Imaging the Deep Venous System

Utilizing the available imaging modalities to improve patient selection for interventional treatment.

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Much has changed with regard to treatment options for deep vein obstruction (DVO) over the past 2 decades. Acute DVO (deep vein thrombosis [DVT]) and chronic DVO have both undergone changing treatment paradigms, shifting from strictly conservative treatment regimens (anticoagulation and compression) to more aggressive and minimally invasive treatments based on symptom severity and risk assessment. The concept is twofold. First, patients with iliofemoral DVT must be identified as early as possible for adjunctive minimally invasive thrombus removal in addition to anticoagulation to reduce symptom severity in the acute stage and prevent postthrombotic syndrome (PTS) in the long run. This approach was proven effective in the CAVENT trial.[1] Second, it is important to identify chronic DVO in patients with and without a previous history of DVT. Moderate-to-severe PTS is present in up to 50% of patients with a previous history of iliofemoral DVT and negatively affects them on a daily basis, with a reported lower quality of life related to this disease.[2] It has been clearly shown that patients' quality of life can be improved with interventional treatment.[3]

DVT

Unfortunately, the need for patient identification and selection for more aggressive DVT treatment is currently under debate because the CAVENT trial is the only multicenter randomized controlled trial that has shown a benefit with this approach. Results from the ATTRACT and CAVA trials are highly anticipated to strengthen the evidence for the added value of adjunctive thrombus removal therapy for patients with iliofemoral DVT. Hopefully, both national and international guidelines will incorporate these treatment options as routine practice in their future recommendations.[4,5]

In current clinical practice, we still rely on clinical symptom severity and duplex ultrasound (DUS) findings to identify patients with DVT. In most guidelines and practices, this is limited to the popliteal and femoral (and common femoral) veins.[6] Below the inguinal ligament, DUS suffices to diagnose DVT in a treatment strategy limited to anticoagulation (and compression). Other imaging modalities such as conventional venography, CT venography (CTV), magnetic resonance venography (MRV), and positron emission tomography (PET)-CT are considered when DUS is inconclusive or not possible (Figure 1).

Many physicians still believe that all iliofemoral DVT can be correctly identified based on clinical symptoms and scoring systems. In the acute stage of iliofemoral DVT, this would include upper leg swelling, cramps, pain, and skin changes. In the most severe cases, phlegmasia cerulea dolens will be present, which is difficult to overlook, and these patients are usually referred to a vascular surgeon for more aggressive treatment. However, many patients do not present with these typical symptoms, and even the regularly used scoring systems have their flaws. Primary care physicians, hematologists, and internal medicine specialists are focused on identifying DVT in any deep vein and treat all

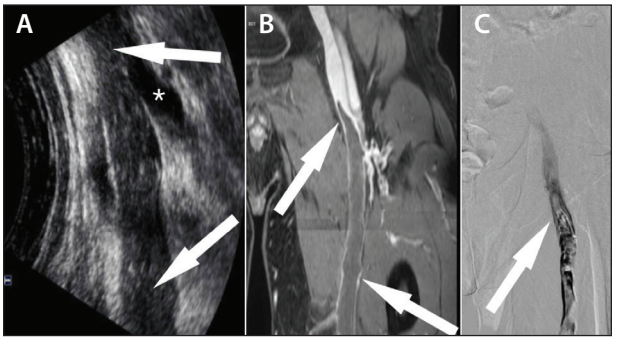
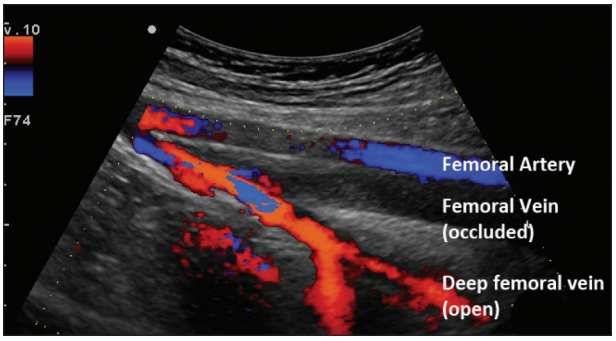


Figure 1. Evaluation of DVT with DUS (A), MRV (B), and conventional venography (C) in the same patient. The arrows indicate the thrombus in the femoral and common femoral vein. The (open) profunda femoris vein is marked with an asterisk.



Courtesy of I.M. Toonder, RVT.

Figure 2. DUS image of the groin in a patient with DVT in the femoral vein extending into the confluence of the femoral and deep femoral vein. The common femoral vein is still patent and proximally free of thrombus due to inflow from an open (nonthrombosed) deep femoral vein.

DVT equally. During follow-up after the initial diagnosis of DVT, the focus is often on the medication and its interactions, not the remaining symptoms. Ideally, patients with severe symptoms and/or involvement of the common femoral vein (which should be specifically reported on) should undergo imaging to evaluate the inferior caval vein and iliac veins to correctly identify iliofemoral DVT (Figure 2).

In these patients, imaging modalities other than DUS offer additional benefits. Both CTV and MRV offer an overview of the entire abdominal and pelvic vascular anatomy, whereas DUS is often limited and hampered by bowel gas and/or obesity. Correctly identifying iliofemoral DVT allows accurate patient selection for more aggressive thrombus removal. With the availability of CTV and/or MRV, there should be no need to perform conventional venography, intravascular ultrasound, or PET-CT for diagnostic purposes in the acute stage of suspected iliofemoral DVT.[7,8] Additionally, CTV and MRV offer insight into any underlying pathology, such as external compression on the iliac veins by a mass or the common iliac vein (eg, May-Thurner syndrome) (Figure 3).[8]

The identification of chronic iliocaval obstruction is essential because it does not require or respond well to thrombolytic therapy and should be treated with recanalization and stenting. Furthermore, CTV and MRV can offer insight into the thrombus load prior to and after treatment.[9] An ongoing subject of investigation is the reliable identification of thrombus age to evaluate susceptibility for specific thrombolytic therapy or mechanical thrombus removal techniques.

CHRONIC DEEP VEIN OBSTRUCTION

In patients with severe PTS, a different approach is required. Many PTS patients are not in the scope of endovascular specialists or vascular surgeons. DVT is often primarily treated by primary care physicians and hematologists with a focus on noninvasive treatment according to the guidelines. They strictly adhere to the anticoagulation protocol, which is continued in cases of persistent complaints or residual vein changes on 6-month follow-up DUS for another 6 months or indefinitely. Patients in the early stages of PTS have difficulties explaining their symptoms, and their treating physicians are generally not inquiring about them. Due to the nature of the disease, these patients tend to adjust their life to their disease, reducing exercise and accepting limitations. In some patients, persistent leg swelling is not very visible. As a result, disease severity is underestimated, and patients accept conservative management, as they are unaware the disease could be treated differently. This shows that we still need to educate primary care physicians, hematologists, and internal medicine specialists on additional treatment options. Patients are more inquisitive these days, and social media can be helpful in spreading information. In my opinion, a more robust pathway of patient referral and identification should be pursued. This is where diagnostic imaging can be helpful. As explained previously, patients referred for DVT imaging should be evaluated with this in mind. Talk to your radiologists and/or vascular technicians about how they evaluate DVT and what they report on. Not only should they report the presence or absence of DVT, but also the location and ideally extent of the DVT. In patients who are reevaluated after 3 or 6 months of conservative (ie, anticoagulation) therapy, signs of chronic DVT sequelae in the deep veins should be reported, and in the case of persistent complaints, the iliac veins should be evaluated. DUS can identify chronic sequelae in the leg, even in the iliac and caval veins. MRV might be superior to DUS for this evaluation, but more rigorous investigation is needed. In some institutions, CTV is used. Again, when evaluating the iliocaval segments, external compression or chronic obstruction should be reported. In our dedicated venous

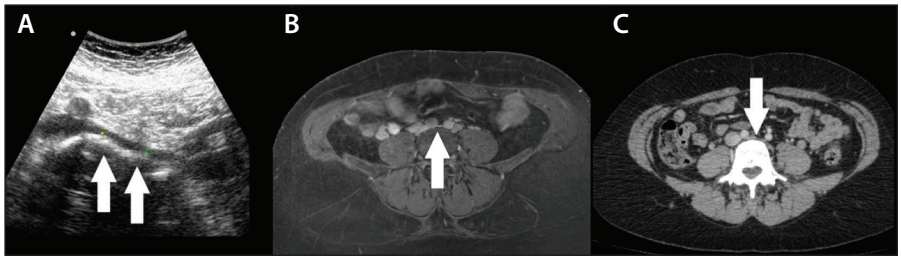


Figure 3. Examples of iliac vein compression and obstruction (arrows) in iliofemoral DVT cases: DUS (A), MRV (B), and CTV (C).

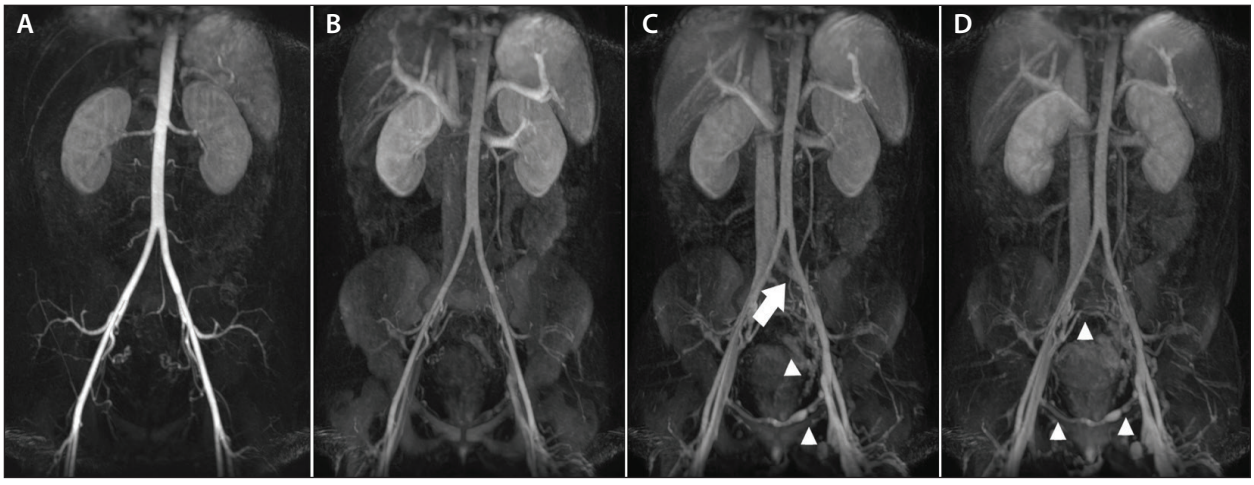


Figure 4. Dynamic MRV images in a patient with a left common (and external) iliac vein obstruction, highlighting the arterial system (A), first signs of contrast in the iliac and caval veins (B), lack of contrast (arrow) in the left common iliac vein (C), and collateral filling (arrowheads) (C, D).

outpatient clinic, we routinely perform DUS and MRV to evaluate all referred patients. With DUS, we specifically pay attention to insufficiency of the deep veins below the inguinal ligament, postthrombotic sequelae, and iliac obstruction. Pelvic and groin collaterals, nonreversibility of compression with augmentation, and an increased velocity ratio > 2.5 are valuable in identifying chronic obstruction.[10,11]

MRV can provide an excellent overview of chronic vein changes in the leg, pelvis, and abdomen. DVT sequelae, external compression, chronic obstruction, collateral pathways, and/or flow redistribution can all be visualized. Some reports have shown the added benefit of acquiring dynamic images showing inflow and outflow of the pelvis vasculature.[12] In our experience, this can highlight the extent of the obstruction and is informative when explaining the disease to patients (Figure 4).

The next step for diagnostic imaging that is currently primarily used to assist in patient evaluation, treatment planning, and confirmation of clinical suspicion of severity is prediction of treatment outcome. I strongly believe that diagnostic imaging can provide the tools to select patients who will benefit from early (minimally invasive) intervention for DVT. This also has potential in chronic DVO, because in our own experience, we have already seen that different obstructions (caval, iliocaval, iliofemoral, femoral) have shown different outcomes after recanalization, stenting, and selected cases endophlebectomy.[3]

CONCLUSION

Diagnostic imaging offers multiple tools to enhance clinical decision making for patients with both acute and chronic DVO. Although the focus has been and still is on identification of DVT and chronic venous obstruction, there are developments in both static and dynamic imaging to help select patients who will optimally benefit from minimally invasive treatment for these diseases. ■

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