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Clinical case

Mechanical aspiration thrombectomy before angioplasty and stenting of the left innominate vein in a patient on hemodialysis with thrombosis and occlusion of the left innominate vein

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Abstract

Introduction: Stenosis or occlusion of central veins associated with catheter use commonly occurs in patients on hemodialysis. Standard management includes performing angioplasty and stent placement to address these lesions, with the aim of reducing swelling in the affected upper limb and preserving the functionality of the arteriovenous fistula. However, in cases where central vein thrombosis coexists, performing these procedures carries the risk of pulmonary embolism, a potentially life-threatening complication.

Objective: To describe the possibility of endovascular management of central vein thrombosis prior to angioplasty in patients with high thrombotic burden and increased risk of pulmonary thromboembolism, with the purpose of mitigating this risk.

Keywords: Hemodialysis, Central Vein Stenosis (CVS), Central Vein Occlusion (CVO), Pulmonary embolism, Mechanical thrombectomy.

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Case presentation: We present the case of a 52-year-old male patient with occlusion of the left innominate vein and a considerable thrombotic burden. Our approach consisted of mechanical aspiration thrombectomy, followed by angioplasty and stent placement in the left innominate and subclavian veins. This intervention achieved favorable angiographic and clinical results, with successful follow-up.
Discussion and conclusion: The risk of pulmonary thromboembolism in patients with central vein thrombosis and high thrombotic burden has been reported in previous publications, including fatal outcomes occurring after angioplasty of these vessels. Mechanical thromboaspiration, using devices designed for this purpose, represents a strategy that significantly reduces this risk and promotes satisfactory results.

Trombectomía mecánica aspirativa previa a angioplastia y *stent* de la vena innominada izquierda en un paciente en hemodiálisis con trombosis y oclusión de la vena innominada izquierda

Resumen

Introducción: la estenosis u oclusión de las venas centrales asociadas al uso de catéteres ocurre comúnmente en pacientes en hemodiálisis. El manejo estándar incluye la realización de angioplastia y colocación de *stents* para abordar estas lesiones, con el objetivo de reducir la hinchazón en la extremidad superior afectada y preservar la funcionalidad de la fístula arteriovenosa. Sin embargo, en casos donde coexiste trombosis de las venas centrales, la realización de estos procedimientos conlleva el riesgo de embolismo pulmonar, una complicación potencialmente mortal.
Objetivo: describir la posibilidad de manejo endovascular de la trombosis de venas centrales previa a la angioplastia en los pacientes con carga trombótica alta y riesgo elevado de tromboembolismo pulmonar, con el propósito de mitigar dicho riesgo.
Presentación del caso: presentamos el caso de un paciente masculino de 52 años de edad, con oclusión de la vena innominada izquierda y una carga trombótica considerable. Nuestro abordaje consistió en una trombectomía mecánica por aspiración, seguida de angioplastia y colocación de *stent* en las venas innominada y subclavia izquierdas. La intervención logró resultados angiográficos y clínicos favorables, con adecuada evolución durante el seguimiento.
Discusión y conclusión: el riesgo de tromboembolismo pulmonar en pacientes con trombosis de venas centrales con alta carga trombótica ha sido informado en publicaciones previas, incluyendo desenlaces fatales posteriores a la angioplastia. La tromboaspiración mecánica, utilizando dispositivos diseñados para este fin, representa una estrategia que reduce significativamente dicho riesgo y favorece resultados satisfactorios.

Palabras clave: hemodiálisis, estenosis de venas centrales, oclusión de venas centrales, embolismo pulmonar, trombectomía mecánica.

Introduction

Central vein stenosis (CVS) or occlusion (CVO) is a common complication in patients with end-stage renal disease (ESRD) who have previously had hemodialysis catheters and are currently receiving hemodialysis through an arteriovenous fistula, leading to subsequent dysfunction, arm swelling, and venous aneurysms [1]. This outflow impairment can directly affect the quality of dialysis therapy by reducing blood flow. Therefore, the treatment of CVS/CVO is of utmost importance to ensure the delivery of vital dialysis therapy to such patients [2]. The current management involves angioplasty and stenting of the affected veins [3]. Surgical options, such as open venous bypass to the superior vena cava (SVC) or right atrial appendage, should be considered only in refractory cases due to their increased risk of complications and longer hospital stays [4].

In some cases, CVS/CVO is associated with thrombosis of the affected veins, and endovascular treatment carries a risk of pulmonary embolism (PE) [5–7], with reported fatal outcomes. Therefore, aspiration of the thrombi or thrombolysis is advisable to reduce this risk. In this paper, we describe the management of a male patient with left innominate vein occlusion and a high thrombus burden. The patient gave consent for the publication of this report.

The case

The patient is a 52-year-old male with arterial hypertension, coronary artery disease, and ESRD, undergoing hemodialysis for the past five years. Initially, he had tunneled hemodialysis catheters placed in both the subclavian and jugular veins. He now has a functional arteriovenous fistula in the left upper arm. Over the past four months, he has developed swelling of this arm (Figure 1).

Duplex scan color ultrasound (DSCU) revealed a brachiocephalic arteriovenous fistula with large, turbulent flow and thrombosis of the left axillary vein. We performed a phlebography of the left arm and central veins, which revealed patency of the basilic, cephalic, axillar and left subclavian veins, as well as occlusion of the innominate left vein with abundant thrombus. Additional findings included ectasia of the left subclavian vein and diversion of flow to the external jugular, costoaxillary, and left subscapular veins (Figure 2).

With ultrasound guidance and prior infiltration with 2 % lidocaine, the left cephalic vein –receiving the fistula flow– was punctured, and a 10F introducer was advanced using the Seldinger technique. Subsequently, the left common femoral vein was punctured under ultrasound guidance, and a 6F introducer was also advanced using the Seldinger technique.

Figure 1. The patient presented with swelling of the left arm and the arteriovenous (AV) fistula (arrow)

Source: Own elaboration.

Hydrophilic guidewires measuring 0.035 x 150 cm and 0.035 x 260 cm, along with a 5F MPA catheter, were introduced through each introducer to access the SVC, left subclavian vein, and innominate vein. Simultaneous manual injection of iso-osmolar contrast medium was performed, confirming the occlusion of the left innominate vein at its junction with the right innominate vein, as well as high thrombus burden in the left subclavian and innominate veins.

A total of 5,000 IU of unfractionated heparin was administered through a peripheral vein. Cineangiography and fluoroscopy were utilized to perform mechanical aspiration thrombectomy of the left innominate and subclavian veins using the Indigo Suction System (Penumbra, CAT 8 and Separator; Penumbra, Inc., Alameda, California) (Figure 3), resulting in the recovery of abundant thrombi. The macroscopic appearance, along with the presence of fibrin sheaths, suggested subacute thrombi. This procedure was conducted via the left arm approach (Figure 4).

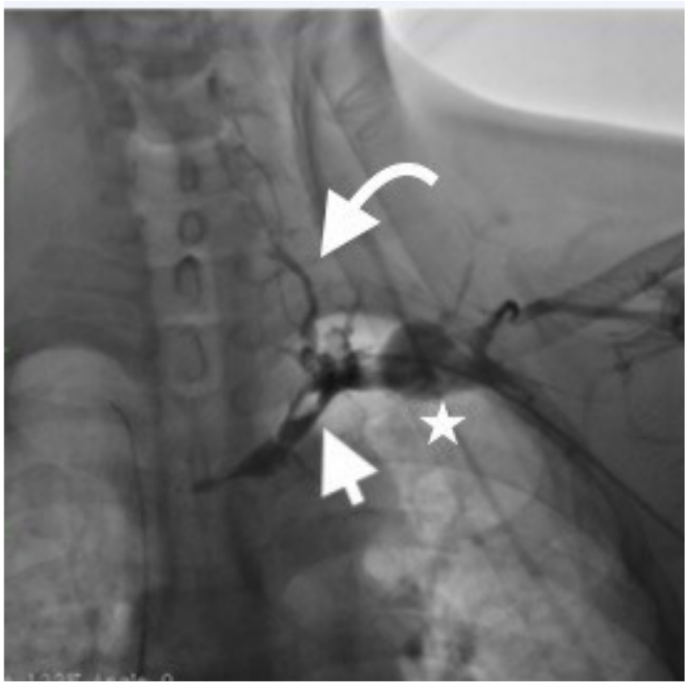

Figure 2. Occlusion of the innominate left vein was observed, with abundant thrombus (arrow), ectasia of the left subclavian vein (star) and diversion of flow to the external jugular, costoaxillary, and left subscapular veins (curved arrow)

Source: Own elaboration.

Then we overcame the occlusion with a hydrophilic guidewire (Figure 5) and performed serial angioplasties with 4 x 80 mm, 6 x 80 mm, and 10 x 40 mm balloon catheters (Admiral Xtreme Balloon Catheters, Medtronic, 9850 NW 41st Street, Suite 450 Doral, FL 33178) in the left subclavian and innominate veins, as well as the SVC (Figure 6).

The angiographic control revealed severe recoil (Figure 7); therefore, a 10 x 60 mm self-expanding stent (Venous Wallstent, 300 Boston Scientific Way, Marlborough, MA 01752-1234) was implanted in the left innominate vein and superior vena cava (Figure 8). The stent was post-dilated with a 10 x 40 mm balloon (Figure 9), resulting in satisfactory angiographic control, with no residual thrombi and wide contrast flow from the left arm to the right auricle (Figure 10).

The edema of the left upper limb completely resolved after the procedure, and the arteriovenous fistula remained functional. Anticoagulation was maintained with low molecular weight heparin (LMWH) for the subsequent three months. During this time, the patient was scheduled for a cardiac catheterization, and no edema was observed in the left upper limb (Figure 11). The arteriovenous fistula remained functional and in use. Angioplasty and

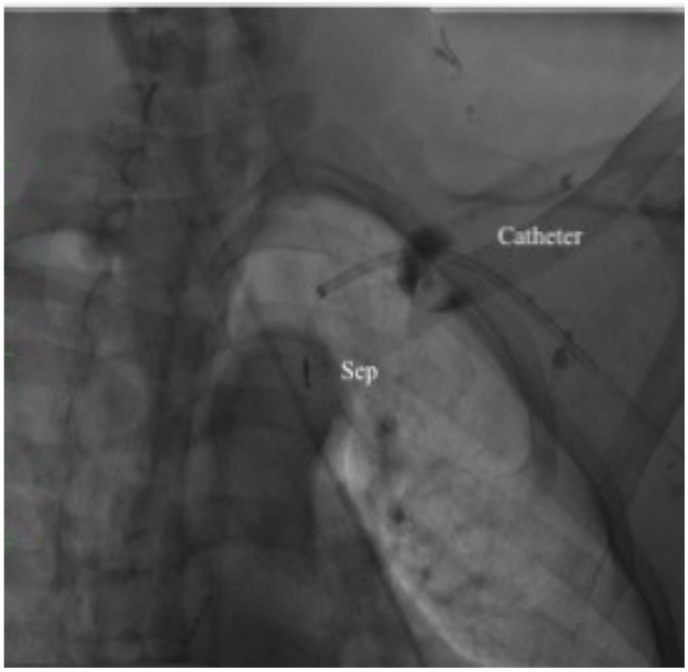

Figure 3. Mechanical aspiration thrombectomy of the innominate and left subclavian veins was performed

Source: Own elaboration.

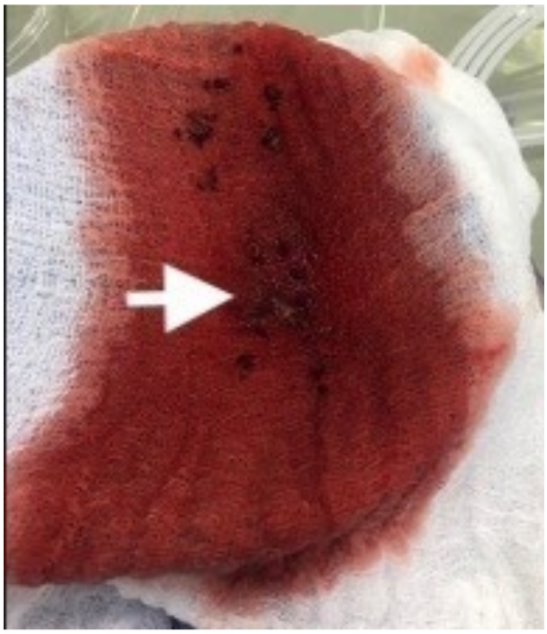

Figure 4. Thrombi (arrow) were successfully extracted

Source: Own elaboration.

Figure 5. Successful crossing of the obstruction

Source: Own elaboration.

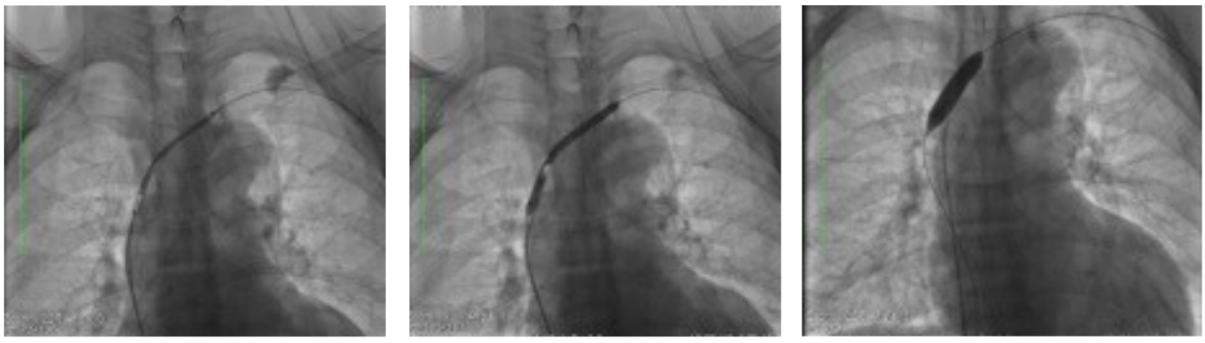

Figure 6. Balloon angioplasties were performed

Source: Own elaboration.

medical stent implantation were performed in the right coronary and circumflex arteries, after which anticoagulation was interrupted. Antiplatelet aggregation therapy with clopidogrel was prescribed. The arteriovenous fistula remained functional for nine months after the procedure, when thrombosis of the cranial cephalic vein was identified along with cellulitis of the upper arm, confirmed by a positive culture of *Streptococcus faecalis*. The arteriovenous fistula was subsequently closed by endovascular embolization of the remaining patent cephalic vein.

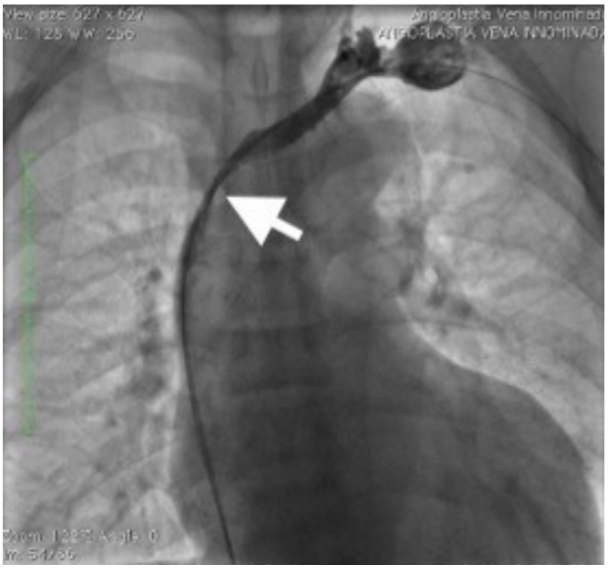

Figure 7. Significative recoil (arrow) was observed

Source: Own elaboration.

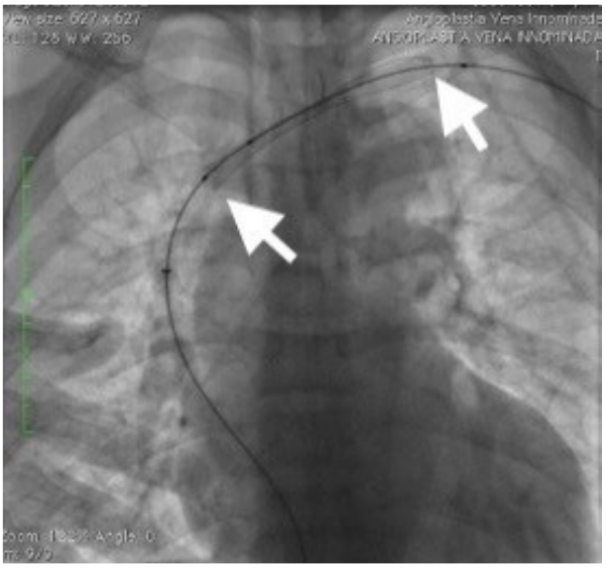

Figure 8. A self-expanding stent was deployed

Source: Own elaboration.

Discussion

Central vein stenosis is a late complication related to previous catheter implantation for hemodialysis, attributable to local inflammatory phenomena resulting from the presence of a foreign body in contact with the endothelium and the turbulence produced by the catheter itself [8]. However, cases of stenosis in these veins have also been reported in patients who

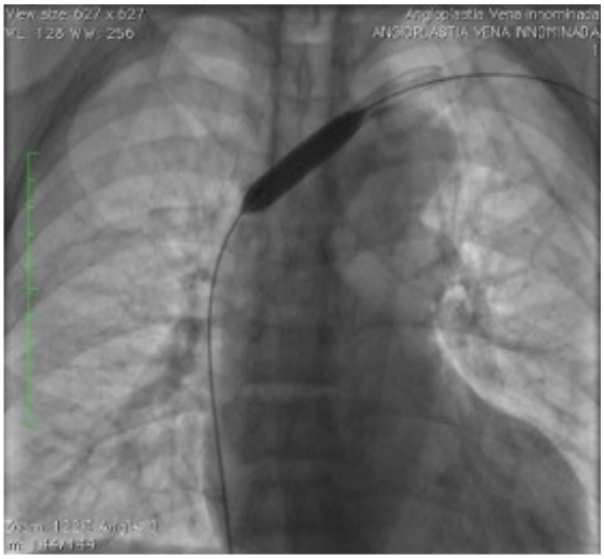

Figure 9. Post-dilation was conducted

Source: Own elaboration.

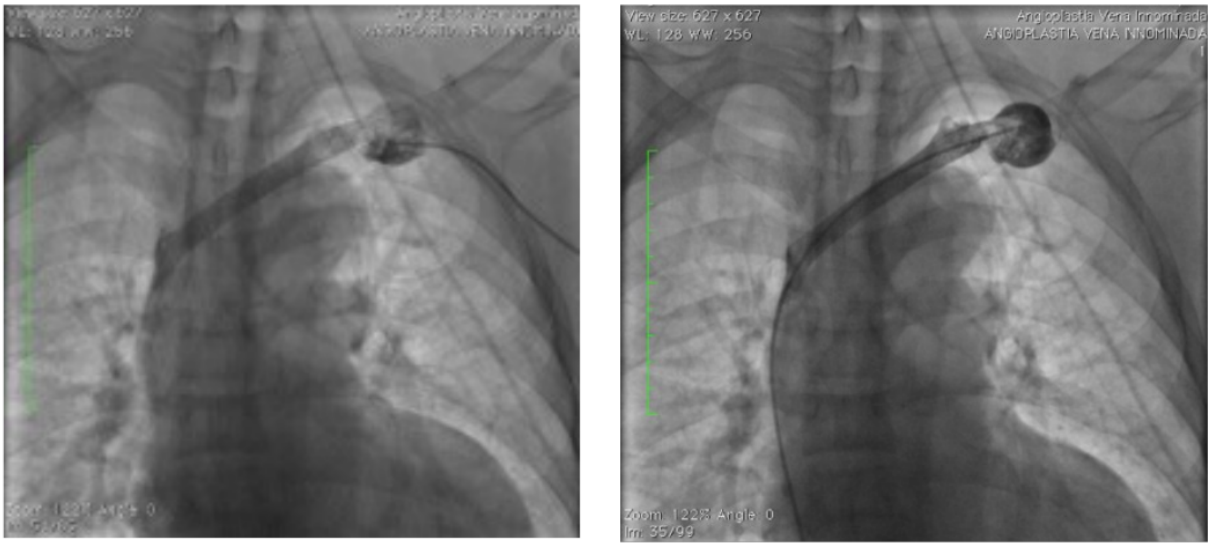

Figure 10. The angiographic control was conducted

Source: Own elaboration.

have not undergone catheterization for hemodialysis; in such cases, the cause is related to the turbulence triggered by the high flow of the ipsilateral upper limb fistula [9].

CVS/CVO can lead to venous hypertension, dysfunction of the arteriovenous fistula, venous aneurysms in the efferent vein, and progressive swelling of the extremity, neck, and face, accompanied by venous collateral circulation. When bilateral, these changes configure

Figure 11. The patient one month after the procedure, with a significant decrease in edema of the upper left limb (arrow)

Source: Own elaboration.

a superior vena cava syndrome (SVC) [10]. Surgical treatment was the choice in the early 1970s [11–13], and more recently, percutaneous transluminal angioplasty (PTA) has become the first-line treatment for symptomatic patients with CVS/CVO, providing temporary

relief [14]. However, in approximately three-quarters of patients, additional interventions are required for the management of recurrent edema [15]. Compared with open repair, repeated PTA offers the advantage of minimally invasive procedures.

CVS/CVO is often associated with thrombosis of the affected veins [16], and endovascular treatment carries a potential risk of pulmonary embolism (PE) [17, 18]. Therefore, thrombus aspiration is advisable to reduce this risk [19, 20]. In the case report by Vijayvergiya et al. (20), PTA and stenting were performed first, followed by mechanical thrombus aspiration. In the present case, we reduced the thrombotic burden in the left subclavian and innominate veins, minimizing the risk of pulmonary embolism before restoring flow using angioplasty and stenting, resulting in a successful outcome. LMWH was administered for three months after the procedure, as recommended by current guidelines for the management of venous thromboembolism [21].

Ethical considerations

Ethical considerations have been carefully followed in the preparation and publication of this case. The patient, conscious and of sound mind, gave written informed consent after receiving a comprehensive and clear explanation of the educational objectives of this publication. His identity has been carefully protected by omitting personal data and any information that could allow his identification. The case was reviewed and approved by our institution's ethics committee to ensure compliance with ethical standards and the academic value of this work.

Authors' contributions

Alvaro Delgado Beltran: Conceptualization, data curation, formal analysis, investigation, methodology, project administration, resources, validation, visualization, writing – review & editing; Laura Catalina Delgado-Murcia: Data curation, formal analysis, software, validation, visualization, writing – original draft, writing – review & editing.

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Conflicts of interest

There were no conflicts of interest in the preparation and/or publication of this work.

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