

CASE REPORT

Sinus thrombectomy for purulent cerebral venous sinus thrombosis utilizing a novel combination of the Trevo stent retriever and the Penumbra ACE aspiration catheter: the stent anchor with mobile aspiration technique

Justin R Mascitelli,¹ Margaret Pain,¹ Hekmat K Zarzour,¹ Peter Baxter,² Saadi Ghatan,¹ J Mocco¹

¹Department of Neurosurgery, Icahn School of Medicine at Mount Sinai, New York, New York, USA

²Department of Otorhinolaryngology, Icahn School of Medicine at Mount Sinai, New York, New York, USA

Correspondence to

Dr J Mocco, Department of Neurosurgery, Icahn School of Medicine at Mount Sinai, 1468 Madison Ave, New York, NY 10029, USA; j.mocco@mountsinai.org

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ABSTRACT

Intracranial complications of sinusitis are rare but life threatening. We present a case of a 17-year-old woman with sinusitis who deteriorated over the course of 12 days from subdural empyema and global purulent cerebral venous sinus thrombosis. The patient was managed with surgery and mechanical thrombectomy utilizing a novel 'stent anchor with mobile aspiration technique', in which a Trevo stent retriever (Stryker) was anchored in the superior sagittal sinus (SSS) while a 5 MAX ACE reperfusion catheter (Penumbra) was passed back and forth from the SSS to the sigmoid sinus with resultant dramatic improvement in venous outflow. The patient was extubated on postoperative day 3 and was discharged with minimal lower extremity weakness on postoperative day 11. This is the first report using the Trevo stent retriever for sinus thrombosis. It is important to keep these rare complications in mind when evaluating patients with oral and facial infections.

INVESTIGATIONS

Laboratory findings were significant for elevated white blood cell count (28 000 cells/ μ L) with left shift. A lumbar puncture was notable for an opening pressure of 51 cm H₂O, 70 red blood cells/ μ L, 0 white blood cells/ μ L, glucose 61 mg/dL, protein 35 mg/dL, and gram stain negative. A CT of the head with and without contrast was significant for small extra-axial collection on either side of the anterior falx, brain edema out of proportion to the size of the collections, a suggestion of CVST of the superior sagittal sinus (SSS), straight sinus (SS), and bilateral transverse sinuses, and near complete opacification of the bilateral frontal, ethmoid, and maxillary sinuses, consistent with a pansinusitis (figure 1). MRI of the brain and orbits was performed, which suggested a diagnosis of pansinusitis, orbital cellulitis, SDE, and global CVST (figure 2).

TREATMENT

The patient was taken emergently to the operating room for a right frontal craniotomy and evacuation of the SDE, as well as functional endoscopic sinus surgery by the ear, nose, and throat service. On opening the dura toward the midline, subarachnoid pus and thrombosed cortical veins were evident. Purulent discharge was extruded from the edge of the SSS. Suction and irrigation was applied until spontaneous flow of venous blood was achieved. The SDE was under pressure and was evacuated from the interhemispheric fissure.

The patient was taken directly from the operating room to interventional radiology. An arterial diagnostic angiogram demonstrated global CVST involving all of the superficial and deep venous sinuses (figure 3). In addition, there was constriction of the bilateral internal carotid arteries as they passed through the cavernous sinuses (CS). The patient was given intravenous heparin with the plan to perform a sinus thrombectomy.

A Neuron MAX (Penumbra, Alameda, California, USA) was placed in the left internal jugular vein. Then, a 5 MAX ACE reperfusion catheter (Penumbra), 3 MAX reperfusion catheter (Penumbra), and Fathom 16 microwire (Boston Scientific, Marlborough, Massachusetts, USA) were used as a triaxial system to reach the anterior

BACKGROUND

Intracranial complications of sinusitis are rare but life threatening.^{1–4} Cerebral venous sinus thrombosis (CVST) is one of the less common complications.¹ We present a case of a 17-year-old woman with sinusitis who deteriorated from subdural empyema (SDE) and global purulent CVST. The patient was managed acutely with surgery and mechanical thrombectomy utilizing a novel technique.

CASE PRESENTATION

The patient is a 17-year-old woman with asthma, seasonal allergies, and a recent tooth extraction, who presented with lethargy and headache for approximately 12 days. The patient had subtle but worsening symptoms during the week prior to admission. Her neurological examination in the emergency room was significant for somnolence but maintained orientation and ability to follow commands, bilateral proptosis and chemosis, nuchal rigidity, and no movement of the left lower extremity. She was febrile but otherwise her vital signs were within normal limits.

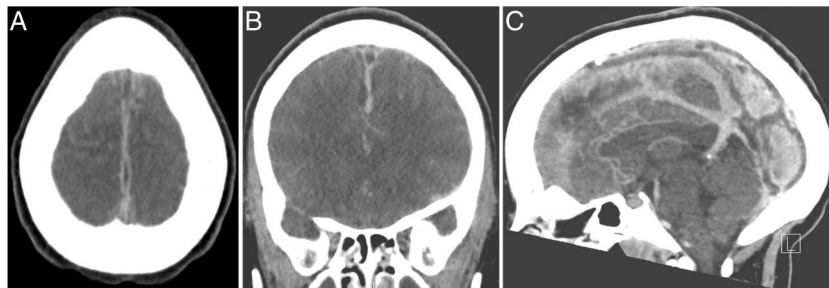


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New devices

Figure 1 CT of the head with contrast: axial (A), coronal (B), and sagittal (C). There are small extra-axial collections on either side of the anterior falx, brain edema out of proportion to the size of the collections, and a suggestion of cerebral venous sinus thrombosis of the superior sagittal sinus, straight sinus, and bilateral transverse sinuses.



portion of the SSS. A venogram at this point demonstrated stasis of contrast within the SSS with no drainage past the mid to posterior aspect of the SSS (figure 4). Direct aspiration of the clot within the SSS was attempted without significant improvement.

Then a Trevo stent retriever (Stryker, Kalamazoo, Michigan, USA) was deployed through the 3 MAX catheter in the anterior portion of the SSS (figure 5). With the Trevo as an anchor, the 3 MAX catheter was removed and the ACE catheter was

Figure 2 MRI of the brain with contrast: axial. There is suggestion of sinus thrombosis (arrows) in the superior sagittal sinus (A), straight sinus (B), and bilateral transverse sinuses (C).

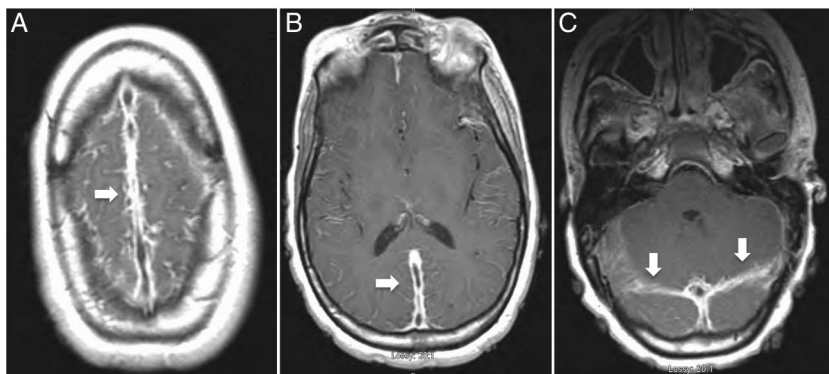


Figure 3 Digital subtraction angiography: left internal carotid artery (ICA) injection, anteroposterior (A, C) and lateral (B, D). Arterial phase injection (A, B) demonstrates significant narrowing of the left ICA cavernous segment (arrows), suggesting external irritation from infection within the cavernous sinus. The venous phase (C, D) demonstrates global cerebral venous sinus thrombosis, with minimal filling of the superior sagittal, transverse, and sigmoid sinuses.

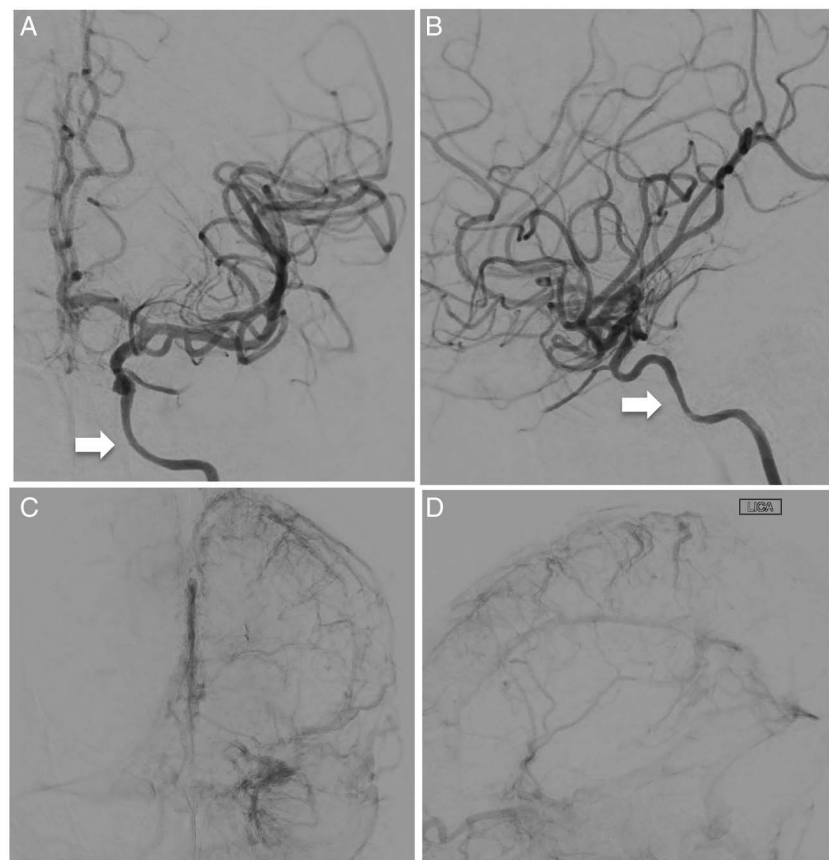
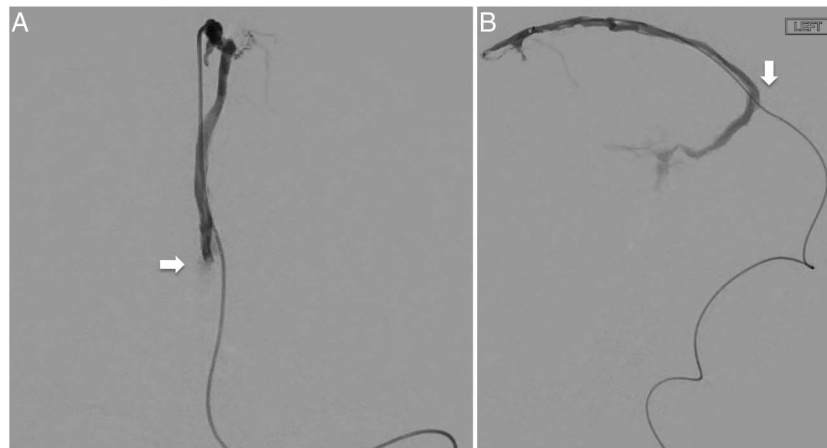


Figure 4 Digital subtraction angiography; superior sagittal sinus (SSS) injection, anteroposterior (A) and lateral (B). Injection from the anterior portion of the SSS demonstrates a narrow and irregular sinus, a single cortical vein, and an abrupt cut-off (arrow) at the mid to posterior portion of the SSS, suggestive of sinus thrombosis.



repeatedly passed back and forth from the mid-SSS all the way to the left SS with aspiration turned on (the ‘stent anchor with mobile aspiration technique’). The aspiration portion of the procedure was approximately 2 min so as to minimize blood loss. The ACE catheter was moved rapidly, passing from the SSS to the SS approximately 10 times during the 2 min aspiration period. The aspiration material was a mixture of purulent material and typical thrombus. The catheter did not become completely occluded but had moments of partial occlusion. The final result was much improved venous drainage (figure 6). Direct injection of tissue plasminogen activator was not performed given the recent surgery.

OUTCOME AND FOLLOW-UP

Following these procedures, the patient was started on a heparin drip, dexamethasone, levetiracetam, and continued on broad spectrum antibiotics (vancomycin, ceftriaxone, and metronidazole). The heparin drip was used to prevent re-thrombosis and/or propagation of residual thrombosis. Gradually, the patient’s

neurological examination improved and she was extubated on postoperative day 3. At that point she was grossly neurologically intact except for persistent proptosis as well as left lower extremity weakness. Follow-up MRI on postoperative day 4 demonstrated minimal evidence of stroke (figure 7), and MR venography demonstrated significant interval improvement in blood flow through all venous sinuses (figure 8). At discharge on postoperative day 11, the patient had mild left lower extremity weakness but was able to ambulate with assistance and was otherwise neurologically intact.

DISCUSSION

Although rare, the intracranial complications of sinusitis can be severe and life threatening.^{1–3} These complications have become exceedingly rare in the antibiotic era. One retrospective series of patients with suppurative intracranial complications of sinusitis found the following complications: epidural abscess (23%), SDE (18%), meningitis (18%), cerebral abscess (14%), SSS CVST (9%), CS CVST (9%), and osteomyelitis (9%).¹ There are far more reports of CS CVST compared with SSS CVST in the literature, however. Given that our patient had frank pus within the sinuses, the most likely route of extension was via the pterygopalatine sinus and/or CS.

SDE is a rare but serious complication of craniofacial infection. Recommended treatment includes urgent surgical evacuation and a prolonged course of antibiotics.⁵ Extra-axial infection is theoretically generated through one of two ways: (1) direct extension through bony erosion, which tends to be associated with epidural abscess; or (2) indirect extension, through mucosal venous drainage and retrograde thrombophlebitis, which is the more important cause of SDE.⁶ In this patient, signs of increased intracranial pressure (ICP) preceded a general toxic appearance by several days, suggesting that perhaps CVST was the predominant pathology. Additionally, the lumbar puncture results were not suggestive of CNS infection but concerning for severe increased ICP, suggesting symptomatic venous congestion.

Endovascular therapy has been a well described treatment option for sinus thrombosis in severe cases when anticoagulation fails or cannot be used.^{7–12} Endovascular treatment options can be broken down into thrombolytic and mechanical. Direct thrombolysis has been performed with urokinase, streptokinase, and recombinant tissue plasminogen activator, with generally good outcomes.⁹

A number of different methods of mechanical thrombectomy have been previously performed and are generally used in

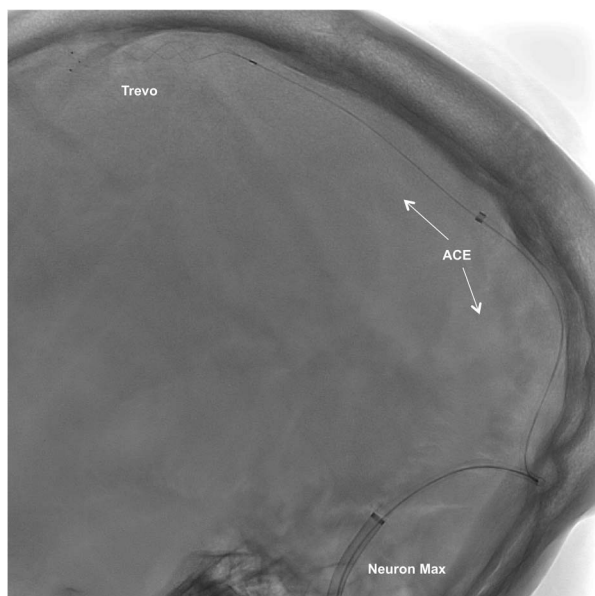


Figure 5 Digital subtraction angiography; unsubtracted lateral view. The ‘stent anchor with mobile aspiration technique’ is demonstrated (A). The Trevor stent is anchored in the anterior superior sagittal sinus (SSS) while the ACE reperfusion catheter is moved back and forth (arrows) from the SSS to the left sigmoid sinus with suction turned on.

New devices

Figure 6 Digital subtraction angiography; superior sagittal sinus (SSS), anteroposterior (A) and lateral (B) injection. After intervention, there was a significant improvement in blood flow. Now venous blood drains all the way from the anterior SSS, to the transverse sinus (TS), the sigmoid sinus (SS), and finally to the left jugular vein.

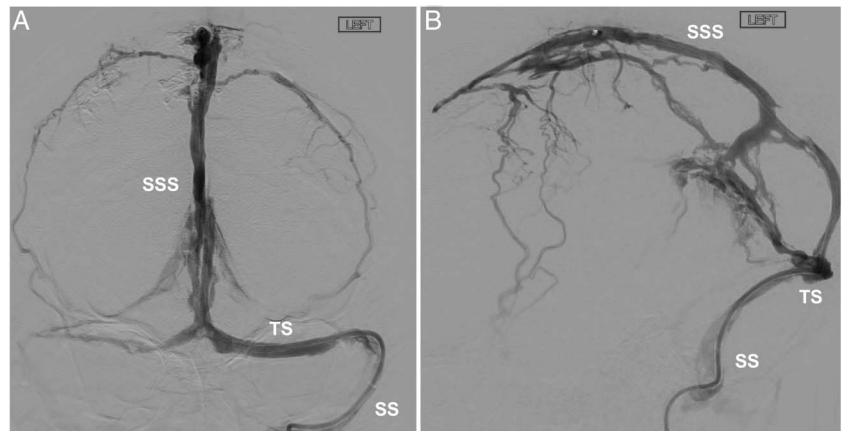
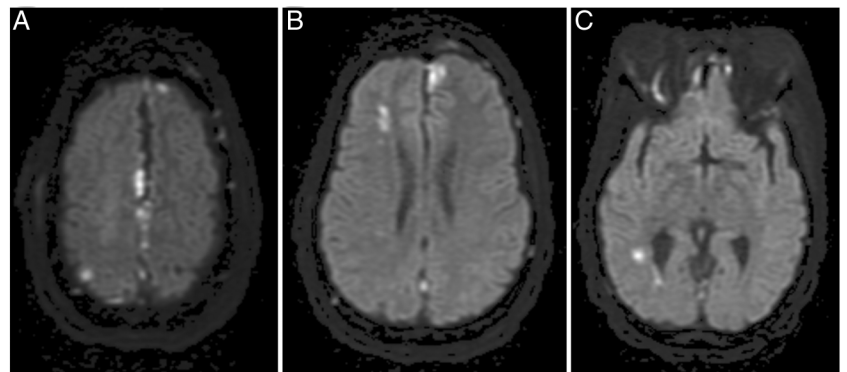


Figure 7 MRI of the brain; diffusion weighted imaging, axial (A–C). MRI days after the procedure shows minimal diffusion changes, suggesting that the patient did not sustain a significant venous infarct.



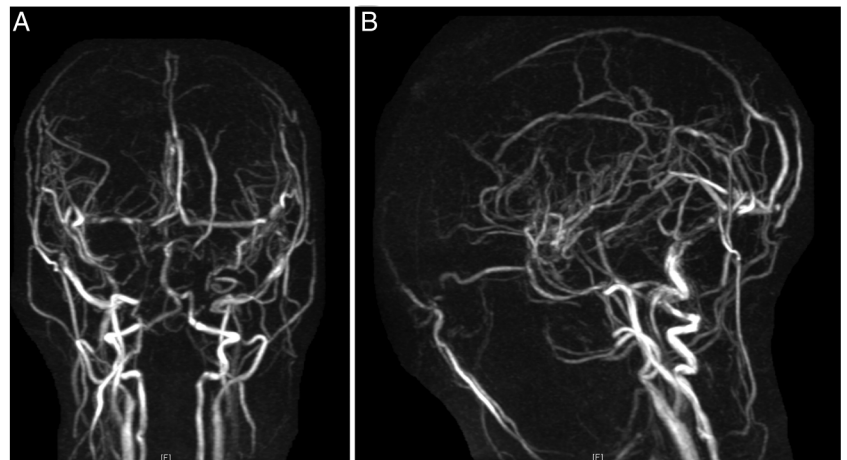
conjunction with systematic anticoagulation and/or direct thrombolysis. Methods of mechanical thrombectomy include balloon angioplasty¹³ with or without stenting,¹⁴ rheolytic therapy with devices such as Angiojet (Boston Scientific),¹² aspiration with devices such as the Penumbra aspiration catheters¹⁵ and, most recently, clot extraction using the stent retriever technology that is more commonly used for acute arterial ischemic stroke.^{16–19}

The only stent retriever that has been reported for venous sinus thrombectomy is the Solitaire device (Medtronic, Minneapolis, Minnesota, USA), and it has only been reported in four cases. Froehler first reported this technique in 2013 for a transverse sinus thrombosis in a young woman with factor V Leiden thrombophilia.¹⁶ Hurst *et al* reported two cases using

this technique for young patients with Crohn's disease and SS thrombosis.^{18 19} Raychev *et al* reported a case utilizing this technique for a young woman on oral contraceptives with SSS CVST. In all four reports, the authors described using the device in the typical fashion (ie, opening the device within the clot and then withdrawing the device into the aspiration catheter with suction turned on). Our report is the first in which the Trevo stent retriever was used for venous sinus thrombectomy. It is also the first report describing the 'stent anchor with mobile aspiration technique'.

Although not well studied, the additional morbidity caused by CVST in the setting of SDE appears to be significant. Sepsis is the most significant risk factor for mortality associated with CVST, increasing this risk to 16%.²⁰ In their retrospective

Figure 8 MR venography of the brain; anteroposterior (A) and lateral (B). MR venography days after the procedure demonstrates patent venous sinuses, suggesting that the therapy was durable.



analysis of 65 cases of pediatric SDE, Banerjee found CVST to predict mortality in 80% of cases versus 1.7% when CVST was not present.⁵ Present recommendations for surgical treatment of septic CVST do not appear to take into account endovascular techniques for clot extraction and tend to focus on control of the origin of infection and treatment with systemic antibiotics.²¹ This case demonstrates that endovascular techniques to improve venous drainage allowed for rapid correction of increased ICP and prevention of venous infarction.

Key messages

- ▶ Global sinus thrombosis is an extremely rare and life threatening complication of sinusitis. Interventional therapy can be life saving and necessary.
- ▶ We introduce the 'stent anchor with mobile aspiration technique' for long segment sinus thrombosis.
- ▶ This is the first report using the Trevo stent retriever for sinus thrombosis.
- ▶ It is important to keep these rare complications in mind when evaluating patients with oral and facial infections.

Contributors All authors were involved in the patient's surgeries/interventions, and all authors participated in manuscript preparation.

Competing interests JM is the National/International PI/Co-PI for the following trials: THERAPY (PI), FEAT (PI), AMERICA (PI), LARGE (Co-PI), and POSITIVE (Co-PI). He is on the Steering Committee for the MAPS trial. He is a consultant for Lazarus Effect, Reverse, Pulsar, Edge Therapeutics, and Medina. He is an investor with Blockade Medical and Medina.

Patient consent Obtained.

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