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Inferior Vena Cava Filter in a Patient with COVID-19 Pneumonia to Prevent a Massive Pulmonary Embolism

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COVID-19 predispose to deep vein thrombosis. We describe an early placement of inferior vena cava filter added to the therapeutic anticoagulation to prevent a massive pulmonary embolism.

INTRODUCTION

Since December 2019, SARS-CoV-2 has generated over 2 million cases of coronavirus disease 2019 (COVID-19) in the world. COVID-19 may predispose to both deep vein thrombosis and acute pulmonary embolism (PE) because of excessive inflammation, hypoxia, immobilization, and diffuse intravascular coagulation (DIC). We describe the first case of an inferior vena cava (IVC) filter placement to prevent a massive PE in a patient with iliac, femoral, and popliteal vein deep thrombosis associated with pulmonary microembolism.

CASE DESCRIPTION

A 61-year-old man presented to the emergency department of the University Hospital of Novara, Italy, on March 06, 2020, with a 10-day history of fever, worsening dyspnea, and persistent cough. A lung computed tomography (CT) scan showed multiple ground glass opacities with bilateral parenchymal consolidations, air bronchogram more extended in the lower lobes and in the dorsal segments of the upper lobes, and interlobular septal thickening. Nasopharyngeal swab was positive for COVID-19 on real-time reverse transcriptase polymerase chain reaction assay. On presentation, his temperature was 39°C.

Blood examinations showed high inflammatory markers and lymphopenia (white blood cell counts 22380/µL, neutrophils 20500/µL, lymphocytes 910/µL), C-reactive protein 17.34 mg/dL, and procalcitonin 6.30 ng/mL. Arterial blood gas analysis showed pH 7.34, partial pressure of carbon dioxide (pCO₂) 30.9 mm Hg, partial pressure of oxygen (pO₂) 27.6 mm Hg, excess basis 7.4 mEq/l, and lactates 7.8 mMol/l.

The patient was intubated, lung protective mechanical ventilation strategy was started, and bronchoalveolar lavage was performed. It resulted negative for influenza A and B viruses, adenovirus, herpes virus, respiratory syncytial virus, parainfluenza 1, 2, 3, Legionella pneumophila, Mycoplasma pneumonias, Aspergillus and Chlamydia pneumonias. The patient was given antibacterial, antiviral, and hydroxychloroquine treatment and prophylactic heparin dose.

On March 08, 2020, the left lower limb appeared swollen, and normothermic, with peripheral pulse present. Compression ultrasonography demonstrated a failure of full compressibility from inguinal femoral vein to
popliteal vein. Heparin was increased to an anticoagulant dosage (8000 UI bid). On March 09, a sudden reduction in peripheral oxygen saturation (SpO2) at 77%, without hemodynamic instability, led to perform an Angio-CT in the suspect of PE. The radiological examination showed the presence of filling defect compatible with thromboembolic phenomena affecting the main branch of the pulmonary artery of the upper right lobe, lower lobe of both sides, and segmental of the lingula. At the same time, an occlusive thrombotic apposition in the external iliac vein immediately after its origin, involving also the superficial and deep femoral vein, was detected. In consideration of the high risk of a massive PE in the context of an iliofemoral-popliteal deep thrombosis, despite the presence of anticoagulant therapy, the patient was selected for placement of an optional IVC filter (Lifetech Aegisy). Through an access in the right femoral vein, the device was released in inferior vena cava below the right renal vein and above the left renal vein because of anatomical variant with left renal vein that flows into the inferior vena cava near the origin of the left common iliac vein (Fig. 1). The IVC filter was removed after thirteen days without complication and the patient was discharged in good condition from the hospital, on March 27, 2020.

**DISCUSSION**

We described the first case of an early placement of IVC filter in a patient with COVID-19 pneumonia and evidence of iliofemoral-popliteal thrombosis and PE. Since the beginning of the outbreak of COVID-19, it was clear the closed correlation between the novel coronavirus pneumonia and the abnormal blood coagulation function associated with high incidence of venous thromboembolism and DIC.\(^1\)

In the study of Klok and colleagues evaluating 184 ICU patients with COVID-19 infection, the incidence of thrombotic complications was 31%.\(^2\) Despite the evidence of a tight interconnection between inflammation and prothrombotic tendency, and the demonstrated protective effect with in vitro immunomodulatory properties of low-molecular-weight heparin, clinical trials are still ongoing and the effective dose to prevent thrombotic events is still unknown.\(^3\)

Llitjos JF and coworkers found a high rate of thromboembolic events even in COVID-19 patients treated with therapeutic anticoagulation, with 56% of VTE and 6 PE in 26 consecutive patients.\(^4\)

IVC filters are mechanical device placed typically in the infrarenal IVC to prevent migration of large thrombi up into cardiopulmonary system, while maintaining relatively unimpeded venous outflow from the lower extremities. According to the ESC guidelines, IVC filters should be considered in patients with acute PE and absolute contraindication to anticoagulation (class IIa level C) or in case of PE recurrence despite therapeutic anticoagulation (class IIa, level C).\(^5\)

In our case, we decided to place an IVC filter early as a prophylactic device with the aim of preventing recurrent pulmonary embolism.

In conclusion, we reported the case of a patient with COVID-19 pneumonia who developed iliofemoral-popliteal thrombosis and high risk of recurrent PE that we decided to prevent with an IVC filter added to the therapeutic anticoagulation, without complication and with successfully recovery of the patient.

**REFERENCES**

1. Tang N, Bai H, Chen X, et al. Anticoagulant treatment is associated with decreased mortality in severe coronavirus disease 2019 patients with coagulopathy. J Thromb Haemost 2020;18:1094–9.
2. Klok FA, Kruij MHA, Van Der Meer NJM, et al. Incidence of thrombotic complications in critically ill ICU patients with COVID-19. Thromb Res 2020;191:145–7.
3. Marietta M, Ageno W, Artoni A, et al. COVID-19 and haemostasis: a position paper from Italian Society on Thrombosis and Haemostasis (SISHT). Blood Transfus 2020;18:167–9.
4. Llitjos JF, Leclerc M, Chococha C, et al. High incidence of venous thromboembolic events in anticoagulated severe COVID-19 patients. J Thromb Haemost 2020. https://doi.org/10.1111/jth.14869.
5. Konstantinides SV, Meyer G, ESC Scientific Document Group. 2019 ESC Guidelines for the diagnosis and management of acute pulmonary embolism developed in collaboration with the European Respiratory Society (ERS): the Task Force for the diagnosis and management of acute pulmonary embolism of the European Society of Cardiology (ESC). Eur Respir J 2020;41:543–603.