Pulmonary Embolism in COVID-19 Treated with VA-ECLS and Catheter tPA

Clinical Medicine Insights: Circulatory, Respiratory and Pulmonary Medicine
Volume 14: 1–3

DOI: 10.1177/1179548420957451

Arda Akoluk[1], Usman Mazahir[2], Steven Douedi[1], Adel Aziz[1], Aref Obagi[3], Daniel Kiss[3], Daniel Flynn[4], Eric Costanzo[2], Sinan A Simsir[5] and Matthew D Saybolt[3]

[1]Department of Medicine, Hackensack Meridian Health, Jersey Shore University Medical Center, Neptune NJ, USA. [2]Department of Pulmonary and Critical Care, Hackensack Meridian Health, Jersey Shore University Medical Center, Neptune NJ, USA. [3]Department of Cardiovascular Disease, Hackensack Meridian Health, Jersey Shore University Medical Center, Neptune NJ, USA. [4]Department of Interventional Radiology, Hackensack Meridian Health, Jersey Shore University Medical Center, Neptune NJ, USA. [5]Department of Cardiothoracic Surgery, Hackensack Meridian Health, Jersey Shore University Medical Center, Neptune NJ, USA.

ABSTRACT

BACKGROUND: Novel coronavirus 2019 (COVID-19) has been the focus of the medical world since being declared a pandemic in March 2020. While the pathogenesis and heterogeneity of COVID-19 manifestations is still not fully understood, viral evasion of cellular immune responses and inflammatory dysregulation are believed to play essential roles in disease progression and severity.

CASE PRESENTATION: We present the first case of a patient with COVID-19 with massive pulmonary embolism treated successfully with systemic thrombolysis, VA-ECLS, and bail out catheter directed thrombolysis. He was discharged from the hospital after an eventful hospital course on therapeutic anticoagulation with warfarin.

CONCLUSIONS: We present the first case of a patient with COVID-19 with massive pulmonary embolism (PE) treated successfully with systemic thrombolysis, VA-ECLS and bail out catheter directed thrombolysis. In our experience catheter directed thrombolysis comes with an acceptable bleeding risk despite use of mechanical circulatory support, particularly with meticulous attention to vascular access and dose response monitoring.

KEYWORDS: COVID-19, pulmonary embolism, thrombolysis, VA-ECMO, tPA

RECEIVED: May 15, 2020. **ACCEPTED:** August 13, 2020.

TYPE: Case Report

FUNDING: The author(s) received no financial support for the research, authorship, and/or publication of this article.

DECLARATION OF CONFLICTING INTERESTS: The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

CORRESPONDING AUTHOR: Steven Douedi, Department of Medicine, Hackensack Meridian Health, Jersey Shore University Medical Center, 1945 Route 33, Neptune, NJ 07753, USA. Email: Steven.Douedi@hackensackmeridian.org

Background

The novel coronavirus 2019 (COVID-19) was declared a pandemic by the World Health Organization (WHO) on March 11, 2020.[1] The most common symptoms of COVID-19 infection include cough and fever, which can unpredictably progress to pneumonia, acute respiratory distress syndrome (ARDS) and multi-system organ failure leading to death.[2] While the pathogenesis and heterogeneity of COVID-19 manifestations is not fully understood, viral evasion of cellular immune responses and inflammatory dysregulation are believed to play essential roles in disease progression and severity.[2] Most critically ill COVID-19 patients have elevated inflammatory markers including D-Dimer and C-reactive protein (CRP) which leads to the hypothesis (and supported by clinical anecdotes) that the virus may raise the risk of both venous and arterial thromboembolic events due to inflammation, hypoxia, immobilization and diffuse intravascular coagulation (DIC) with coexistent endothelial dysfunction.[3,4] We present the first case in the literature of a patient with COVID-19 with massive pulmonary embolism (PE) treated successfully with systemic thrombolysis, veno-arterial extracorporeal membrane oxygenation (VA-ECMO) and bail out catheter directed thrombolysis.

Case presentation

A 50-year-old male with a distant history of unprovoked PE with negative work-up including factor V leiden, antithrombin III, protein C and S, and anti-phospholipid antibodies, presented to our hospital with resuscitated out-of-hospital cardiac arrest, fever, hypoxic respiratory failure and shock. Fourteen days prior to admission he developed fever and self-isolated. Upon paramedic arrival the patient developed asystole treated with cardiopulmonary resuscitation resulting in return of spontaneous circulation. Upon arrival to our hospital he again suffered asystolic arrest and was promptly resuscitated and intubated. Echocardiographic evaluation showed McConnell Sign, highly specific for acute pulmonary embolism. Confirmatory chest CT angiogram (CTA) revealed a saddle

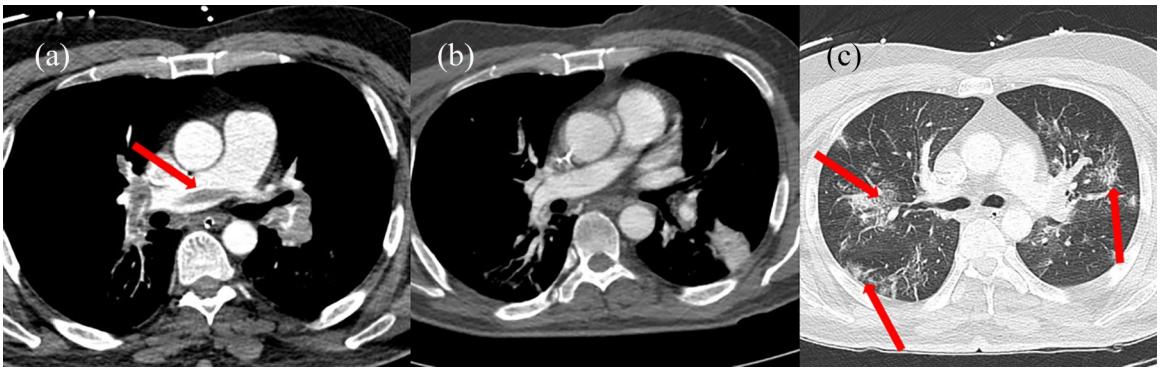

Figure 1. (a,b) Coronal computed tomography angiography (CTA) showing saddle pulmonary emboli with interlobar extension (arrow). (c) CTA showing ground glass opacities (arrows).

PE, dense bilateral interlobar arterial clot burden with diffuse segmental/subsegmental extension (Figures 1a-1b). Bilateral ground-glass and alveolar airspace opacities described in patients with COVID-19 infection were also noted (Figure 1c). Venous doppler studies of the lower extremities were negative for thrombus formation. Laboratory evaluation revealed elevated leukocytes (11.7/mm^2), C-reactive protein (1.76 mg/L), troponin I (0.06 ng/mL) and extremely elevated D-dimer (31 373 µg/mL). After intubation he stabilized and was treated with weight based low-molecular-weight-heparin.

In the ensuing 5 hours he developed refractory hypoxia and shock treated with systemic intravenous thrombolysis (Alteplase 100 mg infused over 2 hours). On hospital day 2, he had 3-pressor refractory shock (systolic blood pressure 70 mm Hg), acidosis, multisystem organ failure, fevers, and hypoxemia (oxygen saturation 45%) and we proceeded with mechanical circulatory support. He was placed on extra-corporal life support (ECLS) urgently. A 25 French percutaneous right atrial cannula (Biomedicus) was inserted through the right femoral vein for inflow into the pump circuitry. The outflow was into an 8 mm Gelweave (Terumo) graft tunneled and anastomosed to the right subclavian artery. The circuitry consisted of a Centrimag magnetic levitation pump head (Abbott), 3/8" Smart coated tubing (LivaNova), Quadrox oxygenator and a Blanketrol (both Maquet) heat exchanger. Post-operatively, the patient's COVID-19 RT-PCR test was found to be positive.

He had an inadequate response to systemic thrombolysis the day prior and after 5 L of fluid for hemodynamic support he remained dependent on vasoactive medications. He was deemed a poor candidate for surgical pulmonary thrombectomy given co-existent multifocal pulmonary infiltrates and active COVID-19 infection. We chose to proceed with bail out catheter directed thrombolysis using rotational embolectomy. Pulmonary arteries were catheterized and exchanged for bilateral multi-side hole infusion catheters and each was bolused with 2 mg alteplase. During transport the left pulmonary catheter was displaced but the right sided catheter remained stable with proximal infusion ports in the main pulmonary artery confirmed with X-ray. We increased unilateral tPA dose to 2 mg/hr for 4 hours and 1 mg/hr for 12 hours with no bleeding complications. By hospital day 5 his VA-ECLS supported was weaned to 1.2 L/min with echocardiographic guidance and his right ventricle remained normal in size/function and hemodynamically stable. On hospital day 6 he was liberated from ECLS during a bedside decannulation and extubated on day 11. Repeat CTA demonstrated interval improvement in clot burden and multifocal opacities. On hospital day 21, right heart catheterization demonstrated normal cardiac output and pulmonary arterial pressures and a Denali (Bard) retrievable inferior vena cava (IVC) filter was placed for added protection during his period of recovery and vulnerability. He was discharged to home on hospital day 22 on therapeutic anticoagulation with warfarin.

Discussion and conclusions

To our knowledge, we present the first case of a patient with COVID-19 with massive PE treated successfully with systemic thrombolysis, VA-ECLS, and bail out catheter directed thrombolysis. Our patient's history of PE and self-isolation/immobilization for presumed COVID-19 caused thromboembolic provocation and inflammation resulting in his initial decompensation.[3-6] We advocate VA-ECLS combined with high dose unfractionated heparin and adjunctive catheter-based therapies as effective and lifesaving treatments for patients with massive PE and refractory shock/hypoxemia. In our experience catheter directed thrombolysis comes with an acceptable bleeding risk despite use of mechanical circulatory support, particularly with meticulous attention to vascular access and dose response monitoring. This treatment pathway need not be withheld even in the presence of COVID-19, assuring first and foremost that all team members have adequate respiratory protection during these potentially aerosolizing procedures.

Author Contributions

All authors have significantly contributed to the article: AA, UM, SD, AA contributed to the conception and design, literature review, manuscript writing and correction, and final approval of manuscript. AF, DK, DF, EC, SAS, contributed to

manuscript correction and final approval of manuscript. MDS contributed to conception and design, manuscript writing and correction and final approval of manuscript.

Consent for Publication

The patient described has given their informed consent to publish this case (including publication of images).

ORCID iD

Steven Douedi https://orcid.org/0000-0001-5006-828X

Availability of Data and Materials

Data sharing is not applicable to this article as no datasets were generated or analyzed during the current study.

REFERENCES

1. Centers for Disease Control and Prevention: Coronavirus Disease 2019 (COVID-19). Situation summary. https://www.cdc.gov/coronavirus/2019-ncov/cases-updates/summary.html#:~:text=On%20March%2011%2C%20the,of%20new%20influenza%20viruses. Accessed 10 May, 2020.
2. Chen J, Wang X, Zhang S, et al. Findings of acute pulmonary embolism in COVID-19 patients. *SSRN* 3548771 2020.
3. Le Berre A, Marteau V, Emmerich J, Zins M. Concomitant acute aortic thrombosis and pulmonary embolism complicating COVID-19 pneumonia. *Diagn Interv Imaging*. 2020;S2211-5684(20)30096-6.
4. Klok F, Kruip M, van der Meer N, et al. Incidence of thrombotic complications in critically ill ICU patients with COVID-19. *Thromb Res*. 2020;S0049-3848(20)30120-1.
5. Ullah W, Saeed R, Sarwar U, Patel R, Fischman DL. COVID-19 complicated by Acute Pulmonary Embolism and Right-Sided Heart Failure. *JACC: Case Rep* 2020;2(9).
6. Rotzinger D, Beigelman-Aubry C, von Garnier C, Qanadli S. Pulmonary embolism in patients with COVID-19: time to change the paradigm of computed tomography. *Thromb Res*. 2020;190:58-59.