

Endovascular revascularization of central veins with a sharp recanalization technique in a hemodialysis patient

Revascularización endovascular de venas centrales mediante la técnica de *sharp recanalization* en un paciente en hemodiálisis

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ABSTRACT

Central venous occlusion (CVO) has an incidence of 25–40% in hemodialysis patients. CVO presents as unilateral edema of the face, neck, or arm, elevated intradialytic pressure, and access dysfunction. The primary management goals are symptom relief and access preservation. Endovascular treatment is the first-line strategy. We describe the case of a hemodialysis patient with CVO in whom conventional revascularization failed and an alternative, more aggressive technique — sharp recanalization — was required. In this patient, the conventional endovascular technique failed. Endovascular central venous revascularization using the sharp recanalization technique (SRT) was performed successfully. The patient is currently on hemodialysis after the procedure without complications and with complete symptom resolution. When conventional techniques fail, CVO can be effectively treated with sharp recanalization with low complication rates.

Keywords: central venous occlusion, hemodialysis, sharp recanalization.

RESUMEN

La oclusión venosa central (OVC) tiene una incidencia de 25% a 40% en pacientes en hemodiálisis. La OVC se manifiesta como edema unilateral en cara, cuello o brazo, aumento de la presión intradiálisis y falla del acceso. El objetivo es aliviar los síntomas y mantener el acceso funcionando. La estrategia endovascular es la de primera elección. Describimos un caso de un paciente en hemodiálisis con OVC donde la estrategia convencional de revascularización fue fallida y requirió de una técnica alternativa y más agresiva como la *sharp recanalization*. Reportamos un paciente en hemodiálisis con OVC donde la técnica endovascular convencional fue fallida. Se efectuó revascularización endovascular de venas centrales con técnica de *sharp recanalization* de forma exitosa. El paciente se encuentra en hemodiálisis posprocedimiento sin complicaciones y con completa resolución de los síntomas. Cuando la técnica convencional falla, la OVC puede ser tratada con *sharp recanalization* con bajas tasas de complicaciones.

Palabras clave: oclusión venosa central, hemodiálisis, *sharp recanalization*.

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INTRODUCTION

Central venous occlusion (CVO) has an incidence in 25–40% of all hemodialysis patients and is associated with significant sequelae including vascular access dysfunction and loss¹. The high incidence of CVO is attributed to prolonged catheter use and the elevated flow generated by native and prosthetic vascular accesses, both of which promote venous intimal hyperplasia and occlusion². CVO presents as unilateral edema of the face, neck, or arm, elevated intradialytic pressure, and access dysfunction. The primary management goals are symptom relief and access preservation. Endovascular treatment is the first-line strategy³.

Crossing the guidewire traversal of the occluded segment is a necessary and critical step for successful recanalization. However, some occlusions are rigid and inflexible, rendering them impassable by conventional techniques. In such cases, more aggressive alternative strategies are required. The sharp recanalization technique (SRT) is used in cases where conventional endovascular methods have failed to recanalize the occlusion⁴. SRT was first described by Ferral in 1996⁵. The technique involves crossing the occluded segment using the stiff distal end of a 0.035-inch guidewire, a Chiba needle, a Colapinto needle, a transjugular hepatic puncture needle, a transseptal puncture system or re-entry device, radiofrequency energy, or laser⁶.

We report the case of a hemodialysis patient with CVO in whom the conventional endovascular technique failed, and successful central venous recanalization was achieved using the SRT.

CLINICAL CASE

The patient was a 68-year-old male with stage V chronic kidney disease on hemodialysis via a right humerobasilic arteriovenous fistula (AVF) for the past year. He had a history of multiple central venous catheters placed through both jugular and both subclavian veins, and he presented with gradually worsening, painful edema in the right upper limb, the face, and the neck.

The AVF was cannulated via the right cephalic vein and a fistulography was performed, revealing occlusion of the right brachiocephalic venous trunk; the left brachiocephalic trunk and superior vena cava were patent and reconstituted through collateral circulation (**Figure 1**).

A 6-Fr introducer was placed in the right cephalic vein, and antegrade crossing of the occlusion was attempted using a 4-Fr vertebral catheter and 0.018-inch and 0.035-inch hydrophilic guidewires, without success (**Figure 2A**). The right common femoral vein was then punctured under ultrasound guidance, and a 9-Fr, 65-cm introducer was positioned in the superior vena cava. Retrograde crossing of the occlusion using conventional techniques was attempted, again without success.

Following failure of conventional retrograde crossing, the SRT was performed using the stiff end of a 0.035-inch guidewire supported by the dilator of the 9-Fr introducer to perforate the distal part of the occlusion. A 0.018-inch guidewire was then advanced, and progressive dilation was performed using a 3-mm balloon (**Figure 2B**).

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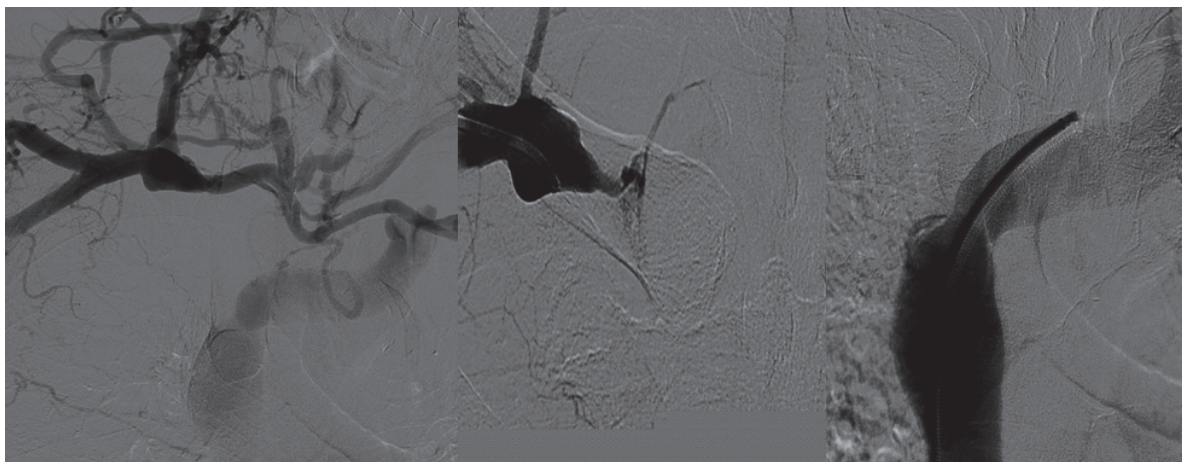


Figure 1.

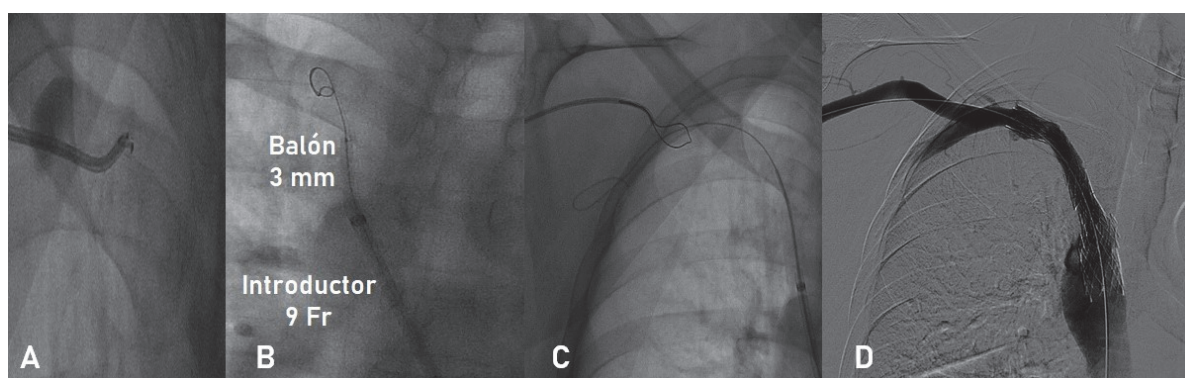


Figure 2. A, B, C, D.

Retrograde crossing was subsequently achieved using a 4-Fr vertebral catheter and a 0.035-inch hydrophilic guidewire. The wire was captured with an endovascular snare (**Figure 2C**) from the cephalic venous access and externalized through the upper access site using a through-and-through technique. Pre-dilation was performed with a 10- $\times$ -60-mm balloon, followed by implantation of an Abre™ venous stent (Medtronic®, Minneapolis, MN, USA; 16 $\times$ 100 mm), and the procedure was completed with post-dilation using a 14- $\times$ -60-mm balloon.

Final completion angiography demonstrated excellent central vein flow with complete resolution of collateral circulation (**Figure 2D**).

Edema resolved within 48 hours.

No procedure-related complications were recorded. On ambulatory follow-up, the patient is undergoing hemodialysis with adequate flow dynamics and complete edema resolution.

DISCUSSION

CVO is a complication that compromises hemodialysis access. When access patency cannot be restored, contralateral vascular access must be considered, potentially leading to progressive exhaustion of available venous resources. Recanalization is therefore critical in the treatment of CVO; however, factors such as calcification, collateral formation, or vascular tortuosity can hinder it. SRT is an effective alternative when conventional methods fail.

There are several limitations for the use of SRT in CVO.

First, anatomical structures adjacent to the occluded veins — including the heart, aortic arch, and carotid arteries — increase the difficulty for the procedure. Consequently, the risk of serious complications is very high when treating CVO with SRT. Second, the negative intrathoracic pressure impairs hemorrhage control following venous perforation. Third, the curvature of the thoracic venous anatomy reduces the safety profile of SRT in this region.

SRT is not the first-line option for CVO management for several reasons. Procedural time for SRT is significantly longer than with conventional recanalization techniques, and radiation exposure is substantially greater. Mediastinal hematoma, hemothorax, and pericardial effusion are well-known complications of SRT, with an incidence of 4%⁷.

To maximize success rates and minimize the incidence of complications, preprocedural assessment with CT angiography or digital subtraction angiography is recommended to evaluate occlusion length, the presence of hard lesions (calcification), and the extent of collateral circulation⁷.

Once the occlusion has been crossed with a guidewire, a through-and-through technique is essential to ensure that a balloon or stent can be advanced through the lesion. SRT may be performed in a centrifugal or centripetal direction. As an advantage, the centrifugal approach carries a relatively lower risk of cardiac injury compared with the centripetal approach, which is associated with a higher risk of cardiac injury⁷.

In this clinical case, the stiff end of a 0.035-inch guidewire was used for the SRT. This technique is best suited for short, relatively straight CVOs. Its advantages include applicability

lity via multiple access sites, low cost, and widespread availability of guidewires in most cath labs. The primary disadvantage is that the stiff end does not navigate well through diagnostic catheters in tortuous venous anatomy, as it tends to track in a straight trajectory. An additional concern is that considerable force may be required to penetrate chronic, fibrotic venous occlusions, thus increasing the risk of inadvertent perforation of adjacent structures if the stiff end advances beyond the intended target.

CONCLUSION

Several effective revascularization techniques are available for the treatment of CVO following failed conventional attempts. Complication rates are variable and relatively low, and they seem to depend on factors including the device used, operator experience, and the specific characteristics of the CVO. Regardless of the SRT modality employed, meticulous technique and preparedness for the management of potentially life-threatening complications are essential.

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