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Case Report

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Pharmacoinvasive Treatment of High-Risk Pulmonary Thromboembolism: A Case Report

Tratamiento farmacoinvasivo en el tromboembolismo pulmonar de alto riesgo: informe de caso

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Abstract

Pulmonary thromboembolism is defined as the sudden obstruction of the pulmonary circulation by an embolus originating from the venous system, most commonly from the lower extremities or the pelvic region. Its most severe form, high-risk pulmonary thromboembolism, presents with acute right ventricular failure, hypotension, or cardiogenic shock. It is among the top five causes of death worldwide. Immediate reperfusion measures, along with cardiovascular and respiratory life support, are required to prevent rapid hemodynamic deterioration and to improve patient survival. We present the case of a patient who arrived at the emergency department with a clinical presentation of acute right ventricular failure due to high-risk pulmonary thromboembolism, treated with a mechanical-pharmacological approach as an alternative to guideline-recommended therapy, resulting in successful recovery.

Keywords: Pulmonary thromboembolism; Acute heart failure; Shock; Catheter-guided fibrinolysis

Resumen

El tromboembolismo pulmonar se define como la obstrucción súbita de la circulación pulmonar por un émbolo proveniente del territorio venoso, generalmente de los miembros inferiores o de la región pélvica. Su forma más grave, el tromboembolismo pulmonar de alto riesgo, se presenta con insuficiencia ventricular derecha aguda, hipotensión o shock cardiogénico; constituye una de las primeras cinco causas de muerte a nivel mundial. Se necesitan medidas de reperfusión inmediata y soporte vital cardiovascular y respiratorio para evitar el rápido deterioro hemodinámico y aumentar la supervivencia de estos pacientes. Se presenta el caso de un paciente que acudió a los servicios de urgencia con cuadro clínico de insuficiencia ventricular aguda por tromboembolismo pulmonar de alto riesgo, tratado con modalidad mecánico-farmacológica como alternativa al tratamiento recomendado por las guías actuales, con lo cual se logró su recuperación.

Palabras clave: *Tromboembolismo pulmonar; falla cardiaca aguda; shock; fibrinólisis dirigida por catéter.*

Introduction

Despite advances in the diagnosis and treatment of pulmonary thromboembolism, this condition remains the third leading cause of death from cardiovascular diseases, after myocardial infarction and cerebrovascular disease. The risk of developing it doubles with each decade of life after the age of 40, making it a disease with high incidence in countries with aging populations.[1-4]

High-risk pulmonary thromboembolism is defined by hemodynamic instability with hypotension, shock, and cardiac arrest, with a mortality rate exceeding 50% within the first hour of presentation.[5]

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It should be suspected in patients presenting with hemodynamic instability accompanied by elevated central venous pressure, after ruling out pericardial tamponade, acute myocardial infarction, and tension pneumothorax. Rapid identification of these patients, together with prompt reperfusion therapy, can significantly reduce mortality. Bedside echocardiography and computed tomography, along with internationally validated scoring systems, are the main diagnostic tools.[5,6]

The objective of this report is to present a treatment option for high-risk pulmonary thromboembolism in low-resource settings, offering a viable alternative to improve patient survival.

Case Report

This case report is that of a 69-year-old male patient with a history of dyslipidemia and former smoker who presented to the emergency department with a one-week history of dyspnea on moderate exertion and sudden onset of dyspnea at rest upon sitting up in bed that morning. He also reported intense, oppressive precordial chest pain radiating to the right side of the back, without relief at rest.

On initial physical examination, the patient exhibited marked tachypnea and an appearance consistent with severe illness. Heart sounds were regular and tachycardic; there was moderate jugular venous distention. Breath sounds were globally decreased, with no crackles appreciated in the lung fields. Vital signs were as follows: blood pressure 80/50 mmHg, heart rate 128 beats per minute, and respiratory rate 32 breaths per minute.

In the emergency department, an electrocardiogram showed sinus tachycardia with no other abnormalities. Portable transthoracic echocardiography revealed a left ventricle with impaired contractility secondary to right ventricular overload, mild (grade 1) mitral regurgitation, and a left ventricular ejection fraction of 28-30%. The interventricular septum was shifted toward the left ventricle, giving it a "D-shaped" appearance. Severe tricuspid regurgitation was observed (maximum velocity of 4.4 m/s, gradient of 70 mmHg), tricuspid annular plane systolic excursion (TAPSE) was 16 mm. The inferior vena cava was not dilated but showed reduced inspiratory collapse, based on which the pulmonary artery systolic pressure was estimated at 90 mmHg. Brain natriuretic peptide was elevated at 1700 pg/mL.

Based on the clinical presentation and echocardiographic findings, the patient was admitted to the intensive care unit with a diagnosis of high-risk pulmonary thromboembolism. Inotropic support with dobutamine and norepinephrine was initiated, and pulmonary angiography and coronary angiography were performed for both diagnostic and therapeutic purposes.

Coronary angiography revealed no significant lesions in the epicardial coronary arteries (**Figure 1**). However, pulmonary angiography demonstrated thrombotic material within the left pulmonary arterial tree, with reduced flow in the upper and middle lobes, as well as thrombi in the right pulmonary artery with reduced flow in all lobes (**Figure 2A**). The pulmonary systolic pressure was 90 mmHg; mean pressure of 50 mmHg, and diastolic pressure of 60 mmHg. These findings confirmed the diagnosis of bilateral pulmonary thromboembolism. Mechanical thrombus fragmentation combined with in situ fibrinolysis via a catheter inserted into the pulmonary artery (alteplase 12.5 mg/h for 3 hours) was performed, achieving improved pulmonary circulation and rapid hemodynamic stabilization (blood pressure, oxygen saturation, and heart rate). After the procedure, treatment with furosemide, sildenafil, rosuvastatin, and inhaled iloprost was initiated.

At 72 hours, a follow-up pulmonary angiography was performed. The left pulmonary arterial tree showed a mild decrease in flow in the upper lobe and minimal thrombotic material. The right pulmonary arterial tree demonstrated improved flow in the middle and lower lobes, with thrombi in the segmental arteries. Pulmonary systolic pressure decreased to 50 mmHg (**Figure 2B**). Low-molecular-weight heparin was then added (initially withheld due to bleeding risk associated with fibrinolysis), and treatment with furosemide, sildenafil, and rosuvastatin was continued. Repeat echocardiography demonstrated improvement in left ventricular segmental contractility and ejection fraction.

At one-week follow-up, the patient was asymptomatic, without dyspnea or chest pain, with normal vital signs and a normal transthoracic echocardiogram (normal chamber sizes, no valvular insufficiency, TAPSE = 24 mm, and left ventricular ejection fraction of 55%). Brain natriuretic peptide decreased to 144 pg/mL. No bleeding complications were observed during the procedure or follow-up. Oral anticoagulation, statins, and beta-blockers were continued due to transient left ventricular dysfunction.

Comment

Pulmonary thromboembolism is defined as the sudden obstruction of the pulmonary circula-

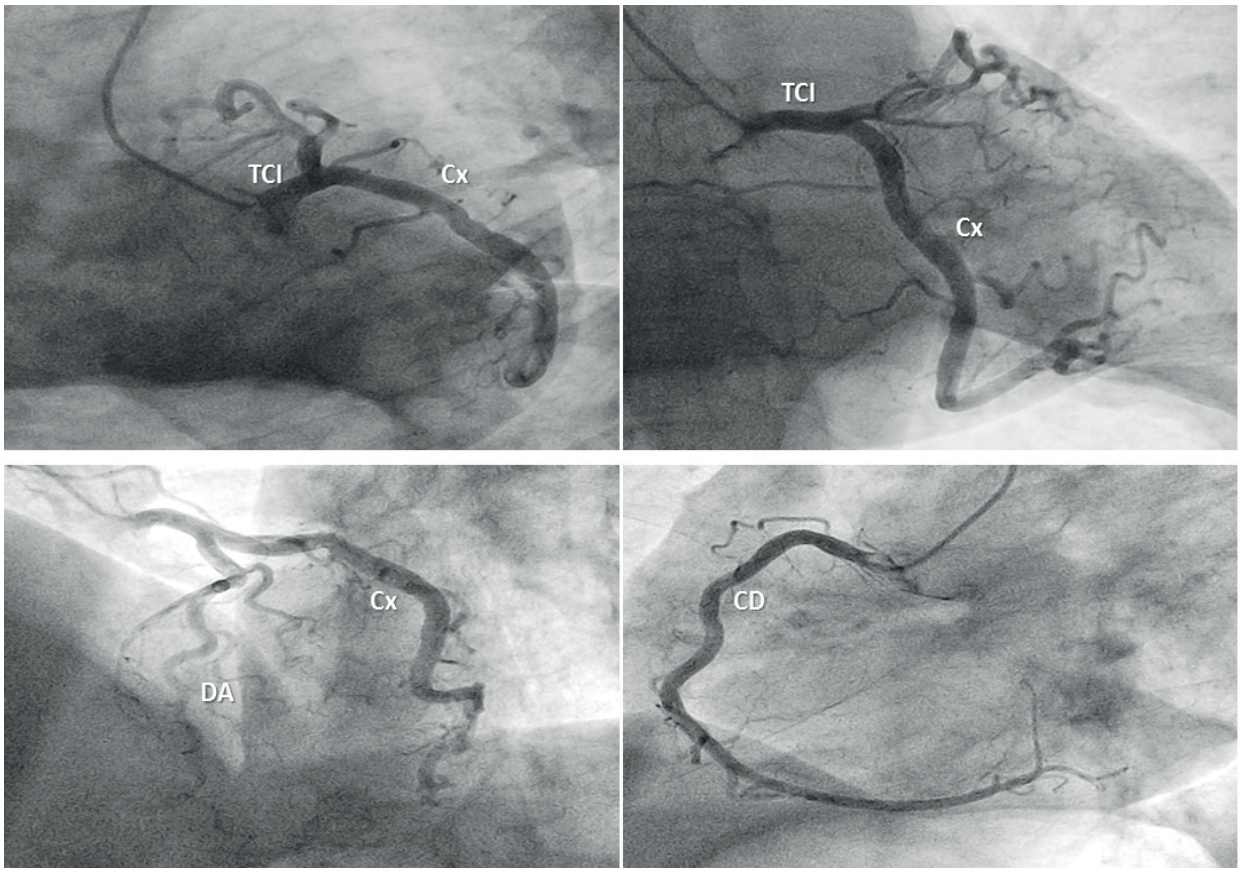

Figure 1: Coronary angiography showed no significant lesions.
TCI (LM: left main coronary artery); DA (LAD: left anterior descending artery);
Cx (LCX: left circumflex artery); CD (RCA: right coronary artery)

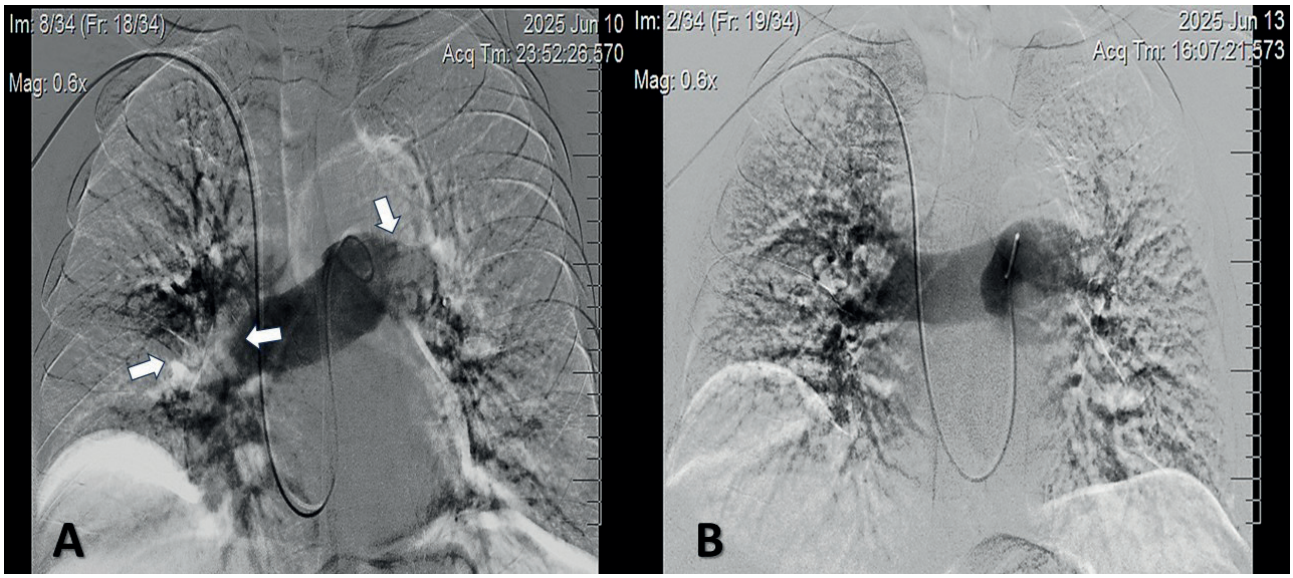

Figure 2: Pulmonary angiography. **A.** Filling defects are observed in the pulmonary circulation (arrows), limiting and interrupting blood flow. **B.** Improved pulmonary flow is achieved using the described technique.

tion due to embolic material originating from the lower extremities, pelvic region, or abdominal vessels. Several risk factors are associated with this medical emergency, including prolonged immobilization, long-bone fractures of the lower limbs, and malignancy, among others.[7] Current treatment for high-risk pulmonary thromboembolism includes anticoagulation, systemic fibrinolysis, and embolectomy (both percutaneous and surgical).[8-10] However, sys-

temic fibrinolysis and anticoagulation are associated with bleeding at multiple sites. Additionally, studies have shown that fibrinolytic agents preferentially distribute to well-perfused areas, resulting in limited contact with the thrombus surface.[11,12] On the other hand, embolectomy is only available in specialized centers, and is therefore of limited accessibility for patients living far from such facilities.[13]

Catheter-guided fibrinolysis has emerged as an alternative for patients with high-risk pulmonary thromboembolism. This technique involves selective drug administration into the pulmonary arteries, allowing direct contact with the thrombus and improved clot dissolution. Lower doses are used compared to systemic fibrinolysis, reducing the risk of bleeding.[14,15]

In a single-center study conducted in Buenos Aires, Seropian et al.[16] evaluated the outcomes of catheter-guided thrombolysis in patients with pulmonary thromboembolism. Efficacy was assessed by improvement in pulmonary pressures, and safety by the absence of major bleeding with hemodynamic deterioration. Catheter-guided thrombolysis was performed under ultrasound guidance, using 25–35 mg of tissue plasminogen activator. The study showed a statistically significant reduction in mean pulmonary pressure from 35 mmHg pre-procedure to 24 mmHg post-procedure. No cases of intracranial hemorrhage were reported, and only one case (2%) of major bleeding occurred. The authors concluded that catheter-guided thrombolysis is an effective alternative, significantly reducing pulmonary pressures.

In a retrospective observational study, Aguilar[17] evaluated the effectiveness of catheter-guided thrombolysis in patients with pulmonary thromboembolism and right ventricular dysfunction treated at the Department of Radiology at the *Complejo Hospitalario Dr. Arnulfo Arias Madrid* in Panama between 2020 and 2022. Lower doses than those used in systemic fibrinolysis were administered. Effectiveness was measured using the RV/LV ratio and the Qanadli index (thrombotic burden) before and after the procedure. Before treatment, 77.8% of patients had an RV/LV ratio >1, indicating right ventricular overload; after treatment, 61.1% achieved a ratio <0.9, reflecting significant hemodynamic improvement. The reduction in thrombotic burden, as assessed by the Qanadli index, was statistically significant in this study. Before treatment, 44.4% had a Qanadli index of 51-75%, whereas after treatment, 72.1% had an index of 0-25%, supporting the efficacy of the treatment in reducing pulmonary arterial obstruction. The safety profile was acceptable, with 72.1% of patients experiencing no complications. The most common complications were puncture-site hematomas (11.1%) and one case of remote hemorrhage (5.6%).

In the present case, 36.5 mL (50%) of the standard fibrinolytic dose was used, achieving favorable angiographic and echocardiographic outcomes, including improved left ventricular function and contractility, without bleeding complications. These findings support both the efficacy and safety of the procedure. Notably, the improvement in left ventricular function reinforces the pathophysiology of pulmonary thromboembolism, where increased pressure and volume overload in the right heart chambers affect left heart function due to ventricular interdependence.

High-risk pulmonary thromboembolism is a potentially fatal condition in which rapid implementation of pulmonary reperfusion strategies is essential for patient survival. Current treatment options include anticoagulation, systemic fibrinolysis, thromboaspiration devices, and surgical embolectomy, which are not always available and may increase complication risk when combined. The mechanical-pharmacological therapeutic approach used in this case represents an effective and safe alternative, as demonstrated by the clinical outcome.

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