Case report

Catheter directed thrombolysis combined with ECMO for massive pulmonary emboli

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ABSTRACT

This case report discusses a previously healthy young male who suffered an in hospital cardiac arrest, found to be secondary to massive pulmonary emboli (PE). This patient was not a candidate for PE dosing of tPA, but continued to have worsening cardiogenic shock and acute hypoxic respiratory failure. The decision was made to initiate venoarterial extracorporeal membrane oxygenation (VA ECMO) in combination with catheter assisted thrombolysis.

With time, the sequelae of his disease process changed. Although his cardiogenic shock improved, the hypoxemia worsened, and the patient was transitioned from VA to venovenous (VV) ECMO, while managing further complications due to multiple episodes of cardiac arrest and severe coagulopathy with multiple, acute, life-threatening bleeding events.

Albeit a growing field, VA and VV ECMO are less than common, individually; however, this case report outlines the even rarer event of transition from VA to VV ECMO in combination with catheter assisted thrombolysis treatment via the EKOS EndoWave Infusion Catheter System. Providing care for critically ill patients often demands a collaborative effort between multiple specialties. This case report exemplifies this collaboration, leading to the combination and unification of alternative treatments: ECMO and catheter assisted thrombolysis.

1. Introduction

The following case report discusses a previously healthy young male who suffered an in hospital cardiac arrest, found to be secondary to massive pulmonary emboli. Although an unfortunate event, this led to a collaborative effort from Interventional Cardiology team as well as the Critical Care extracorporeal membrane oxygenation (ECMO) team. Albeit a growing field, VA and VV ECMO are less than common, individually; however, this case report outlines the even rarer event of transition from VA to VV ECMO in combination with catheter assisted thrombolysis treatment via the EKOS EndoWave Infusion Catheter System.

2. Case presentation

A 38 year old Caucasian male presented to the emergency department of an academic medical center hypotensive and hypoxic. He reported complaints of shortness of breath as well as a syncopal event at home. His past medical history was significant for asthma, atopic dermatitis, and alcohol abuse. His family history was significant for recurrent deep vein thromboses (DVT) and pulmonary emboli (PE) of unknown etiology in his father. After initial stabilization in the emergency department, the patient was admitted to a general medicine floor with acute hypoxic respiratory failure that was initially presumed to be an asthma exacerbation.

The following day, due to persistent hypoxia and tachycardia, an EKG was obtained which revealed S1Q3T3 (Image 1), and the patient was transported for CT scan further evaluation of PE. Unfortunately, prior to transfer back to the floor, the patient sustained cardiac arrest while in the CT scanner. The patient underwent advanced cardiac life support with CPR and emergent endotracheal intubation. After twenty minutes of CPR, patient had return of spontaneous circulation. The CT chest did reveal large near occlusion of bilateral main pulmonary arteries by thromboembolism (Image 2).

A variety of therapies exists as options for treatment of hemodynamically unstable patients with massive PE. One of these options is systemic thrombolysis; however, our patient was not a candidate for PE dosing of tPA due to prolonged cardiopulmonary resuscitation. Another consideration for these patients is surgical intervention, which limits the amount of systemic anticoagulation and resultant bleeding.

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complications. However, perioperative mortality is higher in patients with hemodynamic instability, and our patient was not felt to be stable enough to be a candidate for surgical thrombectomy due to multiple code events. Instead, Interventional Cardiology was consulted for catheter directed thrombolysis and the Critical Care team was consulted for ECMO evaluation.

Emergently, ECMO cannulas for VA ECMO (6 French braided antegrade arterial sheath, Brand: Biometicus from Medtronic, Femoral artery: 18 gauge femoral vein: 25 gauge) and ECMO was initiated (flow rate 3.7 LPM (3.2–4.8 LPM) with anticoagulation goal ACT: 180–220). Simultaneously, bilateral 18mm EKOS catheters (EKOS EndoWave Infusion Catheter System) were inserted for catheter-guided PA thrombolysis. A two mg tPA bolus was infused in each EKOS catheter simultaneously, with subsequent initiation of a 12 hour alteplase infusion at a rate of 1mg/hr per catheter. During the procedure, the patient arrested several times, but return of spontaneous circulation was achieved each time in less than 2 minutes.

He was then transferred to the cardiovascular intensive care unit for further management of VA ECMO, EKOS catheter directed tPA infusion, as well as supportive measures including vasopressors, mechanical ventilation, broad spectrum antibiotics, therapeutic cooling post-arrest and continuous renal replacement therapy for an acute kidney injury. Although the ECMO circuit was heparin coated, due to large clot burden and use of tPA, a decision to continue heparin infusion was made. Transthoracic echo revealed a left ventricular ejection fraction of 25% with severe reduced right ventricular systolic function.

Ten hours after placement of EKOS catheters and initiation of VV ECMO, the patient was noted to be profoundly anemic, with an acute drop in his hemoglobin from 13.0 at admission to 4.9. The tPA infusion was immediately discontinued. In total, patient received the initial 2 mg tPA bolus plus 1 mg/hr infusion for ten hours of the previously planned 12 hour infusion via the EKOS catheters.

Blood products were transfused, and hemoglobin and hematocrit were closely monitored. A chest x-ray revealed a large effusion with concern for a hemothorax, possibly from injury related to prolonged cardiac compressions followed by TPA infusion. Further imaging studies were obtained to evaluate for hemothorax, and a CT chest revealed an area of active extravasation adjacent to the right fifth rib consistent

![Image 1](image1.jpg)

![Image 2](image2.jpg)
with active bleeding, possibly secondary to intercostal artery injury with rib fracture with a right chest wall hematoma. However, embolization could not be attempted due to lack of active extravasation. Ultimately, a large bore chest tube was placed with substantial blood return (3.1L).

His hospital course was further complicated by Streptococcus pneumoniae bacteremia, pneumonia, and ARDS. Despite these critical complications and multiple code events, patient stabilized for the next two days with a promising neurologic exam; he continued to be alert and following commands when off sedation. Additionally, his oxygenation and cardiac function improved, allowing the ECMO flows to be weaned.

On hospital day eight, patient sustained a short cardiac arrest again with rapid return of spontaneous circulation, prompting repeat CT scans of his chest and head. A CT scan chest showed continued enlargement of the right hemothorax, worrisome for repeat active bleeding. In addition, a repeat CT scan head revealed a small interval hemorrhage in the bilateral occipital lobes with local mass effect but no midline shift. With worsening hemothorax, labile hemodynamic status, and new hemorrhagic conversion of brain infarcts, there was a need for discontinuation of anticoagulation, however patient continued to have ongoing clotting of the heparin-coated ECMO circuit. With this in mind, a surgical exploration of the thoracic bleeding and possible conversion to VV ECMO with lower ACT goal was deemed essential for control of bleeding and survival of the patient. In consultation with the cardiothoracic surgical team, a decision to convert from VA to veno-venous (VV) ECMO (RIJ 21 french, R femoral vein 25 vein, Flow 6LPM, Brand Biometicus from Medtronic) with simultaneous exploration of right hemithorax was made. In the operating room, patient was converted from VA to VV ECMO, and four liter of hematoma was evacuated from the chest; no active site of bleeding was found. Heparin infusion was withheld for 6 hours, however due to the continued clotting the ECMO circuit, heparin infusion was restarted with ACT goal to a lower threshold (160–180).

Over the following 12 hours, the hemodynamic status improved and the patient was able to be quickly weaned from VV ECMO and decan- nulated 18 hours post-surgical exploration (hospital day 9) along with placement of IVC filter. Further systemic anticoagulation was able to be discontinued in the setting of acute intracranial hemorrhage. Unfortunately, repeat CT head imaging showed increasing hematoma and hemorrhages, so patient underwent a hemicraniotomy and evacuation of hemorrhage.

After the neurosurgical intervention, patient’s neurologic exam again improved dramatically with increased alerterness and the ability to follow commands in all four extremities. Repeat transthoracic echo showed marked improvement in both left and right ventricular function with a left ventricular ejection fraction of 70% and only slight right ventricular dysfunction. After twenty-two days of hospitalization, including nine days of ECMO therapy, the patient was discharged.

3. Discussion

Due to several episodes of cardiac compressions, he suffered from rib fractures leading to hemothorax while fully anticoagulated for ECMO following TPA infusion. As ECMO therapy continues to grow, so will the associated challenges and triumphs. Although a growing field, VA and VV ECMO are performed relatively infrequently. We feel, this case is unique in that the patient had EKOS directed thrombolysis while on VA ECMO, underwent a conversion from VA to VV ECMO subsequently, had neurological complication and still made full recovery. Literature reports conversion from VV to VA ECMO [1] and transition from VV to VA-venous ECMO with success [2]. This defines a different successful strategy to manage life-threatening cardiac arrest and severe, life-threatening respiratory failure and hemodynamic compromise secondary to PE.

Another unique feature of this case is that we placed patient on VA ECMO immediately post-cardiac arrest. Although, technically not an ECPR, we placed the patient on VA ECMO immediately post-cardiac arrest. Literature suggests that the survival rates for adult ECPR are very low (25–50% for VA ECMO and 50–70% for VV ECMO) [3]. With renewed interest in ECMO, improved ECMO awareness, better equipment/circuits/catheters, we may start to see improved survival rates for adult ECPR.

In summary, this patient suffered from acute bilateral pulmonary embolism with multiple episodes of cardiac arrest and course that was complicated by severe coagulopathy with multiple, acute, life-threa- tening bleeding events. Thanks to a collaborative effort between multiple teams: the Critical Care ECMO team for mechanical support; the Interventional Cardiology team for EKOS catheter directed thrombo- lysis; Nephrology team providing continuous renal replacement therapy; the Neurology consulting team contributing invaluable in- formation; and the Neurosurgical and Cardiothoracic teams providing life saving interventions; the patient was successfully resuscitated, stabilized, and survived to be discharged.

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Appendix A. Supplementary data

Supplementary data related to this article can be found at http://dx.doi.org/10.1016/j.rmcr.2018.05.029.

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