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Veno-Arterial Extracorporeal Membrane Oxygenation and Thrombectomy for Massive Pulmonary Embolism

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ABSTRACT

Massive pulmonary embolism (PE) is associated with high mortality rates. Pulmonary Embolism Response Team (PERT) collaboration with prompt access to veno-arterial extracorporeal membrane oxygenation (VA ECMO) during mechanical or aspiration thrombectomy for massive PE can be life-saving; ECMO stand-by should be considered for high-risk cases. We describe a case of massive PE treated with intraprocedural VA ECMO during catheter-directed intervention.

INTRODUCTION

Massive pulmonary embolism (PE), defined as PE accompanied by profound hemodynamic compromise (sustained systolic blood pressure (SBP) < 90 mmHg, bradycardia < 40 bpm), has been associated with a mortality ranging from 15-80% [Jaff 2011]. We present a patient with massive PE treated collaboratively with catheter-directed intervention (CDI) and intraprocedural veno-arterial extracorporeal membrane oxygenation (VA ECMO).

CASE REPORT

A 75-year-old woman with past medical history of endometrial cancer currently in remission presented to the emergency department (ED) with a seven-day history of constipation and a one-day history of dyspnea, bilateral lower extremity swelling, and palpitations. She was noted to be tachycardic, borderline hypotensive with SBP in the mid-90s, and hypoxic. Initial laboratory studies revealed leukocytosis (WBC: 13.1 k/uL), lactic acidosis (6.3 mmol/L), troponinemia (0.81 ng/mL), and BNP of 657 pg/mL. COVID-19 PCR was negative. Electrocardiogram demonstrated atrial fibrillation with the rapid ventricular response and right bundle branch block. Computed tomography pulmonary angiography demonstrated saddle PE, right heart strain (RV/LV basal diameter ratio in end-diastole ~2.0), and near-complete occlusion of right and left pulmonary arteries with extension into subsegmental arteries. (Figure 1) (**Supplemental Video 1- https://vimeo.com/688410864**) Large thrombi were noted in transit in the right atrium and RV.

The Pulmonary Embolism Response Team (PERT) was activated, and an emergent conference involving medical ICU, interventional radiology (IR), cardiac surgery, and ECMO teams was held. Given the clot in transit and her declining clinical status, a treatment strategy of CDI with medical ICU, cardiac surgery, and ECMO teams present in the IR suite was pursued.

Upon arrival to the IR suite, consideration was given to placing her on ECMO prior to CDI.

Given her body habitus (BMI 34.1), it was felt that percutaneous cannulation was a high risk for vascular complications and that she would not tolerate a femoral cutdown and open

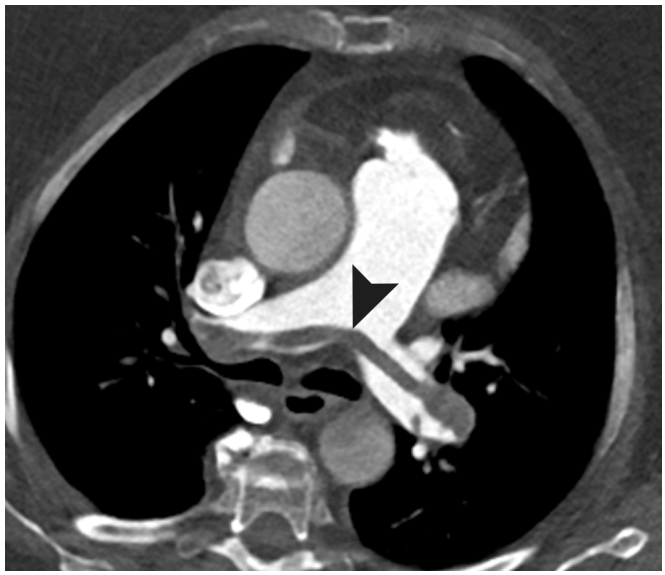

Figure 1. CT scan demonstrating saddle PE

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cannulation without intubation. The decision was made to proceed with CDI, with the ECMO team remaining in the room in anticipation of the need for ECMO. Left femoral arterial and venous access and large-bore right femoral venous access was obtained (24Fr). Aspiration thrombectomy of the right atrial thrombus was performed with the FlowTriever system (Inari Medical, Irvine, Calif.). (Figure 2) Shortly after the removal of the initial thrombus, the patient experienced profound hypoxia and bradycardia, which progressed to pulseless electrical activity. Cardiopulmonary resuscitation (CPR) was initiated, and the patient was emergently intubated and cannulated for VA ECMO via exchanging out the IR sheaths for a 17Fr left femoral arterial cannula (Medtronic, Minneapolis, Minn.) and 23/25Fr two-stage right venous cannula (LivaNova, London, UK). ECMO was initiated after three rounds of CPR, with initial settings of 3.5 LPM blood flow and sweep gas rate of 3LPM with 100% oxygen. Distal perfusion was accomplished via an 8Fr antegrade catheter placed in the right superficial femoral artery.

Once stabilized, the IR team performed additional thrombectomy utilizing the Indigo CAT12 thrombectomy system (Penumbra, Inc.; Alameda, Calif.) via left femoral venous access (Figure 3; Supplemental Video 2), and initiated bilateral catheter-directed thrombolysis (CDT). (Figure 3) (**Supplemental Video 2 - https://vimeo.com/688411692**) The patient was transferred to the ICU on VA ECMO.

Figure 2. Clot burden removed via suction embolectomy prior to initiation of VA ECMO

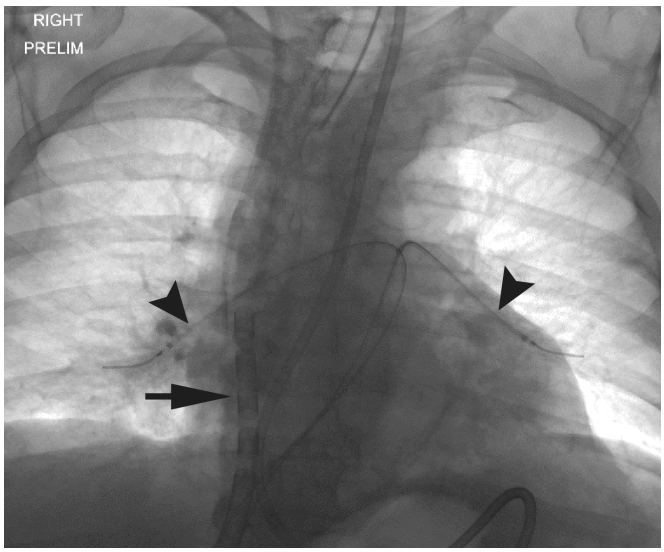

Figure 3. Use of thrombectomy system with concomitant VA ECMO

Transthoracic echocardiogram (TTE) following intervention revealed acutely reduced LV and RV ejection fractions (LV < 15%, RV systolic function severely reduced), with segmental wall motion abnormalities consistent with Takotsubo cardiomyopathy. CDT was continued for 48hrs after which PA pressures were 27/11 (mean 15) mmHg, and the catheters were removed. On post-procedural day 3, repeat TTE demonstrated complete recovery of biventricular function, and the patient was decannulated from VA ECMO. She was discharged on hospital day 24 to a skilled nursing facility and has since returned home. She was seen in follow-up in the IR and Vascular Medicine clinics at 2 months with minimal deconditioning.

DISCUSSION

VA ECMO is a life-saving adjunct in the management of patients presenting with massive PE [Al-Bawardy 2019; Pasrija 2018]. Here, ECMO was considered during initial PERT discussion and utilized to rescue from cardiopulmonary arrest during CDI. First-line therapy of massive PE is typically systemic thrombolytic therapy in the absence of contraindications. Some have advocated for utilization of VA ECMO for massive PE with signs of end-organ dysfunction, with surgical embolectomy reserved for patients whose emboli do not resolve with systemic anticoagulation [Pasrija 2018]. CDI, such as mechanical or aspiration thrombectomy, and CDT represent additional options, which avoid the risks of surgical embolectomy and the inflammatory cascade of cardiopulmonary bypass. This collaborative approach to VA ECMO for massive PE may better facilitate the utilization of limited resources while optimizing patient outcomes, which is especially important in the backdrop of the ongoing COVID-19 pandemic [Myc 2020].

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