Clot in Transit in a Patient with COVID-19: Transesophageal Echocardiographic Guidance of Mechanical Cardiopulmonary Resuscitation

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INTRODUCTION

The incidence of thrombotic complications among critically ill patients with coronavirus disease 2019 (COVID-19) is high despite thromboprophylaxis. We describe a case of a young, otherwise healthy patient admitted to our intensive care unit with COVID-19-associated acute respiratory distress syndrome (ARDS). Despite an initial uncomplicated course, he experienced cardiopulmonary arrest with a right ventricular (RV) clot in transit (CIT) identified on point-of-care ultrasound and redemonstrated on transesophageal echocardiography (TEE). We highlight the association between COVID-19 and thrombosis as well as the utility of TEE during cardiac arrest for both diagnostic and therapeutic purposes.

CASE PRESENTATION

A 34-year-old man presented to our emergency department with a 1-week history of dyspnea and cough. On arrival, he was in acute respiratory distress with a respiratory rate of 40 breaths/min with arterial oxygen saturation of 88% when placed on a nonrebreather mask. The patient tested positive for severe acute respiratory syndrome coronavirus 2 by polymerase chain reaction. Chest radiography demonstrated diffuse bilateral patchy airspace opacities consistent with COVID-19 pneumonia (Figure 1). He was emergently intubated, placed on mechanical ventilation, and admitted to the intensive care unit. Laboratory data on admission revealed markedly elevated inflammatory serum markers, including serum D-dimer of 438 ng/mL (upper limit of normal, <230 ng/mL), C-reactive protein of 188 mg/L (reference range, 0–5 mg/L), and ferritin of 4,101 ng/mL (reference range, 22–248 ng/mL). Treatment with hydroxychloroquine, azithromycin, and tocilizumab was initiated, and he was placed on subcutaneous heparin for thromboprophylaxis.

The patient remained on mechanical ventilation with a lung-protective ventilation strategy for management of ARDS, with a gradually improving course over the next 3 days. On the fourth hospital day, he developed supraventricular tachycardia and hypotension requiring emergent direct-current cardioversion. Point-of-care ultrasound revealed severe RV dilation and hypokinesis with a CIT in the right heart (Figure 2, Video 1).

Moments later, he developed pulseless electrical activity, and cardiopulmonary resuscitation (CPR) was initiated. A large CIT was redemonstrated on TEE in the right atrium during active CPR (Figure 3, Video 2). TEE was emergently performed to guide proper positioning of a Lucas mechanical CPR device (Jolife, Lund, Sweden). On TEE, the area of maximal compression (AMC) by mechanical CPR was compressing the left ventricular outflow tract (LVOT; Figure 4, Video 3). Under transesophageal echocardiographic guidance, the mechanical CPR device was moved caudally transitioning the AMC toward the body of the left ventricle (Figure 5, Video 4). Despite extensive resuscitative efforts, including intravenous administration of tissue plasminogen activator, the patient developed an agonal rhythm (Figure 6, Video 5) and expired shortly thereafter.

DISCUSSION

The incidence of thrombotic complications among patients with COVID-19 is high. In a study of 184 intensive care unit patients with COVID-19 pneumonia, 31% had thrombotic events despite prophylactic anticoagulation, with pulmonary embolism (PE) being the most frequent (81% of thrombotic events).[1] Patients with COVID-19 pneumonia have been found to have PE in the absence of predisposing risk factors.[2,3] We describe the case of a previously healthy, young critically ill patient with COVID-19 ARDS who developed a large CIT and experienced cardiopulmonary arrest likely because of a massive PE.

RV thrombi, or CITs, are uncommon, occurring in about 4% of unselected patients with PE, but are associated with a considerable 27% to 45% mortality rate.[4-6] Optimal therapy for CIT is not defined, as most data are based on case series or registry results. However, meta-analytic data suggest superior results with thrombolytic therapy in these patients compared with alternative treatment modalities.[5,7] As our patient was in cardiopulmonary arrest, likely because of massive PE, tissue plasminogen activator was the indicated therapy.

TEE has been used as a modality to evaluate patients during resuscitation; imaging can effectively diagnose the cause of arrest, alter therapy, and guide chest compressions.[8,9] In a study of 33 patients with out-of-hospital cardiac arrest presenting to the emergency

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VIDEO HIGHLIGHTS

Video 1: Point-of-care ultrasound imaging in off-axis four-chamber view demonstrates a severely dilated right ventricle (RV) and a large CIT in the right atrium (RA). *LV*, Left ventricle.
Video 2: TEE in the approximate bicaval view demonstrates a large serpiginous CIT tumbling in the right atrium (RA) during different parts of the cardiac cycle during chest compressions.
Video 3: Transesophageal echocardiographic guidance of mechanical CPR. In this instance, the AMC over the right ventricle (RV) is directed toward the LVOT. This obliterates the LVOT and prevents proper left ventricular emptying. *LA*, Left atrium; *LV*, left ventricle.
Video 4: Transesophageal echocardiographic guidance of mechanical CPR. In this instance, the AMC over the right ventricle (RV) is directed toward the body of the left ventricle (LV) and away from the LVOT. This allows for proper left ventricular emptying. *LA*, Left atrium.
Video 5: TEE demonstrates an agonal rhythm leading to cardiac standstill. *RA*, Right atrium; *RV*, right ventricle; *TV*, tricuspid valve.

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department, 12% of those presumed to be in asystole were found to have fine ventricular fibrillation by TEE. Importantly, the AMC was identified to be over the aortic root or LVOT in 53% of patients.[8] TEE has demonstrated that left ventricular stroke volume is correlated with the location of the AMC. Left ventricular stroke volume improves when the AMC is over the left ventricle and away from the LVOT and aorta.[10] In our case, the AMC of the mechanical CPR device was initially noted on TEE to be malpositioned over the LVOT. Under transesophageal echocardiographic guidance, it was repositioned over the left ventricle to improve chest compressions.

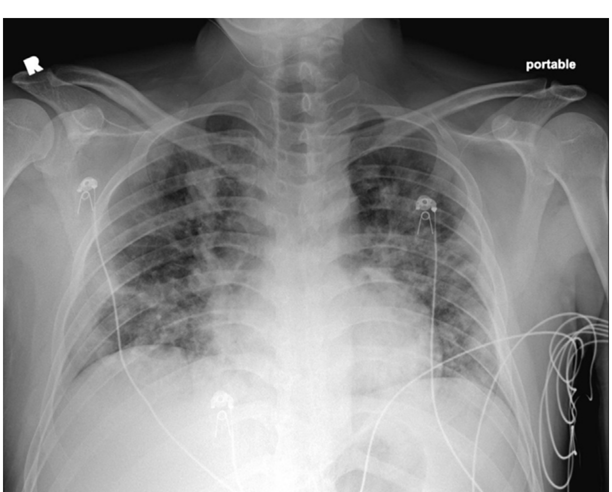

Figure 1 Chest radiography demonstrates diffuse bilateral patchy airspace opacities consistent with COVID-19 pneumonia.

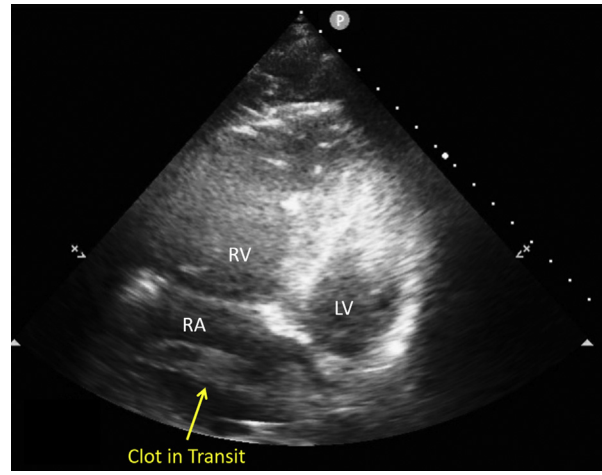

Figure 2 Point-of-care ultrasound imaging in off-axis four-chamber view demonstrates a severely dilated right ventricle (RV) and a large CIT in the right atrium (RA). *LV*, Left ventricle.

CONCLUSION

We present the case of a patient with COVID-19 ARDS who experienced cardiopulmonary arrest, likely as a result of a massive PE, and was found to have a CIT with severe RV dysfunction. We highlight the utility of point-of-care ultrasound as well as use of resuscitative TEE to establish the cause of cardiopulmonary arrest, as well as to guide CPR.

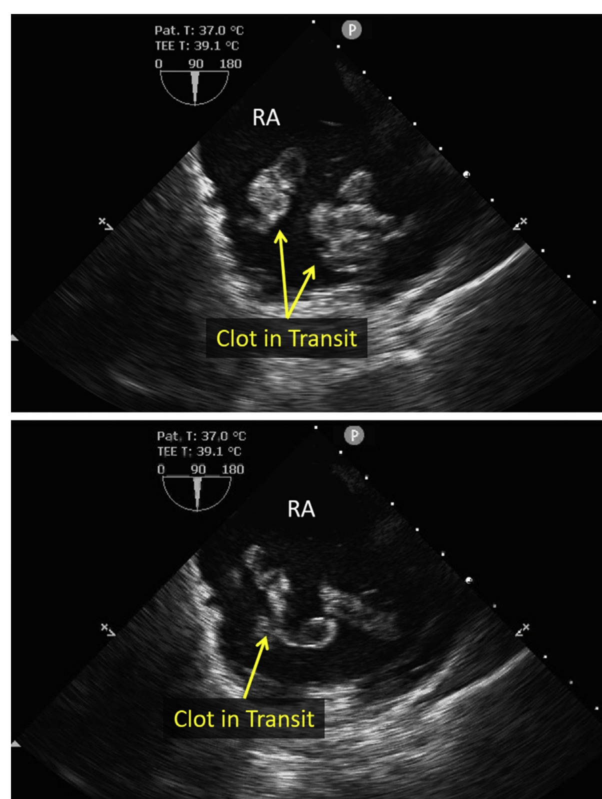

Figure 3 TEE in the approximate bicaval view demonstrates a large serpiginous CIT tumbling in the right atrium (RA) during different parts of the cardiac cycle during chest compressions.

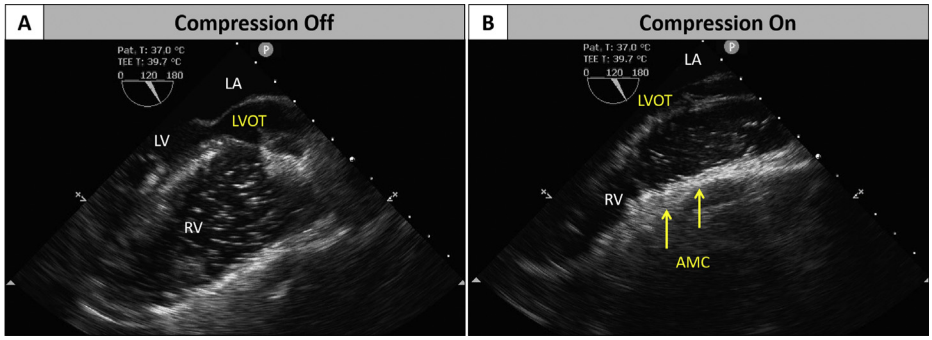

Figure 4 Transesophageal echocardiographic guidance of mechanical CPR. In this instance, the AMC over the right ventricle (RV) is directed toward the LVOT. This obliterates the LVOT and prevents proper left ventricular emptying. *LA*, Left atrium; *LV*, left ventricle.

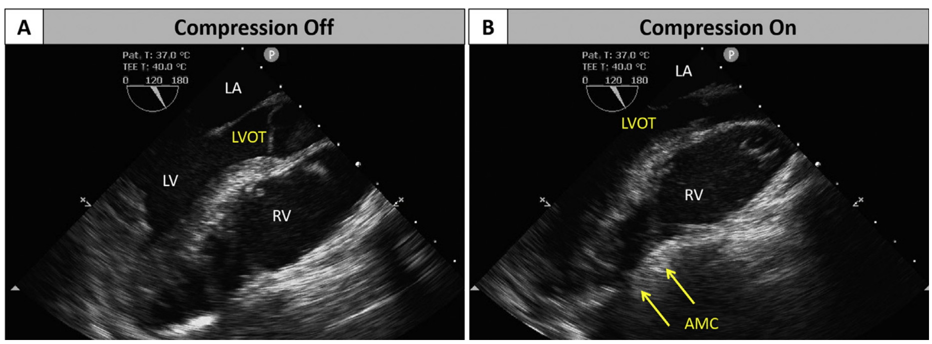

Figure 5 Transesophageal echocardiographic guidance of mechanical CPR. In this instance, the AMC over the right ventricle (RV) is directed toward the body of the left ventricle (LV) and away from the LVOT. This allows for proper left ventricular emptying. *LA*, Left atrium.

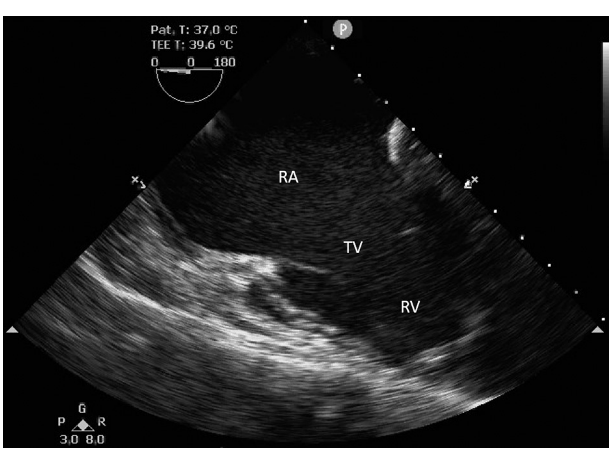

Figure 6 TEE demonstrates an agonal rhythm leading to cardiac standstill. *RA*, Right atrium; *RV*, right ventricle; *TV*, tricuspid valve.

SPECIAL NOTE

In response to this year's global health crisis, the American Society of Echocardiography Foundation, with the help of our generous donors, raised more than $5,000 for COVID-19-related aid in May. The American Society of Echocardiography Foundation is proud to cover the processing fee for this report from these funds.

SUPPLEMENTARY DATA

Supplementary data related to this article can be found at https://doi.org/10.1016/j.case.2020.12.003.

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