

Sub-Massive Pulmonary Embolism due to COVID-19 Treated with Catheter-Directed-Thrombolytic Therapy

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Abstract

We present a case of a 38-year-old male with one month of shortness of breath and fever after a recent plane trip. The patient was diagnosed with COVID-19 infection and was found to have associated submassive pulmonary embolism on a computed tomography scan with evidence of right heart strain. He was treated with catheter-directed lytic therapy, which resulted in rapid clearance of pulmonary embolism and significant improvement in shortness of breath. This case highlights the successful management of submassive pulmonary embolism using catheter-directed lytic therapy in the setting of an active COVID-19 infection.

Keywords: Pulmonary Embolism; COVID-19; Catheter-Directed-Thrombolytic Therapy; Lytic Therapy; Submassive Pulmonary Embolism

Abbreviations

MT: Mechanical Thrombectomy; ED: Emergency Department; tPA: Tissue Plasminogen Activator; USCDT: Ultrasound-Facilitated Catheter-Directed Thrombolysis; PASP: Pulmonary Artery Systolic Pressure

Introduction

COVID-19 is associated with vascular inflammation and thromboembolic complications [1]. Management of submassive pulmonary embolism continues to evolve and includes anticoagulants with heparin, lytic therapy, and mechanical thrombectomy [2]. Concerning systemic thrombolytics in patients with COVID-19 thromboembolism, reports suggest bleeding complications in COVID-19 patients [3]. Lytic therapy is more effective than heparin anticoagulant alone [4]. This can be administered systemically or by direct catheter placement in the pulmonary artery. Although mechanical thrombectomy (MT) has increased in use for submassive pulmonary embolism, no randomized control trials have been conducted. This case report describes our successful experience using catheter-directed lytic therapy in a patient with submassive pulmonary embolism and COVID-19 pneumonia.

Case Presentation

A 38-year-old male presented initially with sudden onset shortness of breath, hypoxia, and generalized weakness shortly after returning from a plane trip. The patient was diagnosed with Covid-19. Subsequently, he had low-grade fevers. His blood pressure in the ED was 138/62, heart rate was 71 and SpO₂ was 88% on room air. Chest X-ray (Figure 1) shows bilateral diffuse airspace hazy opacification, and a computed tomography scan of the chest with contrast (Figure 2) shows evidence of parenchymal infiltrates in all lobes and bilateral

submassive pulmonary embolism. The echocardiographic image (Figure 3) shows signs of right heart strain. After a multidisciplinary meeting, it was decided to proceed with catheter-directed lytic therapy.



Figure 1: Chest X-ray showing diffuse airspace hazy opacification.



Figure 2: Computed tomography image demonstrating saddle embolus at the bifurcation of pulmonary artery.

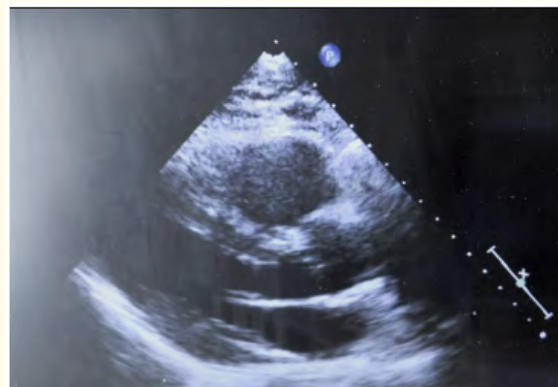


Figure 3: Echocardiographic image demonstrating the incidence of right heart strain.

In the hybrid room, under ultrasound guidance and fluoroscopy, the right internal jugular vein was accessed, and a 7 Fr vascular sheath was placed. An additional access point was established adjacent to the first site, leading to a 6 Fr vascular sheath placement. A 5 Fr RC2 catheter and a 0.035-inch Terumo Advantage wire were introduced through the sheath, enabling catheterization of the main pulmonary artery. A pulmonary angiogram (Figure 4) confirmed the presence of a saddle embolus. Pressure measurements were obtained, which were normal at 15/9/12 mmHg. Further catheterization of the left and right pulmonary arteries was performed, and infusion catheters were accurately placed. 0.5 mg/hr of tissue plasminogen activator (tPA) through each pulmonary artery infusion catheter (for a total of 1 mg/hr tPA) was delivered, and the Infusion rate was adjusted to Q 6 H fibrinogen as per protocol for a total infusion time of 24 - 48 hrs. Post-procedure the patient was monitored for any complications.

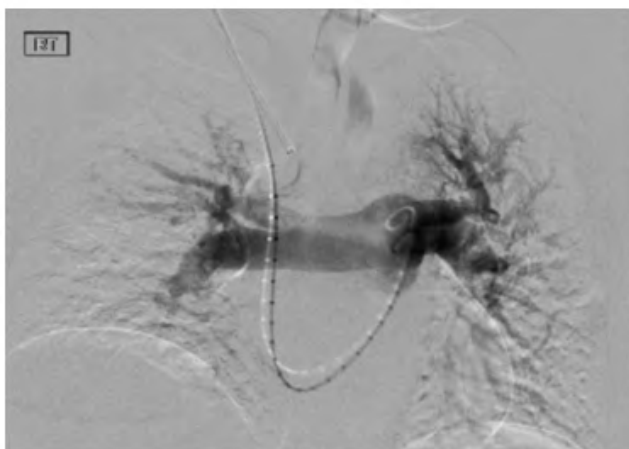


Figure 4: Pulmonary angiogram image demonstrating saddle pulmonary embolus.

Results

Follow-up CT angiography (Figure 5) conducted two days later revealed near total clearance of the bilateral PE clot burden. The pulmonary clot burden and right heart strain were significantly reduced, and near-complete resolution of the emboli in the pulmonary arteries was achieved.



Figure 5: Follow-up computed tomography image showing significant decrease in Pulmonary clot burden.

Discussion

Catheter-directed thrombolysis (CDT) involves catheter insertion into thrombi, often coupled with high-frequency ultrasound waves (US-CDT) that enhance the binding of tPA to fibrin [5-7]. In some studies, CDT appears promising in reducing pulmonary pressure and right ventricular dysfunction (RVD). The ULTIMA trial found a decreased RV/LV ratio with US-CDT compared to using heparin alone, and the SEATTLE II showed improvements in RV/LV ratio, mean pulmonary artery systolic pressure (PASP), and clot burden in massive and submassive PE with US-CDT [8,9]. While the OPTALYSE PE trail revealed reductions in RV/LV ratios and clot burden with US-CDT, there were associated bleeding risks [10]. Some studies, like the SEATTLE II trial, observed higher significant bleeding rates, potentially addressable through dose reductions [9].

A case was reported in 2022 in which catheter-directed thrombolytic therapy successfully treated a COVID-19 patient with intermediate-risk pulmonary embolism and high bleeding risk, resulting in a safe recovery in four days [11].

Paul D. Stein., *et al.* conducted a retrospective cohort study based on Nationwide Inpatient Sample data. Catheter-directed thrombolysis was investigated as a potential treatment for sub-massive pulmonary embolism (PE). The study analyzed outcomes in 13,130 hospitalized patients with PE and acute cor pulmonale. Among these patients, 1,500 (11%) received catheter-directed thrombolysis, while 11,630 (89%) were treated with anticoagulants alone. The findings revealed that catheter-directed thrombolysis was associated with lower in-hospital all-cause mortality than anticoagulants, mainly when administered within the first 3 days. The study concluded that catheter-directed thrombolysis reduces mortality risk in sub-massive PE cases while maintaining low associated risks [12].

Another study by Sarah Gorgis., *et al.* analyzed 192 consecutive patients who received ultrasound-facilitated catheter-directed thrombolysis (USCDT) for submassive pulmonary embolism (PE) between January 2013 and February 2019. Another group of 192 patients with acute PE treated with anticoagulation alone (AC) was identified through propensity matching. Baseline characteristics were similar between the groups. Results showed that the USCDT group had a significant reduction in mean systolic pulmonary artery pressure (CPAP) compared to the AC group and a more substantial improvement in right ventricular (RV) dysfunction. Patients who underwent USCDT exhibited lower 30-day, 90-day, and 1-year mortality. The study suggests that USCDT in submassive PE patients improved mortality outcomes, enhanced RV function, and a more significant reduction in CPAP compared to AC alone [13].

A study was conducted by Tyler L. Bloomer., *et al.* This study comprises a two-center registry for acute PE patients treated with catheter-directed thrombolysis (CDT) and a meta-analysis of contemporary CDT studies. The registry included 137 patients, showing low rates of major complications (9.4%) and a decrease in invasive pulmonary artery systolic pressure (PASP). The meta-analysis covered 16 studies with 860 patients, demonstrating a significant complication rate of 4.65% and improvement in PASP and right ventricular to left ventricular (RV/LV) ratio. In-hospital mortality was higher in massive PE (12.9%) than in submassive (0.74%) [14].

Using a single-center registry by Theresa M. Kline., *et al.* 102 patients with submassive PE were assessed for ultrasound-facilitated catheter-directed thrombolysis (USAT) versus anticoagulation alone. Bleeding rates were comparable between groups (2.0% USAT vs. 5.9% control). Patients with bleeding had lower fibrinogen levels. USAT showed no significant fibrinogen depletion or intracranial hemorrhage, indicating potential safety [15].

Conclusion

In conclusion, the utilization of catheter-directed lytic therapy demonstrated notable success in effectively resolving emboli and alleviating right heart strain, and it could be regarded as a primary treatment option for individuals afflicted by submassive pulmonary embolism concomitant with COVID-19. However, additional, comprehensive studies are essential to validate the consistent effectiveness of such interventions among similar patient populations.

Disclosures

Consent was obtained or waived by all participants in this study. Conflicts of interest: In compliance with the ICMJE uniform disclosure form, all authors declare the following: Payment/services info: All authors have declared that no financial support was received from any organization for the submitted work. Financial relationships: All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. Other relationships: All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

Bibliography

1. Han Huan., *et al.* "Prominent changes in blood coagulation of patients with SARS-CoV-2 infection". *Clinical Chemistry and Laboratory Medicine* 58.7 (2020): 1116-1120.
2. Nguyen Phillip C., *et al.* "Submassive Pulmonary Embolism: Current Perspectives and Future Directions". *Journal of Clinical Medicine* 10.15 (2021): 3383.
3. Boira Ignacio., *et al.* "Major Bleeding Complications in COVID-19 Patients". *Cureus* 13.8 (2021): e16816.
4. Siordia Juan Arturo and Amanpreet Kaur. "Catheter-directed Thrombolysis versus Systemic Anticoagulation for Submassive Pulmonary Embolism: A Meta-Analysis". *Current Cardiology Reviews* 18.1 (2022): 112-117.
5. Owens Charles A. "Ultrasound-Enhanced Thrombolysis: EKOS EndoWave Infusion Catheter System". *Seminars in Interventional Radiology* 25.1 (2008): 37-41.
6. Francis CW., *et al.* "Ultrasound accelerates transport of recombinant tissue plasminogen activator into clots". *Ultrasound in Medicine and Biology* 21.3 (1995): 419-424.
7. Siddiqi F., *et al.* "Binding of tissue-plasminogen activator to fibrin: effect of ultrasound". *Blood* 91.6 (1998): 2019-2025.
8. Kucher Nils., *et al.* "Randomized, controlled trial of ultrasound-assisted catheter-directed thrombolysis for acute intermediate-risk pulmonary embolism". *Circulation* 129.4 (2014): 479-486.
9. Piazza Gregory., *et al.* "A Prospective, Single-Arm, Multicenter Trial of Ultrasound-Facilitated, Catheter-Directed, Low-Dose Fibrinolysis for Acute Massive and Submassive Pulmonary Embolism: The SEATTLE II Study". *JACC: Cardiovascular Interventions* 8.10 (2015): 1382-1392.
10. Tapson Victor F., *et al.* "A Randomized Trial of the Optimum Duration of Acoustic Pulse Thrombolysis Procedure in Acute Intermediate-Risk Pulmonary Embolism: The OPTALYSE PE Trial". *JACC: Cardiovascular Interventions* 11.14 (2018): 1401-1410.
11. Kocas Betül Balaban and Kadriye Kilickesmez. "Catheter-directed thrombolysis in a COVID-19 patient complicated with pulmonary embolism". *Turkish Journal of Emergency Medicine* 22.1 (2022): 54-57.
12. Stein Paul D., *et al.* "Catheter-Directed Thrombolysis in Submassive Pulmonary Embolism and Acute Cor Pulmonale". *The American Journal of Cardiology* 131 (2020): 109-114.
13. Gorgis Sarah., *et al.* "Ultrasound-assisted catheter-directed thrombolysis versus anticoagulation alone for management of submassive pulmonary embolism". *Journal of Cardiology* 80.5 (2022): 441-448.

14. Bloomer Tyler L., *et al.* "Safety of catheter-directed thrombolysis for massive and submassive pulmonary embolism: Results of a multicenter registry and meta-analysis". *Catheterization and Cardiovascular Interventions: Official Journal of the Society for Cardiac Angiography and Interventions* 89.4 (2017): 754-760.
15. Kline Theresa M., *et al.* "Ultrasound-assisted catheter-directed thrombolysis versus systemic anticoagulation alone for submassive pulmonary embolism". *Journal of Thrombosis and Thrombolysis* 52.1 (2021): 130-137.

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