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CASE IMAGE IN CARDIOVASCULAR ULTRASOUND

Pulmonary thromboembolism with multiple right heart mural thrombus in a patient with COVID-19

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Hypercoagulation state during COVID-19 disease has been confirmed recently. Herein we present a 40-year-old hypertensive otherwise healthy male who was admitted with complaints of myalgia, low grade fever, dry cough, leg swelling, and exacerbating dyspnea in the last two weeks with history of recent recovery from COVID-19 in his wife. At presentation, he was afebrile with stable vital signs (blood pressure: 114/81 mmHg, respiratory rate: 16/minute, heart rate: 75 bpm) despite hypoxemia ($SPaO_2$ of 74% on room air, 94% on nasal O2 therapy). Coarse crackles in the lung fields, symmetric pitting leg edema and elevated jugular venous pressure were noticed in clinical exam with low voltage QRS, extreme right axis deviation and negative T waves in the precordial leads in electrocardiogram (Fig. 1a). Chest CT scan demonstrated pericardial and pleural effusions, filling defects in right atrium (RA) and right ventricle (RV) cavities, peripheral based ground glass opacities (compatible with COVID involvement), wedge-shaped pulmonary infarct and pulmonary arterial branch thrombosis (Fig. 1b, supplementary video1). No deep vein thrombosis was found. Transthoracic and transesophageal echocardiography showed preserved left ventricular systolic function, flattened interventricular septum, moderate right atrium (RA) and right ventricular (RV) enlargement and dysfunction, plethoric inferior vena cava with two large mural thrombi (4 cm × 2.5 cm) in RA appendage and RV apex (Fig. 1c, d, supplementary videos 2, 3).

In laboratory data, positive oropharyngeal swab for severe acute respiratory syndrome corona virus 2 ($SARS\text{-}COV_2$), lymphopenia (782 per μL) without leukocytosis (4150 per μL), elevated d-dimer (4510 ng/ml, normal < 250), cardiac troponin I (115 ng/L, normal < 50) and C-reactive protein (18.9 mg/L, normal < 5) were observed.

Under full intravenous anticoagulation and oral vitamin K antagonist the thrombus size was reduced significantly and RV function was improved.

COVID-19 disease, has been proposed to be associated with cardiovascular manifestations including acute coronary syndrome, arrhythmia, myocarditis and thromboembolism [1]. Hypercoagulation state during COVID-19 is attributed to systemic inflammation, immobility and hypoxemia [2]. The theory of endothelial lung injury along with micro thrombus formation in pulmonary vascular bed, leads to the general agreement for anticoagulant therapy in critically ill hospitalized patients with COVID-19 as a standard prophylactic approach [3].

Although there are reports of successful thrombolytic therapy in unstableCOVID-19 patients with right heart thrombus, the stable subacute presentation of the patient, leads us to follow conservative approach [4, 5].

This patient presented with pulmonary thromboembolism accompanied by multiple large right heart thrombus represents a unique serious form of cardiopulmonary injury during COVID-19 disease.

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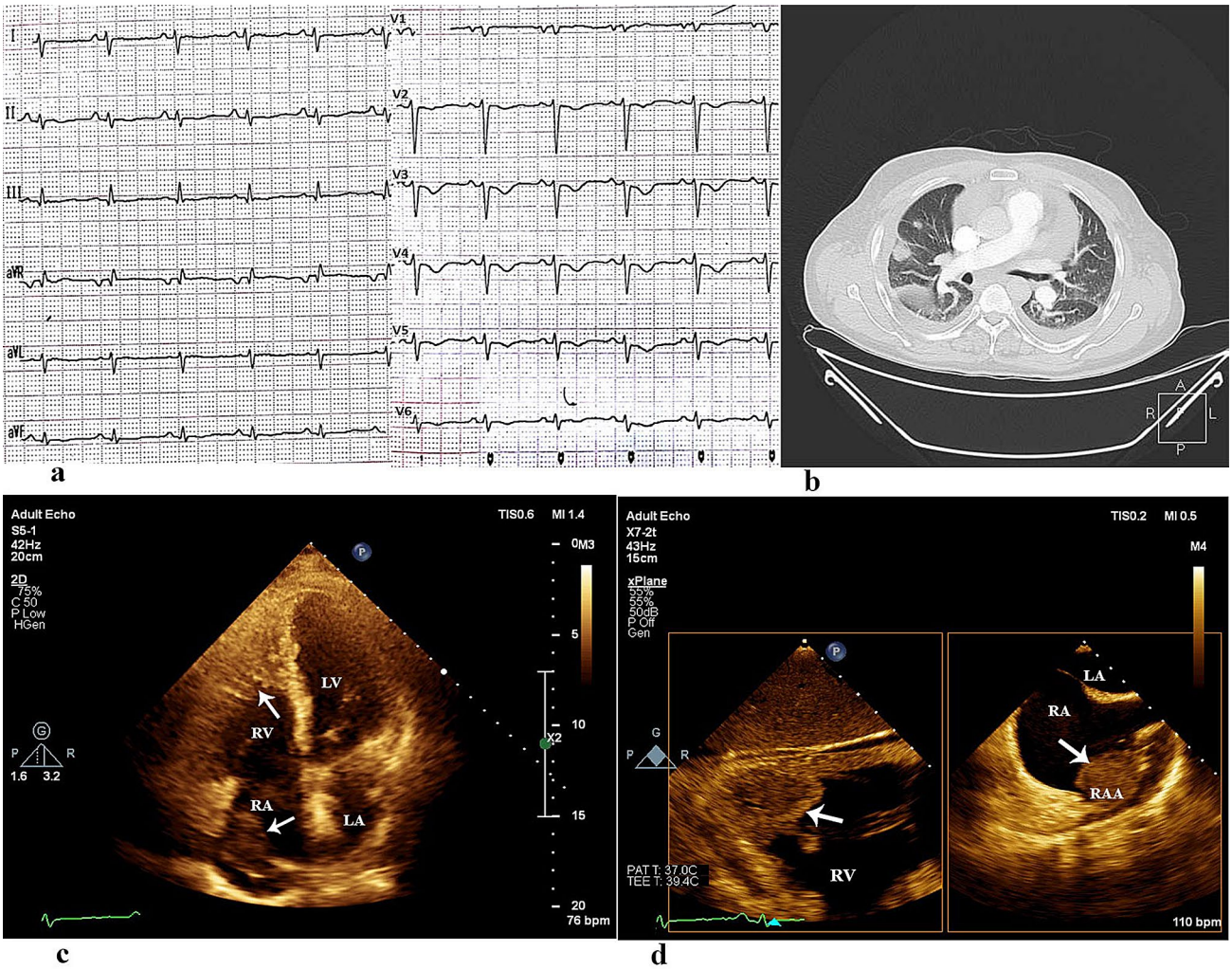

Fig. 1 **a** Surface electrocardiogram shows normal sinus rhythm, low voltage QRS, extreme right axis deviation and negative T waves in the precordial leads. **b** Mid thoracic slice of chest CT scan demonstrated moderate pericardial and bilateral pleural effusions, peripheral based patchy ground glass opacities and wedge-shaped pulmonary infarct in the right lower lobe. **c** and **d** Transthoracic and transesophageal echocardiography (trans gastric and mid esophageal bicaval views) shows two large mural thrombus (average size of 4 cm × 2.5 cm) in RA appendage (RAA) and RV apex along with small circumferential pericardial effusion

Compliance with ethical standards

Conflict of interest Houman Dehghan and Azam Soleimani declare that they have no conflict of interest.

Human rights statements and informed consent All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1964 and later versions. Informed consent was obtained from the patient for being included in the study.

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