# Endovascular treatment in an intermediate-high risk pulmonary Embolism but High bleeding risk: A great aspiration time!

## Tratamiento endovascular en embolia pulmonar de riesgo intermedio-alto y alto riesgo de sangrado: ¡Un momento de gran aspiración!

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## ABSTRACT

Pulmonary embolism is the third leading cause of cardiovascular death after myocardial infarction and stroke. We present the case of an 80-year-old woman with hypertension, hypertriglyceridemia, and ventricular extrasystoles, who experienced a sudden onset of dyspnea, NYHA functional class III-IV, and palpitations. Oxygen saturation was 93%, with poor ventilatory mechanics and anemia. A CT scan revealed a right ventricle/left ventricle ratio of 1.3. Echocardiography showed a dilated right ventricle with severe dysfunction and deep vein thrombosis. Biomarkers (TnI, BNP) were elevated, indicating an intermediate-to-high risk with a high bleeding risk. The therapeutic alternative of choice was endovascular treatment consisting of pulmonary arteriography followed by successful thromboaspiration using the FlowTriever device. At three months, the patient experienced no further hospitalizations, exhibited good functional class, and had normal pulmonary pressure.

***Keywords:*** FlowTriever, thrombectomy, pulmonary embolism, pulmonary artery thrombectomy

## RESUMEN

La embolia pulmonar es la tercera causa principal de muerte cardiovascular después del infarto de miocardio y el accidente cerebrovascular. Presentamos un caso de una paciente de 80 años, hipertensión arterial, hipertrigliceridemia, extrasístoles ventriculares, con episodio de disnea súbita CF III-IV asociado a palpitaciones, SO2 93% con mala mecánica ventilatoria, anémica. En tomografía, índice ventrículo derecho/ventrículo izquierdo = 1,3. Por ecocardiograma, ventrículo derecho dilatado, deterioro severo de la función y trombosis venosa profunda. Elevación de biomarcadores (TnI, BNP). Configura riesgo intermedio-alto, con alto riesgo de sangrado. Se decide tratamiento endovascular con arteriografía pulmonar seguido de tromboaspiración exitosa con dispositivo FlowTriever. A 3 meses sigue sin nuevas internaciones, buena clase funcional, presiones pulmonares normales.

***Palabras clave:*** FlowTriever, trombectomía, embolia pulmonar, trombectomía arteria pulmonar.

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## INTRODUCTION

Pulmonary embolism (PE) is the third leading cause of cardiovascular death after myocardial infarction and stroke, with an overall 30-day mortality rate of approximately 10%[1]. Management strategies for PE vary depending on disease severity.

Patients with submassive or intermediate-risk PE who exhibit biochemical evidence of myocardial injury or findings of right ventricular (RV) dysfunction constitute a controversial treatment group. Mortality rates between 7 and 30 days for intermediate-risk PE treated with anticoagulation only range from 2-3% in controlled studies, although registries have reported mortality rates up to 15% over a follow-up period of 7-90 days, with approximately 10% of patients deteriorating into a high-risk category[2].

Adverse outcomes in this population with anticoagulant treatment have prompted consideration of higher-scale therapeutic strategies, whether they be medical therapy, catheter-based treatment, or surgical embolectomy (which is rare). In this study, we present our case of pulmonary artery thrombectomy with a catheter using an endovascular device in a patient with intermediate-to-high risk and a high bleeding risk.

## CLINICAL CASE

Our patient is an 80-year-old female woman with a history of hypertension, hypertriglyceridemia, and ventricular extrasystoles. Her regular medication included losartan 50 mg every 12 hours, bisoprolol 2.5 mg daily, and fenofibric acid 135 mg daily. Regarding her current illness, she experienced a sudden onset of dyspnea (NYHA class III-IV) lasting 2 hours with palpitations, leading her to seek emergency care. Upon physical examination, her blood pressure (BP) was 125/83 mmHg; her heart rate (HR), 112 bpm; oxygen saturation ($SO_2$): 93% ($FiO_2$ 36%); respiratory rate (RR), 38 breaths/min. The patient was lucid with poor ventilatory mechanics, no clinical signs of heart failure, and good peripheral perfusion. Her electrocardiogram showed sinus tachycardia, HR of 110 bpm, axis 45°, complete right bundle branch block, with S1Q3T3 pattern **(Figure 1).**

Her laboratory results indicated hemoglobin at 9.9 g/dL; hematocrit, 30.7% (indicative of iron deficiency); pre-renal kidney dysfunction with creatinine 1.76 mg/dL; BNP,

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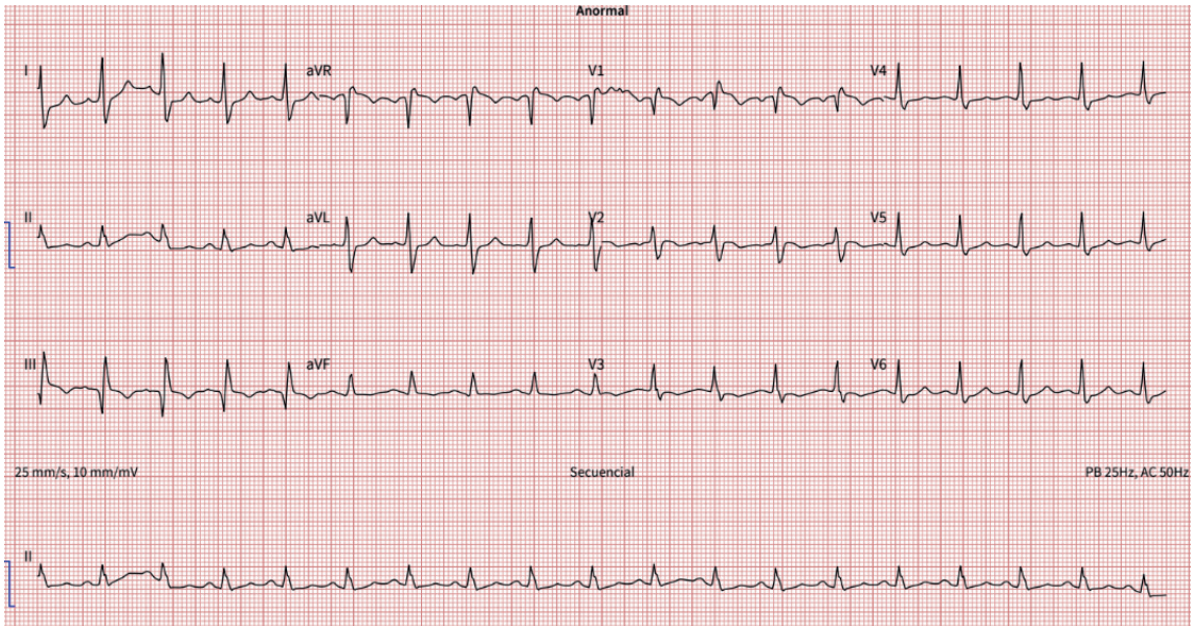


***Figure 1.*** *Complete right bundle branch block with S1Q3T3 pattern..*

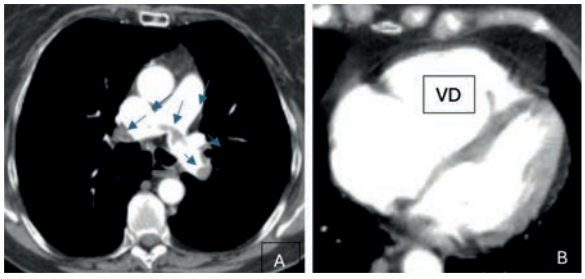


***Figure 2.*** *A. Thrombi in the pulmonary trunk and the right and left branches of the pulmonary artery.B. Right ventricle/left ventricle ratio = 1.3.*

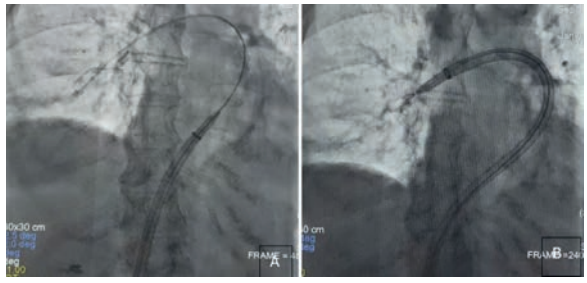


***Figure 3.*** *A. 24-Fr FlowTriever aspiration catheter device advanced through a 24-Fr introducer.B. The Amplatz guidewire is advanced and maintained.*

9000 pg/mL; Troponin I, 193 ng/L. A chest computerized tomography showed that her RV/LV ratio was 1.3 **(Figures 2A and 2B)**. An echocardiography showed a dilated RV (basal diameter, 48 mm; mid-diameter, 51 mm; longitudinal diameter, 59 mm), severe functional impairment, free wall hypokinesia, and tricuspid annular plane systolic excursion (TAPSE): 9 mm. Her pulmonary artery systolic pressure (PASP) was 65 mmHg. A lower limb Doppler ultrasound confirmed deep vein thrombosis (DVT) in the left popliteal vein and the soleus venous plexus. Based on RV dysfunction findings and elevated biomarkers (TnI, BNP), intermediate-to-high risk pulmonary thromboembolism was diagnosed (PESI score IV). Anticoagulation with enoxaparin 1 mg/kg was started.

At 72 hours, the patient remained stable but exhibited increasing oxygen requirements and poor ventilatory mechanics.

A reperfusion strategy was agreed upon and endovascular treatment was chosen due to the high bleeding risk (RIETE[3] score: 5 points, high). The selected alternative included pulmonary arteriography and thromboaspiration using the Inari FlowTriever device (Inari Medical Inc, Irvine, CA, USA). A 24-Fr introducer sheath and a 24-Fr aspiration catheter were used, advancing the device over an Amplatz guidewire. The system allowed thrombi to be filtered and blood reinfused to minimize blood loss **(Figure 3).** A right femoral venous access was obtained under ultrasound guidance, followed by percutaneous closure with a device included in the kit. Additionally, a Swan-Ganz catheter was used to measure hemodynamic parameters. Thrombolysis was not considered as an alternative due to high bleeding risk.

In total, 14 aspirations were performed (**Figure 4**) and significant thrombotic material was filtered and extracted (8 thrombi from the right lung, 6 from the left); filtered blood was reinfused (**Figure 5**). The patient required no supplemental oxygen 24 hours after the procedure, with stable hemoglobin and hematocrit levels.

Her post-procedure hemodynamic parameters were BP 120/80 mmHg, HR 85 bpm, and $SO_2$ 96% (0.21).

At the 2-month follow-up, the patient remained anticoagulated with acenocoumarol, with no new hospitalizations and good functional status. Control echocardiography showed a mildly dilated RV with preserved systolic function and TAPSE 16 mm. Her PASP was 20 mmHg.

## DISCUSSION

The Inari FlowTriever catheter system is a valuable tool in the treatment of pulmonary embolism (PE). It features a thrombectomy catheter with nitinol discs and an aspiration cannula[4-6].

This system is designed for effective emboli aspiration and removal in the pulmonary arteries. Studies have demonstra-

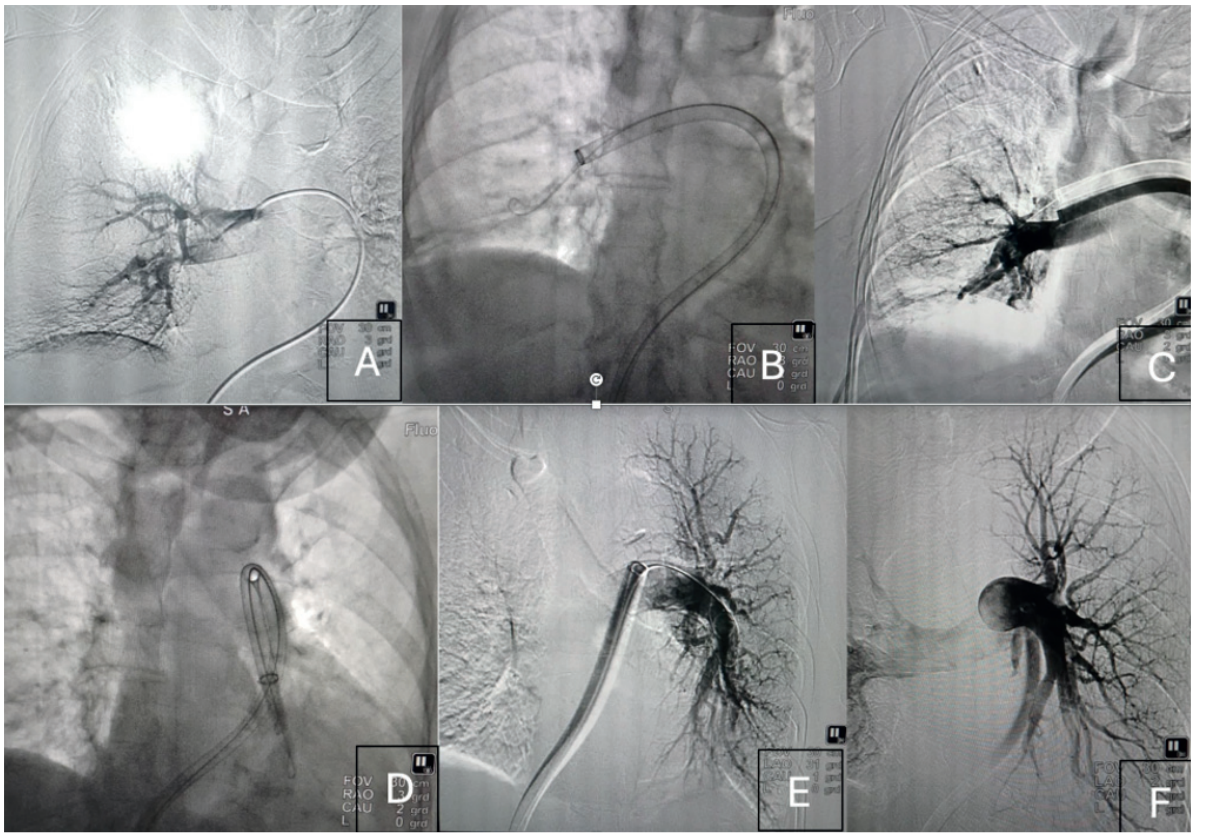


***Figure 4.*** *A. Previous right pulmonary angiography:thrombi.B. Thromboaspiration performed with the guidewire as vascular wall protection.C. Post-right thrombectomy angiography.D. First left pulmonary thromboaspiration.E. Initial test of the left pulmonary artery.F. Left pulmonary angiography.Final result.*

ted successful outcomes using the FlowTriever system in cases of submassive and massive PE[7].

The device has also been used in more complex scenarios, such as clot-in-transit in the right ventricle and in the right atrium, which shows its versatility in managing different PE-related complications[8].

The safety and efficacy of the Inari FlowTriever system have been highlighted in various reports and clinical studies. In a retrospective study by Wible *et al.*[9], which included 46 patients, large-bore mechanical aspiration thrombectomy significantly reduced mean pulmonary artery pressure in massive or submassive PE. Only 2 patients experienced significant procedure-related adverse, and there was no 30-day mortality. The average blood loss associated with aspiration was 280 mL, and only one patient required a transfusion of red blood cell concentrates. All patients survived until hospital discharge; the 30-day mortality rate was 4.3%, and it was not attributed to the procedure or pulmonary embolism. This is a promising "real-world" single-center experience.

The device has been proven effective in reducing clot burden, improving pulmonary reperfusion, and facilitating hemodynamic recovery in patients with acute PE. Additionally, it has been successfully used in challenging scenarios such as cardiac tamponade after catheter manipulation while trying to reach the distal portion of the pulmonary arterial tree, followed by pulmonary embolectomy, further showing its usefulness in challenging situations[10]

Additionally, the FlowTriever system has been employed as rescue treatment for PE in a critical patient undergoing resuscitation with venoarterial extracorporeal membrane oxygenation (VA-ECMO) who suffered from severe acute right heart failure. In this particular high-risk population, where thrombolysis is largely inapplicable, this new technology could be a promising solution, since the combination of aspiration and extraction of large-bore thrombi successfully removes large emboli. In this case, right ventricular function improved rapidly after the procedure, ECMO was discontinued, and the patient was discharged two weeks later[11].

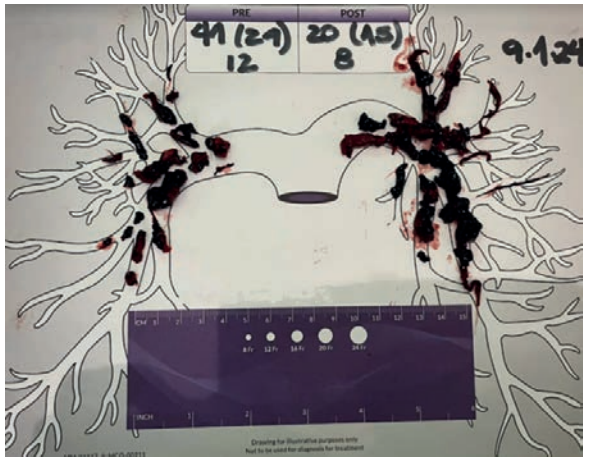


***Figure 5.*** *Thrombi extracted after 14 aspirations—most from the left side.*

The device can also reduce right ventricular strain in patients with acute submassive PE, which emphasizes its role in improving hemodynamic parameters in such cases. A study by Toma *et al.*[12] included 34 patients: 18 with massi-

ve PE, four intubated, and 12 normotensive but with a cardiac index (CI) <1.8. The mean age was 56 years. The patients were at high bleeding risk: 13 had recently undergone surgery (posing a high bleeding risk), six had experienced trauma, and four had recently suffered a stroke. Six patients underwent cardiopulmonary resuscitation, and two required additional mechanical circulatory support. All patients exhibited RV dilation and elevated biomarkers. Clot extraction was successful in 32 out of 34 patients. The CI improved from 2.0±0.1 L/min/m$^2$ before thrombectomy to 2.4±0.1 L/min/m$^2$ after the procedure (p=0.01). Mean pulmonary artery pressure decreased from 33.2±1.6 mmHg to 25.0±1.5 mmHg (p=0.01). Two patients—both with either no thrombus or minimal thrombus extracted—deteriorated during the procedure: one died and the other was successfully stabilized on ECMO. There were no other significant complications. All other patients were alive at the time of data collection (mean follow-up: 205 days). Establishing a registry of pulmonary thrombectomies performed in Argentina using the FlowTriever device, following the example of the rheolytic thrombectomy in pulmonary embolism registry[13], is of the utmost importance.

Such a registry would allow for the systematic evaluation of the safety, efficacy, and long-term outcomes of the FlowTriever device in our population, facilitating comparisons with alternative techniques and devices, and promoting improved clinical decision-making.

## CONCLUSIONS

The FlowTriever aspiration system was effective in this patient with intermediate-to-high-risk PE and high bleeding risk. The procedure, with no complications, was notably safe for this type of intervention.

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