Endovascular release of an Adams-DeWeese clip and iliocaval reconstruction for debilitating lower extremity swelling

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ABSTRACT

More than 10 million cases of venous thromboembolisms are reported on an annual basis and are major contributors to morbidity and mortality. Studies have found that ≤90% of pulmonary embolisms originate from the abdominal and lower extremity veins. The mainstay of venous thromboembolism treatment has been, and still continues to be, anticoagulation. However, for patients for whom anticoagulation is contraindicated or has failed, physicians have turned to surgical innovations such as inferior vena cava (IVC) filters to create partial interruption of the IVC. Before the invention of IVC filters, the Adams-DeWeese clip was developed to create caval interruption, which allowed for venous return while preventing pulmonary emboli from distal veins. We report a case of endovascular release of a long-term Adams-DeWeese clip, which had caused IVC occlusion and debilitating bilateral lower extremity swelling. (J Vasc Surg Cases Innov Tech 2024;10:101445.)

Keywords: Adam-DeWeese clip; Deep vein thrombosis; Iliocaval reconstruction; Inferior vena cava; Venous disease

The Adams-DeWeese clip was developed as an early method for caval interruption to prevent progression of distal venous emboli from advancing to the pulmonary system, resulting in morbidity and mortality. First introduced at a meeting of the Society for Vascular Surgery in 1964, the Adams-DeWeese clip allowed surgeons to partially occlude the inferior vena cava (IVC) while allowing for venous return through 3-mm serrations in the clip. The clip itself was made of Teflon due to its nonirritating properties and secured using a piece of suture (Fig 1). Animal studies compared the effectiveness of the Adams-DeWeese clip against other methods of caval interruption and concluded the Adams-DeWeese clip was the most efficacious method of interruption, with an added benefit of being able to be placed expeditiously and to compartmentalize the IVC to the appropriate size.[1]

The present patient had undergone Adams-DeWeese clip placement 50 years prior but had been experiencing increasing lower extremity discomfort for the past year. We present a case of endovascular release of an Adams-DeWeese clip with complete endovascular reconstruction of his iliocaval system. The patient provided written informed consent for the report of his case details and imaging studies.

CASE REPORT

The patient was a 77-year-old man who presented with a 1-year history of significantly worsening bilateral lower extremity swelling. He reported constant discomfort that was worse with ambulation and activity and had led to significant impairment to enjoying his life in retirement. These symptoms persisted despite meticulous compression therapy. In 1968, he had suffered a tank injury in Vietnam that resulted in injuries and multiple pulmonary emboli. He described undergoing placement of an Adams-DeWeese clip via an open right retroperitoneal surgical access for caval interruption. He had experienced bilateral lower extremity swelling since then, which had severely worsened during the previous year. More recently, he had undergone right shoulder orthopedic surgery that was complicated by deep vein thrombosis postoperatively and treated with therapeutic apixaban. His other medical history was significant for stage 2 chronic kidney disease, gastroesophageal reflux, diverticulosis, and a 20 pack-year smoking history.

On initial examination, he had bilateral lower extremity edema that extended above his knees, with discoloration of the soles of his feet and toes. He had palpable dorsalis pedis and posterior tibial artery pulses bilaterally, and his skin was warm, dry, and without lower extremity wounds. He had full motor strength, and sensation was intact to light touch in the bilateral lower

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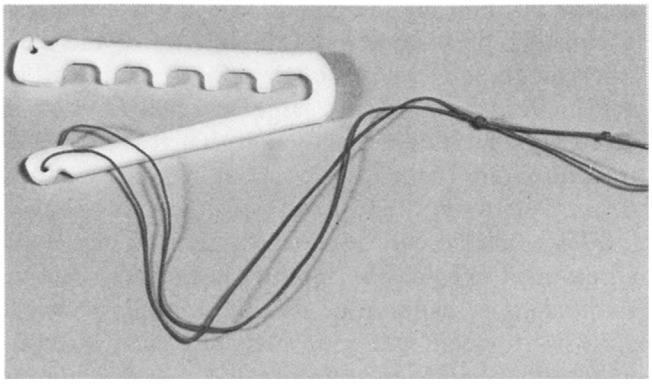

Fig 1. Photograph of the Adams-DeWeese clip. Reprinted, with permission, from Adams and DeWeese.[1]

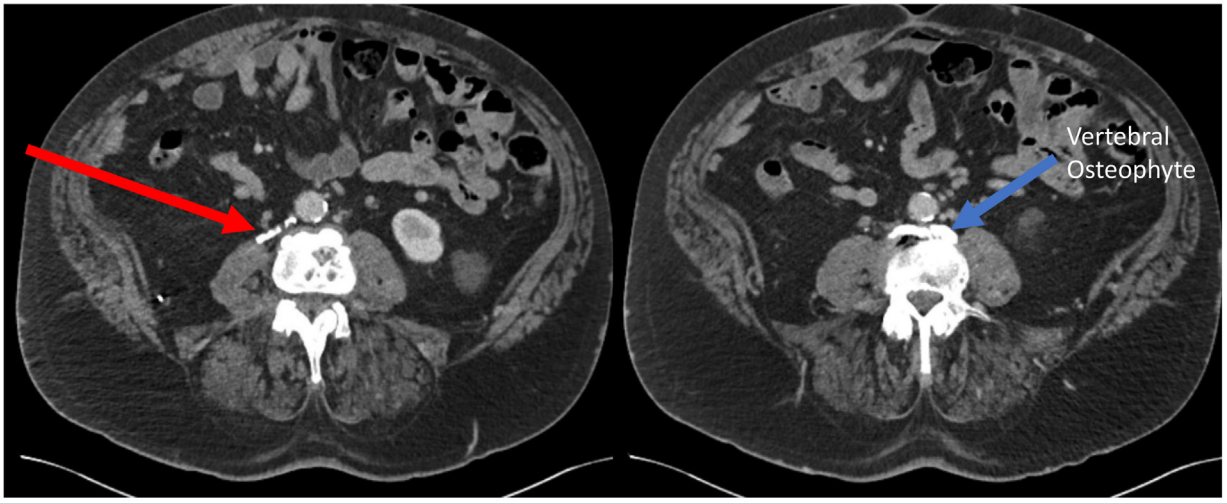

Fig 2. Transverse computed tomography venogram showing calcified thrombus directly inferior to the Adams-DeWeese clip (*red arrow*) within the suprarenal inferior vena cava (IVC), with total occlusion of the distal vena cava extending to the level of the bilateral iliac veins.

extremities. The venous clinical severity score was 10 and the CEAP (clinical, etiologic, anatomic, pathophysiologic) classification was C3, Es, Ad, Po. Lower extremity venous duplex ultrasound did not show deep vein thrombosis in either lower extremity; however, computed tomography venography revealed the previously placed Adams-DeWeese clip ~3 cm distal to the renal veins and adjacent total occlusion of the infrarenal IVC that extended to the bilateral common iliac veins (Fig 2). The decision was made to attempt endovascular release of the clip with iliocaval reconstruction.

Under general anesthesia, ultrasound-guided percutaneous access of the right internal jugular vein was made, followed by the introduction of catheters into the superior vena cava until the Adams-DeWeese clip was abutted in the abdominal IVC. A 12F sheath was introduced into the IVC proximal to the clip, and venography was performed, which demonstrated total occlusion of the suprarenal vena cava and the vena cava distal to the Adams-DeWeese clip. A wire could be passed through the 3-mm channel in the Adams-DeWeese clip; however, an Atlas balloon (Becton, Dickinson and Co) could not be threaded through the 3-mm channel despite the use of a long sheath for additional stability. At this point, the decision was made to access both the right and the left common femoral veins with ultrasound guidance to aid in clip removal. Venograms were performed from both femoral veins, which demonstrated proximal occlusion with multiple collateral vessels. Intravascular ultrasound confirmed total occlusion of the vena cava that extended from suprarenal vena cava to the left common and external iliac veins. A wire was able to be passed through one of the 3-mm channels in the Adams-DeWeese clip and was switched for a stiff Glidewire (Terumo Corp) that allowed for a snare from the right internal jugular access to create a through wire from the right femoral vein to the right internal jugular vein. A 7-mm × 40-mm Atlas balloon was passed through the channel and inflated, which created a waist but could not release the clip. Via the same channel, subsequent passage and inflation of a 24-mm × 40-mm balloon resulted in complete release of the Adam-DeWeese clip by "busting" open the secure suture (Fig 3).

Fig 3. Balloon venoplasty through the Adams-DeWeese clip channel with a 24-mm × 40-mm Atlas balloon.

Balloon venoplasty of the suprarenal vena cava that extended to the IVC and into the bilateral common and external iliac veins was performed. The infrarenal vena cava was stented with a 20 × 60-mm Venovo stent (Becton, Dickinson and Co) distal to the lower renal vein and terminated directly inferior to a left lumbar vein. Subsequently, 14 × 160-mm Venovo stents were placed in the bilateral common iliac veins in a double barrel fashion and deployed simultaneously. An additional 14 × 100-mm stent was placed in the left external iliac vein that extended to the middle of the femoral head and the common femoral vein (Fig 4). Venography and intravascular ultrasound confirmed patency of the iliocaval reconstruction (Fig 5). He was discharged home the next day and instructed to continue his apixaban and to start taking aspirin.

At the 4-week follow-up, he described symptomatic improvement and an ability to ambulate greater distances without pain or discomfort in his bilateral extremities. Duplex ultrasound demonstrated patent IVC and bilateral iliac vein stents. The patient is scheduled to undergo repeat ultrasound scans every 3 months for the first year and annually thereafter. He continues using compression stocking therapy and lifelong apixaban and aspirin treatment. He continues to remain well at the 3-month follow-up.

DISCUSSION

IVC thrombosis remains a rare, but serious, sequela of deep vein thrombosis that remains underrecognized.[2,3]

Fig 4. Fluoroscopic view of the final iliocaval reconstruction.

Only 1.3% of all hospitalized patients diagnosed with venous thromboses between 1979 and 2005 were considered to have vena cava thromboses. However, the lack of standardized detection methods and gaps in clinical awareness could have led to the underdiagnosis of this condition.[4] The risk factors for vena cava thrombosis mirror those for other venous thromboembolism diseases and also include anatomic anomalies and external venous compression, such as malignancies.[5]

In the present case, we opted for endovascular release of the Adams-DeWeese clip with complete reconstruction of the iliocaval venous system given the extensive occlusion that extended from the suprarenal vena cava to the bilateral iliac veins. It is presumed that our patient's history of deep vein thromboses was a direct result of his traumatic tank injury in Vietnam. The

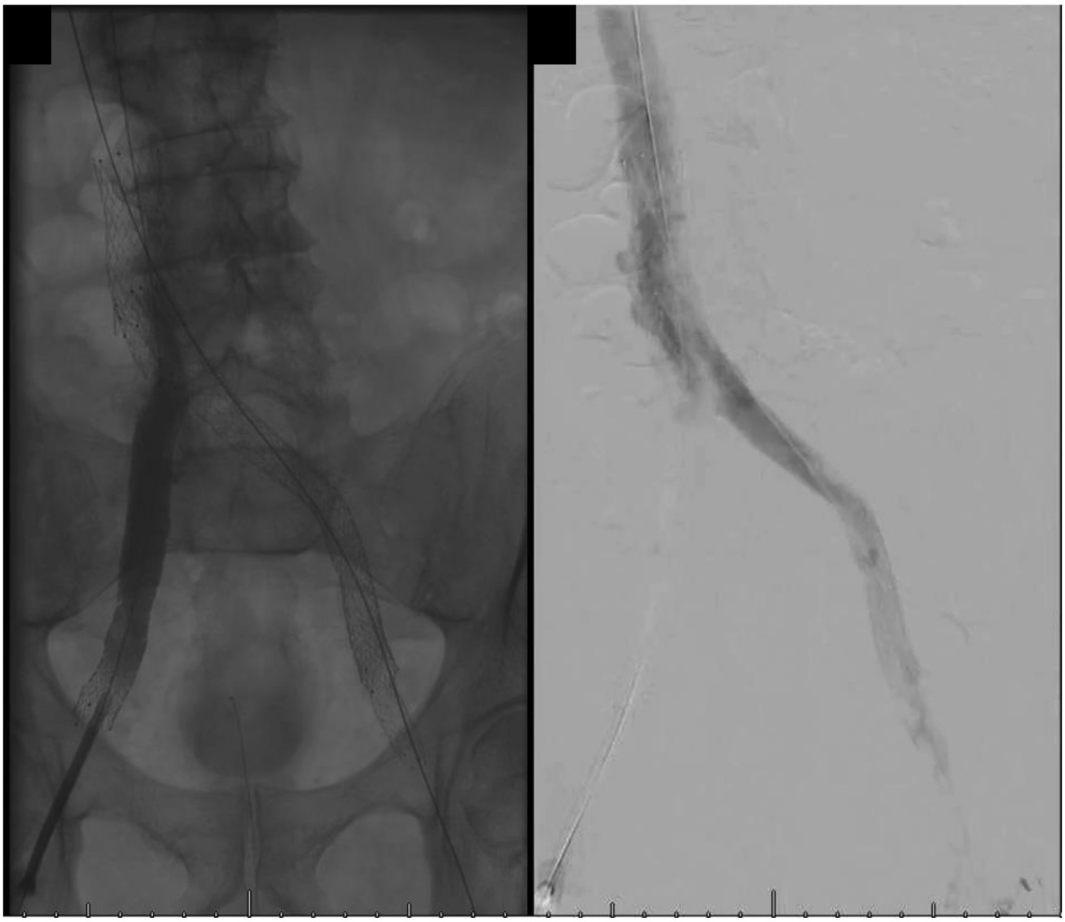

Fig 5. Patent flow through suprarenal inferior vena cava (IVC) extending to the bilateral iliac veins after percutaneous venoplasty and stenting.

Adams-DeWeese clip successfully prevented further advancement of the deep vein thromboses into his pulmonary system but resulted in long-segment venous total occlusion distal to the clip. This backflow of venous pressure presented as severe, lifestyle-limiting bilateral lower extremity edema and pain.

The advent of the Adams-DeWeese clip resulted from frustration in preventing pulmonary emboli, which at the time, were often a fatal sequelae of surgery.[1] Early surgical techniques included complete ligation of the IVC, which successfully prevented pulmonary emboli but often resulted in cardiogenic shock due to the sudden and drastic decrease in venous return. Additionally, patients often had to live with lifelong complications of lower extremity edema, swelling, and pain. A number of surgical techniques were developed in the 1950s to partially interrupt the vena cava to allow for venous return and prevent pulmonary emboli without complete occlusion of the vena cava. Although successful, these suturing techniques were time-consuming and required mobilization of a long segment of vein. Subsequent devices were designed to externally interrupt the vena cava. This led to the development of the Adams-DeWeese clip, which allowed for quicker application without sacrifices in effectiveness. The original Adams-DeWeese clip was constructed of Teflon and had serrations that allowed for division of the vein into small, 3-mm channels.[1]

Endovascular reconstruction of the iliocaval venous system is a method of reinstating adequate venous return in patients who have chronic venous obstruction secondary to venous injuries or removal of malignant neoplasms invading the vena cava.[6] Iliocaval reconstruction, although successful, is a drastic intervention that is typically reserved for patients for whom anticoagulation therapy has failed and those with contraindications to anticoagulation therapy. The indications for reconstruction include severe and refractory lower extremity edema, varicose veins, and skin hyperpigmentation refractory to anticoagulation and compression therapy.

Currently, no consensus has yet been reached regarding the standard of therapy for total occlusion of the vena cava. Additionally, caval interruption devices such as the Adams-DeWeese clips are rarely

encountered in today's practice, making guidance even more scarce.[7,8] A similar case reported in 2021 by Su et al[7] describes successful endovascular release of an Adams-DeWeese clip through femoral vein access and subsequent mitral valve repair. In their case, jugular access was discussed but ultimately decided against due to consideration of the mitral valve repair.[7]

Our presentation describes the successful endovascular release of an Adams-DeWeese clip with subsequent iliocaval reconstruction for the treatment of extensive total venous occlusion.[9-11] Our patient will continue receiving lifelong anticoagulation and antiplatelet therapy and using lifestyle modifications to reduce his risk of repeat thrombosis.

CONCLUSIONS

We have described successful endovascular release of a previously placed Adams-DeWeese IVC interruption clip with iliocaval reconstruction. Our experience could guide treatment of previously placed IVC interruption devices such as the Adams-DeWeese clip, which have resulted in thrombosis, total IVC occlusion, and refractory and lifestyle-limiting symptoms. Clip release with reconstruction can be done successfully as an outpatient procedure. IVC stenting remains a viable option for treatment and can restore venous patency even in cases of extensive occlusion.

DISCLOSURES

J.L.R. is a Chan Zuckerberg Biohub Physician-Scientist Fellow. The funding organization was not involved in the design or conduct of the study; collection, management, analysis, or interpretation of the data; or preparation, review, or approval of the manuscript. E.S. and D.Z. have no conflicts of interest.

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