Percutaneous mechanical thrombectomy of lower extremity deep vein thrombosis in a pediatric patient

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ABSTRACT

Deep vein thrombosis is relatively rare in the pediatric setting, though it carries significant risk for pulmonary embolism and post-thrombotic syndrome. We report a case of a 10-year-old girl diagnosed with pulmonary embolism and right iliofemoral vein deep vein thrombosis with concomitant granulomatosis with polyangiitis (formerly Wegener's granulomatosis) and acute glomerulonephritis. Owing to lifestyle-limiting venous claudication, we performed percutaneous, mechanical thrombectomy using the ClotTriever system with successful removal of likely both acute and chronic thrombus. After the procedure, the patient had near complete resolution of her venous claudication symptoms. (J Vasc Surg Cases and Innovative Techniques 2020;6:543-6.)

Keywords: Deep venous thrombosis; DVT; Venous claudication; Mechanical thrombectomy; Mechanical thrombolysis; Pediatric DVT; Post-thrombotic syndrome

Deep vein thrombosis (DVT) remains uncommon in the pediatric population, occurring in approximately 10 to 14 out of 10,000 pediatric admissions annually.[1] However, owing to advances in treatment for critically ill children and those with chronic diseases, there is greater awareness of the prevalence of DVT.[2] The majority of pediatric DVT cases are provoked, such as those associated with central venous catheterization, surgery, or trauma. In addition, many are associated with congenital prothrombotic disorders, acquired hypercoagulable states, inflammatory bowel disease, renal comorbidities, and infection.[1] DVT in a pediatric population, similar to that in adults, carries the potentially serious complications of pulmonary embolism and post-thrombotic syndrome (PTS), the latter of which may have significant quality of life implications owing to the longer life expectancy in children. We report a case of an iliofemoral DVT in a pediatric patient causing severe, lifestyle-limiting venous claudication that was successfully treated with single-session, percutaneous, mechanical thrombectomy. Permission was obtained from the parents to publish this case.

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CASE REPORT

A 10-year-old girl was transferred to our pediatric intensive care unit from an outside hospital for management of granulomatosis with polyangiitis (GPA)-associated glomerulonephritis. She presented to the outside hospital 1 week before, after developing acute, severe right leg edema. On duplex ultrasound examination and computed tomography scan, she was diagnosed with a right common femoral to external iliac DVT and segmental pulmonary embolism. For the previous 5 months, she had experienced frequent cough, hemoptysis, epistaxis, and ear infections. Various antibiotics were prescribed at emergency room and primary care physician visits with no symptom improvement. Given her symptoms and positive antineutrophil cytoplasmic autoantibody (ANCA) serology, she was diagnosed with GPA. Over the course of a week, her renal function deteriorated prompting transfer to our institution for aggressive management of suspected glomerulonephritis. One week after transfer, vascular surgery was consulted for management of her DVT. On our examination, she was noted to have significant right leg edema and severe venous claudication with the inability to ambulate more than 10 steps despite 2 weeks of therapeutic heparinization. She denied any family history of hypercoagulopathy and reported a long international flight 1 month before the development of leg edema.

Magnetic resonance imaging venography at our institution confirmed the diagnosis of right common femoral DVT extending into the distal external iliac vein (Fig 1). After a discussion with the primary team, the patient's parents, and the patient, a decision was made to proceed with a right lower extremity venogram with possible mechanical thrombectomy. Pharmacomechanical thrombolysis was not considered owing to her underlying renal dysfunction requiring intermittent dialysis (creatinine of 4.2 mg/dL at the time of procedure). The patient was placed supine with her right leg in an externally rotated position. Under ultrasound guidance, micropuncture sheath access was obtained of the right small saphenous vein just distal

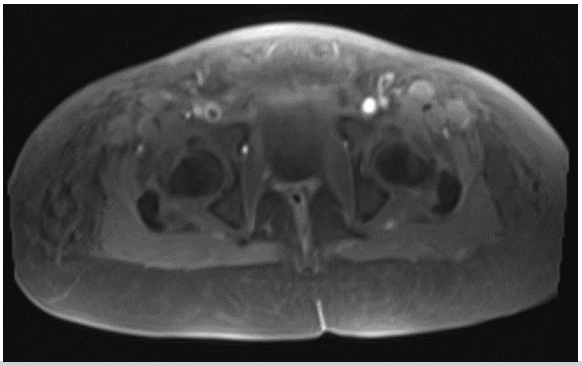

Fig 1. Magnetic resonance imaging confirming diagnosis of deep vein thrombosis (DVT) of the right lower extremity.

to the saphenopopliteal junction, which was comparable in size with the popliteal vein. Venogram and intravascular ultrasound examination of the right lower extremity showed no evidence of thrombus in the popliteal, femoral, or common iliac veins, and complete occlusion of the common femoral and distal external iliac veins with collateralization (Fig 2). No evidence of stenosis was found on intravenous ultrasound examination within the common iliac vein or inferior vena cava.

The access vessel was serially dilated to accommodate a 13F sheath. The ClotTriever catheter (Inari Medical, Irvine, Calif) consists of a coring element to separate thrombus from the vessel wall and an integrated nitinol collection bag for embolic protection. After two passes with the ClotTriever catheter, a significant amount of acute and chronic appearing thrombus was removed (Fig 3). A completion venogram (Fig 4) and intravascular ultrasound (Fig 5) demonstrated excellent flow with no residual thrombus. Estimated blood loss for the procedure was minimal and no untoward events occurred during her postoperative care. Use of contrast during the procedure was minimized (20 mL). Her symptoms improved with immediate resolution of the venous claudication and right leg edema. She was transitioned to warfarin and follow-up venous duplex at 1 month showed normal phasicity of the right common femoral vein and no evidence of lower extremity DVT. Her renal function recovered (most recent creatinine of 0.9) after intensive therapy (pulsed steroids and rituximab) for biopsy-proven necrotic glomerulonephritis.

DISCUSSION

We safely and effectively treated lower extremity DVT in a pediatric patient with percutaneous mechanical thrombectomy, extracting a large volume of likely acute and chronic thrombus. In the adult setting, treatment of proximal iliofemoral DVT typically includes anticoagulation and/or endovascular interventions. We ultimately chose to intervene owing to the acuity of the DVT and lifestyle-limiting venous claudication. In this setting, mechanical thrombectomy using the ClotTriever System was favored over pharmacochemical thrombolysis owing to her acute renal failure and the potential risk

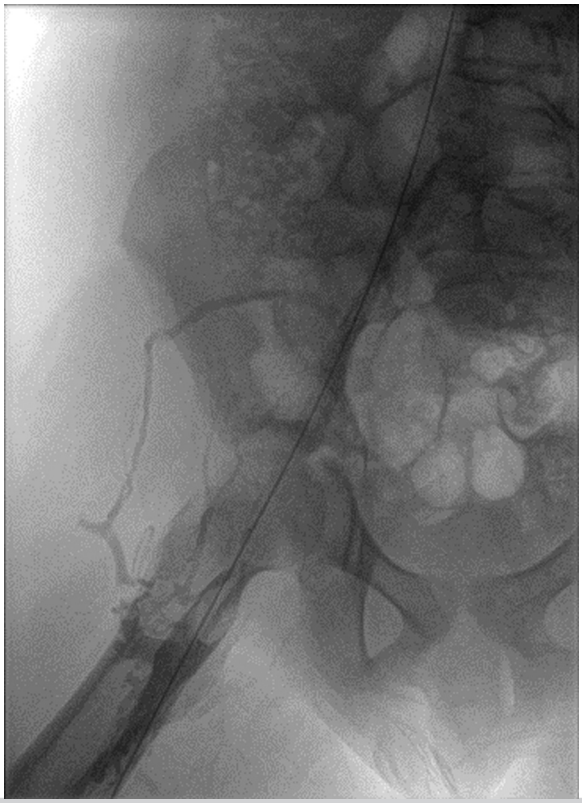

Fig 2. Preprocedure venogram revealing extensive thrombus in the right common femoral and external iliac veins with collateralization indicating possible chronic component of thrombus.

for further renal dysfunction. Rheolysis has increasingly been associated with greater risk for acute renal failure owing to the nephrotoxicity of hemoglobin degradation products.[3] This association is greatest with venous rheolytic thrombectomy, in which the glomerular filtration rate is inversely proportional to the extent of rheolysis.[4]

Although relatively rare, DVT in children is associated with considerable risk of morbidity. In a large cohort study of 405 children, venous thromboembolism (VTE) recurrence occurred in 8.1% of patients and PTS developed in 12.1% of patients.[5] The rate of PTS likely reflects an underestimate secondary to the difficulty of measuring clinical symptoms in children. Given the longer life expectancy of this patient population, PTS may have a lasting and costly impact on quality of life.

Pediatric DVT is most often provoked by medical treatment of other disorders, such as those requiring central venous catheterization. In this case, however, the patient had no previous treatment of the right lower extremity. We suspect that her GPA was the primary contributor to DVT development, which was further exacerbated by her recent international plane flight. ANCA-associated vasculitides have been strongly associated with increased risk for VTE in population-based studies, with more than 8% to 12% of adults with GPA developing a VTE more than nearly 5 years of follow-up.[6-9] Although

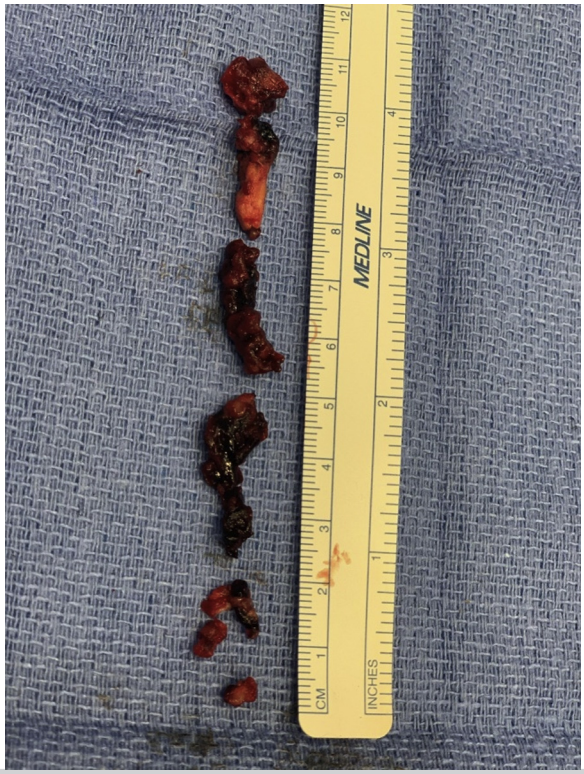

Fig 3. Extensive acute and chronic thrombus extracted with two passes of the ClotTriever catheter.

GPA in childhood remains very rare, the risk for VTE remains equally high with more than 15% of children found to have a VTE on GPA diagnosis.[10] As in this patient, the majority of VTEs are limited to the lower extremity in both adults and children.[10-12] The underlying mechanism for increased VTE occurrence is not well-understood, but patients with GPA have been found to have elevated endogenous thrombin potential and factor VIII relative to healthy subjects suggesting a hypercoagulable state. Although we did not encounter complications, mechanical thrombectomy may damage endothelium further exacerbating a prothrombotic state, which may be tempered with adequate inflow and therapeutic anticoagulation. In this case, significant collateralization of the right common femoral vein suggested a chronic component to the acute DVT, as did the appearance and texture of the extracted thrombus. The ClotTriever System's mechanical approach to thrombus removal was able to extract the chronic thrombus, which may not have been possible with standard anticoagulation or catheter-based thrombolysis.[13]

In conclusion, we successfully performed mechanical thrombectomy of an iliofemoral DVT in a pediatric patient with ANCA-associated vasculitis via a percutaneous, nonpharmacologic treatment option. There should be greater consideration of this option to mitigate the long-term sequelae of iliofemoral DVTs in select pediatric patients with appropriate indications.

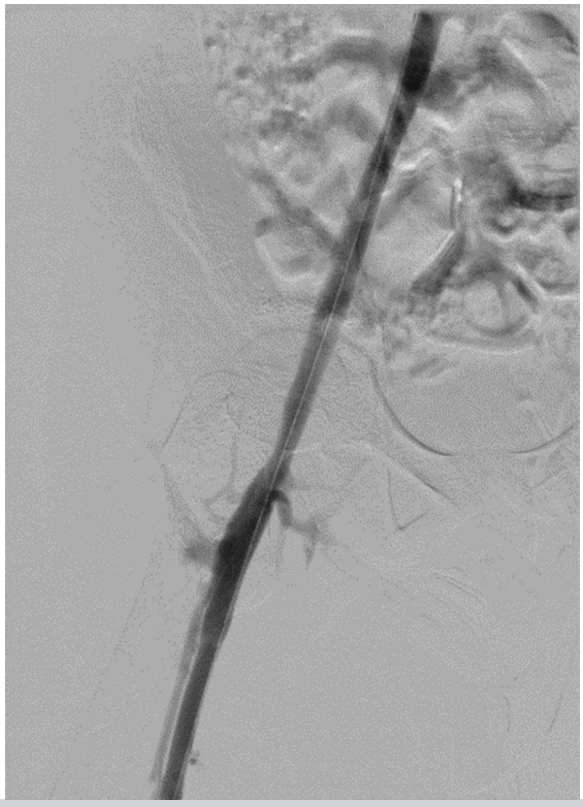

Fig 4. Postprocedure venogram demonstrating complete extraction of thrombus and normal flow in the right common femoral and external iliac veins.

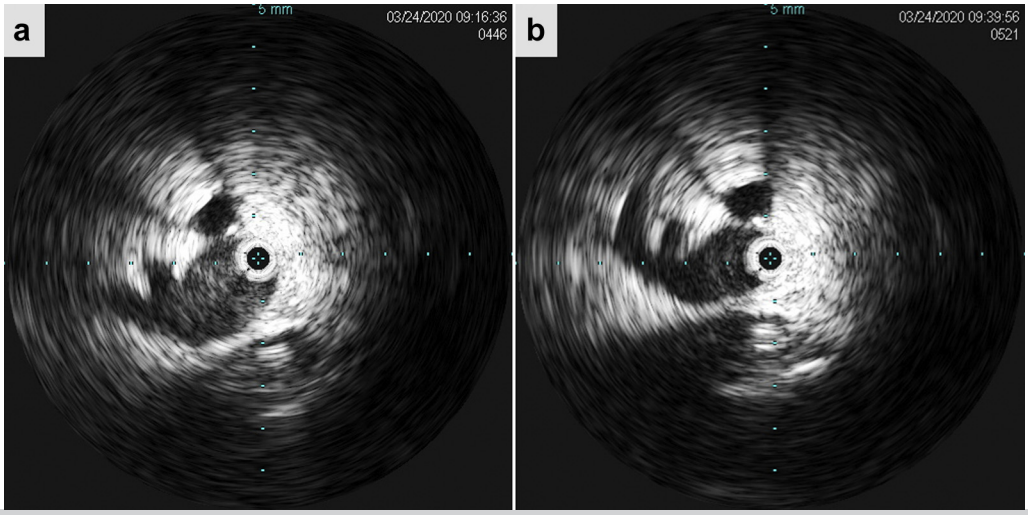

Fig 5. Preprocedural **(a)** and postprocedural **(b)** intravascular ultrasound showing complete extraction of thrombus from the right common femoral and external iliac veins.

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