

CASE REPORT

Emergent mechanical thrombectomy for right atrial clot and massive pulmonary embolism using flowtriever

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Abstract

This case demonstrated a feasible alternative to treat "clot in transit" associated with pulmonary embolism using FlowTrieve Inari device. The pre-existing approved AngioVac device requires extracorporeal circulation support and more invasiveness. FlowTrieve permits mechanical thrombectomy with versatile approach without additional extracorporeal perfusion setting. Additional studies are required to reach a definitive conclusion.

KEYWORDS

clot in transit, FlowTrieve, pulmonary embolism, right heart thrombus

1 | INTRODUCTION

The association of right heart thrombus (RiHT) and massive pulmonary embolism (PE) has an incidence of 4%-18%. It is a life-threatening condition that requires emergent diagnosis and treatment with reported fatal outcomes up to 21% in 14 days. Endovascular mechanical thrombectomy of right heart clot has been described focused on the use of AngioVac (AngioDynamics, Latham, NY, USA); however, a recent report supported the safety of image guided FlowTrieve (Inari Medical Inc, Irvine, CA, USA). Our case report describes the use of FlowTrieve device as a feasible alternative to treat clot in transit and massive PE when thrombolysis is contraindicated.

Alternative therapies to massive or submassive pulmonary embolism (PE) include surgical embolectomy, systemic thrombolysis, and endovascular catheter directed lysis. In patients with contraindication to thrombolysis, mechanical thrombectomy can restore pulmonary circulation and avoid

cardiogenic shock. Surgical thrombectomy is a tool for patients with rapid hemodynamic deterioration, clot-in-transit within the right heart, or when an underlying right-to-left shunt is present.¹ The 2011 American Heart Association and the 2019 European Society of Cardiology (ESC) guidelines recommend surgical pulmonary embolectomy or percutaneous catheter-direct treatments as alternative in patients with contraindications to receive fibrinolysis, or patients who remain unstable after thrombolysis.^{2,3} Reported complications of the surgical approach included rethrombosis risk, post-operative bleeding, cardiac tamponade, and sternal wound infection.⁴

The AngioVac device (AngioDynamics, Latham, NY USA) offers an important alternative to surgical thrombectomy for right heart thrombus (RiHT) with a success rate reported up to 87% in a literature review including 28 patients.⁵ However, the reported success for pulmonary embolism (PE) was significantly lower at 12.5%. The complication rate was up to 12% (Total of 56 patients treated) including fatal

retroperitoneal hemorrhage or right ventricular perforation.^{6,7} A recent case report described the use of FlowTrieve (Inari Medical Inc, Irvine, CA, USA) under transthoracic echocardiography (TTE) guidance for mechanical thrombectomy of right intra-atrial thrombus with instantaneous and marked decrease in clot burden and pulmonary reperfusion and hemodynamic recovery. It also described the benefit of less blood loss than the AngioJet (Boston Scientific, Inc USA) and Penumbra systems (Penumbra, Inc USA).⁷ We report the use of FlowTrieve device as a modality to treat clot in transit and massive PE when thrombolysis is contraindicated.

2 | CASE REPORT

A 53-year-old man with a past medical history of high-grade glioma and recent brain surgery presented to emergency department (ED) after a syncopal episode. His head computed tomography (CT) was negative for intracranial hemorrhage or infarct. Simultaneous Chest CT-PE protocol (2 mm slices) noted large saddle pulmonary embolism with significant clot burden (Figure 1A, B). It revealed a “snake-like” thrombus in the right atrium suggesting free-floating clot with significant right heart (RH) strain (Figure 2A, B). The N-terminal pro-B-type natriuretic peptide (NT-proBNP) was 832 pg/mL (Ref Range: ≤ 300 pg/mL) and Troponin I 0.91 ng/mL (Ref Range: 0.00 - 0.03 ng/mL). Electrocardiogram showed inversion of T waves in AVR, AVF, III, and V1 leads; QR pattern in AVF, V1, and III leads. Bilateral lower extremities venous

Doppler's reported acute vein thrombosis in the left popliteal vein. The patient was transferred to the intensive care unit (ICU) with a heart rate (HR) of 127 beats/min, systolic blood pressure of 120 mmHg, and peripheral capillary oxygen saturation (SpO₂) of 92% on 6 liters of oxygen in a non-rebreather. Full anticoagulation with unfractionated Heparin was started. The use of thrombolysis was precluded given his neurological status. Interventional radiology and cardiothoracic surgery (CTS) were consulted for possible mechanical thrombectomy of pulmonary embolism and clot in the right atrium (RA).

The patient was sedated and monitored by cardiovascular anesthesia. Additional venous and arterial 6 Fr vascular sheaths were inserted to anticipate any urgent transition to extracorporeal membrane oxygenation (ECMO). Through a right common femoral vein approach, a catheter was advanced into the inferior vena cava (IVC). IVCgram demonstrated clot extending from the IVC into the RA (Figure 3A, B). Given the potential risk of dislodging clot that could increase the PA pressure, the Trieve20 catheter (Inari Medical Inc, Irvine, CA, USA) was inserted for mechanical thrombectomy. Suction thrombectomy was performed at the level of the IVC confluence and RA under fluoroscopic guidance. Moderate amount of clot was aspirated (Figure 4), and resolution was confirmed with a follow-up cavogram. The main pulmonary artery (PA) was accessed using a 6 Fr, 100 cm Vert catheter. The initial mean PA pressure was elevated (46/13 mmHg, mean of 38 mmHg). Pulmonary angiography demonstrated extensive saddle embolism (Figure 5A, B, C).

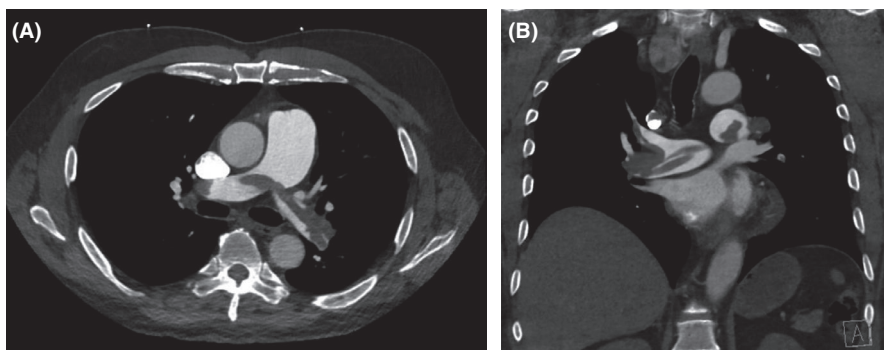


FIGURE 1 a. b. Axial (1a) and coronal (1b) CT images show saddle pulmonary embolus extending from the main pulmonary artery (PA) into both the right and left main pulmonary artery

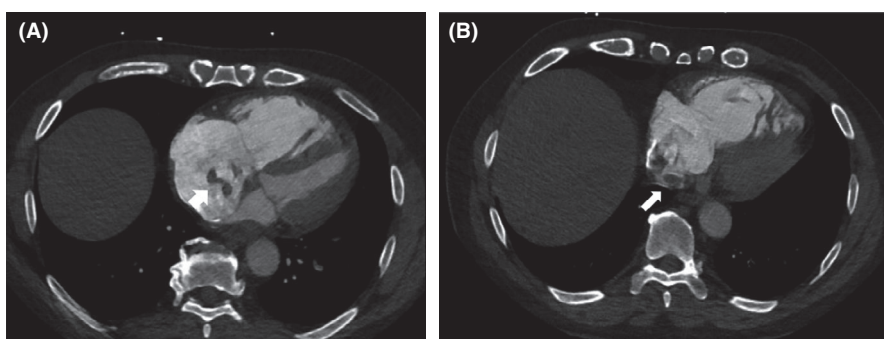


FIGURE 2 a. b. Axial CT sections showing the 4 chamber view of heart showing the right atrial clot in transit (White arrows) and the abnormal high RV/LV diameter ratio > 1 suggesting right heart strain

FIGURE 3 a. b. IVC gram at different levels shows the filling defect at the cavoatrial junction (White arrow) and extending into the right atrium consistent with the CT findings

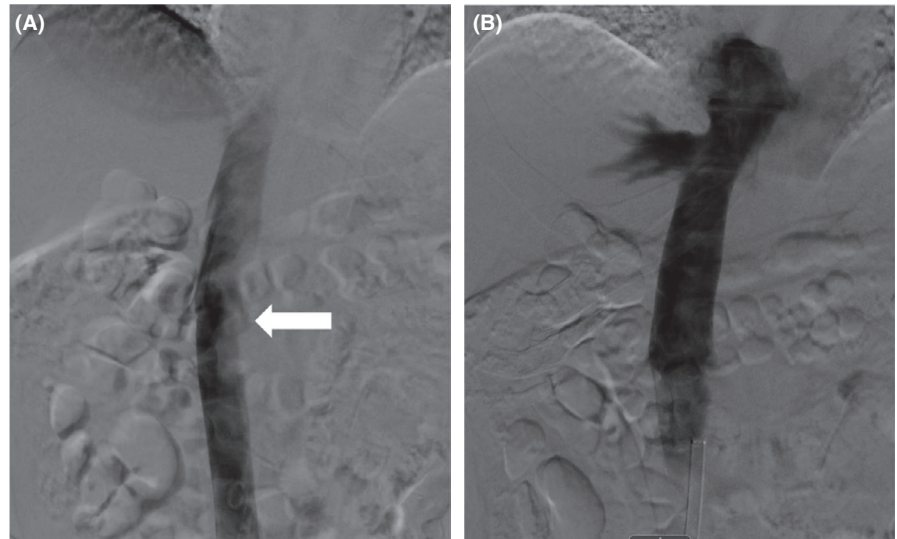


FIGURE 4 Aspirated clot through the FlowTrier

Next, the Trierer20 catheter was advanced to the left PA and a large amount of clot was retrieved from the segmental branches with minimal residual thrombus. The self-expanding

nitinol disks of the device were not required given the results obtained with aspiration. The same intervention was repeated in the main and right PA with improvement of PA pressures (28/9 mmHg, mean 14mmHg) and oxygen demand. The blood loss was approximately 150 cc and there was no change in the hemoglobin monitored throughout and after the procedure.

One-week follow-up chest CT-PE protocol demonstrated decreased clot burden in the RA and PA without visualization of right heart strain (Figure 6A, B). Subsequent TTE reported no definite RA thrombus. Walking oxygen assessment showed resting SpO₂ of 96% and walking SpO₂ 100% on room air. The patient did not require ECMO and remained in the ICU for 24 hours on heparin infusion. Four days later after the procedure, the patient was discharged on Apixaban for a period of 6 months, decided by the pulmonologist in order to prevent recurrence.

3 | DISCUSSION

RiHT are classified as type A Thrombi, those serpiginous, highly mobile, and with high mortality. Type B Thrombi are less mobile, pedunculated, broad base, and have better prognosis. And type C is an intermediate in all characteristics.⁸ The association of free-floating right heart thrombi and massive pulmonary embolism (PE) has an incidence of 4%-18%.¹ It is a life-threatening condition that requires emergent diagnosis and treatment with reported fatal outcomes up to 21% in 14 days.⁹ Thrombi that are adherent to the RA or right ventricle (RV) wall usually have a more benign prognosis.⁸ However, free-floating, “snake-like” thrombi are uncommon and usually associated with massive unstable pulmonary embolism.^{10,11} Some studies have reported the clot in transit as a predictor of poor outcome.¹² There are no evidence-based guidelines for treatment of

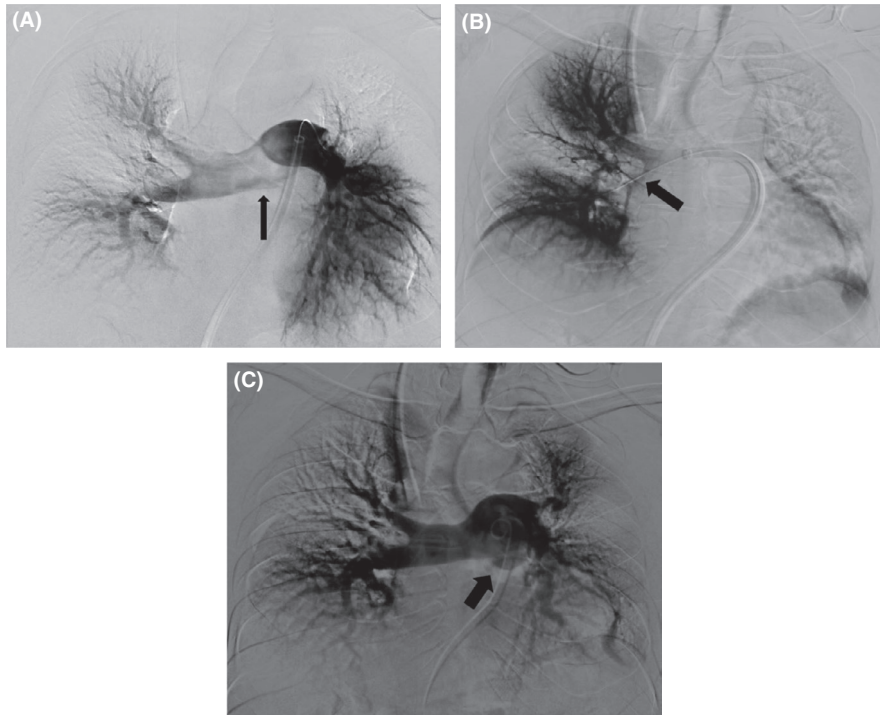


FIGURE 5 a, b, and c. Pulmonary angiography showing the findings of filling defect in the main (a), right (b) and left (c) pulmonary arteries (Black arrows)

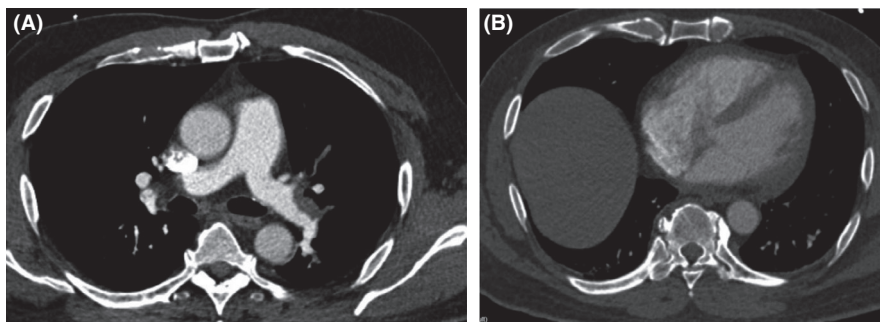


FIGURE 6 Follow-up CT scan shows no residual clot in PA and reduced RV/LV diameter ratio

pulmonary embolism complicated by free-floating RH thrombus.¹³

In a retrospective analysis of 177 cases of right heart thromboembolism and pulmonary embolism in 98% of the cases, the mortality rate associated with no therapy, anticoagulation therapy, surgical embolectomy, and thrombolysis was 100.0%, 28.6%, 23.8%, and 11.3%, respectively.¹⁴ One year later, the European Cooperative Study reported a mortality rate of 60% for anticoagulated patients; 40% for those treated with thrombolytics; and 27% for those submitted to surgical procedures, which suggested the surgical approach to be the most effective.⁹ Although some small case series of RiHT type A showed thrombolytic therapy with a favorable outcome in relation to mortality,⁸ some controversy has arisen with systemic thrombolysis in the treatment of giant right atrial thrombosis and clot fragmentation, with subsequent fatal results related to the development of cardiogenic shock.¹⁵ Until 2017, there were no studies that clearly determined which patients with PE and RiHT would benefit from reperfusion

treatment.¹⁶ With this purpose, the Registro Informatizado de la Enfermedad Trombo Embolica (RIETE) Registry compared the outcome during the first month after treatment of standard anticoagulation therapy (heparin) against reperfusion treatment (including thrombolysis or cardiac surgery). The study did not show differences in survival among patients who received standard anticoagulation compared with the reperfusion therapy.¹⁶ They concluded that reperfusion therapies might be reserved for patients who have acute symptomatic pulmonary embolism, associated hypotension, or shock irrespective of the presence or absence of coexisting RiHT.¹⁶

Few reports of percutaneous treatment of free-floating thrombus in the right atrium and PE have been published, and their results have been promising. In these cases, several types of catheters were used in which they also included direct AngioVac and IVC filters, or a Cook intravascular retrieval.¹⁷⁻²⁰

FlowTrieve System, an FDA approved device for treatment of PE, allows it to be maneuvered into the pulmonary

segmental branches and to aspirate central and more distal pulmonary clot. It permits the use of contrast injections through a coaxial system which enables us to monitor the progress of the intervention. In the multicenter single-arm FLARE (FlowTrier Pulmonary Embolectomy Clinical Study), presented in 2018 on 106 patients with intermediate-risk PE who underwent catheter embolectomy using the FlowTrier catheter, they found the system safe and effective. There was a significant improvement in RV/LV ratio and minimal major bleeding. Potential advantages included immediate thrombus removal, absence of thrombolytic complications, and reduced need for postprocedural critical care.²¹

This report highlights the effectiveness of FlowTrier for mechanical thrombectomy of RiHT and PE in this case although this use is considered “off label”. Limitations described for AngioJet or AngioVac as dysrhythmias, or difficult maneuverability were not found.⁷ Additionally, its use showed a rapid normalization of PA pressure and SpO₂. This method allowed removal of the clot in a high-risk patient who exhibited contraindications to thrombolysis. Indigo CAT (Penumbra) device has been evolving to larger diameters which can be manipulated at a more segmental level, and it is an especially useful alternative for pulmonary embolism; however, the use on right atrium has not been reported.

4 | CONCLUSION

It is feasible to perform mechanical thrombectomy using FlowTrier device in the presence of PE with concomitant clot in transit. FlowTrier permits the simultaneous injection of contrast to evaluate the residual clot burden under fluoroscopic guidance. It requires further investigation to define it as a frontline tool.

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CONFLICT OF INTEREST

The case report followed the Helsinki declaration and was not supported by any funding. The authors declare that they have no conflicts of interest. The data supporting the results are available from the corresponding author.

AUTHOR CONTRIBUTIONS

Maria del Pilar Bayona Molano: performed the case, planned, and wrote the paper. Jason Salsamendi: contributed writing and reviewing the paper. Naganathan Mani: edited the report.

DATA AVAILABILITY STATEMENT

The data for this article is available for review.

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