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Iliocaval Reconstruction in Chronic Deep Vein Thrombosis

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Chronic occlusion of the iliac veins and the inferior vena cava is a source of significant morbidity to often otherwise healthy patients, but it can be successfully managed with percutaneous recanalization and stenting. In this article, I summarize our current approach to patients with chronic occlusion of the iliac veins: patient selection, timing of intervention, commonly needed equipment, procedure, difficulties encountered, complications, clinical follow-up, and outcomes. An ideal patient is the one who is physically active (or was so before iliocaval occlusion), is at least 6 months past acute iliocaval thrombosis, has a patent common femoral vein and hepatic vein or caval confluence, and has no thrombophilic state. The duration of the occlusion has not affected our technical success of recanalization but may, by predisposing the patient to recurrent deep vein thrombosis, affect long-term patency by degrading the size and number of inflow vessels. Secondary patency rates at 4 years can be as high as 70%-90%. We anticipate that even higher success rates will follow with ongoing evolutions in device design (stents with appropriate diameter, length, radial conformity to conduits of varying diameter, and resistance to compression); better understanding of the biological interaction of the stent, the veins, and the coagulation system; and improved navigation systems to cross longer, occluded segments that are resistant to guidewire passage.
Tech Vasc Interventional Rad 17:109-113 **© 2014 Elsevier Inc. All rights reserved.**

Introduction

Thrombosis in the iliac vein and the inferior vena cava (IVC) is a common cause of significant morbidity in otherwise relatively healthy patients. Correcting chronic iliocaval thrombosis is a gratifying and liberating procedure for many patients, whose personal stories often include years of well-meant but discouraging, often nihilistic, advice that they should "learn to live with it."

Clinical Evaluation of the Patient

Iliocaval thrombosis naturally divides into acute and chronic occlusions. In our experience, the ideal times to treat iliocaval thrombosis are within 2 weeks for acute occlusion or more than approximately 4 months for chronic occlusion. We often find ourselves working outside these windows, as patients frequently present with acute or chronic thrombosis or because of special circumstances such as patient preference or medical necessity to delay treatment of acute occlusion or accelerate treatment of chronic occlusion. Although the focus of this article is on chronic venous occlusion, surgeons should be familiar with techniques for treating acute venous thrombosis discussed elsewhere, as acute deep vein thrombosis (DVT) can complicate the treatment of chronic disease, especially when treatment involves sharp recanalization and postponement of anticoagulation, or when anticoagulation is interrupted.

Physical and clinical examinations are important components of treatment, as they reflect the extent of thrombus and the gravity (or lack of gravity) of the disease, which are necessary to modulate the aggressiveness or the duration of therapy. The clinical history should elicit the evolution of the current clinical crisis—past manifestations of disease including previous interventional treatment like IVC filters or thrombolysis, family history of

Potential conflicts of interest: Boston Scientific, scientific advisory committee Cook Inc, consultant on device trial.

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1089-2516/13/$ - see front matter © 2014 Elsevier Inc. All rights reserved.
http://dx.doi.org/10.1053/j.tvir.2014.02.008

prothrombotic conditions, previous medical treatment and its efficacy, risk factors or other medical conditions affecting choice of recanalization options, and patient's customary habits of exercise or maximal lower extremity exertion. Laboratory values pertinent to treatment include standard anticoagulation parameters, renal function, and baseline complete blood count. Imaging studies are crucial for assessing the extent of disease, detecting anatomical variations, discussing prognosis and probable outcomes, and planning and securing vascular access.

Indications for Treatment

In our experience, unassisted balloon angioplasty is not a durable treatment of chronic iliocaval thrombosis. There is currently no Food and Drug Administration approved stent for use in the iliocaval system, and all stents used here are off-label. Our approach to these cases embodies the following convictions: the crucial feature of success in recanalization is connecting good venous inflow to good venous outflow. The primary mode of stent failure is thrombosis. The most vulnerable period of stent integrity is in the first 1-3 days after stenting, when establishing adequate anticoagulation may be outside the control of the patient and the interventionalist and depends on the vagaries of the electronic record as well as nursing and pharmacy customs at the hospital.

The usual indications for iliocaval recanalization are venous occlusion in the setting of recurrent DVT, severe postthrombotic syndrome, or severe curtailment of customary activities. Although DVT is customarily considered chronic when the threat of mobilization and embolization has passed, at approximately 2 weeks, such "chronic" thrombus can still be quite bulky and can limit the expansion of stents necessary to create a flow channel. Consequently, if we have missed the window of 2-4 weeks for thrombolysis, we prefer to treat a patient medically until about 4 months, when the thrombus has contracted and is partially organized. At the other extreme, we consider no venous thrombosis too old to recanalize and no mode of IVC interruption irreversible. Although postponing recanalization does not, in our opinion, jeopardize success of recanalization, it does expose the patient to the risk of recurrent DVT, with the further risk of eroding venous inflow, which is crucial to maintaining stent patency. Occasionally, we are asked to treat patients with paraplegia. Although the lack of motor activity and sensation in these patients seems to argue that reopening veins may be of marginal benefit, recanalization relieves venous hypertension and limb edema, which can complicate skin care and impede patient mobility for caregivers.

Equipment Needed

Standard equipments for venous recanalization include a vertebral tip catheter and a straight stiff Glidewire. As these easily buckle when encountering obstruction, they are inserted through and buttressed by a 6-F or larger sheath, and the progress gained by the catheter and the wire is secured and reinforced by sheath advancement. Recanalization is the result of a patient convergence of catheters from peripheral inflow and outflow channels. For iliocaval recanalization, our preferred access routes include right internal jugular (IJ) vein and both the great saphenous veins (GSV). These have the advantage of being superficial and easily compressed even with systemic anticoagulation. For iliac reconstruction, we access the right IJ vein and the ipsilateral GSV.

When sharp recanalization is required to correct obstruction that is resistant to simple catheter and guidewire recanalization, our preferred option is a transseptal needle such as the BRK-1 needle (St Jude Medical Inc, St. Paul, MN), which can be advanced through a 6-F sheath. The needle is aimed at a loop snare on the other side of the obstruction, and the 0.018 stylet is advanced. Once the snare closes on the stylet, the needle is further advanced until the needle tip itself is captured, at this time, the stylet is removed, and an exchange 0.018 wire is advanced into the loop snare, engaged, and extracted from the opposing access, thus providing a through-and-through access. Disadvantages of the BRK needles are that they are relatively flimsy and bow when advanced against dense obstruction, and the stylet can kink at the needle tip. Other needles and re-entry catheters can be used if they provide the needed combination of length and stiffness.

We have not had extensive experience using the radio frequency wire. Although some occlusions are exceedingly difficult to cross with catheter-wire combinations or transseptal needles (eg, veins occluded in drug abusers), the radio frequency wire, by contrast, does seem to melt through occlusions. In long-distance recanalizations, the effortless advancement of the radio frequency wire may be hazardous rather than helpful.

Procedural Steps

Vascular Access

In iliocaval reconstruction, we routinely access the right IJ vein and the bilateral GSV, with ultrasound guidance. We try to avoid access into the common femoral or popliteal veins because we consider full anticoagulation a crucial beginning when access across the occlusion is achieved, and in most patients who have undergone complete anticoagulation, control at common femoral and popliteal puncture sites is difficult to achieve.

Recanalization

Our recanalization tool of choice is a vertebral tip catheter and a straight stiff glidewire. We begin recanalization from upstream to downstream, such as from the saphenofemoral vein to the IVC, so that intermittent contrast injections can guide catheter and guidewire manipulations. For example, injection into the saphenous veins fills a welter of tortuous collaterals, but it frequently fills a straight thin channel in the target deep vein, which we

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