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CASE REPORTS

Endovascular Treatment of Cerebral Venous Sinus Thrombosis

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Abstract

Background: The causes of cerebral venous sinus thrombosis (CVST) are diverse, and headache is the only symptom in mild cases. However, in severe cases, perfusion disorders may concomitantly cause intracerebral hemorrhage, resulting in serious complications. Herein, we report two severe CVST cases in which good outcomes were obtained following endovascular treatment.

Patients and Methods: Case 1) A 42-year-old man consulted an ophthalmologist with a chief complaint of decreased vision. The patient had a considerably high intraocular pressure and papilledema. However, due to unknown etiology, he was only prescribed eye drops. He subsequently developed headaches and experienced an alteration in his mental status. An urgent surgery was performed with using the pull-back technique using a suction catheter, following which, the patient's neurological symptoms improved.

Case 2) A 50-year-old man presented with generalized clonic convulsions and was transferred to the hospital for a thorough examination. The patient was diagnosed with venous sinus thrombosis. Attempts were made to crush the thrombus with a percutaneous transluminal angioplasty balloon and aspirate the thrombus with an aspiration catheter. However, thrombus removal and recanalization could not be achieved. Subsequently, a thrombectomy was performed using the FilterWire technique with a distal embolic protection device. Anterograde blood flow was restored, and the convulsive seizures disappeared.

Conclusion: Venous perfusion injury should be avoided in severe cases of CVST, and endovascular treatment using various devices is a therapeutic option in such cases.

Key Words: *Acute venous thrombosis; Endovascular surgery; Mechanical thrombectomy; Pull-back technique; FilterWire technique*

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Introduction

Headache is the only symptom in mild cases of cerebral venous sinus thrombosis (CVST). However, in severe cases, perfusion disorders can cause intracerebral hemorrhage, leading to serious complications [1]. Anticoagulation therapy, including the administration of low-molecular-weight heparin, is the basis of treatment in such cases. However, sudden worsening of neurological symptoms requires rapid recovery of venous perfusion, and removal of the thrombus by endovascular treatment is effective [2,3].

Herein, we report two cases of severe CVST in which good outcomes were achieved by mechanical thrombectomy with a suction catheter using the pull-back and FilterWire techniques.

Patients and Methods

Case 1: A 42-year-old man consulted an ophthalmologist with a chief complaint of impaired vision. A prominently high intraocular pressure and papilledema was observed upon examination. He was diagnosed with papilledema of unknown cause and prescribed eye drops, and his course was followed up as an outpatient. However, his visual impairment worsened further and after two weeks affected his light perception. He also developed headaches and then somnolence. Results of blood test were consistent with the diagnosis of polycythemia. Cranial magnetic resonance venography showed thrombosis in the superior sagittal sinus, and the patient was diagnosed with CVST due to polycythemia. Although continuous infusion of low-molecular-weight heparin was started immediately, the patient's mental status worsened further. Therefore, an urgent endovascular treatment was recommended. Cerebral angiography confirmed occlusion of the posterior part of the superior sagittal sinus (Figure 1). The right femoral vein was punctured, and an 8Fr guiding microcatheter was placed in the left internal jugular vein. The microcatheter was guided to the occlusion site. Venography revealed stagnant blood flow and a large amount of thrombus (Figure 2). We tried to crush the thrombus with a percutaneous transluminal angioplasty (PTA) balloon as the treatment device, but recanalization could not be achieved (Figure 3). Thrombus aspiration was performed using a suction catheter, commonly used to treat acute occlusion of the main cerebral arteries. However, the thrombus could not be detected. Therefore, the suction catheter was guided to the central part of the superior sagittal sinus (Figure 4a). We then repeatedly suctioned, while pulling back (the pull-back technique). Subsequently, we noted the recovery of anterograde blood flow in the superior sagittal sinus (Figure 4b). Thereafter, intraocular pressure decreased considerably, and the papilledema improved (Figure 5).

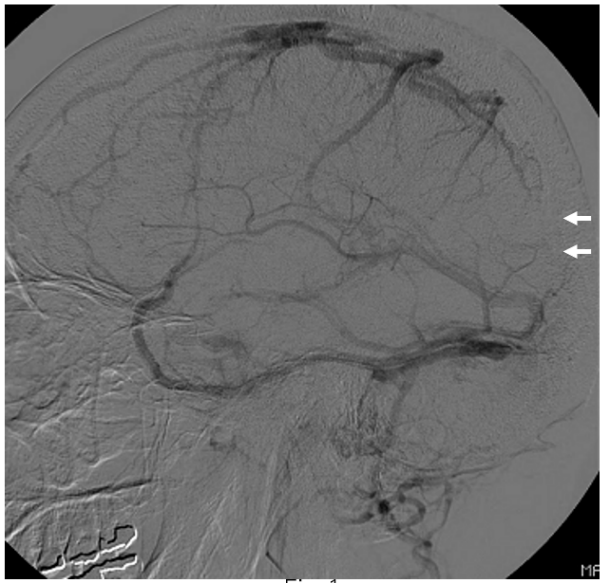

Figure 1) *Right internal carotid angiography, venous phase. Occlusion of the latter half of the superior sagittal sinus is noted (arrow).*

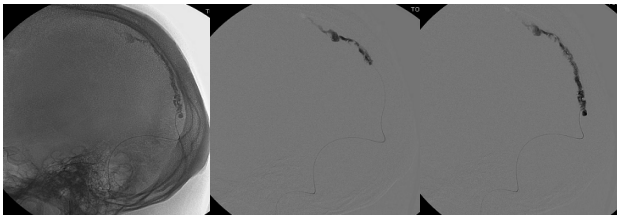

Figure 2) *Microcatheter contrast-enhanced imaging of the venous sinus. The thrombus and the stagnant contrast medium are observed.*

Figure 3) *The percutaneous transluminal angioplasty balloon was expanded during the attempts to crush the thrombus, but recanalization could not be achieved.*

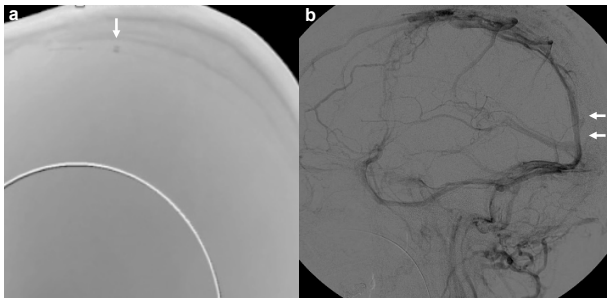

Figure 4) *a) Penumbra system 4MAX was guided to the central part of the superior sagittal sinus(arrow). b) The thrombus was aspirated, and recanalization was achieved(arrow).*

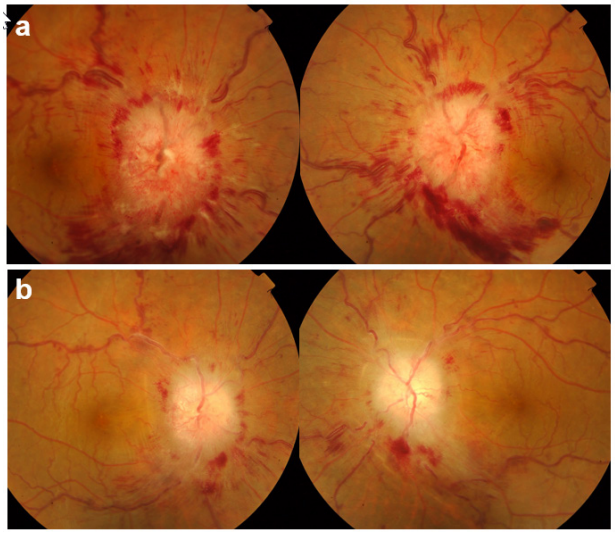

Figure 5) *a) Pre-treatment fundus: Vd=0.1; 20 mmHg, Vs=0.01; 20 mmHg. b) Post-treatment fundus: A decrease in visual acuity and intraocular pressure is observed. Vd=0.7; 8 mmHg, Vs=0.2; 8 mmHg*

Case 2: A 50-year-old man was brought to the emergency department with complaints of chronic headaches and generalized clonic convulsions. Brain magnetic resonance imaging showed no space-occupying lesions in the parenchyma, and there were no abnormalities on electroencephalogram. Cerebral angiography revealed superior sagittal sinus obstruction and the development of collateral circulation. The patient subsequently developed status epilepticus and underwent an emergent endovascular treatment. The right femoral vein was punctured and an 8-Fr guiding microcatheter was inserted into the left internal jugular vein. We tried to remove the thrombus with a suction catheter, but the thrombus hardened, and recanalization could not be obtained. Therefore, we tried to crush it with the PTA balloon, but failed to achieve recanalization. To collect the thrombus, we deployed the FilterWire EZ (Boston Scientific, Natick, MA, USA), a distal embolic protection device commonly used for carotid stenting, in the central part of the superior sagittal sinus. A large amount of the thrombus was removed (Figure 6). Subsequently, recanalization of the superior sagittal sinus was observed (Figure 7), following which, the patient's headaches and convulsive seizures disappeared, and the patient was discharged eventually.

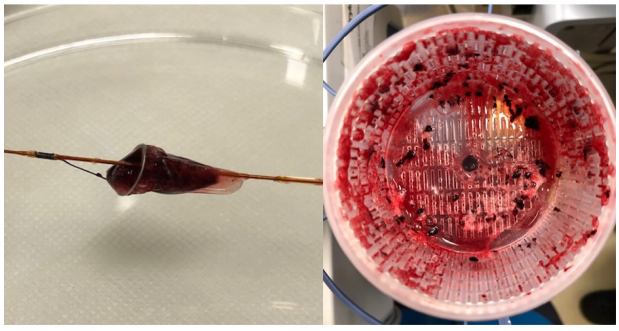

Figure 6) *Thrombus collected by the FilterWire technique.*

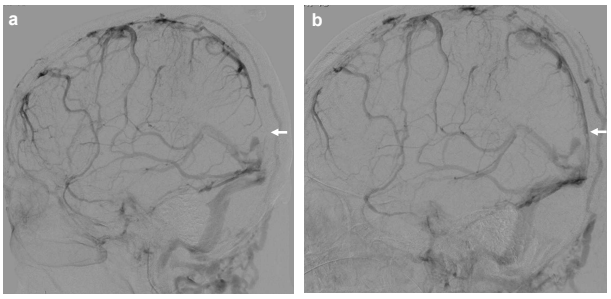

Figure 7) *a) Preoperative right internal carotid angiography, venous phase. Occlusion in the latter half of the superior sagittal sinus is noted (arrow). b) Postoperative right internal carotid angiography, venous phase. The thrombus was collected, and re-canalization was achieved.*

Discussion

CVST reportedly account for 0.5-1.0% of all stroke cases, with the highest reported involvement in the lateral/sigmoid sinus (56-75%), followed by the superior sagittal sinus (45-65%). Overall, 46-71% of cases are reported to involve multiple sinuses. Its causes include pregnancy, use of oral contraceptives, malignant tumors, hypercoagulable states, such as infectious diseases and trauma. There are also congenital coagulation disorders such as protein C and S deficiency and antithrombinIII deficiency. However, despite various tests, the cause is often unknown [1-3]. In addition, due to the rarity of the disease, early diagnosis may not be established, and rapid deterioration of neurological symptoms may be observed, as in this case. With the advent of endovascular treatment, the probability of partial or complete recovery is 87.2%, and the recanalization rate within one year is 85% [4].

The basis of treatment for CVST is anticoagulant therapy, mainly low-molecular-weight heparin, as recommended by the American Hospital Association or the American Stroke Association [5]. Further, with progressive worsening of symptoms and severe cases, there is a high rate of permanent residual neurological symptoms, and the mortality rate is reported to be 4.4-38%. Therefore, revascularization should be considered as soon as possible. One method to achieve revascularization is local fibrinolytic therapy, in which a microcatheter is guided to the occluded site, and urokinase and recombinant tissue plasminogen activator are locally administered [6-8]. However, there is no consensus on the optimal dose to be used. In addition, it is difficult to use these drugs in patients with cerebral hemorrhage in CVST. In such cases, thrombus removal using various devices is a priority. Recently, thrombus has been reported not only in PTA balloons and micro snares, but also in aspiration catheters and stent retriever [9-13].

In Case 1, infusion of low-molecular-weight heparin did not improve the symptoms, and urgent revascularization was deemed necessary. An attempt was made to crush the thrombus with a PTA balloon as a treatment device, but recanalization could not be achieved. It was likely that the thrombus had hardened due to the underlying polycythemia. In addition, two weeks had passed from the onset of symptoms to diagnosis, which may have further hardened the thrombus. The suction catheter was guided to the occlusion site and the thrombus was aspirated, but only a small amount could be collected; thus, recanalization could not be achieved. Therefore, we performed a pull-back technique in which the following steps were repeated: 1) The tip of the suction catheter was guided to the distal part of the occlusion. 2) The catheter was pulled back to the proximal part on continuous suction. 3) It was then guided distally again. Some thrombi remained, but recanalization was observed. The Penumbra system (Penumbra Inc, CA, USA: PS) 4MAX was selected as the suction catheter, considering the effective length of the catheter. Most large-diameter catheters have an effective length of 132 cm and are limited to guidance to the latter

half of the superior sagittal sinus. Although the suction force is slightly lower than that of the large diameter, the medium-diameter PS 4MAX has an effective length of 139 cm. It can be guided to the central superior sagittal sinus. Effective length is important when selecting a suction catheter, and direct puncture of the internal jugular vein should be considered when using a large-diameter catheter.

In Case 2, the patient was resistant to anticonvulsants, and the status epilepticus persisted. Therefore, urgent revascularization was necessary. We tried to crush the thrombus with a PTA balloon and aspirate it with a suction catheter; however, recanalization could not be achieved. To attempt thrombus aspiration with a large-diameter catheter, a sheath inducer was placed directly in the jugular vein. Despite aspiration attempts with the AXS Catalyst 7 (Stryker Neurovascular, Freemont, CA, USA), recanalization was not achieved. Therefore, the FilterWire EZ was inserted into the AXS Catalyst 7, guided to the distal occlusion site, and deployed. Thereafter, it was slowly pulled back to the proximal part of the obstruction, withdrawn to catalyst 7, and the entire system was removed. A large amount of thrombus was collected in the FilterWire EZ (Figure 6). Although the thrombus remained in the superior sagittal sinus, recanalization was achieved (Figure 7). The FilterWire technique in the venous sinus carries a risk of venous perforation. It was necessary to guide the suction catheter in advance and confirm that it was in the venous sinus by contrast enhancement before the deployment.

It has been suggested that severe cases showing progressive deterioration of neurological symptoms have many hardened thrombi. In addition, it is challenging to improve treatment of perfusion disorders by administering anticoagulant therapy alone. It is important to collect as many thrombi as possible and strengthen postoperative anticoagulant therapy by endovascular surgery using various devices.

Conclusion

We experienced mechanical thrombectomy for severe CSVT. The presented technique is useful in cases with large and hard thrombus.

Disclosure of conflict of interest: The authors have no conflicts of interest to declare.

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