ASK THE EXPERTS

Chronic Venous Occlusion: What's Your Dream Device?

Advanced mechanical design to address both subacute, organized thrombus and more dense, fibrotic tissue; devices with a low profile, built-in imaging, and drug elution capabilities; and AI-guided navigation are among the wish-list items.

With Houman Jalaie, MD; Erin H. Murphy, MD, FACS; and Steven Abramowitz, MD

Houman Jalaie, MD
Associate Professor of Vascular Surgery
Head of European Venous Center Aachen
Department of Vascular Surgery
University Hospital RWTH
Aachen, Germany
hjalaie@ukaachen.de
Disclosures: Consultant to Medtronic, BD, Optimed, Philips, Bentley, Abbott, Boston Scientific, and VeinWay.

The ideal device for treating chronic venous obstruction (CVO) in the future would combine innovative, efficient, and minimally invasive features to restore venous flow and prevent complications. Such a device would incorporate an advanced, fully controllable tip design to effortlessly navigate through challenging occlusions. This feature would significantly reduce procedure time and increase technical success rates to nearly 100%. Although current techniques and devices exist for crossing difficult occlusions, they are often limited in applicability and associated with potential complications, indicating that they are still in a premature stage. A low-profile device with a steerable needle capable of attaching to the vein wall for fixation to maximize pushability would be a transformative addition.

Further, integrating precise intraoperative imaging with the ability to quantify hemodynamic patterns, such as flow volume, would enhance the accuracy of determining optimal landing zones for stenting. An intravascular ultrasound (IVUS) catheter with built-in flow measurement tools would provide real-time insights into venous flow dynamics, ensuring more precise decision-making during procedures.

To address the issue of in-stent thrombosis and restenosis, which are persistent challenges after recanalization and stenting, a drug-eluting or drug-coated stent would be essential. Such stents, coated with anti-inflammatory and antithrombotic agents, would minimize inflammatory responses and reduce the risk of stent failure, ensuring long-term patency and improved outcomes. If a chronic in-stent occlusion has already occurred, then an additional safe debulking tool would help enormously.

Finally, as artificial intelligence (AI) becomes increasingly integrated into health care, an AI-guided catheter navigation system would represent a significant advancement. This system could simplify procedures and reduce operator error by identifying key venous anatomic features, such as areas of slow blood flow, tributary ostia, and diameter changes. By providing real-time guidance and predictive analytics, AI could ensure safer, more efficient navigation and device placement.

In summary, the ideal device would combine advanced mechanical design, precise imaging capabilities, drug-eluting technology, and AI-guided navigation to address the current challenges in treating CVO. It would be a ground-breaking innovation, improving procedural efficiency, reducing complications, and ensuring better long-term outcomes for patients with advanced postthrombotic syndrome (PTS) due to CVO.

Erin H. Murphy, MD, FACS
Venous and Lymphatic Center
Sanger Heart and Vascular
Atrium Health
Charlotte, North Carolina
erin.murphy@atriumhealth.org
Disclosures: Consultant to BD, Boston Scientific, Gore & Associates, Philips, and Medtronic.

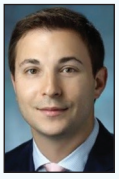
Intervening for CVOs can be both impactful and rewarding. These procedures have the potential to significantly improve quality of life and restore venous function in patients with PTS. However, the central challenge remains achieving durable long-term patency. Many of these patients present with inflow disease and are at high risk for rethrombosis, often requiring indefinite anticoagulation. Once a venous stent occludes, recanalization becomes difficult if not addressed early and may even prove futile. This can leave patients with debilitating, irreversible symptoms and limited treatment options.

As a tertiary referral center frequently managing complex cases of chronic stent occlusion, I believe there is a pressing need for device innovation in this space. An ideal device would address both subacute, organized thrombus as well as more dense, fibrotic tissue seen in chronically occluded stents, while minimizing endothelial damage and preserving stent integrity.

From a practical standpoint, the ideal system should be low profile and single access, enabling outpatient intervention. It should safely and effectively remove fibrotic, in-stent collagen and thrombus, even in long-standing occlusions. Real-time feedback and image guidance—such as integrated IVUS visualization—would enhance precision

and reduce procedural risk. Crucially, debris management must be built into the system to avoid distal embolization and ensure procedural efficiency.

Although several tools are available to address acute and subacute thrombus, few are truly optimized for the mechanical challenges of chronic stent occlusions. Existing options often require prolonged procedural times, complex techniques, and large-caliber sheaths, often exceeding 20 F, which limit outpatient use and hinder broader adoption. With the right innovation, we have a powerful opportunity to transform outcomes for a population that has long been underserved.



Steven Abramowitz, MD
Executive Director
MedStar Vascular Surgery Program
Chair, Department of Vascular Surgery
MedStar Washington Hospital Center
Associate Professor of Surgery
Georgetown University
Washington, DC
steven.d.abramowitz@medstar.net
Disclosures: Consultant to Inari (Stryker), Philips, Gore, Boston Scientific, Medtronic, and Argon.

Despite rapid advances in the endovascular management of deep venous disease, dedicated devices for addressing CVO disease remain limited. Distinct challenges inherent to CVO pathology need to be addressed to achieve technical success, resulting in long-term patency for a patient population at high risk of rethrombosis. When I consider CVO technologies, two different (yet at times overlapping) patient pathologies exist: postthrombotic scar (PTS) and in-stent occlusion.

For postthrombotic disease, my ideal device would be a low-profile, single-access system with incorporated distal embolic protection. Such a device would be versatile enough to allow for the removal of organized, highly collagenated, scar-like material from the vein lumen, as well as fracture and removal of intravenous webbing while preserving the integrity of the vein wall. The device would have a steerable, AI imaging–guided catheter tip with automated trajectory and treatment suggestions to target focal areas of postthrombotic scar for removal. Real-time feedback would avoid vessel wall trauma and accurately identify the true lumen. This would allow for precise removal of intravenous material to restore both vein compliance and natural flow. It could be deployed from vessels as small as the tibial veins to address inflow from the tibiopopliteal confluence to the common femoral vein.

In cases of in-stent occlusion, the device would have similar characteristics as previously mentioned yet also include specialized tools for entering the origin of and crossing an occluded stent. Either via AI guidance or self-centering capabilities, the device would address the entirety of highly organized in-stent occlusive material via means of mechanical or energy-assisted debulking technology. A key feature would be to assess restored stent flow in real time to recommend the need for stent relining or additional inflow work. In both patient populations, the potential for adjuvant drug delivery systems to reduce rethrombosis would be ideal.

The creation of such devices would be an engineering marvel. A more realistic vision is that a dream device for CVO would not be a single tool but rather a comprehensive, adaptive platform—engineered with the versatility to address both de novo and in-stent disease and with the precision to prioritize safety, durability, and, most importantly, patient-centered outcomes. The impact of such a system, especially for those with PTS, would be profound. PTS and in-stent occlusion remain a major source of long-term morbidity. Whether addressing a first-time recanalization of a postthrombotic segment or rescuing a failed venous stent, a purpose-built, intelligent device could significantly improve technical success rates, reduce recurrence, and ultimately restore function and comfort to patients who often face years of debilitating symptoms. ■