

INTERVIEW

Simplifying Complex DVT Thrombectomy Cases With the New Protrieve Sheath

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Vascular Disease Management speaks with interventional radiologists Jeffrey Forris Beecham Chick, MD, MPH, and Abdullah Shaikh, MD, about their use of the Protrieve sheath from Inari Medical during complex deep vein thrombosis (DVT) and inferior vena cava (IVC) thrombectomy cases. Their case reports follow the interview.

What percentage of your DVT patients present with complex DVT, meaning either bilateral disease or with thrombus extending into the IVC?

Dr. Chick: Most of my patients are complex venous patients; more than 70% involve the IVC or bilateral lower extremities.

Dr. Shaikh: When we started our DVT practice, we began by using Inari devices on acute unilateral DVTs. As we became more comfortable with the devices, we started to take on more complex cases. If we define complex cases as having bilateral or caval involvement, this represents about 40% of our DVT patients.

How have you treated complex DVT patients in the past? What were some of the limitations of those approaches?

Dr. Chick: The field has changed drastically over the past 10 years. In the distant past, these cases were quite complicated, usually requiring a variety of lytic-based therapies where we used tissue plasminogen activator (tPA) to break up acute and chronic thrombus. These were multi-day

procedures where the patients had to be treated for an extended period.

Also, in the past, we didn't have optimal-sized devices for treating many of these patients, which led to inadequately treated DVT and multiple interventions. That has changed over the past 3 to 4 years due to the advent of the Inari devices.

Dr. Shaikh: Treatment of complex DVT has changed very quickly in recent years. Three years ago, I was doing these procedures mostly using lytics with small-bore aspiration catheters.

About a year ago, I began to use FlowTrievers in tandem with Trierer aspiration catheters for challenging IVC cases. Let's say the patient had caval thrombus extending above the level of the renal veins. I would have advanced the FlowTrievers catheter through a popliteal access site and deployed the XL disks—which treat vessels of 19–25 mm—superior to the thrombus. From the contralateral popliteal vein, I would have used either a Trierer20 or a Trierer24 for aspiration thrombectomy. This technique was only possible from a groin or popliteal approach, as an internal jugular (IJ) approach wouldn't allow you to pass the Trierer catheters next to those disks.

What are the advantages of the new Protrieve sheath during complex DVT thrombectomies?

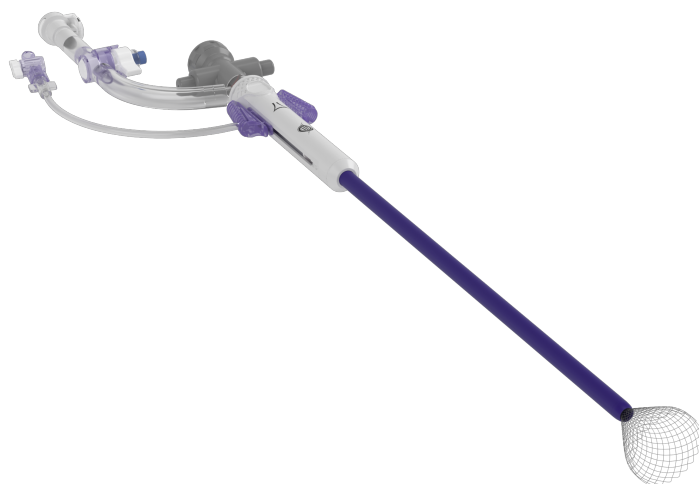


Figure 1. Protrieve sheath with nitinol mesh funnel deployed.

useful in these cases.

Dr. Shaikh: One of the main advantages of the Protrieve sheath (20 F) is the nitinol mesh funnel at the distal end of the device (**Figure 1**). The sheath is introduced from an IJ access and advanced into the IVC, and the 33.5-mm nitinol mesh funnel is deployed using the side actuators. The funnel gains full wall apposition in the caval region, which ultimately means that I can take on challenging cases knowing that the device is capable of trapping emboli. The sheath also has a large-bore side port for aspiration of residual thrombus trapped in the funnel, which is very

The sheath was designed to simplify complex DVT and IVC procedures, and it has done that in my practice for sure. The nitinol mesh funnel is intended for vessels up to 30 mm (17–30 mm treatment range), which is a perfect size, even for a dilated IVC. The actuators on the side work smoothly to deploy and then recapture the funnel. And, when the Protrieve sheath and funnel are deployed, it becomes possible to use the FlowTrievers toolkit (**Figure 2**) and ClotTrievers catheters from an IJ approach, which was not the case previously.

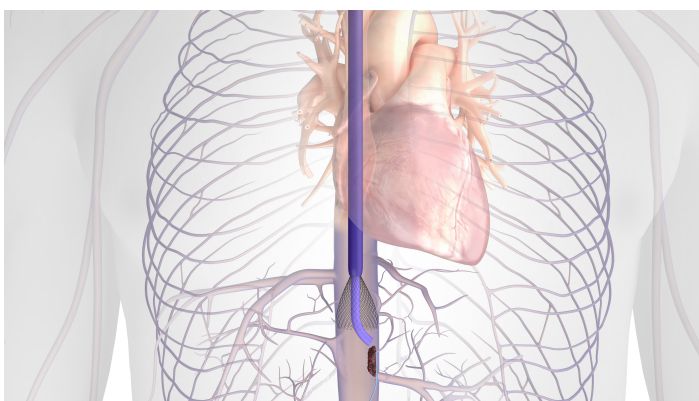


Figure 2. Trierer20 Curve catheter telescoped through Protrieve to aspirate IVC thrombus.

Dr. Chick: In the past, various techniques have predisposed patients with thrombus of the IVC and lower extremities to embolization. Whether we did thrombolysis or mechanical thrombectomy, there was always this proposed risk of embolization. Embolization of acute or chronic thrombus, which may migrate upstream to the pulmonary arteries, increases the risk of cardiopulmonary complications and may require additional treatments.

The Protrieve 20F sheath has allowed for the trapping of such material during thrombectomy with devices like ClotTrievers, whether it be acute or chronic thrombus. We can also perform venography through the sheath itself.

What are the patient outcomes when using Protrieve during these complex DVT cases? How do patients do immediately after the procedure and at follow-ups?

Dr. Shaikh: The use of the Protrieve sheath leads to quicker and more favorable outcomes as compared to prior attempts with other methods. We've had no access site complications with the sheath. Patients with IVC thrombus extending through the iliac vein down the lower extremity will demonstrate improvement on the table post procedure. Clinically, we see that the leg is softer, and the color is improved. The next day, patients will start to notice that the pain, cramps, heaviness, and swelling have improved or are starting to improve. By 1 month, I expect the patients to be back to baseline or close to normal in comparison to the contralateral side.

Dr. Chick: Overall, there have been no intraprocedural complications, and all patients have done well within 24 to 48 hours post procedure. We have used the Protrieve sheath in 8 procedures thus far. All patients have had good clinical outcomes at 2-week follow-up.

How will Protrieve change your approach to complex DVT in the future?

Dr. Chick: Protrieve is a useful adjunctive tool during a high-risk caval or lower extremity thrombectomy. I believe that future studies will show its true utility.

Dr. Shaikh: Protrieve is an absolute must on my shelf. Complex cases require planning and time no matter what, but this sheath simplifies the procedure and reduces the overall case time. There is an obvious benefit to less resource utilization and sedation in these cases, and, while access site complications are low with venous procedures, reducing the number of access sites is always a bonus. Most significantly, I'm able to approach central thrombus cases more aggressively, knowing that the Protrieve funnel will trap any emboli.

Case Report

Protrieve Simplifies Mechanical Thrombectomy Treatment in a Complex Case of Deep Vein Thrombosis Originating in the Intrahepatic IVC

Abdullah Shaikh, MD

Patient Presentation

A 65-year-old female with a 2-year history of cholangiocarcinoma presented with new jaundice the day after a liver biopsy. Prior to the biopsy, the patient was taken off Eliquis, which she had been on prophylactically due to a liver mass causing compression of the IVC. In the emergency room, computed tomographic (CT) venography was performed, which showed thrombus within the intrahepatic IVC extending down to involve the left renal vein, the infrarenal IVC, and the right common iliac vein (A). The patient was started on a heparin drip, and interventional radiology was consulted for mechanical thrombectomy.

Procedural Overview

The patient was placed in the supine position, and moderate sedation was started. She was pre-medicated due to a contrast allergy; therefore, the plan was to perform minimal venography and use IVUS when appropriate.

The initial plan was to access the right IJ vein and right common femoral vein. Once the patient was sterilely prepped and draped, the right IJ was accessed using a micropuncture needle. This was then transitioned up to an 8F sheath. Next, using a Berenstein catheter and a stiff Glidewire, the catheter wire combination was negotiated down the IVC and right iliac system without difficulty. Intravascular ultrasound was then performed over the wire from the cavoatrial junction through the right external iliac vein, followed by venography of the IVC (B).

A Berenstein catheter and Glidewire combination was then used to select the right common femoral vein. The catheter was placed into the popliteal vein, and the wire was exchanged for a superstiff Amplatz wire. The catheter was then removed.

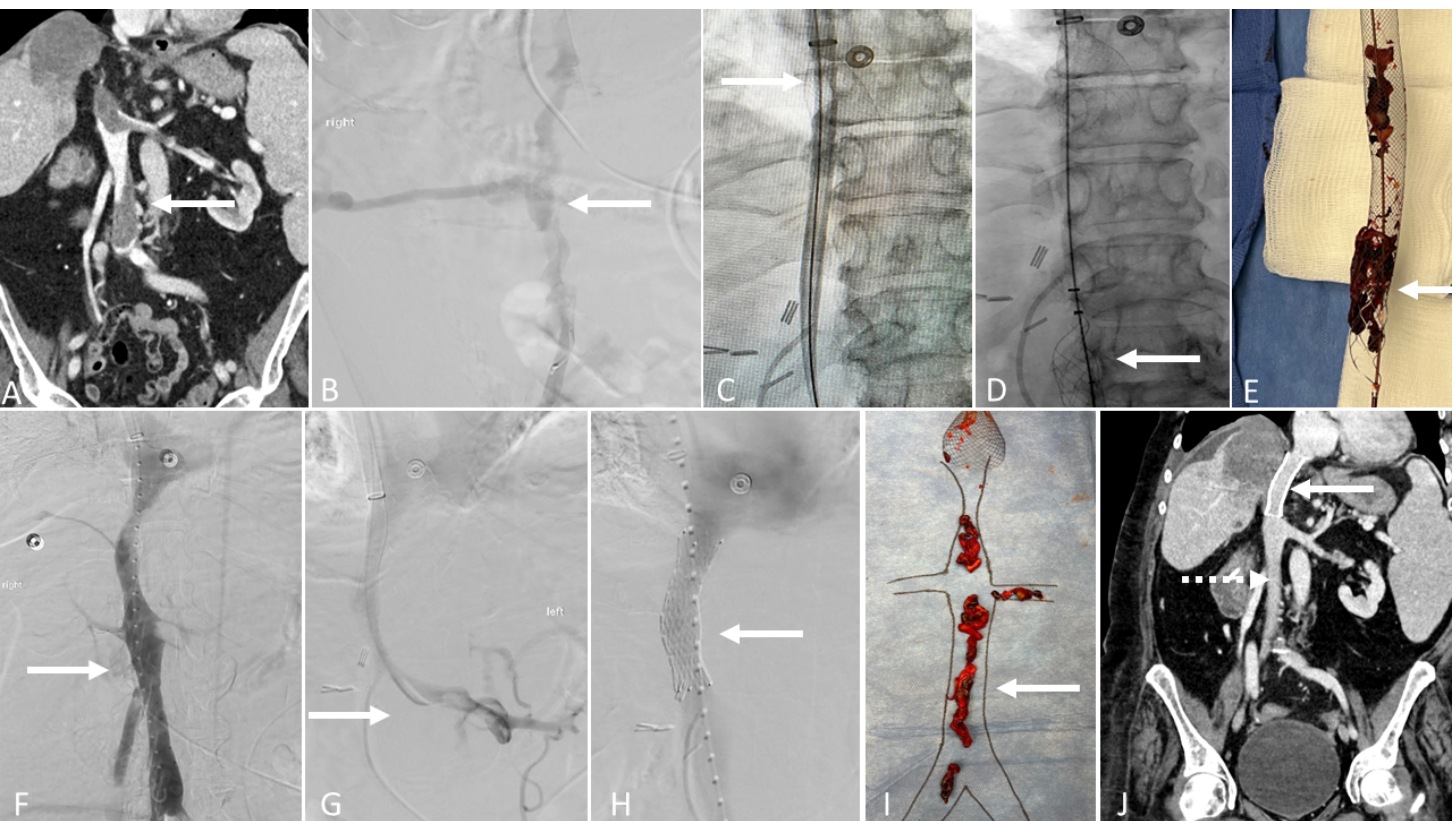


Figure 1. Preprocedure CT venography demonstrates thrombus within the intrahepatic IVC, left renal vein, infrarenal IVC, and right common iliac vein (A). Venography of the IVC indicates significant clot burden in the IVC with poor flow (B). A 20F Protrieve sheath was placed in the IVC (C), and the funnel was subsequently deployed below the cavoatrial junction. Mechanical thrombectomy was performed with the ClotTriever BOLD catheter from the popliteal vein up to the IVC (D). Extracted thrombus is seen within the coring element and collection bag following 1 of 4 passes with the ClotTriever device (E). Repeat venography confirmed that no residual thrombus remained in the IVC (F). Venography of the left renal vein was performed (G). A Venovo stent was deployed in the intrahepatic IVC (H). Extracted thrombus (I). One-month post-procedure CT venography demonstrating patency of IVC stent (J; solid arrow), remainder of the IVC, and left renal vein (J; dashed arrow).

The existing 8F right IJ sheath was then removed, the tract was dilated, and the 20F Protrieve sheath was placed (C). The funnel was deployed below the cavoatrial junction.

A 16F ClotTriever sheath was advanced into the Protrieve sheath in the right IJ, and the funnel was deployed. Then, the ClotTriever BOLD mechanical thrombectomy catheter was advanced over the wire (D). The coring element was deployed in the right common iliac vein. A total of 4 passes were performed, yielding 100% of the thrombus burden (E). The coring element was collapsed at the level of the Protrieve nitinol mesh funnel with each pass. Repeat venography and IVUS were performed, demonstrating no residual thrombus in the IVC (F). The ClotTriever sheath was then removed.

Attention was then turned to the left renal vein. Using a Berenstein catheter and glidewire, the left renal vein was selected. Contrast was injected through the catheter and a venogram of the left renal vein was performed (G). An Amplatz wire was then placed into the left renal vein, and great attention was paid to ensure that the wire would not advance to the renal hilum.

Next, a Triever20 catheter was advanced over the wire and parked within the ostium of the left renal vein. A total of 3 aspirations were performed. The aspirated contents were filtered through the FlowSaver Blood Return System, and blood was given back to the patient via the sideport of the Protrieve sheath. Repeat venography of the left renal vein was performed through the Triever20 catheter and then removed.

Stenting the intrahepatic IVC was the final step to help relieve the compression from the cholangiocarcinoma. After identifying appropriate landmarks using both venography and IVUS, a 16-mm x 60-mm Venovo stent was deployed in the intrahepatic IVC (H). The stent was then post dilated with a balloon and repeat venography and IVUS of the IVC was performed. The right IJ Protrieve sheath was removed after a purse string suture had been placed. Pressure was held for 15 minutes after the suture had been cinched. Thromboemboli were observed in the Protrieve funnel.

Discussion

The Protrieve sheath made it possible to simplify this complex case by using only one access site. It allowed us to use ClotTriever and FlowTriever from a right IJ approach to clear out thrombus that extended centrally from the right common iliac vein (I). Pathology confirmed the thrombus was bland and not from tumor invasion. The 1-month post-procedure CT venography demonstrates patency of the IVC stent (J; solid arrow), the remainder of the IVC, and left renal vein (J; dashed arrow).

Case Report

Protrieve Sheath Used in a Complex Mechanical Thrombectomy Procedure With the ClotTriever and Novel InThrill Systems

Jeffrey Forris Beecham Chick, MD, MPH

Patient Presentation

A 57-year-old female with recently diagnosed stage IVB cervical cancer post chemotherapy (cisplatin/paclitaxel/bevacizumab) presented with right lower extremity pain and swelling for >5 days. Venous duplex examination of the right lower extremity demonstrated acute occlusive thrombus throughout the right external iliac vein, common femoral vein, femoral vein, and popliteal vein. CT venography of the abdomen and pelvis demonstrated a large necrotic cervical mass (A; solid arrow) with metastatic lymphadenopathy as well as chronic thrombus throughout the right ilio caval and iliofemoral venous segments and left renal vein (A; dashed arrow).

Procedural Overview

The patient was placed supine, and general anesthesia was administered per institutional preference. Access to the right popliteal vein was obtained, and a sheath was placed. Right lower extremity ascending venography was performed, demonstrating acute occlusive thrombus (B).

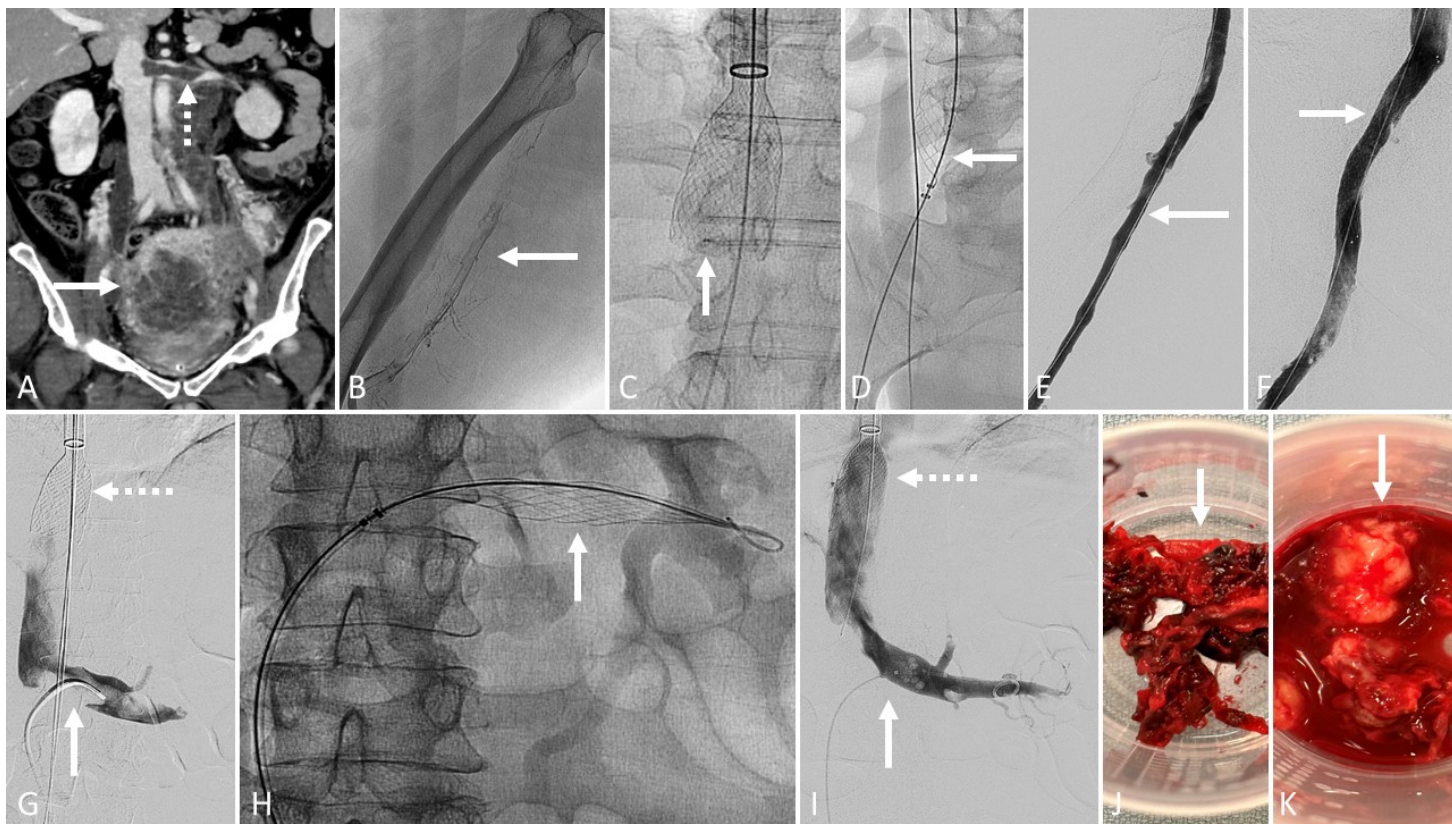


Figure 1. CT venography demonstrated a large necrotic cervical mass (**A; solid arrow**) with metastatic lymphadenopathy and chronic thrombus in the right iliofemoral segments and left renal vein (**A; dashed arrow**). Preprocedural venography of the right lower extremity confirmed acute occlusive thrombus (**B**). The Protrieve funnel was deployed in the patent suprahepatic IVC (**C**). The ClotTriever thrombectomy catheter was deployed (**D**). Completion venography confirmed clearance of thrombus from the right lower extremity, and brisk in-line flow (**E**). A stent was placed in the right common iliac and external iliac veins (**F**). Left renal venography showed non-occlusive thrombus (**G; solid arrow**). The Protrieve sheath remained in place (**G, dashed arrow**). The InThrill thrombectomy catheter (**H; arrow**) was used to remove thrombus from the left renal vein. Completion left renal venography confirmed removal of thrombus and brisk in-line flow (**I; solid arrow**). The Protrieve sheath (**I; dashed arrow**). Thrombus extracted from the lower right extremity (**J**) and Protrieve sheath (**K**).

A wire and catheter were navigated into the IVC. Access to the right IJ vein was obtained, and the 20F Protrieve sheath was placed. The device funnel (C) was deployed in the patent suprahepatic IVC.

From the right popliteal access, the ClotTriever thrombectomy catheter (D) was used to make 3 thrombectomy passes of the IVC, right iliofemoral, iliofemoral, femoral, and popliteal veins. Completion right lower extremity ascending venography demonstrated removal of acute occlusive thrombus with brisk in-line flow (E).

There was extrinsic compression of the right common iliac and external iliac veins for which a 14-mm x 80-mm Abre stent (F) was placed. Post-deployment angioplasty was performed with a 12-mm balloon.

Access to the left common femoral vein was obtained, and a sheath was placed. A wire and catheter were navigated into the left renal vein. Left renal venography demonstrated non-occlusive thrombus (G; solid arrow), and the Protrieve sheath was left in place (G; dashed arrow).

From the left common femoral vein access, the InThrill thrombectomy catheter (H) was used to make 3 thrombectomy passes of the left renal vein. Completion left renal venography demonstrated removal of acute occlusive thrombosis with brisk in-line flow (I; solid arrow). The Protrieve sheath was removed, and hemostasis was achieved.

At the conclusion of the procedure, thrombus from the right lower extremity thrombectomy (J) and Protrieve sheath (K) had been removed. Swelling improved within 48 hours.

Discussion

Emboic complications from chronic thrombus, which is unlikely to respond to anticoagulation or thrombolysis, pose risks of cardiopulmonary compromise and may necessitate additional invasive procedures. The 20F Protrieve sheath funnel diameter of 33.5 mm provides atraumatic caval wall apposition and was utilized in this case to perform rapid removal of thrombotic material via a large-bore manual aspiration mechanism, similar to the FlowTriever System.

