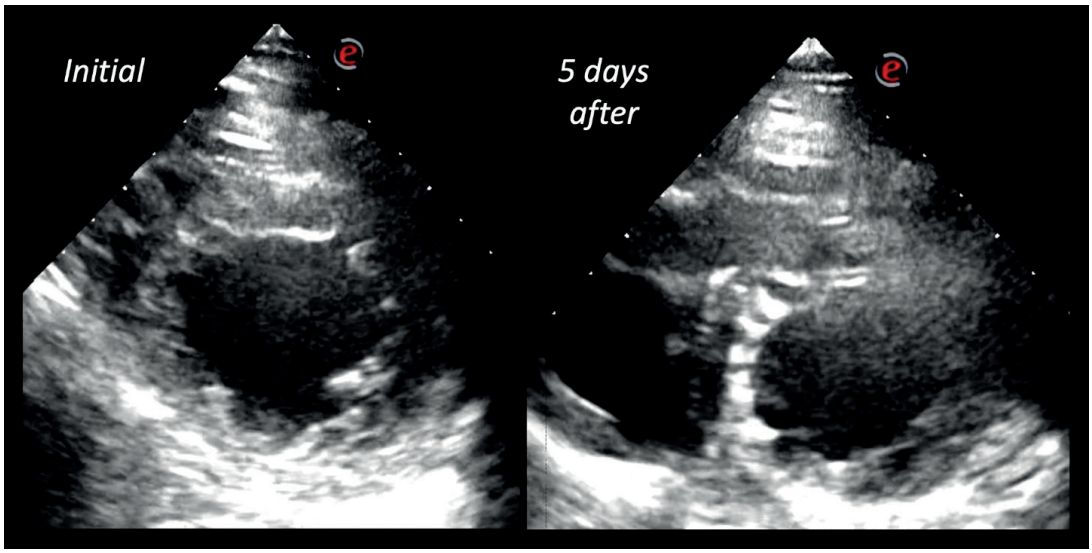
Study Association

This study is not associated with any thesis or dissertation work.

Ethics Approval and Consent to Participate

This article does not contain any studies with human participants or animals performed by any of the authors.



Video 3 – *http://abcimaging.org/supplementary-material/2024/3702/2024-0014_RC_Video_3_1.mp4*

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