AKADÉMIAI KIADÓ

"Heart full of thrombi": Post COVID-19 multisite thrombosis assessed by echocardiography and pulmonary CT

IMAGING

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CASE REPORT

ABSTRACT

Thrombosis in general, and especially venous thromboembolism (VTE) is one of the most common complications associated with COVID-19 infection. We present a 48 years old male patient with dyspnea and severe multisite post Covid-19 disease thrombotic complications, with pattern never seen before, that includes both ventricles, pulmonary arteries and peripheral vein involvement, assessed by echocardiography, vascular ultrasound and pulmonary CT angiography.

KEYWORDS

COVID-19, thrombosis, echocardiography, pulmonary CT angiography

Case report

A 48y old male (MD) was admitted to our intensive care unit with decompensated heart failure (HF). One month earlier he was hospitalized for "SARS-CoV-2" infection" confirmed by PCR test and pulmonary CT findings for COVID-19 pneumonia at the infective disease clinic. He had no previous history of cardiovascular disease (CVD). On admission he presented with dyspnea at rest and mild physical activity, tachyarrhythmia and signs of decompensated HF (NYHA III) with lower leg edema. Laboratory D-dimers values were 10.765 ngr/mL (normal values 500 ngr/ml), NTproBNP 6700 pg/ml (normal values 125 pg/ml) and procalcitonin S 0,4 (normal values 0.15 ng/mL), with other results within normal limits. In addition, urgent echocardiography revealed presence of multiple thrombi (7 in total), 5 in the left ventricle (LV) with different size and mobility (the largest LV thrombi had dimensions of 3.9 mm x 2.4 mm) (Fig. 1 - A and B; arrowheads). The ejection fraction of the LV was severely reduced with a global hypokinesia, left ventricular ejection fraction (LVEF) of 34%, end diastolic volume 176 ml, end systolic volume 98 ml at the admission with improvement of LV function at the discharge with LVEF of 45%. Right ventricular (RV) function was also reduced with TAPSE 16, and TDI S' wave velocity 8 cm/sec, tricuspid regurgitation of 3.0 m/sec and pulmonary artery systolic pressure of 37 mmHg. Also, there was large thrombus in the RV with dimensions 29 x 32 mm and a smaller one with dimensions 13 x 10mm (Fig. 1 - B; arrowhead). Pulmonary artery was dilated (27 mm) with floating thrombus on the bifurcation (Fig. 1 - D), with a high risk of embolization. Inferior vena cava was with borderline dimensions (20 mm), with inspiratory collapse. CT angiography revealed pulmonary embolism (PE), with thrombus extending towards the right pulmonary artery (Fig. 1 - D; arrowhead). Pulmonary CT scans showed multiple bilateral peripheral and central post COVID-19 fibrotic lesions (Fig. 1 - E; arrowheads). Venous Doppler ultrasound - Iliofemoral thrombosis: non compressive communis femoral vein, femoral superficial vein and non-occlusive thrombus in left popliteal vein. He was hemodynamically stable during hospitalization. Medical therapy for HF was started (perindopril

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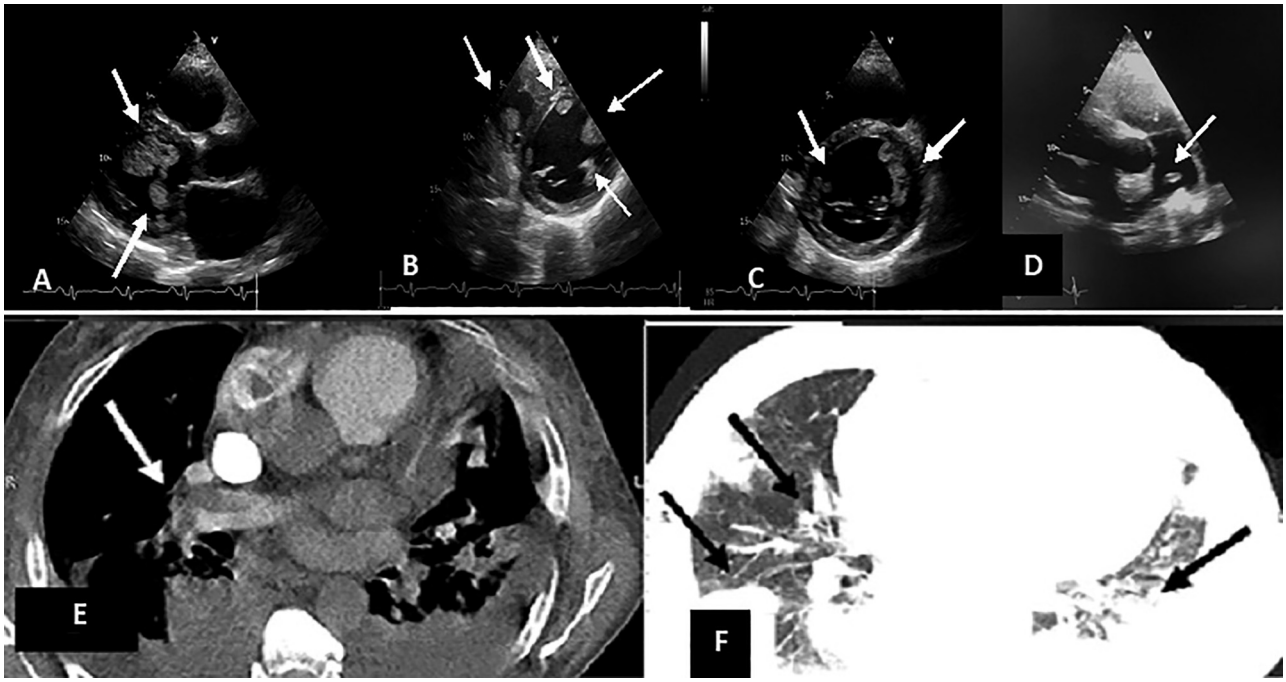

Fig. 1. Echocardiography, pulmonary CT and pulmonary CT Angiography findings: Echocardiography (A–D) showed large thrombmi in the left ventricle on the parasternal long axis view (PLAX), (A; arrowheads). Multiple thrombi in the right and left ventricle on the apical four chamber echocardiographic view (4C) (B; arrowheads). Multiple thrombi in the left ventricle on the short axis view (C; arrowheads). Short axis aortic valve view showing floating thrombus on the pulmonary artery bifurcation (D; arrowhead). Pulmonary CT angiography showing thrombus in the right pulmonary artery (E; arrowhead). Pulmonary CT showing multiple bilateral peripheral and central post COVID-19 fibrotic lesions (F; arrowheads)

4 mg od, carvedilol 6.25 mg bid, spironolactone 50 mg od, furosemide 125 mg od) and anticoagulation with low molecular heparin 1.5 mg/kg bid for the first 3 days, then direct oral anticoagulant Rivaroxaban 15 mg bid for the following 21 days. Confluent thrombus formation with decrease of thrombus number and mobility was noted on the control echocardiographic exam (Fig. 1 C; arrowhead). Performed thrombophilia analyses showed heterozygous mutations for factor V Leiden, prothrombin and plasminogen activator inhibitor PAI-1. Patient survived hospitalization and was discharged after 24 days with the medical therapy for heart failure and anticoagulation therapy with rivaroxaban 20 mg od for three months with close follow up and possible extension of anticoagulant treatment up to 6 months. Coronary angiography, cardiac magnetic resonance (CMR) and complete testing for thrombophilias was scheduled to be additionally performed on outpatient basis.

Discussion

Coronavirus disease-2019, caused by the severe acute respiratory syndrome-coronavirus-2 (SARS-CoV-2), predisposes patients to thrombotic disease, due to excessive inflammation, platelet activation, endothelial dysfunction, and stasis. Early reports suggest incidences of deep vein thrombosis (DVT) and PE up to 30% in patients with COVID-19 disease [1, 2]. Treatment of our patient was challenging because of the concomitant presence and complexity of the inflammatory consequences, severe hypercoagulable state and the myocardial dysfunction [2]. Bed site point of care ultrasound (POCUS) echocardiography is very useful imaging technique for fast assessment of LV function or PE indirect signs, which also provides possible answers for patient clinical instability [3]. Echocardiography enables detection and follow up of thrombus formations in the heart cavities and pulmonary artery. Vascular ultrasound and CT angiography are imaging methods that gives us an opportunity to assess and follow up thrombosis in different vascular beds [3]. The proposed mechanisms for COVID-19 disease–induced thrombosis include a cytokine-mediated diffuse microvascular damage, disease-specific hypercoagulable state, hypoxia, immobilization, diffuse intravascular coagulation and, in some cases, reactive thrombocytosis [4]. In the present case, the patient had elevated C-reactive protein (45 mg/l, normal values 6 mg/l) and D-dimer levels with no other risk factors for pulmonary embolism, thereby indicating a COVID-19 disease–related hypercoagulable state as a possible cause of multivesicular venous thrombosis including PE. There are studies indicating that patients with LV thrombosis have significantly higher C-reactive protein (CRP) values than the non-thrombus patients [4]. The generalized endotheliopathy induced by COVID-19 disease is assumed to persist even after the infection recovery, which predisposes the patients to increased thrombotic risk [5]. However, our patient also had severe left ventricular dysfunction and thrombophilia mutations which additionally increase the risk for thrombotic complications. Although LV thrombi are present in 10–30% of patients with dilated

cardiomyopathy, our patient had multiple thrombi in both ventricles, pulmonary embolism and DVT at the same time which is quite rare and cannot be explained by the presence of left ventricular dysfunction only. The constellation, of endothelial injury, hypercoagulability, and blood stagnation, which are well described previously as Virchow's triad, is responsible for the formation of thrombus [7]. The most logical explanation we have is that post COVID-19, the disease triggered multivascular thrombosis in the patient with coagulation abnormality and previous pneumonia. Left ventricular thrombosis (LVT) complicates both ischemic and non-ischemic cardiomyopathies and is a potential cause of thromboembolic complications such as stroke. Contemporary management of LVT is primarily based on studies before the widespread use of potent pharmacological and interventional therapies such as primary percutaneous coronary intervention. Though advances in imaging techniques have improved detection of LVT, we as clinicians are facing several uncertainties in the management of LVT in our daily practice. Anticoagulation therapy with enoxaparin which was continued with Rivaroxaban leads to decrease of thrombus number and mobility in our patient case. Since our patient had significant improvement of LV function during hospitalization, we assume that heart failure might be caused by COVID-19 induced myocardial injury (myocarditis). Myocarditis may be an important cause of the acute cardiac injury in COVID-19 patients. However, the prevalence, clinical importance, and mechanisms of myocardial inflammation in COVID-19 disease remain unclear. We do not have solid evidence of direct myocardial cytotoxic effects of the virus.

Treatment of these patients is very challenging since due to acute liver injury and reduced AT III levels during the acute phase of the disease, these patients have reduced therapeutic response to heparin. Anticoagulant and concomitant heart failure therapy and close follow up of the patient is mandatory in order to evaluate treatment success and patient recovery [6–8].

One of the limitations in our case is the lack of coronary angiography and cardiac magnetic resonance (CMR) in the acute phase, which are planned to be performed.

Conclusions

Patients with COVID-19 disease are at increased risk of thromboembolic complications. COVID-19 disease induced inflammation, hypercoagulability and endothelial dysfunction might cause thrombotic complications in any vascular site. We should use high clinical suspicion and imaging techniques for onetime diagnosis and treatment of thrombotic complications in both acute infection and post COVID-19 disease patients.

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Supplementary material

The following are the supplementary data related to this article:

Movie 1. 2D Transthoracic echocardiography (TTE) four chamber view showing multiple thrombi in the left ventricle with global hypokinesia

Movie 2. 2D Transthoracic echocardiography (TTE) short axis view at the level of mitral valve showing multiple thrombi in the left ventricle with D shaped left ventricle due to the presence of pulmonary hypertension

Movie 3. 2D Transthoracic echocardiography (TTE) apical three chamber view showing multiple thrombi in the left ventricle with the presence of severe left ventricular dysfunction

Supplementary video related to this article can be found at https://doi.org/10.1556/1647.2021.00047.

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