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CASE REPORT

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VA-ECMO-assisted aspiration thrombectomy in a patient presenting with acute massive PE with absolute contraindications to thrombolytics

Mit Patel MD | **Mark Mujer MD** | **Alan John MD** | **Amir Darki MD, MSc**

Loyola University Medical Center, Maywood, Illinois, USA

Correspondence
Mit Patel, MD, Loyola University Medical Center, 2160S 1st Ave, Maywood, IL 60153, USA.
Email: Mit.r.patel@luhs.org

Abstract

Massive pulmonary embolism (PE) is a life-threatening complication of major surgery with a mortality rate up to 50%. First-line therapy for massive PE is systemic thrombolytics, but surgical patients are at high bleeding risk with absolute contraindications. As surgical thrombectomy carries a high burden of morbidity and mortality, endovascular interventions are becoming more common in these clinical scenarios. We report a case of a neurosurgical patient whose postoperative course was complicated by massive PE and subsequent cardiac arrest that required emergent venoarterial extracorporeal membrane oxygenation, followed by aspiration thrombectomy with the Inari FlowTriever Device (Inari Medical). The patient had immediate hemodynamic improvement with eventual recovery to baseline functional status.

KEYWORDS
cardiogenic shock, pulmonary embolism, Inari FlowTriever, VA-ECMO

1 | INTRODUCTION

Venous thromboembolism (VTE) is associated with a significant clinical and economic burden accounting for an annual incidence of 300,000–600,000 in the United States.[1] Pulmonary embolism (PE) remains the most common preventable cause of in-hospital death.[2] Surgery is a major transient risk factor for VTE, increasing the risk fivefold.[3] Furthermore, patients presenting with massive PE have a mortality rate of up to 30%–50%.[2,4,5] Postoperative massive PE poses a significant challenge as recent surgery is often an absolute contraindication to systemic tissue plasminogen activator (tPA) due to bleeding risks.[6] In such cases, surgical thrombectomy is often possible but carries a high morbidity and mortality rate.[7,8] Alternative therapies such as endovascular interventions have been more frequently used in patients with acute PE and contraindications to systemic tPA.[7] In recent years, there have been reported cases of venoarterial extracorporeal membrane oxygenation (VA-ECMO) being described to stabilize patients with acute massive PE.[9] In this report, we describe a complex clinical scenario where a postoperative neurosurgical patient suffers from cardiopulmonary arrest secondary to obstructive shock from massive PE, requiring hemodynamic support with VA-ECMO followed by aspiration thrombectomy.

2 | CASE SERIES

A 63-year-old male with a history of meningioma, status post resection 1 month before presentation, was transferred to our medical center with suspected meningitis. The patient underwent endoscopic endonasal repair of the cerebrospinal fluid leak and

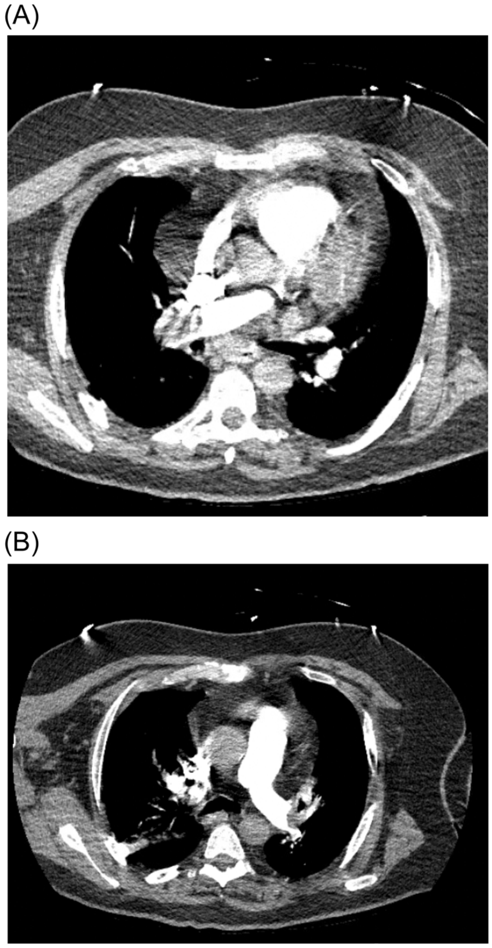

FIGURE 1 Computed tomography demonstrating large pulmonary emboli in the right (A) and left (B) main pulmonary arteries with occlusion.

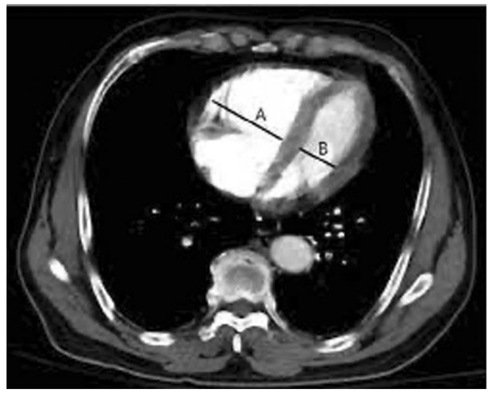

FIGURE 2 Computed tomography of the heart demonstrating a right ventricle to left ventricle ratio of 2.7.

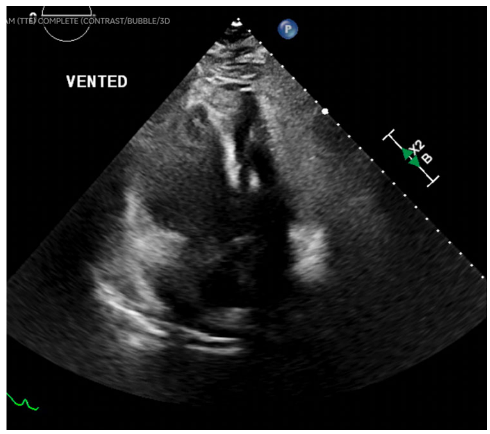

FIGURE 3 Transthoracic echocardiogram demonstrating right ventricular enlargement and strain with underfilled left ventricle. [Color figure can be viewed at wileyonlinelibrary.com]

lumbar drain placement with neurosurgery. On postoperative day 5, the patient suddenly became acutely unresponsive and had pulseless electrical activity cardiac arrest. Return of spontaneous circulation (ROSC) was obtained after 18 min of cardiopulmonary resuscitation, however, the patient remained in severe cardiogenic shock with increasing markers of ischemia, including elevated lactate of 13.0 mmol/L and troponin of 2.50 ng/ml. The patient required support on multiple vasopressors and maximal ventilatory support. Approximately 3 h after ROSC was obtained, computed tomography identified a large burden of acute bilateral, proximal emboli of the right and left main pulmonary arteries (Figure 1) with a marked increase in the right ventricle to left ventricle ratio to 2.7 (Figure 2). Transthoracic echocardiogram demonstrated significantly reduced right ventricular systolic function with underfilling of the left ventricle due to right ventricular dilation and pressure overload (Figure 3). There was emergent activation of the pulmonary embolism response team (PERT). Due to recent intracranial neurosurgery, the patient had an absolute contraindication to systemic tPA and catheter-directed thrombolysis.[6] Furthermore, given severe obstructive shock, the patient was not hemodynamically stable for surgical thrombectomy. As a result, after multidisciplinary discussion, it was decided to pursue aspiration thrombectomy with venoarterial extracorporeal membrane oxygenation (VA-ECMO) support, as this had the most favorable risk-benefit profile for the patient.

2.1 | Procedure

The patient was emergently brought to the catheterization lab. Percutaneous access was obtained in the left common femoral artery and vein and peripheral VA-ECMO was initiated, approximately 12 h after ROSC was obtained. The heparinized VA-ECMO flow was sustained at 4.5 L/min. The patient's hemodynamics improved but continued to remain labile throughout the case. The patient was started on inhaled epoprostenol at this time. Next, percutaneous access was obtained in the right common femoral vein to perform aspiration thrombectomy. A right heart catheterization was performed demonstrating moderate pulmonary hypertension with reduced cardiac output. Subsequently, a planning

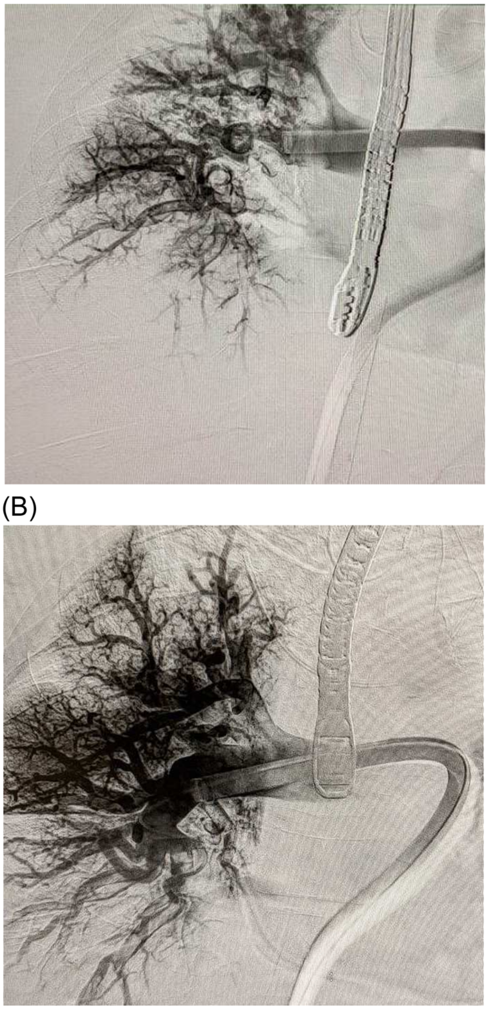

FIGURE 4 (A) Baseline pulmonary angiogram with filling defects in the interlobar and segmental branches. (B) Postcatheterization pulmonary angiogram with a resolution of filling defects.

pulmonary angiogram was performed demonstrating occlusive filling defects in the right interlobar and basilar branches with the absence of perfusion (Figure 4A). The patient had been supported on VA-ECMO for approximately 25 min at this time. With the aid of the pulmonary angiogram, aspiration thrombectomy was performed multiple times via the Inari FlowTriever Suction Device (Inari Medical) with significant thrombus removal (Figure 5) and immediate improvement in hemodynamics. A post-thrombectomy pulmonary angiogram demonstrated restoration of perfusion in the interlobar and basilar branches (Figure 4B). Given the improvement of invasive hemodynamics and right ventricular systolic function on intraprocedure transesophageal echocardiogram, the patient was decannulated from the ECMO circuit approximately 14 h from initial ROSC. The patient remained on a Heparin drip after decannulation from the ECMO circuit to prevent a recurrence of embolization. To conclude, a retrievable infrarenal inferior vena cava filter was placed, and the patient was transferred to the intensive care unit. A follow-up transthoracic echocardiogram

FIGURE 5 Aspirated embolism obtained during thrombectomy. [Color figure can be viewed at wileyonlinelibrary.com]

FIGURE 6 Follow-up transthoracic echocardiogram demonstrating resolution of right ventricular strain and improved left ventricular function. [Color figure can be viewed at wileyonlinelibrary.com]

demonstrated improvement in both right and left ventricular function (Figure 6). The patient was extubated on postoperative day 11 and the patient was discharged to rehabilitation on a postoperative day 27 with near baseline cognitive status. The patient was doing functionally well after discharge at a follow-up PERT clinic appointment, 2 months following cardiac arrest.

3 | DISCUSSION

Massive PE is a rare but life-threatening form of VTE that poses a significant challenge in postoperative patients.[1,4,6] In patients with contraindications to systemic tPA, endovascular interventions are now increasingly favored over traditional surgical thrombectomy due to decreased rates of morbidity and mortality.[7,8,10] Aspiration thrombectomy with the Inari FlowTriever Device (Inari Medical) has been previously shown to have favorable outcomes in patients with submassive PE, right ventricular strain, and contraindications to thrombolytics.[10,11] Furthermore, VA-ECMO has been described in previous reports as a bridge to therapy in hemodynamically unstable patients with massive PE.[9,12] In our case of severe post-obstructive cardiogenic shock due to massive PE, VA-ECMO was able to immediately stabilize the patient and provide hemodynamic support during aspiration thrombectomy for effective thrombus removal. Furthermore, although aspiration thrombectomy may not have removed all thrombus from the vasculature, the ongoing heparinization during VA-ECMO and subsequent continuation of the Heparin drip likely treated residual emboli and prevented recurrence. As a result of the timely multidisciplinary intervention, the patient was able to make a substantial recovery to a high-functioning baseline.

Other case reports have described hemodynamic support with VA-ECMO during endovascular thrombectomy, and current guidelines reference aspiration thrombectomy as an alternative if thrombolytics fail.[13] Specifically, a case report by Stadler et al. describes a patient with postoperative PE following trauma surgery from a motor vehicle accident and in whom VA-ECMO assisted aspiration thrombectomy was performed after thrombolytics failed to improve hemodynamics.[14] However, our case, to the best of the authors' knowledge, demonstrates VA-ECMO and aspiration thrombectomy of massive PE in a postcardiac arrest patient in whom thrombolytics were absolutely contraindicated, which has not been previously reported. The interventions utilized in this case can serve as an option for future massive PE patients in whom systemic thrombolytics is contraindicated. Many massive PE patients would not benefit from VA-ECMO given the potential complications, including infection, limb ischemia, and thrombosis. Specifically, postoperative patients who cannot receive any anticoagulation are at risk for massive thrombosis given the extravasation of blood into the ECMO circuit and the hypercoagulative state following surgery. The converse is true as well, as postoperative patients who have received thrombolytics are at risk for increased bleeding while on the ECMO circuit due to recent surgery. Therefore, this protocol should be reserved for the most hemodynamically unstable patients with massive PE who can tolerate anticoagulation, as that provides the best risk-benefit profile for success. Furthermore, surgical thrombectomy must be reserved as an alternative if aspiration thrombectomy fails to produce an improvement in hemodynamics. Lastly, this case also demonstrated the value of a rapid response, multidisciplinary PERT team in facilitating an emergent intervention for a decompensating patient, further adding to the increasingly studied benefits of PERT deployment for newly diagnosed PE.[15]

4 | CONCLUSION

Our report demonstrates the successful application of VA-ECMO during aspiration thrombectomy in a critically ill patient with cardiac arrest following massive PE. VA-ECMO can serve to hemodynamically support patients in severe obstructive shock to allow for endovascular thrombectomy. The protocol utilized in this case can provide guidance in future critically ill patients presenting with acute massive PE for whom systemic thrombolytics are contraindicated.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

ORCID

Mit Patel https://orcid.org/0000-0003-4421-2999

REFERENCES

1. Essien EO, Rali P, Mathai SC. Pulmonary embolism. *Med Clin North Am*. 2019;103(3):549-564. doi:10.1016/J.MCNA.2018.12.013
2. White RH, Zhou H, Romano PS. Incidence of symptomatic venous thromboembolism after different elective or urgent surgical procedures. *Thromb Haemost*. 2003;90(3):446-455. doi:10.1160/TH03-03-0152/ID/JR0152-3
3. Geerts WH, Bergqvist D, Pineo GF, et al. Prevention of venous thromboembolism: American College of Chest Physicians evidence-based clinical practice guidelines (8th edition). *Chest*. 2008;133(6): 381S-453S. doi:10.1378/CHEST.08-0656
4. den Exter PL, van Es J, Klok FA, et al. Risk profile and clinical outcome of symptomatic subsegmental acute pulmonary embolism. *Blood*. 2013;122(7):1144-1149. doi:10.1182/BLOOD-2013-04-497545
5. Anderson FA, Spencer FA. Risk factors for venous thromboembolism. *Circulation*. 2003;107(SUPPL. 23):9-16. doi:10.1161/01.CIR.0000078469.07362.E6
6. Igneri LA, Hammer JM. Systemic thrombolytic therapy for massive and submassive pulmonary embolism. *J Pharm Pract*. 2020;33:74-89. doi:10.1177/0897190018767769
7. Licha CRM, McCurdy CM, Maldonado SM, Lee LS. Current management of acute pulmonary embolism. *Ann Thorac Cardiovasc Surg*. 2020;26(2):65. doi:10.5761/ATCS.RA.19-00158
8. Stein PD, Matta F. Case fatality rate with pulmonary embolectomy for acute pulmonary embolism. *Am J Med*. 2012;125(5):471-477. doi:10.1016/j.amjmed.2011.12.003
9. Guliani S, Gupta JD, Osofsky R, et al. Venoarterial extracorporeal membrane oxygenation is an effective management strategy for massive pulmonary embolism patients. *J Vasc Surg Venous Lymphat Disord*. 2021;9(2):307-314. doi:10.1016/J.JVSV.2020.04.033
10. Toma C, Khandhar S, Zalewski AM, D'Auria SJ, Tu TM, Jaber WA. Percutaneous thrombectomy in patients with massive and very high-risk submassive acute pulmonary embolism. *Catheter Cardiovasc Interv*. 2020;96(7):1465-1470. doi:10.1002/CCD.29246
11. Wible BC, Buckley JR, Cho KH, Bunte MC, Saucier NA, Borsa JJ. Safety and efficacy of acute pulmonary embolism treated via large-bore aspiration mechanical thrombectomy using the Inari FlowTriever device. *J Vasc Interv Radiol*. 2019;30(9):1370-1375. doi:10.1016/J.JVIR.2019.05.024
12. Giraud R, Laurencet M, Assouline B, de Charrière A, Banfi C, Bendjelid K. Can VA-ECMO be used as an adequate treatment in massive pulmonary embolism. *J Clin Med*. 2021;10(15):3376. doi:10.3390/JCM10153376
13. Konstantinides Sv, Meyer G. The 2019 ESC guidelines on the diagnosis and management of acute pulmonary embolism. *Eur*

Heart J. 2019;40(42):3453-3455. doi:10.1093/EURHEARTJ/EHZ726
14. Stadler S, Debl K, Ritzka M, Maier LS, Sossalla S. Bail-out treatment of pulmonary embolism using a large-bore aspiration mechanical thrombectomy device. *ESC Heart Fail*. 2021;8:4318-4321. doi:10.1002/ehf2.13571
15. Wright C, Goldenberg I, Schleede S, et al. Effect of a multidisciplinary pulmonary embolism response team on patient mortality. *Am J Cardiol*. 2021;161:102-107. doi:10.1016/J.AMJCARD.2021.08.066

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