Journal of
Vascular Surgery
Venous and Lymphatic Disorders™

Endovascular stent reconstruction of a chronic total occlusion of the inferior vena cava using bidirectional wire access and a balloon puncture by a re-entry device

Luise Adam, MD,[a] Thomas Rudolf Wyss, MD,[b] Dai-Do Do, MD,[a] Iris Baumgartner, MD,[a] and **Nils Kucher, MD,[a]** *Bern, Switzerland*

Venous angioplasty with stenting of iliac veins is an important treatment option for patients suffering from post-thrombotic syndrome due to chronic venous obstruction. Interventional treatment of a chronically occluded vena cava, however, is challenging and often associated with failure. We describe a case of a chronic total occlusion of the entire inferior vena cava that was successfully recanalized using bidirectional wire access and a balloon puncture by a re-entry catheter to establish patency of the inferior vena cava. (J Vasc Surg: Venous and Lym Dis 2015;3:442-5.)

The post-thrombotic syndrome (PTS) is a frequent long-term complication of deep venous thrombosis.[1] It is often associated with reduced quality of life and demands frequent medical care.[2]

PTS evolves from damage to the venous wall and valves by inflammation and residual obstruction of nonrecanalized veins, resulting in venous hypertension often accompanied by venous valve insufficiency.[3,4]

Chronic iliocaval venous obstruction is the most important contributor to the development of PTS. Venous angioplasty with stenting of chronically occluded iliac veins for re-establishment of venous patency improves clinical signs and symptoms and has become an important treatment option for PTS.[5,6] Few case series exist describing endovascular techniques for the treatment of an obstructed inferior vena cava.[7-9] Even with the use of sophisticated chronic total occlusion guidewires and support catheters, intraluminal recanalization of a chronically obstructed inferior vena cava is occasionally impossible. Re-entry devices are used when antegrade or subintimal guidewire passage into the true lumen is inaccessible. They allow re-entry after subintimal guidewire passage of the occlusion using a needle puncture to reach the true lumen.[10,11] Available re-entry devices were designed for chronic total occlusions in the arteries, and no data are available to support their use in the venous system.

We describe a case of a chronic total occlusion of the entire inferior vena cava that was successfully recanalized using bidirectional wire access and a balloon puncture by a re-entry catheter to establish patency of the inferior vena cava. The patient consented to publication of this report.

CASE REPORT

A 58-year-old man with a history of recurrent thrombotic events and documented hyperhomocysteinemia as well as elevated von Willebrand factor antigen was referred because of severe lifestyle-limiting bilateral venous claudication. His walking distance was reduced to 50 m. Thrombosis involving the inferior vena cava and iliac veins was diagnosed 2 years ago. The patient suffered from severe PTS including swelling, heaviness, cramping, hyperpigmentation, and reticular varicose veins on both legs. Both feet showed a purple discoloration and corona phlebectatica as well as suprapubic collateralization (Clinical, Etiologic, Anatomic, and Pathophysiologic classification, $C_{4a}E_sA_dP_o$; Villalta score, 15).

His medical history included recurrent bilateral iliofemoral deep venous thrombosis involving the inferior vena cava and pulmonary embolism. The patient was receiving long-term oral anticoagulation with phenprocoumon and was compliant with use of graduated compression stockings on a daily basis.

Duplex ultrasound examination revealed bilateral occluded iliac veins. Both common femoral veins were patent without significant post-thrombotic changes. Magnetic resonance venography confirmed chronic total occlusion of the suprarenal and infrarenal inferior vena cava and both iliac veins (Fig 1, *A*); both renal veins were draining through collaterals into the azygos and hemiazygos system. The epigastric echocardiogram revealed an intrahepatic stump of the inferior vena cava, measuring 2 cm from the right atrium (Fig 1, *B*).

From the Clinic for Angiology, Swiss Cardiovascular Center,[a] and Department of Cardiovascular Surgery,[b] Inselspital, University Hospital Bern.

Author conflict of interest: none.

Correspondence: Nils Kucher, MD, Clinical and Interventional Angiology, Swiss Cardiovascular Center, University Hospital Bern, 3010 Bern, Switzerland (e-mail: nils.kucher@insel.ch).

The editors and reviewers of this article have no relevant financial relationships to disclose per the Journal policy that requires reviewers to decline review of any manuscript for which they may have a conflict of interest.
2213-333X

http://dx.doi.org/10.1016/j.jvsv.2015.04.006

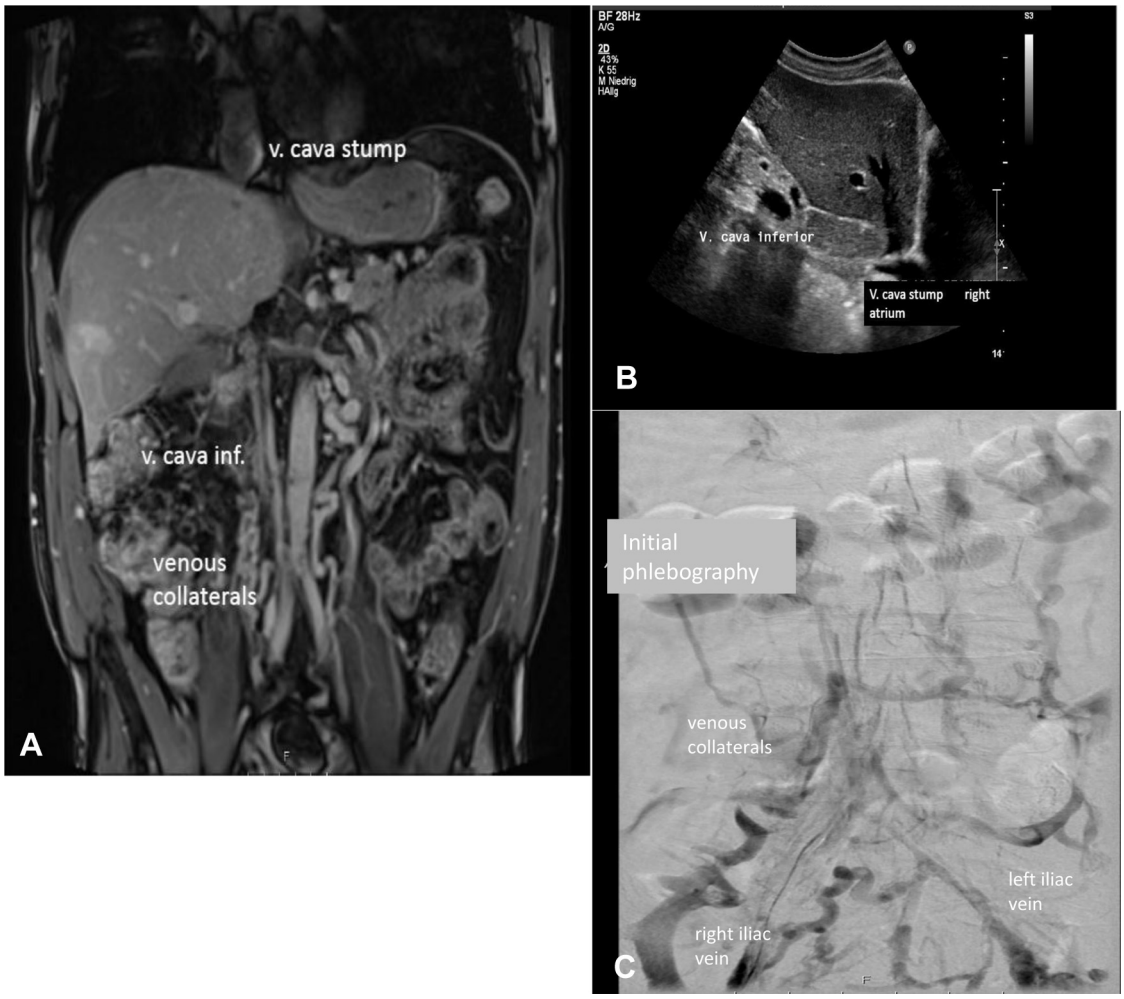

Fig 1. A, Magnetic resonance angiography (venous phase) showing the post-thrombotic vena cava with venous collaterals as well as the residually open cava stump. **B,** Duplex sonography showing the residual vena cava stump close to the right atrium. **C,** Baseline digital subtraction venography, posteroanterior view, showing complete occlusion of the vena cava as well as partial occlusion of the iliac veins and venous collateralization.

Intervention. Endovascular therapy was performed under conscious sedation using a continuous infusion of intravenous remifentanil. Both common femoral veins were accessed with an Avanti 10F sheath (Cordis, Bridgewater, NJ). Right jugular venous access was obtained with a 40-cm 7F Destination sheath (Terumo, Somerset, NJ) with its tip placed within the stump of the occluded inferior vena cava. Diagnostic venography from femoral access confirmed complete occlusion of the iliac veins and entire inferior vena cava (Fig 1, *C*).

Intraluminal guidewire passage using a stiff 0.035-inch Glidewire (Terumo) and a 0.018-inch chronic total occlusion wire (Astato 30; Asahi, Burlington, Mass) could not be achieved from either femoral or jugular access. Bidirectional wire access was then attempted with one 0.014-inch chronic total occlusion wire (Astato 20; Asahi) introduced from femoral access and another 0.014-inch chronic total occlusion wire (Astato 20, Asahi) introduced from jugular access. However, it was not possible to connect the wire tips within the inferior vena cava. Both wire tips were in proximity (maximum distance, 3 mm) at the level of the renal veins, suggesting that the wires were intraluminal but could not be connected because of intraluminal webs (Fig 2, *A*).

For through-and-through guidewire passage from the femoral to the jugular vein, a 0.014-inch low-profile balloon catheter (3.0 × 60 mm) was introduced from the jugular sheath and inflated within the occluded inferior vena cava at the level of the renal veins. A balloon catheter with a balloon length of at least 4 cm should be used to enable successful wire snaring after puncture. An Outback (Cordis) re-entry catheter was forwarded from femoral access to the level of the inflated balloon catheter. The Outback catheter was then used to puncture the inflated balloon, which was confirmed by extravasation of contrast material from the balloon. The 0.014-inch wire within the re-entry catheter was then forwarded into the punctured balloon (Fig 2, *B* and *C*). The femoral wire was advanced while the deflated balloon catheter was simultaneously retrieved through the jugular sheath containing the entrapped femoral wire, thus securing guidewire passage