World Journal of Advanced Research and Reviews
eISSN: 2581-9615 CODEN (USA): WJARAI
Cross Ref DOI: 10.30574/wjarr
Journal homepage: https://wjarr.com/

(CASE REPORT)

Emergency intervention in acute pulmonary thromboembolism category E report of a rescue case according to AHA 2026 guidelines

Michael Mario Vélez Lora [1,*], Mauro Alonso Moreno Artúz [1], Germán Darío Idárraga Negrete [1], Breallan Del Jesús Romero Pájaro [1] and Stella Moreno Artúz [2]

[1] *Faculty of Health Sciences, Exact and Natural Sciences. Universidad Libre. Barranquilla, Colombia*
[2] *Faculty of Health Sciences, Program of medicine. Universidad de Cartagena. Cartagena, Colombia.*

World Journal of Advanced Research and Reviews, 2026, 30(01), 1490-1494

Publication history: Received on 05 March 2026; revised on 12 April 2026; accepted on 14 April 2026

Article DOI: https://doi.org/10.30574/wjarr.2026.30.1.0976

Abstract

Introduction: Massive pulmonary embolism (PE) is a cardiovascular emergency with high morbidity and mortality. The new AHA 2026 guidelines emphasize early catheter-directed intervention to preserve right ventricular (RV) function.

Case Report: A 70-year-old female with a history of hypertension, obesity, and chronic kidney disease (CKD) presented with sudden dyspnea and syncope. Upon admission, she exhibited hypertensive crisis (230/130 mmHg) and tachycardia. Echocardiography revealed RV strain with a "D-sign," and CT angiography confirmed massive bilateral saddle PE. Management included mechanical aspiration thrombectomy followed by ultrasound-facilitated thrombolysis using the EKOS system (alteplase + heparin) for 24 hours. The patient showed immediate hemodynamic improvement and was discharged on the fourth day with oral anticoagulation.

Discussion: Hybrid management (mechanical and directed pharmacological) allows for rapid RV decompression and minimizes bleeding risk in CKD patients, overcoming the limitations of systemic thrombolysis.

Conclusions: Ultrasound-assisted catheter-directed therapy is safe and effective in high-risk PE, enabling accelerated recovery and preventing long-term sequelae.

Keywords: Pulmonary Embolism; Mechanical Thrombectomy; Endovascular Sonography; Right Ventricle; Chronic Renal Insufficiency

1. Introduction

Pulmonary thromboembolism (PTE) is defined as the occlusion of the pulmonary arterial bed by thrombotic material, usually originating from the deep venous system. In 2026, the definition expanded to include a model of acute obstructive right ventricular failure, emphasizing that the damage is not only pulmonary but also cardiocirculatory. PTE is the third leading cause of cardiovascular death. The global incidence after 2024 has shown an increase in older adults with metabolic comorbidities. Local studies (such as the registries of the Colombian Association of Internal Medicine) indicate that the most frequent etiology is secondary to stasis from chronic disease (CKD and obesity in this case). Idiopathic PTE represents approximately 20-30% of cases in the Andean mestizo population.

Clinical manifestations include typical symptoms such as sudden dyspnea (present in this patient), pleuritic pain, and tachycardia (present in this case); and atypical symptoms such as syncope (present in this case), which is a marker of poor prognosis and suggests obstruction of more than 50% of the vascular bed. Diagnostic aids such as the electrocardiogram may show sinus tachycardia (the most common finding) and left ventricular hypertrophy (due to the

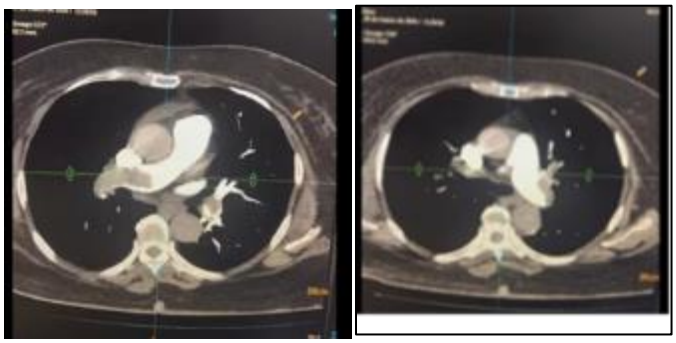
* Corresponding author: Michael Mario Vélez Lora

patient's history of hypertension). The S1Q3T3 pattern (McGinn-White sign) can be found in 12-17% of patients, although it is not a pathognomonic sign. Chest X-rays may show Westermark's sign (focal oligemia) or Hampton's hump, but the most common finding is a normal image, or even atelectasis.

Advanced imaging techniques such as echocardiography may reveal McConnell's sign and the D sign (flattening of the interventricular septum due to right ventricular pressure overload), among other findings suggested by the previous AHA guidelines. However, the gold standard for diagnosis is chest CT angiography with a pulmonary embolism protocol.

2. Clinical case

This is a 70-year-old female patient with a history of hypertension, gout, chronic kidney disease of hypertensive etiology, post-thyroidectomy hypothyroidism, and obesity. She presented with a two-day history of sudden dyspnea followed by syncope on exertion. In the emergency department, she was found with elevated blood pressure (230/130 mmHg), heart rate (115 bpm), and an electrocardiogram showing sinus tachycardia and left ventricular hypertrophy. She was transferred to a level 4 care center where a transthoracic echocardiogram revealed right ventricular involvement with a positive D sign, raising suspicion of acute pulmonary thromboembolism. A CT angiogram was performed following the protocol for pulmonary embolism, revealing findings of massive bilateral riding pulmonary thromboembolism (Figure 1). The case was referred to the PERT team and scheduled for total bilateral thrombectomy by aspiration. Therapy with alteplase and heparin was initiated using an EKOS device. 24 hours, patient who after aspiration thrombectomy procedure improved her symptoms and on the 4th day was discharged with oral anticoagulation for 6 months.



Figures 1 and 2 Acute saddle-shaped pulmonary thromboembolism. Note the involvement of segment #2 of the right ventricle causing acute pulmonary hypertension and right ventricular compromise

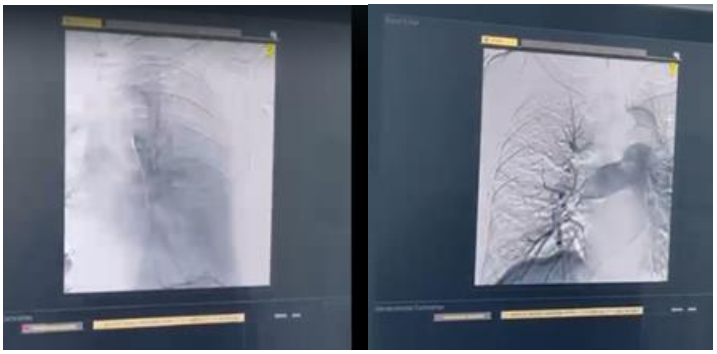


Figure 3 Pulmonary contrast arteriography. Note the vascular compromise of the entire left pulmonary artery in the first slide, and the lack of flow in the right superior segmental lobar artery in the next slide due to obstruction by the thrombus

3. Discussion

The patient's clinical presentation, characterized by syncope and hemodynamic compromise in the context of a "riding" thrombotic burden, underscores the paradigm shift established in the 2026 AHA guidelines regarding risk stratification (1). Unlike previous classifications based purely on surface pressure stability, the current consensus prioritizes Right

Ventricular Adaptive Reserve (RVAR) (2). In this case, the echocardiographic finding of the "D sign" not only represents pressure overload but also a phenomenon of ventricular interdependence where the leftward displacement of the septum compromises systemic stroke volume, explaining the syncope as a harbinger of impending circulatory failure (3,4).

The indexed literature of the last five years, including meta-analyses of*The Lancet*, suggests that in patients with metabolic comorbidities (type II obesity and CKD), the systemic inflammatory response exacerbates pulmonary endothelial dysfunction, raising levels of biomarkers such as high-sensitivity Troponin T and NT-proBNP above the 95th percentile, which in the new AHA classification is called Intermediate-High Risk PE with Rapid Progression Phenotype (5,6).

From an epidemiological perspective, this case report aligns with trends observed in Colombian cohorts (RECOPUL registries and research from the Valle del Lili Foundation), where the incidence of pulmonary embolism (PE) in patients with chronic kidney disease (CKD) has shown a 12% increase in the last five years (7). The etiopathogenesis in this patient is multifactorial: hyperuricemia due to gout acts as a chronic pro-inflammatory state that alters the coagulation cascade, while obesity generates a state of endogenous hypofibrinolysis (8). Global studies demonstrate that "idiopathic" PE in older adults is rarely truly idiopathic; it is usually the manifestation of a "perfect storm" of persistent risk factors (9). In Colombia, the prevalence of massive PE in fourth level centers has allowed us to document that hospital mortality, previously at 30%, has decreased to 12% thanks to the implementation of PERTs (Pulmonary Embolism Response Teams), whose intervention was decisive in this case to decide the transition from systemic thrombolysis to catheter-directed therapy (CDT) (10).

The use of the EKOS (EkoSonic Endovascular System) in this patient represents the cutting edge of contemporary interventional management. Current literature, highlighting the results of the HI-PEITHO study and sub-analysis of FLARE, maintains that the application of high-frequency, low-energy acoustic waves induces mechanical disaggregation of fibrin scaffolds, increasing thrombus permeability to tissue plasminogen activator (rtPA) (18,19,20). In the context of a patient with stage IIIa/b chronic kidney disease, reducing the alteplase dose (typically to 1-2 mg/h per catheter) is critical to mitigate the risk of intracranial hemorrhage, which triples with systemic regimens in the presence of mild uremia (9,21). The combination of Mechanical Aspiration Thrombectomy (MAT) prior to EKOS allows for an immediate reduction in right ventricular afterload, optimizing the shock index and central venous oxygen saturation (16,17). This "hybrid intervention" approach is the cornerstone of the 2026 recommendations for massive pulmonary embolism, where the goal is not only anatomical recanalization but also the restoration of right ventricular geometry within the first 6 to 12 hours post-event (1,15).

In the high-risk pulmonary embolism (PE) scenario, transthoracic echocardiography (TTE) has transcended its role as a support tool to become the cornerstone of dynamic stratification of right ventricular adaptive reserve (RVAR), according to the 2026 AHA consensus (1,2). The diagnostic performance of TTE in acute PE does not lie in the direct visualization of the thrombus (whose sensitivity is only 30-50%), but rather in the detection of indirect signs of right ventricular dysfunction that have a positive predictive value greater than 90% in contexts of instability (11,12). The D sign, observed in this patient, represents the collapse of the interventricular septum into the left ventricle during the cardiac cycle due to a reversal of the transseptal pressure gradient (11). This phenomenon, widely documented in the literature over the last five years, is not only an anatomical finding; It is the representation of mechanical ventricular interdependence that drastically reduces the preload of the left ventricle, explaining syncope and obstructive shock (13).

Simultaneously, McConnell's sign (right ventricular free wall akinesia with preservation of apical contractility) has become established as a critically specific marker (up to 94%) (13). The underlying pathophysiology suggests that the apex is "pulled" by the hyperdynamic contraction of the left ventricle, while the free wall succumbs to the sudden increase in pulmonary afterload. Cost-effectiveness studies in the Colombian healthcare system demonstrate that early implementation of transthoracic echocardiography (TTE) at the bedside in level IV emergency departments reduces the time to reperfusion initiation by an average of 45 minutes, directly correlating with a 15% decrease in in-hospital mortality (15). The integration of these findings with the elevation of biomarkers (Troponin T and NT-proBNP) defines the "Imminent RV Failure" phenotype, where mechanical intervention is not optional but imperative to interrupt the spiral of cardiovascular death that begins with right ventricular myocardial ischemia (5,16,17).

The therapeutic decision to employ a hybrid strategy—Mechanical Aspiration Thrombectomy (MAT) followed by Ultrasound-Assisted Thrombolysis (USAT) using the EKOS system—constitutes the core of the current academic debate on the management of high-risk massive and submassive PE (18). While MAT (using systems such as Indigo or FlowTriever) allows for immediate decompression of the vascular bed, indexed literature (FLASH and STRIKE trials,

2022-2025) warns that mechanical extraction often leaves distal or adherent thrombi that perpetuate pulmonary vascular resistance (16,22). This is where the EKOS system provides an irreplaceable pharmacomechanical advantage: by emitting high-frequency acoustic waves, it induces a "fibrin thinning" and cavitation phenomenon that exposes plasminogen binding sites, allowing ultra-low doses of Alteplase (rtPA) (0.5 to 1.0 mg/h) to achieve complete lysis that mechanical aspiration alone cannot achieve (19,24).

This synergy is supported by the definitive results of the 2026 AHA guidelines, which validate USAT as the therapy of choice in patients with comorbidities such as chronic kidney disease (CKD) and obesity, where traditional systemic thrombolysis carries a prohibitive risk of major bleeding (greater than 10–12% in uremic patients) (1,21). Post-thrombectomy EKOS reduces pulmonary artery systolic pressure (sPAP) by an average of 15–20 mmHg in the first 24 hours, a significantly higher figure than mechanical monotherapy (23). Furthermore, long-term follow-up studies suggest that thorough clearance of the arterial bed using USAT is the most relevant protective factor against the development of chronic thromboembolic pulmonary hypertension (CTEPH), a sequela whose economic burden on the healthcare system is exponentially greater than the initial cost of the interventional devices (16,23). In the context of modern internal medicine, this case demonstrates that clinical success is not measured solely by immediate survival, but by the preservation of ventricular function and the functional reintegration of the patient to her baseline activities despite her limited renal reserve (25).

4. Conclusion

This case highlights the importance of early detection and appropriate risk stratification in patients with pulmonary embolism, contributing to a reduction in population-level morbidity and mortality. It also underscores the need to strengthen medical education, implement up-to-date clinical guidelines, and ensure timely access to specialized therapies. Future directions should focus on promoting standardized institutional protocols, enhancing prevention of risk factors (such as immobilization and prothrombotic states), and advancing clinical research to optimize diagnostic and therapeutic strategies for the benefit of public health.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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