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CASE REPORT

EkoSonic Endovascular System and RP Impella Support Acute Right Ventricular Failure From Massive Pulmonary Embolism

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Pulmonary embolism (PE) is now the third most common cause of cardiovascular-related death in the United States after myocardial infarction and stroke.[1] The high mortality in patients with submassive and massive PE, which comprises about 45% of all PEs, results in part from overly conservative treatment, even though the patients are critically ill. Patients with submassive or massive PEs who arrive to the emergency department have a high mortality risk because they are either mistakenly undertreated for acute coronary syndrome (ACS) and subsequently decompensate quickly under the ACS pathway. These patients are undertreated with intravenous anticoagulation, which prevents the clot from progressing but doesn't treat the existing clot. In addition, patients treated with systemic thrombolysis have a 3% risk of intracranial hemorrhage.[2,3]

We treat nearly all patients with submassive and massive PEs with ultrasound-accelerated catheter-directed thrombolysis (the EKOS System) in our institution if they have no contraindications for tPA because we've found it to be the most effective aggressive therapy. The EKOS technology allows us to deliver about 25% of the standard dose of tPA used for systemic thrombolysis, minimizing the risk of bleeding. The ULTIMA and SEATTLE II studies found no intracranial hemorrhages and no significant bleeding events in patients who received EKOS therapy at the lower dose. The ultrasound energy, in combination with the tPA, penetrates the fibrin strands and dissolves the clot.

CASE PRESENTATION

A 60-year-old male patient, with a history of deep vein thrombosis (DVT), presented to the emergency department in respiratory distress with a blood pressure of 76/30 and swelling in his right calf. The retired science teacher and avid amateur nature photographer reported that he had

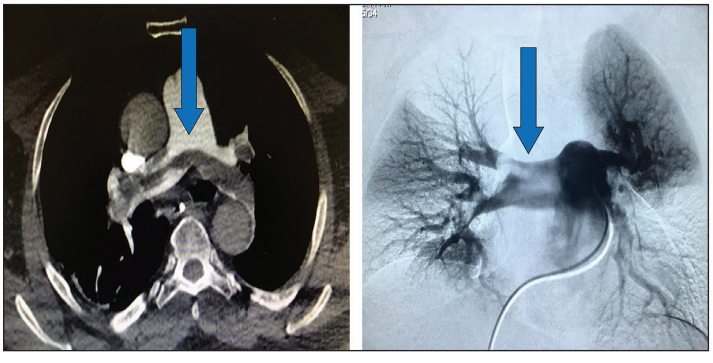

Figure 1. CT scan and pulmonary angiogram.

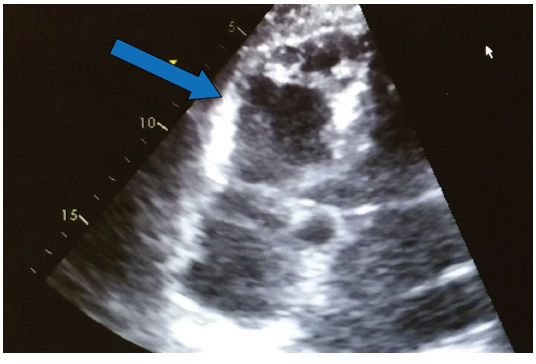

Figure 2. Dilated right ventricle with McConnell's sign.

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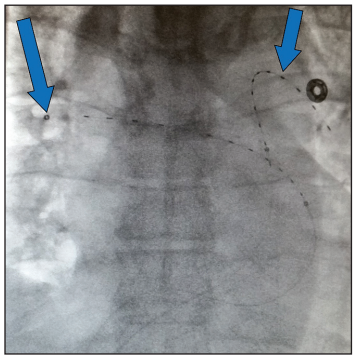

Figure 3. Bilateral EKOS.

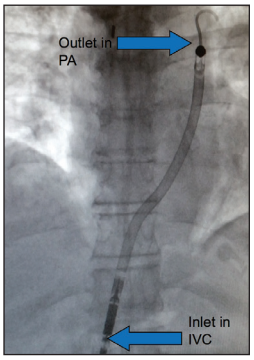

Figure 4. RP Impella.

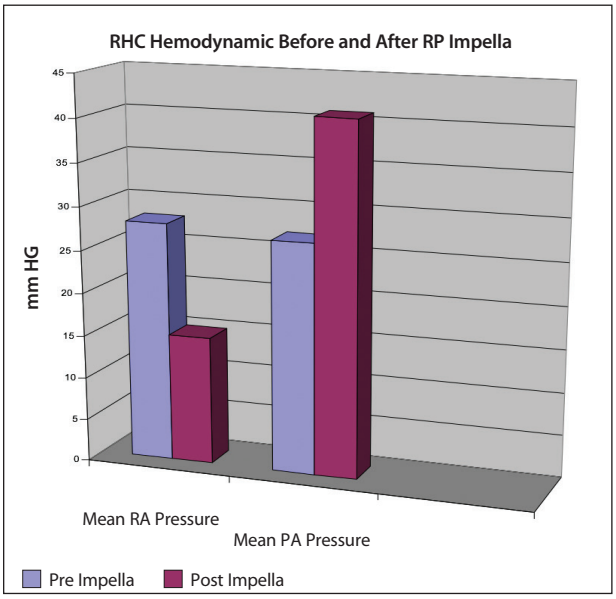

Figure 5. Improvement in hemodynamic data.

severe pain in his right leg for 2 days. He had stopped taking anticoagulants as directed by his physician without any bleeding complications.

With a high suspicion for PE, we ordered a CT scan, which confirmed massive PE. The RV/LV ratio was > 1. The Pulmonary Embolism Severity Index (PESI) score was 132, a class V PE with a very high mortality rate of 10% to 24.5% in 30 days. The echocardiogram showed McConnell's sign, which supported the massive PE diagnosis (Figures 1 and 2).

We immediately brought the patient to the cardiac cath lab due to his unstable vital signs. His mean right arterial (RA) pressure was 28, and pulmonary artery (PA) pressure was 65/38. He had right ventricular (RV) failure with a PulmonaryArtery Pulsatility Index (PaPi) score of < 1. The pulmonary angiogram confirmed saddle PE, and we decided to perform bilateral EKOS catheter-directed thrombolysis. We gave a 5-mg bolus of tPA to each pulmonary artery and started the patient on tPA with the EKOS System at 1 mg per hour for 2 hours followed by 0.5 mg per hour for 6 hours–a total of 20 mg of tPA (Figure 3).

The repeated pulmonary angiogram 24 hours later showed improved lung perfusion with near resolution of PE. However, the patient's right ventricular failure did not recover. His blood pressure was still low, and he needed vasopressor support. The repeated echo also showed a dilated and hypokinetic right ventricle. We decided to proceed with right ventricular mechanical support with the RP Impella until his right ventricle recovered (Figure 4). Following the Impella placement, his RA pressure was 17/19/15 mm Hg, and his RV pressure was 55/11/15 mm Hg. His PA pressure was 58/32/41 mm Hg (Figure 5).

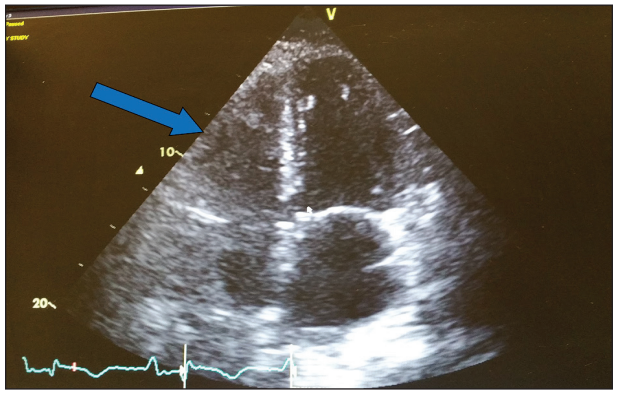

Figure 6. Recovered right ventricle.

Seventy-two hours after we inserted the Impella, the repeated echo showed better right ventricular function. We were able to wean down the RP Impella and then remove it uneventfully. A day later, the patient was discharged home. A week later, an echo showed that he had near-normal right ventricular function (Figure 6). He was advised to take anticoagulants for the rest of his life.

In our experience at Detroit Medical Center, most patients recover from right ventricular failure due to hemodynamic insult from PE with catheter-mediated thrombolysis with the EKOS System. Rarely does a patient require temporary hemodynamic support with the RP Impella such as this patient did. With the combination of these two technologies, we can improve patients' care and the rapid recovery of their right ventricles, reducing morbidity and mortality from PE.

The EKOS System is a welcome tool to treat PE, allowing us to provide aggressive treatment to the most unstable patients and with better outcomes than with systemic thrombolysis. Thus far, we have successfully treated over 200 patients with EKOS technology without direct complications. ■

1. Goldhaber SZ, Bounameaux H. Pulmonary embolism and deep vein thrombosis. Lancet. 2012;379:1835-1846.
2. Piazza G, Hohlfelder B, Jaff MR, et al. A prospective, single-arm, multicenter trial of ultrasound facilitated, low-dose fibrinolysis for acute massive and submassive pulmonary embolism: the SEATTLE II study. J Am Coll Cardiol Intv. 2015;8:1382-1392.
3. Kucher N, Boekstegers P, Müller OJ, et al. Randomized, controlled trial of ultrasound-assisted catheter-directed thrombolysis for acute intermediate-risk pulmonary embolism. Circulation. 2014;129:479-486.