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Case Report

Mechanical venous thrombectomy and prolonged infusion of tissue plasminogen activator for cerebral venous sinus thrombosis: Video case report

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ABSTRACT

Background: Cerebral venous sinus thrombosis (CVST) is a rare and often misdiagnosed condition with mortality rates ranging from 6 to 10%. Diagnosis and monitoring are typically achieved through noninvasive imaging, including computed tomography or magnetic resonance venography. The current standard of treatment is systemic anticoagulation. However, in patients who continue to decline neurologically or do not show sufficient response to or have absolute contraindications to systemic anticoagulation, endovascular treatments are an alternative. Endovascular options are poorly studied and specific devices have not been developed, partially due to the rare nature of the disease. Here, we present a case report detailing the treatment of extensive CVST from the vein of Galen to the sigmoid sinus using mechanical thrombectomy and local infusions of unfractionated heparin (UFH) and tissue plasminogen activator.

Case Description: A 53-year-old man presented and was found to have extensive CVST extending from the vein of Galen to the left sigmoid sinus. Systemic UFH was begun; however, his condition continued to decline, and he was taken for endovascular intervention, wherein mechanical thrombectomy was undertaken using combinations of stent retrievers and balloon catheters, which provided acceptable revascularization. Unfortunately, his hospital course was further complicated by a cerebellar hematoma that was surgically evacuated and reocclusion of the sinus for which a microcatheter was placed for infusion of UFH and tissue plasminogen activator.

Conclusion: Complicated CVST may require aggressive endovascular management. Local infusions of heparin and thrombolytic agents as well as mechanical thrombectomy are safe alternative options.

Keywords: Cerebral venous sinus thrombosis, Endovascular therapy, Heparin, Mechanical venous thrombectomy, Tissue plasminogen activator

Annotations

1) 0:30 – Presenting images
2) 0:55 – Dual solitaire (Medtronic) technique
3) 4:00 – Fogarty maneuver
4) 6:22 – Velocity microcatheter (Penumbra) located in the vein of Galen and internal cerebral vein
5) 6:26 – Posttreatment imaging.

INTRODUCTION

Cerebral venous sinus thrombosis (CVST) is a rare condition that accounts for approximately 1% of all strokes.[2] Presentations range from mild headache to cranial nerve palsies, seizures, and altered levels of consciousness.[2] The estimated incidence of CVST is 1.3/100,000 person-years in the general population, 2.8 per 100,000 person-years in women ages 31–50 years, and 0.7 per 100,000 in children younger than 18 years.[7] CVST carries an approximate mortality rate of 6–10%.[9] Associated risk factors are vast, and some of the most common are inherited prothrombotic disorders (i.e., methylenetetrahydrofolate reductase mutations, protein C and S deficiencies, and factor V Leiden deficiency), pregnancy, and oral contraceptive use.[1,7] Approximately 15% of patients with CVST do not have identifiable risk factors.[8]

CVST is diagnosed with computed tomography (CT) or magnetic resonance imaging (MRI) and best appreciated with venography. Cerebral digital subtraction angiography can be a useful confirmatory modality. Lee *et al.* published an algorithm that effectively outlines the diagnosis and management of suspected CVST.[7] After the diagnosis has been confirmed, treatment is initiated systemically with either unfractionated heparin (UFH) or low-molecular-weight heparin, even in patients with hemorrhage. In patients who do not respond appropriately or continue to decline despite systemic anticoagulation, surgical and neurointerventional procedures such as decompressive craniectomy, intrasinus thrombolysis, and/or mechanical thrombectomy become options.[7] Unfortunately, endovascular options are poorly studied and specific devices have not been developed, partially due to the rare nature of the disease. Therefore, case studies become important in describing new techniques and fine tuning others so that the field can continue to advance and improve outcomes.[4] Here, we describe the case of a patient who underwent both systemic and endovascular intervention in the treatment of CVST.

CASE DESCRIPTION

The patient's family gave informed consent for treatment and video recording. The Institutional Review Board approval was deemed unnecessary.

A 53-year-old man placed on aspirin (81 mg, daily) for cardioprotection presented from an outside facility secondary to concerns for a traumatic subarachnoid hemorrhage. He had been experiencing headaches, nausea, and vomiting for 3 days before falling backward from a chair and striking his head against the floor. The following morning, he was found with a subtle dysphasia and intermittent confusion by his family and taken to an outside facility for evaluation. Noncontrast-enhanced head CT scan revealed a hyperdense streak along the left transverse sinus, initially thought to represent subarachnoid hemorrhage. Upon arrival at our facility, the neurosurgery service found that the patient mildly disoriented with a subtle expressive aphasia. Noninvasive imaging, including a CT stroke study, CT angiography (CTA), CT venography (CTV), MRI, and MR venography, revealed near-complete occlusion from the vein of Galen through the left sigmoid sinus [Figure 1]. The patient was started on a UFH infusion with a 4000-unit bolus. A target activated partial thromboplastin time (aPTT) of 80–110 s was rapidly achieved and maintained with 6 h monitoring. Given his mild examination findings and the risks associated with venous thrombectomies, he was not taken emergently for neuroendovascular intervention.

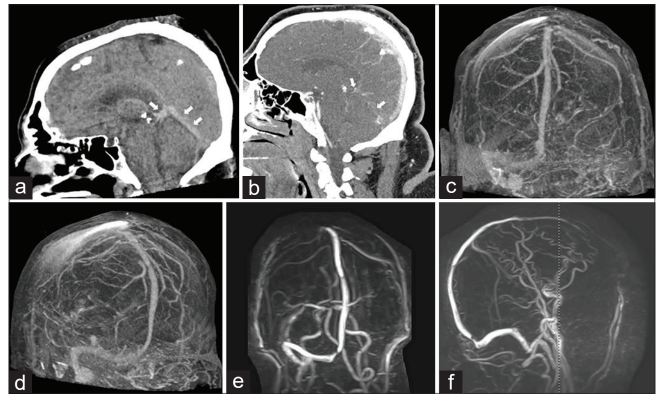

Figure 1: (a) Mid sagittal computed tomography (CT) section of the head showing hyperdense thrombus in the straight sinus and vein of Galen (arrows). (b) Contrast-enhanced head CT scan showing opacification of the superior sagittal sinus. There is a lack of opacification of the straight sinus, vein of Galen, and deep veins. (c) CT angiogram (CTA). Occlusion of the left transverse and sigmoid sinuses cannot be seen. (d) Oblique CTA shows occlusion of the straight sinus and vein of Galen. (e) Anteroposterior magnetic resonance venogram shows occlusion of the left transverse and sigmoid sinuses. (f) Lateral magnetic resonance angiogram. The straight sinus and vein of Galen cannot be visualized.

Over the next 48 h, the patient remained stable until his neurological status rapidly declined overnight with rightward gaze deviation, localization to noxious stimuli on the right side, and extensor posturing on the left side. He was then taken emergently to the neuroendovascular suite on hospital day 2 where extensive thrombosis was confirmed [Figure 2].

The first attempt at crossing the thrombus using a soft tipped, 0.014 inch wire to minimize the risk of venous perforation was unsuccessful as a sufficient channel could not be located. At this point, an 8-French NeuronMax guide catheter (Penumbra, Alameda, CA) was placed into the jugular bulb, and a thrombectomy was performed from the left vein of

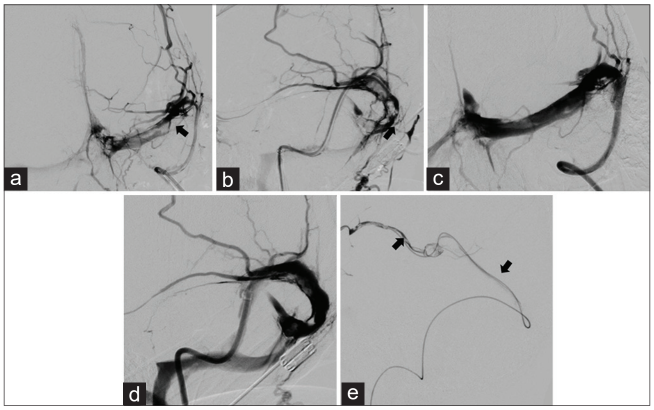

Figure 2: (a) Anteroposterior angiogram shows left transverse sinus thrombosis (arrow). (b) Lateral angiogram showing thrombus in the left sigmoid sinus (arrow). (c) Anteroposterior angiogram showing left transverse sinus following thrombectomy. (d) Lateral angiogram shows left sigmoid sinus following thrombectomy. (e) Velocity microcatheter in place (arrows).

Galen to the sigmoid sinus. A dual solitaire stent retriever (Medtronic, Dublin, Ireland) technique[6] was used given that the size of the sinus exceeded that of currently approved devices (Video 1). In addition, a Fogarty maneuver was performed with a 7 × 15 mm TransForm balloon (Stryker Neurovascular, Fremont, CA) given the persistent thrombus burden following multiple thrombectomy attempts with the stent retriever. Although there is some concern regarding packing of the proximal venous system with thrombus using the Fogarty technique, the overall improvement in circulation was felt to justify the increased risk of complication. Partial recanalization was achieved, and the patient returned to the neurointensive care unit [Figure 2]. On postangiography noncontrast head CT, the patient had developed a left cerebellar hematoma that was expanding on serial imaging studies. He underwent suboccipital craniectomy for hematoma evacuation, and postprocedural imaging showed good decompression of the hematoma [Figure 3]. Because of concern for reocclusion of the sinuses, a solitaire thrombectomy was again performed, followed by a Fogarty maneuver in a final attempt at opening the sinus, this time using a Scepter XE balloon (MicroVention-Terumo, Aliso Viejo, CA). Given the heavy thrombus burden that remained, a velocity microcatheter (Penumbra) was placed in the straight sinus for local infusion of UFH into the deep venous system at a rate of 500 u/h [Figure 2 and Video 1]. Although UFH does not have a lytic effect, it was chosen to protect access while the fresh surgical bed became stable for local administration of tissue plasminogen activator (tPA; alteplase).

Clot burden was monitored with serial CTA and CTV; and on hospital day 5, tPA was begun, infusing through the microcatheter at a rate of 1 mg/h.[5,10,11] Daily CTA and CTV

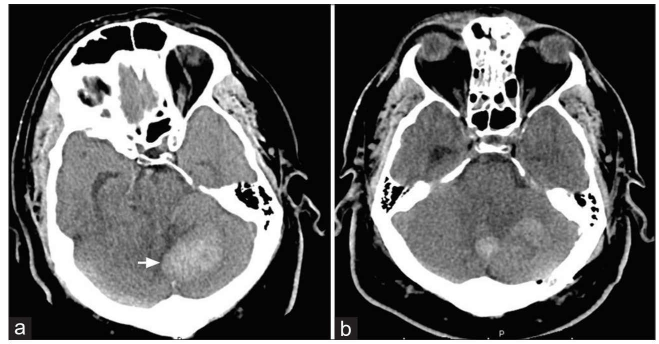

Figure 3: (a) Head computed tomography (CT) scan shows a left cerebellar hematoma (arrow). (b) CT scan obtained postoperatively shows acceptable evacuation of clot.

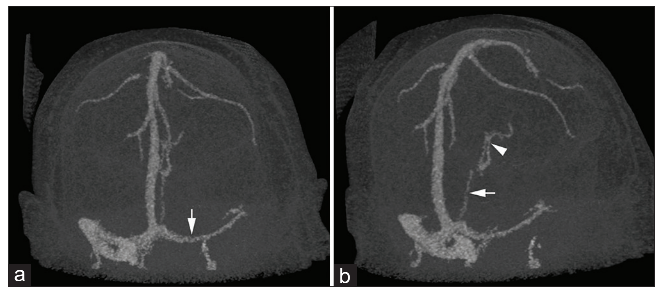

Figure 4: (a) Anteroposterior computed tomography venogram (CTV) shows reconstitution of the left transverse and sigmoid sinus (arrow). (b) Oblique CTV shows reconstitution of the straight sinus (arrow) and vein of Galen (arrowhead).

monitoring showed progressive increases in blood flow throughout the previously thrombosed deep venous system [Figure 4].[3] The microcatheter was removed on hospital day 8 following acceptable revascularization observed on CT imaging, and systemic heparin was restarted.

Following extubation on hospital day 9, the patient was oriented with hypophonic speech and was antigravity in all four extremities. He remained on intravenous UFH through hospital day 11, when this therapy was converted to intravenous argatroban (Pfizer, New York, NY) (0.5–2.5 mcg/kg/min, monitored by aPTT) secondary to heparin-induced thrombocytopenia. On hospital day 15, he was transferred to a medical rehabilitation unit. Systemic heparin therapy was bridged to sodium warfarin on hospital day 18. Intensive rehabilitation resulted in his sole remaining deficit being 4/5 strength in the right hip flexors. He was discharged home with family care and to follow-up with neurologists and neurosurgeons close to his home.

DISCUSSION

Advancements in neuroendovascular technologies have made it possible to mitigate the systemic risks of anticoagulation and provide local effects of anticoagulation and thrombolysis directly to the site of thrombosis. Here, we report on a patient with thrombosis extending from the left vein of Galen into the sigmoid sinus whose condition declined rapidly despite systemic anticoagulation. He was subsequently taken for endovascular thrombectomy and administered local anticoagulation and thrombolysis with good results despite the development of an intraparenchymal hemorrhage that required surgical evacuation and delayed administration of local thrombolytics. Anticoagulation and thrombolysis carry risk, especially in the face of an intraparenchymal hemorrhage, so managing therapeutic options to allow for the shortest window to surgery given the half-lives of thrombolytic agents versus novel anticoagulants play a crucial role in early medical decision-making for these patients.

CONCLUSION

This report illustrates the potential for advancements in the treatment of CVST that is not responsive to traditional therapies or in patients who may have contraindications to systemic anticoagulation. Further investigation into endovascular therapies for CVST is necessary; however, given the low incidence of the disease, case reports help to provide ideas and evidence that aid in providing better and more effective treatment. Here, we show that endovascular thrombectomy followed by local infusion of tPA is safe and feasible. Nonetheless, more research is needed to help elucidate new frontiers in the treatment of a potentially devastating disease.

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Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent.

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