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Case Report

Successful ilio-femoral-popliteal venous aspiration thrombectomy using a 12 French system in a pediatric patient ☆,☆☆

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ABSTRACT

Deep venous thrombosis can be observed in pediatric patients, especially in teenagers. There is a paucity of published treatment recommendations in this patient population. This technical note illustrates the successful utilization of aspiration thrombectomy to manage a lower extremity deep venous thrombosis in a 17-year-old boy. This shows that thrombectomy devices utilized in adult practice can be used in pediatric patients, with careful consideration of vessel size and patient specific factors.

Introduction

Deep vein thrombosis (DVT) occurs rarely in the pediatric population, at an annual rate of 10-14 per 10,000 children admitted to hospital [1], yet incidence has been shown to be rapidly increasing [2]. Despite its rarity, DVT carries a risk of serious complications including pulmonary embolism and post-thrombotic syndrome. Indeed, pediatric mortality secondary to DVT has been reported at 2% [2]. There are a variety of therapeutic options for lower extremity DVT including anticoagulation, thrombolytics, and endovascular thrombectomy [2], however these approaches are mainly described in the adult population [3–5]. As such, it is challenging to apply these approaches in children due to the lack of evidence, especially with new devices. This case report describes the successful utilization of a 12 French aspiration thrombectomy device in a teenager.

Case presentation

Informed consent was obtained from the patient's legal guardian for publication. This case describes a 17-year-old boy, previously diagnosed with T-Cell Acute lymphoblastic

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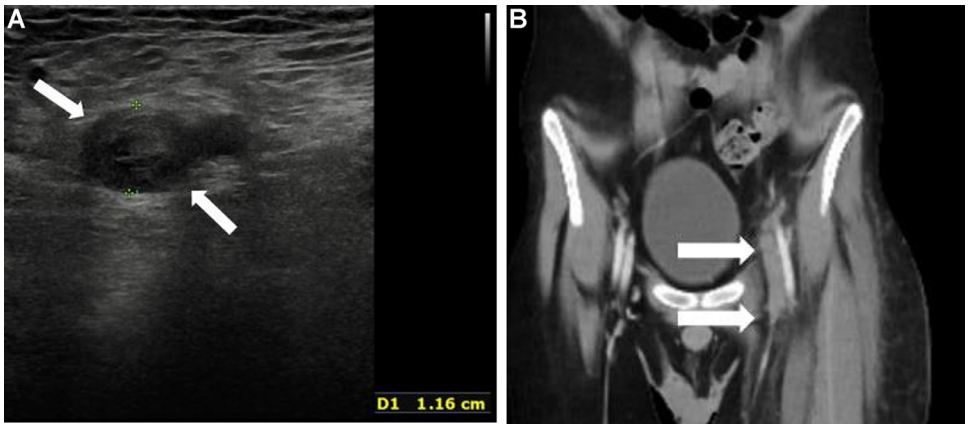

Fig. 1 – (A) Sonographic image of the right common femoral vein showing noncompressible intraluminal hypoechoic material and dilation (arrows), compatible with deep venous thrombosis. (B) Coronal CT reconstruction showing a portion of the extensive left lower extremity DVT, extending from the bifurcation of the left common iliac vein to the popliteal vein, including the common femoral vein (arrow).

leukemia (ALL), who presented to the emergency department with a 1-day history of left leg swelling and fever. Upon assessment, the patient was noted to have swelling of the left lower limb, from foot to mid-thigh, with associated pain and inability to ambulate. Pedal pulses were intact, and no skin changes were noted. The patient denied shortness of breath, cough, or hemoptysis. Due to the presence of fever, blood cultures were obtained, and the patient was started on antibiotics. The patient had a recent 5-day admission due to mucositis and poor oral intake in the context of delayed intensification treatment as per specific ALL protocol. On day of discharge, the patient was noted to have predominately left-sided mild lower limb edema. This was attributed to low albumin levels given the lack of additional symptoms. The subsequent day post-discharge, the patient's edema continued to progress, and the patient was re-admitted.

Grey scale and color-Doppler ultrasound of the left lower extremity was performed showing lack of flow from the left popliteal vein to the left common iliac vein (CIV), compatible with extensive DVT (Fig. 1A). The inferior vena cava (IVC) appeared patent with no signs of intraluminal thrombus. The patient was admitted, and a therapeutic dose unfractionated heparin infusion was initiated.

Computed Tomography of the abdomen and pelvis was performed to delineate the extension of the thrombosis. It confirmed patency of the IVC and characterized the occlusive thrombus as extending from the left common iliac vein origin to the popliteal vein (Fig. 1B), with marked subcutaneous and cutaneous inflammatory changes of the left upper leg. A short segment nonocclusive thrombus was additionally seen within the mid right common iliac vein. Notably, compression of the left common iliac vein was observed between the right common iliac artery and underlying lumbar vertebrae, raising the possibility of May-Thurner syndrome. Due to the extension of the thrombosis and the patient's inability to ambulate, a multidisciplinary decision between Interventional Radiology, Oncology and the Thrombosis team was made to proceed with mechanical aspiration thrombectomy and thrombolysis of the left lower limb. It was decided not to intervene on the right leg given the small size of the thrombus.

At the time of the procedure the 12 French Penumbra Lightning ™ 12 Indigo® system (Penumbra Inc, Alameda, CA, USA) was recently approved in the local practice, therefore it was decided to attempt to use this new size of catheter for the first time, considering that the size of the patient's veins appeared to be sufficient to accommodate a 12 French vascular sheath. The procedure was performed under general anesthesia, using sterile technique, and in the prone position. The preprocedural mapping ultrasound of the left popliteal fossa showed a patent inferior portion of the popliteal vein, sufficient for access with a 12 French sheath. Under ultrasound guidance, the left popliteal vein was accessed using a 21-gauge micropuncture needle. The access was subsequently upsized to a 12 French vascular sheath and secured using a 2-0 Prolene stitch. Through the sheath, a 0.035″ hydrophilic wire was advanced to the level of the IVC, followed by an angled Bernstein catheter over the wire. A pullback venography demonstrated diffuse clot burden throughout the left iliofemoral system and further evidence of May-Thurner syndrome (Fig. 2A). Venous collaterals were noted in the pelvis and thigh. After placement of a 20-cm infusion length Cragg-McNamara catheter ™ (ev3, Micro Therapeutics, Inc; Irvine, CA, USA), pulse-spray tPA (20mg alteplase in 50 mL solution) was infused across the length of the clot burden and left in situ for 30 minutes.

Following tPA infusion, the 12 French aspiration catheter was advanced over the wire. Aspiration was performed throughout the left iliofemoral system (Fig. 2B), resulting in significant removal of mixed age clot. Intermittent repeat venography demonstrated significant removal of clot burden from the distal iliac and femoral veins. Further successful removal of clot was performed using repeat aspiration thrombectomy (Fig. 2C). Subsequent venogram demonstrated significantly improved flow through the iliofemoral system. Intravascular ultrasound was performed which con-

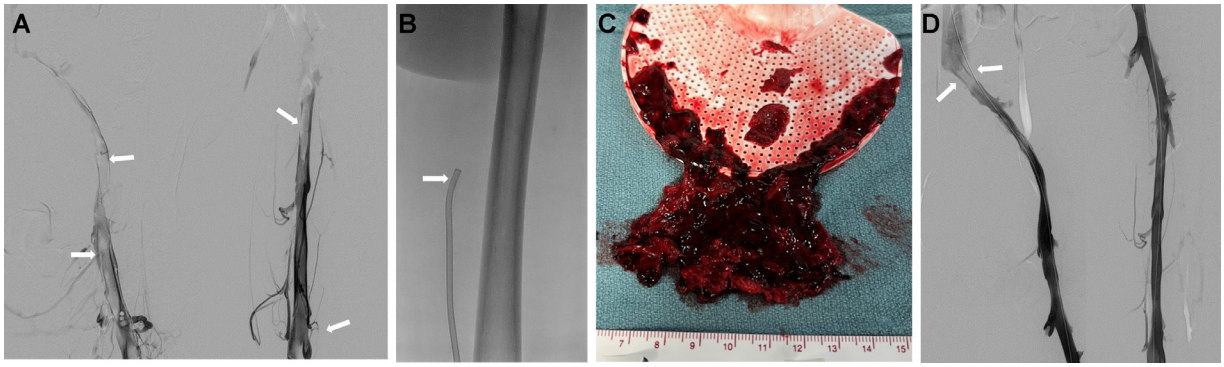

Fig. 2 – (A) Preprocedure venogram showing stagnant contrast within the left ilio-femoral-popliteal venous system, due to extensive thrombosis (arrows). (B) 12 French aspiration thrombectomy catheter is situ (arrow). (C) Significant amount of mixed age thrombus was removed. (D) Post-thrombectomy and angioplasty venogram showing excellent patency and caliber of the deep venous system and improvement of the proximal common iliac vein stenosis (arrows).

firmed no residual clot burden of the left distal external iliac and femoral veins and identified proximal left common iliac vein decreased caliber, due to the known external compression. Decision was then made to perform a balloon angioplasty of the stenotic area using a 10 mm x 4 cm noncompliant balloon. Five dilatations were performed across the area with a duration of 1 minute each. Postangioplasty venogram revealed significant interval improvement of the stenosis and flow across the lesion, as well as sustained patent femoral and popliteal veins to the level of the sheath (Fig. 2D). Bleeding was noted at the sheath access site for which manual compression was applied. After consultation with the thrombosis team, systemic heparin infusion was reduced from a therapeutic to a prophylactic dose. The procedure was terminated following the placement of a 100 cm × 50 cm infusion length Cragg-McNamara catheter from the level of the CIV-IVC junction to just distal to the sheath tip. The heparin infusion was transferred to the sidearm of the popliteal vascular sheath and an alteplase infusion (1 mg/hour in 100 mL of solution) was initiated through the Cragg-McNamara catheter for pharmacological thrombolysis. The procedure was completed without complication and the patient was transferred to the pediatric intensive care unit.

On day one postprocedure, the patient returned to the interventional radiology suite for a pelvic and lower extremity venogram. Contrast was injected through the sidearm of the popliteal vein sheath, which demonstrated a widely patent left iliofemoral system (Fig. 3A). The proximal CIV demonstrated residual narrowing, yet this appeared to be improved as compared to the prior assessment. No venous collaterals were noted, and a small amount of nonocclusive residual clot was observed adjacent to the stenosis. Ultrasound postprocedure showed widely patent distal iliac, common femoral, and saphenous veins of the left lower limb. As a result, the alteplase infusion was stopped and the Cragg-McNamara catheter was removed, and the heparin infusion was restarted.

On day 2 postprocedure, a lower limb color-Doppler ultrasound confirmed venous patency from the left popliteal vein to the IVC, with a small nonocclusive thrombus at the superficial femoral vein. Clinically, a significant interval improvement of the patient's left lower limb swelling was noted. The left popliteal sheath was removed at the bedside without issue and when the clinical condition of the patient entirely recovered, he was discharged home. Patency was sustained on follow-up ultrasound imaging at 3 months (Fig. 3B and C) and the patient has a normal lower extremity 2 years post procedure, with no signs or symptoms of post-thrombotic syndrome.

Discussion

This case illustrates a teenager who underwent a successful iliofemoral venous mechanical aspiration thrombectomy using the 12 French Penumbra Lightning ™ 12 Indigo® system, leading to near complete removal of clot burden and significant restoration of blood flow. The standard DVT management in adults involves the use of anticoagulation and/or endovascular interventions. Endovascular interventions include catheter-directed thrombolysis, stent deployment, and percutaneous mechanical thrombectomy. Despite established use in adults, the lack of literature / evidence on the use of these approaches in children remains a challenge for DVT management in this population. Aspiration thrombectomy is a type of mechanical thrombectomy in which a catheter-based suction employs negative pressure to target the site of thrombus via a vascular sheath [3]. Success rates using this technique have been described in the literature between 77 and 100% [4]. Furthermore, aspiration thrombectomy has been shown to reduce the incidence of post-thrombotic syndrome, a major complication of DVT, as well as limit rates of bleeding complications given the reduced need for anticoagulation [5]. As such, new thrombectomy devices for the treatment of acute thrombosis continue to rapidly become available. Despite this, however, the adoption of these devices in pediatric patients may be challenging due to a lack of evidence for their use in this population. A study by Monroe *et al*. showed that adolescent patients with DVT undergoing mechanical ve-

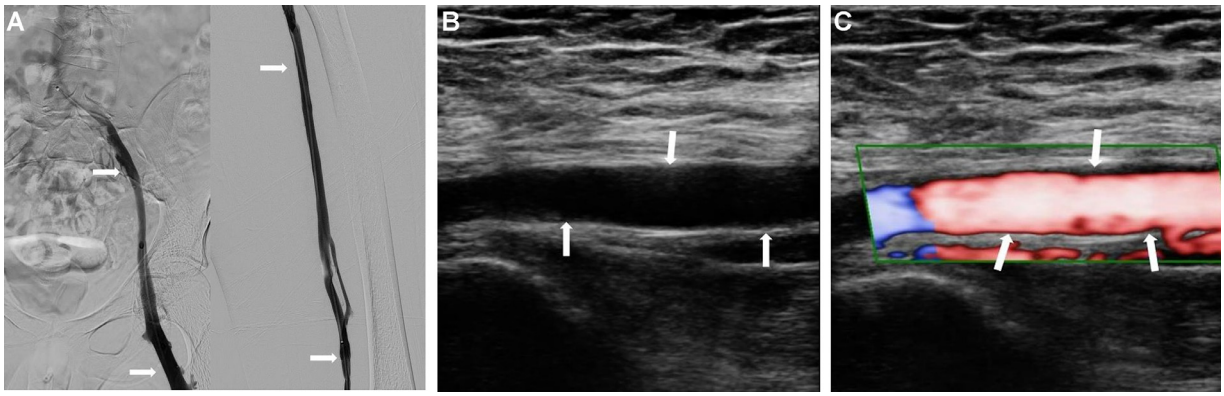

Fig. 3 – (A) Postprocedure day one venogram via popliteal vein sheath showing a widely patent left ilio-femoral-popliteal system (arrows), with a mild residual narrowing at the proximal left common iliac vein, not obstructing the flow into the inferior vena cava. (B) Sagittal grey scale; and (C) color-Doppler sonographic study showing patency of the common femoral vein (arrows) 3 months postprocedure.

nous thrombectomy display a technical and clinical success rate of 80% and 88.9%, respectively [2], whereas a review of thrombolytic therapy in pediatric patients with DVT illustrate a broad range of success from 29% to 100% [6].

The Penumbra Lightning ™ Indigo® system is an aspiration thrombectomy device that enables the use of suction for thrombus evacuation, while simultaneously monitoring blood flow to adjust aspiration strength and limit blood loss [5]. Previous studies have shown 3-6 months of patency in 70% of patients following DVT treatment using this device [7]. Considering that previous literature has described the use of this device in adult patients for various pathologies [4,8–14], this case shows that it can be utilized in the pediatric population. However, these findings may not be generalizable to the entire pediatric population given our report of successful use in a sole case, in a teenager. Overall, this report suggests that despite the large catheter size, aspiration thrombectomy can be considered as an option for DVT management in selected pediatric patients.

Conclusion

This case illustrates the successful use of a 12 French aspiration thrombectomy system in a teenager to manage a left lower extremity DVT. As a sole case, this is not generalizable to the entire pediatric population but suggests that this device can be considered for the treatment of deep vein thrombosis in certain groups of pediatric patients, especially in the population close to adulthood.

Patient consent

Informed consent was obtained from the patient's legal guardian for this publication. This was documented in the patient chart with a signed consent.

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