WHAT WOULD YOU DO?

Filter-Associated DVT in an Elderly Patient

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CASE PRESENTATION

A 90-year-old man with a history of arthritis presents to the emergency department (ED) complaining of left leg swelling and pain. The patient describes developing vague pain in the leg while doing yard work at his home, and in the subsequent 3 days, he developed swelling and a tight pressure sensation that made it difficult to walk, so his family brought him to the ED for evaluation.

Several years ago, the patient was admitted to a community hospital due to a ground-level fall and underwent surgical evacuation of a subdural hematoma. While recovering from surgery, he developed left leg pain and was diagnosed with a deep vein thrombosis (DVT). CTA was negative for pulmonary embolus. An inferior vena cava (IVC) filter was placed. The patient fully recovered from his injury and returned home where he lives independently. In his late 80s, he was evaluated by the community interventional radiology (IR) physician for filter retrieval but was advised to maintain it given his age and history of diverticular bleed several years ago.

In the ED, lower extremity ultrasound reveals occlusion of the left femoral vein extending to but not including the popliteal vein. The patient is started on apixaban, is discharged from the ED, and an outpatient consultation with IR is ordered for further evaluation.

On presentation to the IR clinic 8 days after developing symptoms, the patient describes no improvement in the discomfort and swelling of his leg since starting apixaban. Normally an active person, he spends several hours per day in his recliner due to discomfort in his leg. On examination, there is severe tight edema of the left lower extremity, particularly in the leg and foot, which are warm and red. Circumference of the left leg and thigh is larger than the right. Sensation and motor function are intact, pulses are symmetric, and there are no signs of phlegmasia. The right lower extremity examination is normal. A CT venography (CTV) is ordered to evaluate the extent of the clot (Figures 1 and 2).

Would you intervene on this patient, and why or why not? What factors do you consider when evaluating an elderly patient with acute DVT for intervention, and how might these factors influence your management strategy?

Prof. Villalba: The decision to intervene is based on a patient's characteristics plus presentation and symp-

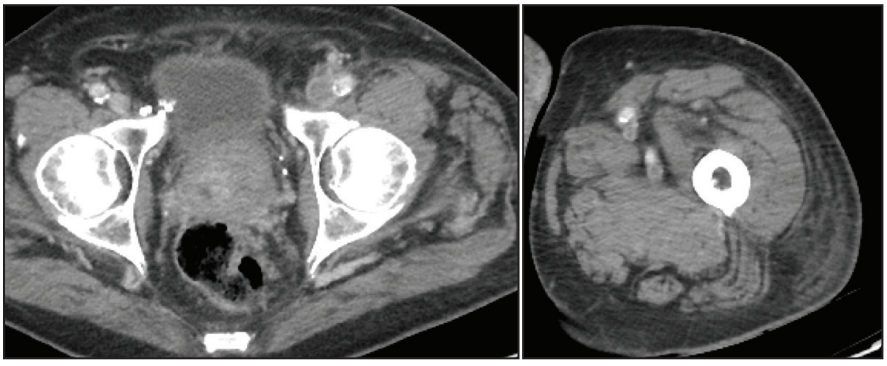

Figure 1. Selected axial views of the left lower extremity.

Figure 2. Centerline reformatted images of the left lower extremity: coronal and lateral projections.

toms versus procedural risks. I would consider interventional treatment for this patient because conservative management failed, and he is severely affected by the DVT. Despite his age, he doesn't seem to have any significant comorbidities and was previously active and living independently at home. Another important factor to determine management strategy is renal function.

Dr. Moriarty: The decision to advance care beyond medical management is always a balance between patient- and clot-specific factors. In this case, I would intervene. Although it is a concern that the patient is elderly, this should not preclude the use of appropriate treatment to relieve symptoms and prevent deconditioning and morbidity. There are 50 million Americans over age 65, which comprises 15% of the population, and intervention in this group is increasingly common. I would be wary of lytics because of the patient's age (shown to be the most important risk factor for intracranial hemorrhage in almost all trials with thrombolysis, including PEITHO) and history of previous intracranial hemorrhage. Given his age, the goal of care is not to prevent postthrombotic syndrome (PTS) but to improve acute symptoms and encourage early mobilization; therefore, I think thrombectomy with the restoration of inline flow is warranted.

Dr. Plett: There are several factors to consider when deciding how to intervene in the setting of DVT. The acuity of symptoms, anatomic extent of the thrombus (eg, iliofemoral, femoropopliteal, or infrapopliteal), and severity of symptoms are all important to consider when deciding between anticoagulation alone, catheter-directed pharmacologic thrombolysis, mechanical thrombectomy, or IVC filtration. Acute thrombus (< 14 days) is more likely to respond favorably to pharmacologic thrombolysis than chronic, organized thrombus (> 4 weeks), which may require venous recanalization and reconstruction.[1] The ATTRACT trial suggested a role for pharmacologic thrombolysis in iliofemoral DVT to reduce the severity of PTS,[2] whereas isolated calf thrombus is generally treated with anticoagulation alone. Urgent thrombectomy and/or thrombolysis remain a mainstay for the treatment of phlegmasia cerulea dolens.

The elderly patient population requires special consideration. It is important to note any comorbidities or medical conditions that affect the projected risk of bleeding, such as frequent falls or recent intracranial or gastrointestinal hemorrhage (within 3 months). The patient's baseline functional status and life expectancy will also influence the management strategy. Given that a major objective of DVT therapy is to prevent or reduce PTS, patients should be ambulatory at baseline and have sufficient life expectancy to warrant a more aggressive approach.

This patient presents with acute iliofemoral DVT, a significant impact on quality of life, and excellent baseline functional status. In the absence of an absolute contraindication to anticoagulation or thrombolysis, he would be an excellent candidate for a more aggressive approach.

Describe how you would approach this patient. How would you manage anticoagulation before and during the procedure? What devices would you use? Would you perform catheter-directed thrombolysis, and what would you do about the IVC filter?

Dr. Moriarty: The CTV shows a large iliocaval thrombus extending to the leg but, importantly, not including the popliteal vein. This is key in decision-making for both the access point into the venous system and the likelihood of good response. In my experience, a patent popliteal vein is a marker for good inflow and, hence, good outcomes, particularly with nonlytic therapies. Due to the patient's age and comorbidities, I would favor a nonlytic approach to thrombectomy. The large-bore options would include AngioVac (AngioDynamics) or FlowTriever (Inari Medical), and both could provide good results and have proven efficacy with large volumes of thrombus. However, my preferred access site into the normal left popliteal vein precludes devices of this size. Therefore, I would proceed with single-session thrombectomy with either Jeti (Walk Vascular, LLC), AngioJet (Boston Scientific Corporation), Indigo (Penumbra, Inc.), or ClotTriever (Inari Medical). At this point, I would not remove the IVC filter and leave it to be removed during a future session.

Dr. Plett: I would schedule this patient for single-session thrombectomy to be performed in the outpatient setting. His stable clinical status, absence of pulmonary embolism, and relatively acute presentation would support this approach. In addition, the presence of a patent popliteal vein would provide an adequate proximal access point to accommodate the platform lengths of thrombectomy devices, intravascular ultrasound (IVUS) catheters, angioplasty balloons, and stents that are readily available in a typical lab.

I would have the patient continue on apixaban. Interprocedurally, I would systemically heparinize the patient using a weight-based dosing protocol. Access should be in the patent popliteal vein below the inferiormost extent of the thrombus. This is a critical step because failing to ensure adequate venous inflow can subvert your best attempts at recanalization due to rethrombosis. Once access is achieved, a bolus dose of alteplase is laced along the entire extent of the thrombus with a multi-side-hole infusion catheter, such as the 5-F Cragg-McNamara catheter (Medtronic), and allowed to dwell for up to

30 minutes. Next, I would proceed with a mechanical aspiration of the clot using either the Indigo CAT8 continuous aspiration mechanical thrombectomy system (Penumbra, Inc.) or the ClotTriever thrombectomy system. IVUS is a useful adjunct to venography to monitor the progress of thrombus clearance. IVUS can also help characterize the chronicity of the thrombus; an acute clot tends to appear hypoechoic and expansile, whereas a chronic clot is echogenic and eccentric. The decision to convert to catheter-directed thrombolysis with overnight intensive care unit hospitalization would depend on the success of initial pharmacochemical aspiration, amount of residual acute thrombus, and overall case duration.

Once the iliofemoral and caval thrombus is sufficiently debulked, the IVC filter requires attention. Chronic indwelling IVC filters have been associated with a variety of complications, including caval thrombosis and proximal DVT.[3] The FDA currently recommends that retrievable IVC filters are removed as soon as possible once the risk for pulmonary embolism has resolved, ideally between 29 and 54 days after implantation. This filter appears well centered without fracture or limb penetration and should be amenable to standard retrieval techniques via a jugular approach.

Prof. Villalba: I would have chosen intravenous heparin throughout the procedure because it is safer for monitoring as well as a single-session thrombolysis/thrombectomy with AngioJet. My preference is with the patient under general anesthesia, in supine position, with cannulation of patent calf vein below the thrombosed area; having access from internal jugular vein and the contralateral groin provides more options, especially for the profunda vein or if the filter retrieval is difficult. Usually, 10-mg tissue plasminogen activator (tPA) delivered into the thrombus via Power Pulse with AngioJet is enough, followed by thrombectomy then IVUS assessment, balloon angioplasty, and possibly stenting. I would aim to retrieve the filter in the same session because it is probably a significant contributor to the problem.

CASE CONTINUED

After extensive single-session thrombectomy of the left lower extremity and infrarenal IVC, the patient is fatigued and the decision is made to terminate the procedure and leave the filter in place to allow for additional endogenous fibrinolysis on anticoagulation before returning to retrieve the filter (Figure 3).

If the patient had been able to tolerate continuing the procedure, what would have been your next step after obtaining the venograms (Figure 3)? What would be your endpoint?

Dr. Plett: The venograms demonstrate persistent iliofemoral and caval thrombus. If the patient was able to tolerate the procedure, additional aspiration thrombectomy and/or venoplasty could be performed to attempt to macerate this clot. My endpoint depends on flow dynamics; in the setting of brisk venous inflow, a small residual clot will likely regress via endogenous fibrinolysis. However, if there is persistent flow-limiting clot or stenosis, venous stasis and rethrombosis are considerable risks.

Prof. Villalba: I prefer to perform these cases with the patient under general anesthesia so that there are no issues regarding patient tolerance. There appears to be some residual thrombus and scarring/stenosis from the previous DVT. I would attempt to resolve the thrombus in the profunda femoris vein because the femoropopliteal segment appears patent but with some residual thrombus/scarring, and inflow should be improved as much as possible. Then, aggressive ballooning of the entire tract would follow, including the inflow vessels.

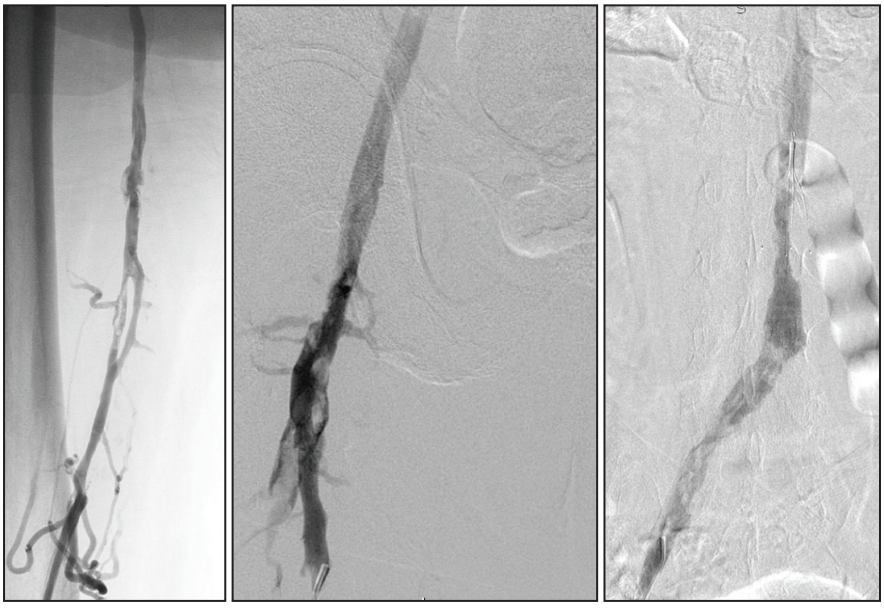

Figure 3. Venograms after thrombectomy.

Finally, I would use IVUS again to assess inflow/outflow and decide whether to stent.

Dr. Moriarty: Endpoints in venous thromboembolism treatment are difficult to pin down and there is significant variability even with experienced operators. For example, with pulmonary embolism, an argument could be made to remove only as much thrombus as will allow the patient to improve (eg, move from massive to submassive status) and not risk complications with further thrombectomy that will not be clinically impactful. With DVT, I would not accept an endpoint that doesn't have high-velocity antegrade flow. Once this is achieved, I am less cavalier with stenting, and if the flow looks good, I will try to avoid stents, particularly in young patients.

CASE CONTINUED

The patient has an uneventful recovery and is discharged after overnight observation in the step-down unit while remaining on apixaban. His extremity tightness and discomfort are markedly improved within 24 to 48 hours. One week after the procedure, his symptoms have resolved.

The patient returns to IR for further intervention and filter retrieval 1 month later. The femoral vein remains patent on ultrasound. The filter is easily retrieved with a trilobed snare from a jugular approach, and venography is repeated (Figure 4).

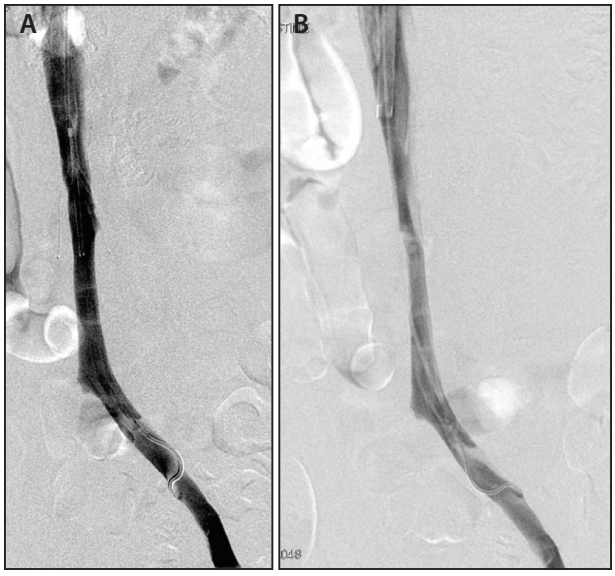

Figure 4. Pre- (A) and post-IVC filter retrieval (B).

How would you manage these findings?

Dr. Moriarty: Given the good response symptomatically and decent lumen with good flow, I would not proceed with further interventions once the filter is removed, but rather ensure adequate anticoagulation, activity, and leg compression and monitor in the office for symptomatic improvement or deterioration in 1 month.

Prof. Villalba: There is obvious stenosis in the IVC and possibly the entire iliac tract. I would assess with IVUS, but if the patient is now asymptomatic and considering he is in his 90s, I would remain conservative and follow up with duplex ultrasound.

Dr. Plett: The infrarenal caval stenosis is a risk factor for the formation of new thrombus; therefore, it should be addressed even if the patient is currently asymptomatic. Because the extent of stenoses is often underestimated with conventional venography,[4] I would use IVUS to accurately define both the circumferential diameter as well as the craniocaudal extent of the lesion and allow for appropriate venoplasty balloon sizing.

CASE CONTINUED

Venoplasty is performed on the stenosis at the L2-3 IVC with 12- and 16-mm balloons (Figure 5). Two weeks later, dual-energy CT is performed to reevaluate the pelvic veins, which shows uniformly small < 10-mm pelvic veins with right-sided collateral, as well as a narrowed infrarenal IVC (Figure 6).

How would you manage the CT findings? How would you determine the "normal" size of the veins in this patient? What would your management approach be in terms of balloon size, stenting, and postprocedural anticoagulation?

Prof. Villalba: I would not make decisions on size based on CT. Multiple factors can affect CT results that are as simple as fluid status or patient positioning. Veins are compliant and significant dynamic changes are common. IVUS allows for real-time assessment, and the Valsalva maneuver can show a wide variation in diameter. IVUS can demonstrate scarring, focal stenosis/trabecula, or a Rokitansky lesion. I would also evaluate the contralateral side to use as a comparison of what "normal" would be for this patient. The IVC sizing would depend on IVUS of the healthy IVC above the filter; however, considering that the filter has been there for a long time, severe scarring and stenosis can be expected and rupture highly probable, so smaller sizes should be considered and stenting might be necessary

to allow remodeling. Sizing is also dependent on the size of the inflow vessels.

In this case, it looks like the IVC stenosis caused by the IVC filter is the main culprit, so I would consider stenting the IVC because balloon angioplasty alone is usually not enough. It appears that the entire femoroiliac segment was considered too small (maybe a Rokitansky lesion) and because the inflow appears suboptimal, I would avoid stenting that as well.

Anticoagulation with low-molecular-weight heparin for the first 4 weeks as well as ruling out malignancy are involved in my protocol. Finally, I would follow-up with duplex ultrasound, followed by warfarin for at least 6 months.

Dr. Plett: Persistence of the caval stenosis suggests that this lesion was refractory to the initial venoplasty attempt. I would use IVUS to assess the length and degree of the stenosis. IVUS can also be used to measure the diameter of "normal" vein proximal and distal to the lesion to best determine the appropriate balloon size for venoplasty. In the IVC, this typically ranges between 18 to 24 mm. After prolonged venoplasty, IVUS is repeated to assess the durability of the dilation. If there is residual luminal stenosis of > 50% or a persistent pressure gradient > 3 mm Hg, an uncovered self-expanding Wallstent endoprosthesis (Boston Scientific Corporation) can be deployed across the lesion. I size these stents to the normal caval diameter as determined by IVUS. In this setting of provoked DVT, I would anticoagulate with a direct oral anticoagulant, such as apixaban, for 3 to 6 months.

Dr. Moriarty: Once a decision to proceed with venoplasty has been reached, adequate sizing is critical. This is where IVUS has greatly changed practice. With IVUS, the focal narrowing and compression that could otherwise be missed on venography are identified and the target size of the normal vessel is estimated. This allows the operator to choose an appropriately sized balloon, typically without oversizing of the target lesion. Then, we perform angioplasty with "long balloons for a long time," meaning that we use long-length balloons to cover the entirety of the affected vessel with 180-second inflations to minimize recoil. If stents are required, then in the era of venous-specific stents such as Vici (Boston Scientific Corporation) and Venovo (BD Interventional), minimal oversizing is advised.

APPROACH OF THE MODERATOR

This is a case of filter-associated DVT caused by a retrievable filter initially placed for a provoked DVT but not retrieved following recovery. The filter should be removed. Given the extent of thrombosis and likely lengthy recovery time on anticoagulation alone, which would expose this elderly patient to the risks of deconditioning and difficulty ambulating over several weeks or months, thrombectomy was offered to the patient. Because of his advanced age and history (albeit remote) of gastrointestinal bleeding and subdural hematoma, a single-session pharmacomechanical thrombectomy was planned with minimal use of tPA to remove the filter after the procedure.

The patient was left on apixaban. In the prone position, access was achieved in the left popliteal vein. The entirety of the thrombosed region was laced with a total of 8-mg tPA via a Unifuse catheter (AngioDynamics) and left to dwell for 15 minutes. The thrombus was then

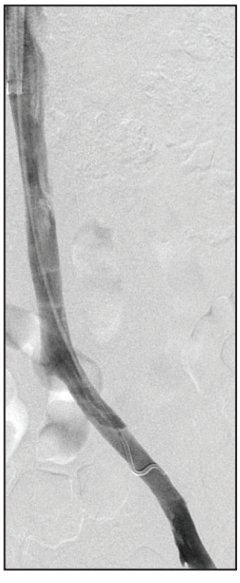

Figure 5. Post-IVC filter retrieval and venoplasty.

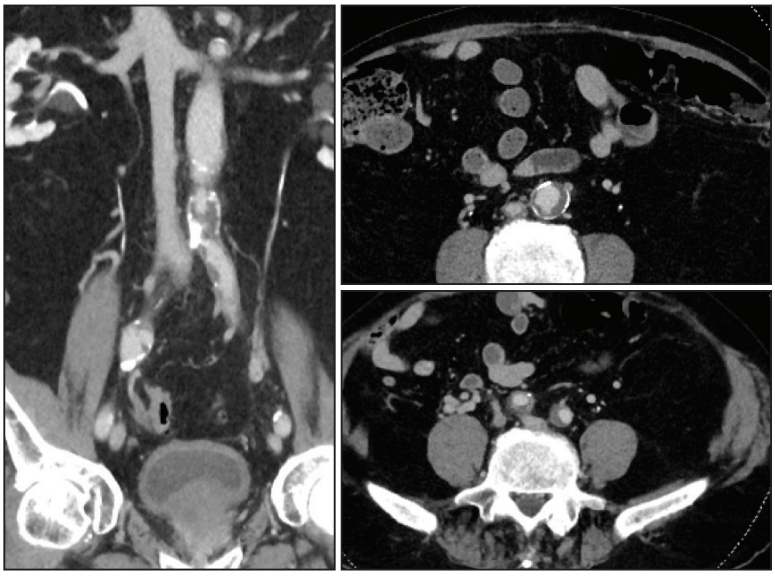

Figure 6. Dual-energy CT after filter retrieval. In the axial projection, infrarenal IVC and pelvic veins are small, and right-sided pelvic venous collateral is present.

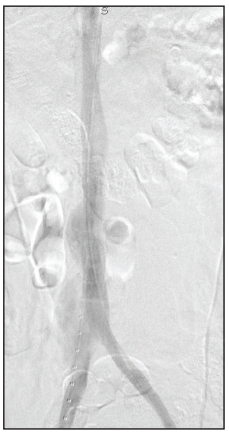

Figure 7. Venogram showing contained rupture of the IVC.

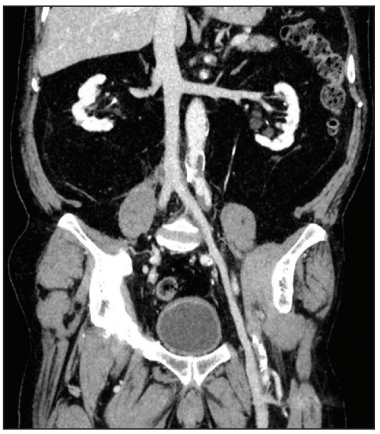

Figure 8. Centerline reformatted image from CTV of the left lower extremity.

aspirated using the Indigo CAT8 catheter, working distally to central. Balloon maceration was also performed with 10- and 12-mm high-pressure balloons with an additional pass with suction thrombectomy. A total of 900 mL of clot was aspirated. At the end of the procedure, expedient inflow and outflow through the filter were restored, and no venous collaterals were seen. The filter was left in place to allow additional endogenous fibrinolysis before filter retrieval.

The filter was easily retrieved 1 month later using a 14-F, 45-cm sheath and trilobed snare. Venoplasty was performed on the mild stenosis at the filter site with 12- and 16-mm balloons.

On follow-up CT, given the presence of venous collateral as well as a reduced caliber of the infrarenal IVC, the patient returned to IR for venoplasty and possible stenting. The left iliac veins were uniformly small in caliber (approximately 8 mm) with moderate stenosis in the infrarenal IVC on IVUS; no May-Thurner lesion was seen (IVUS images unavailable). Venoplasty was performed on the IVC up to 24 mm; no waist was seen. Severe stenosis of the right common iliac vein at the confluence was identified, and a waist was treated with serial venoplasty up to 16 mm. This resolved the large collateral but caused a small asymptomatic contained rupture of the IVC, which persisted after prolonged venoplasty with a large semicompliant balloon (Figure 7).

With the IVC filter now removed, focal stenoses were absent and expedient inflow and outflow were seen on venography despite the relatively small-caliber pelvic veins, and the decision was made to avoid stenting at this time. The patient continued to do well after venoplasty. On follow-up CTV, the contained rupture thrombosed and no recurrent focal stenoses were identified (Figure 8). The patient was transitioned off anticoagulation. At 1-month follow-up, the patient continues to do well and is pleased to have returned to gardening. ■

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