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Technical Notes

Treatment strategy for giant thrombosed aneurysm of the basilar artery with associated obstructive hydrocephalus

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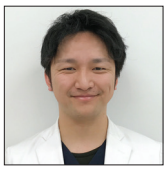

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ABSTRACT

Background: There is no established adequate treatment for thrombosed aneurysm of the basilar artery with obstructive hydrocephalus. We conducted coil embolization and peritoneal shunting followed by placement of a stent expected to exert flow diversion (FD) effects to treat 2 patients with giant thrombosed aneurysms of the basilar artery with associated obstructive hydrocephalus, with good results.

Methods: From April 2019 to March 2021, consecutive two cases of symptomatic hydrocephalus due to giant thrombosed aneurysms in the posterior cranial fossa at our hospital were treated. At first, coil embolization was performed to prevent aneurysm rupture. After coil embolization, ventriculoperitoneal shunting was performed. Finally, stent-assisted coil embolization was performed with flow re-direction endoluminal device (FRED) or low-profile visualized intraluminal support device (LVIS) stent.

Results: Both patients were discharged after recovering well, with no postoperative hemorrhagic or ischemic complications.

Conclusion: Staged surgery using a FRED for flow diverter or an LVIS stent expected to have FD effects may offer an effective treatment option.

Keywords: Flow re-direction endoluminal device, Hydrocephalus, Low-profile visualized intraluminal support device, Neuroendovascular, Thrombosed aneurysm

INTRODUCTION

The prognosis for giant thrombosed aneurysms in the posterior cranial fossa is extremely poor, and the mortality rate is very high if the aneurysm is left untreated.[6,12] This pathology may also cause hydrocephalus requiring ventriculoperitoneal shunting (VP shunting) through mass effects. However, postoperative complications have been reported, and no consensus has been established on the optimal method of treatment. The previous reports have shown that treating hydrocephalus first may induce aneurysm rupture.[3,5,10,13] In addition, it has been reported that if endovascular treatment is performed on the aneurysm first, the aneurysm becomes larger and neuropathy worsens.[8]

We conducted coil embolization and VP shunting, followed by placement of a low-profile visualized intraluminal support device (LVIS stent) (MicroVention, Tustin, CA, USA) or flow re-direction endoluminal device (FRED) (MicroVention, Tustin, CA, USA) for flow diverter in expectation of flow diversion (FD) effects, to treat two patients with giant thrombosed aneurysm and associated obstructive hydrocephalus. We report these staged procedures with discussion of the relevant literature.

MATERIALS AND METHODS

From April 2019 to March 2021, consecutive two cases of symptomatic hydrocephalus due to giant thrombosed aneurysms in the posterior cranial fossa at our hospital were treated.

At first coil embolization was performed to prevent aneurysm rupture. Single antiplatelet therapy (SAPT) was started before the first coil embolization to prevent intraoperative and postoperative ischemic complications. The right femoral artery was punctured and a 6-Fr short sheath was inserted. A 6-Fr Roadmaster guiding catheter (Goodman, Aichi, Japan) was guided into the left vertebral artery. An Echelon 10 microcatheter was, then, inserted and guided into the aneurysm with a CHIKAI 0.014-inch guidewire (Asahi Intecc, Aichi, Japan). A second Echelon 10 microcatheter was guided into the aneurysm with a CHIKAI 0.014-inch guidewire. Due to the large size of the aneurysm, the double-catheter technique was employed for embolization. After coil embolization, VP shunting was performed. The Codman CERTAS Plus (Integra LifeSciences, Princeton, New Jersey, USA) was used as the shunt valve.

Dual antiplatelet therapy (DAPT) was started after shunt placement and continued for over 10 days until second operation to prevent subsequent intraoperative and postoperative ischemic complications.

Stent-assisted coil embolization (SACE) was performed with FRED or LVIS stent. The right femoral artery was punctured and an 8-Fr short sheath was inserted. A Roadmaster guiding catheter was guided into the vertebral artery to the level of the 2nd cervical vertebra. A Headway 27 microcatheter (MicroVention, Tustin, CA, USA) or Headway 21 microcatheter (MicroVention, Tustin, CA, USA) was inserted with a CHIKAI 0.014-inch guidewire to the basilar artery, from where FRED or LVIS stent was deployed. When using LVIS stent, an Echelon 10 microcatheter was guided into the residual aneurysm with a CHIKAI 0.014-inch guidewire and used for coil embolization.

Finally, DAPT was continued over 6 months to prevent postoperative ischemic complications.

RESULTS

All surgical procedure was completed [Table 1 and Figures 1-3]. The chief complaint of both patients was gait disturbance, but the postoperative symptoms tended to improve. They progressed without ischemic and hemorrhagic complications and were transferred to another hospital for rehabilitation. More than 1 year has passed since the operation. No recurrence of the aneurysm has been observed in case #1 [Figure 4]. Imaging evaluation was not possible for case #2, because he had refused to visit the hospital due to the global COVID-19 epidemic. He died of sepsis from pneumonia about 2 years after the operation.

DISCUSSION

Giant thrombotic aneurysms in the posterior cranial fossa that causes a mass effect have an extremely poor prognosis, including the development of neurological abnormalities due to brainstem compression. If left untreated, the mortality rate reportedly exceeds 50% within 2–3 years.[6,12] Multiple different aneurysm locations have been reported, but the basilar artery is usually involved, as in both our patients.[1,11,17] A number of case reports have described the use of VP shunting for large or giant basilar aneurysms with associated obstructed hydrocephalus.[3,5,10,13] According to those reports, although good results have been obtained in some cases, serious complications occurred in others, including enlargement of the aneurysm comparatively soon after surgery in approximately 15% of patients, and

Table 1: Patients characters and materials. Details of aneurysms and treatment are also provided.

Case	Sex	Age	Chief complaint	Aneurysm size	Number of inserted coils (1st embolization)	Duration of 1st embolization and shunting	Duration of shunting and 2nd embolization	Number of inserted coils (2nd procedure)	Stent	Complication
#1	Male	39	Gait disturbance	28 mm	26	4 days	15 days	22	LVIS stent	None
#2	Male	84	Gait disturbance	38 mm	20	2 days	15 days	0	FRED	None

FRED: Flow re-direction endoluminal device, LVIS: Low-profile visualized intraluminal support device

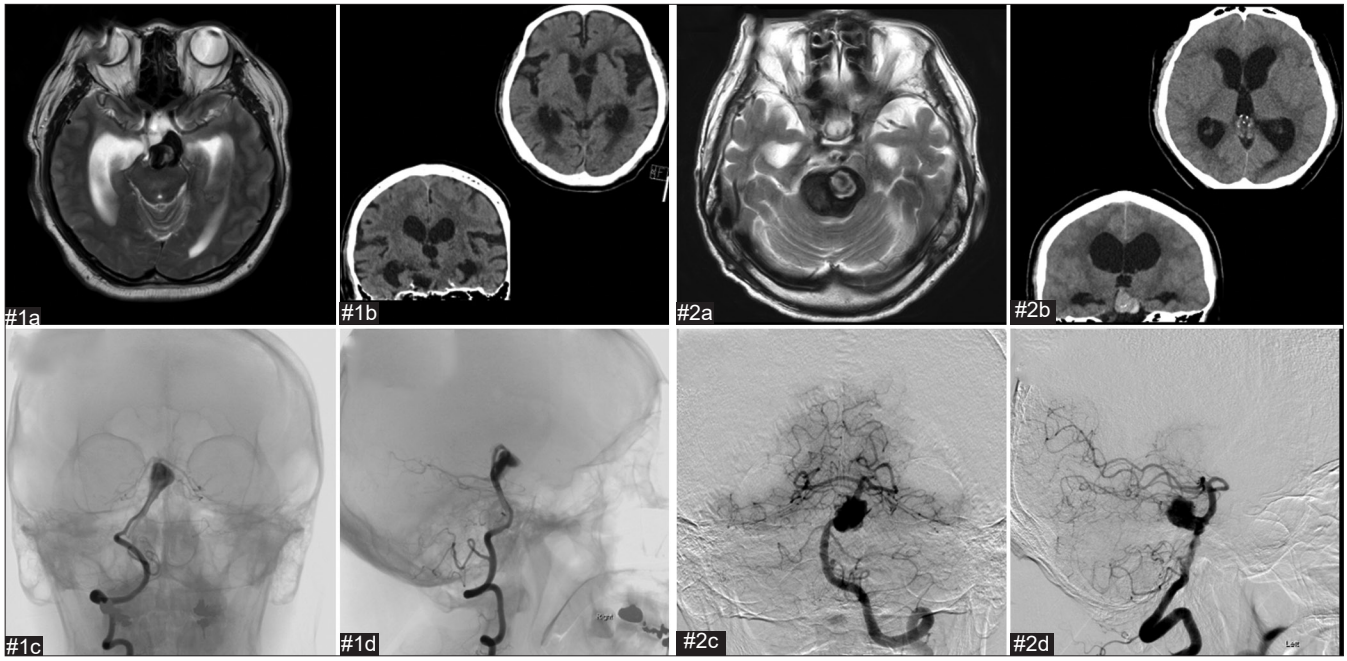


Figure 1: Preoperative images of case# 1 and case# 2. (a) Axial T2-weighted MRI. (b) Axial and coronal CT. Ventricular enlargement with Evans index>0.3, sharpening of the callosal angle, and disproportionately enlarged subarachnoid space hydrocephalus were observed. (c) Frontal digital subtraction angiography (DSA). (d) Lateral DSA.

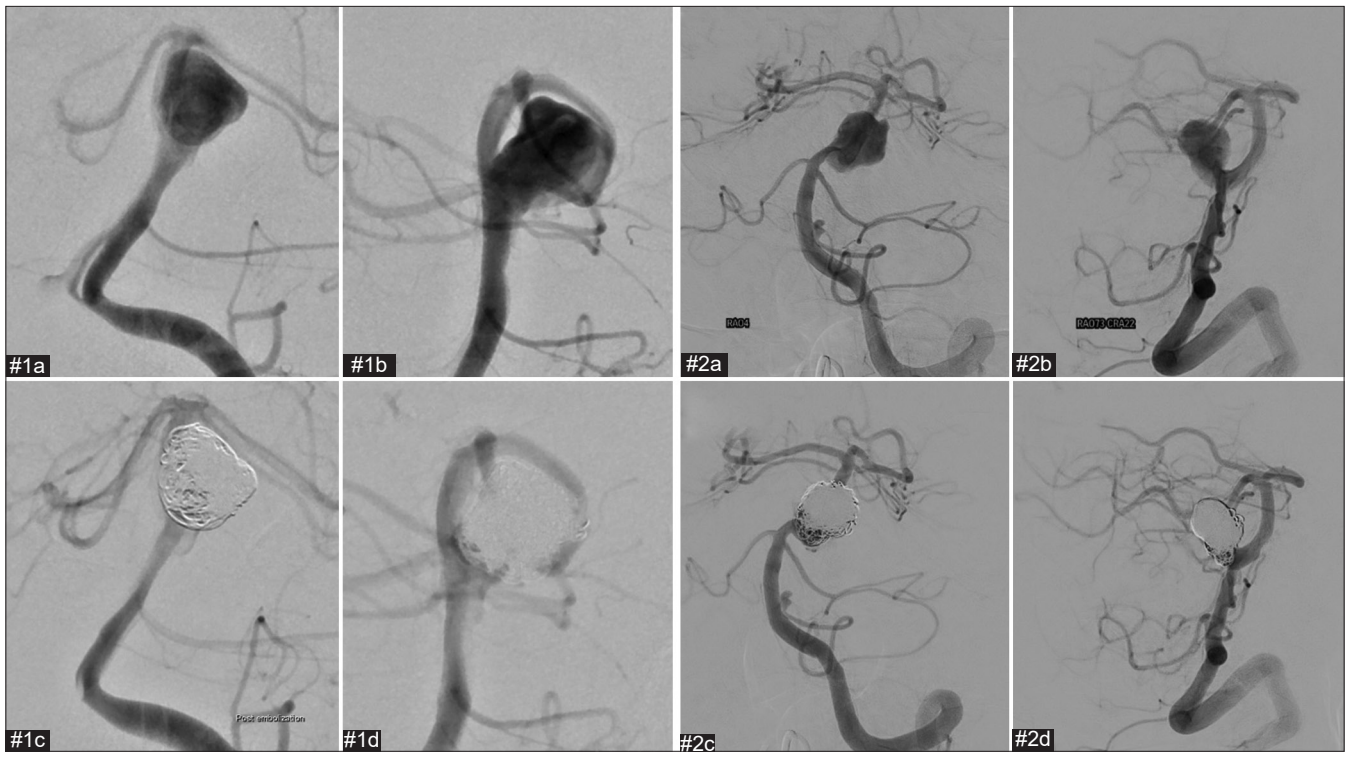


Figure 2: Postoperative and preoperative images of the first coil embolization for cases #1 and #2. (a) Preoperative frontal digital subtraction angiography (DSA). (b) Preoperative lateral DSA. (c) Postoperative frontal DSA. (d) Postoperative lateral DSA.

death due to subarachnoid hemorrhage in another 15%. No statistical analyses have been undertaken because these complications have occurred over an extended time scale (from immediately to 4 weeks postoperatively,[3,5,10,13] but

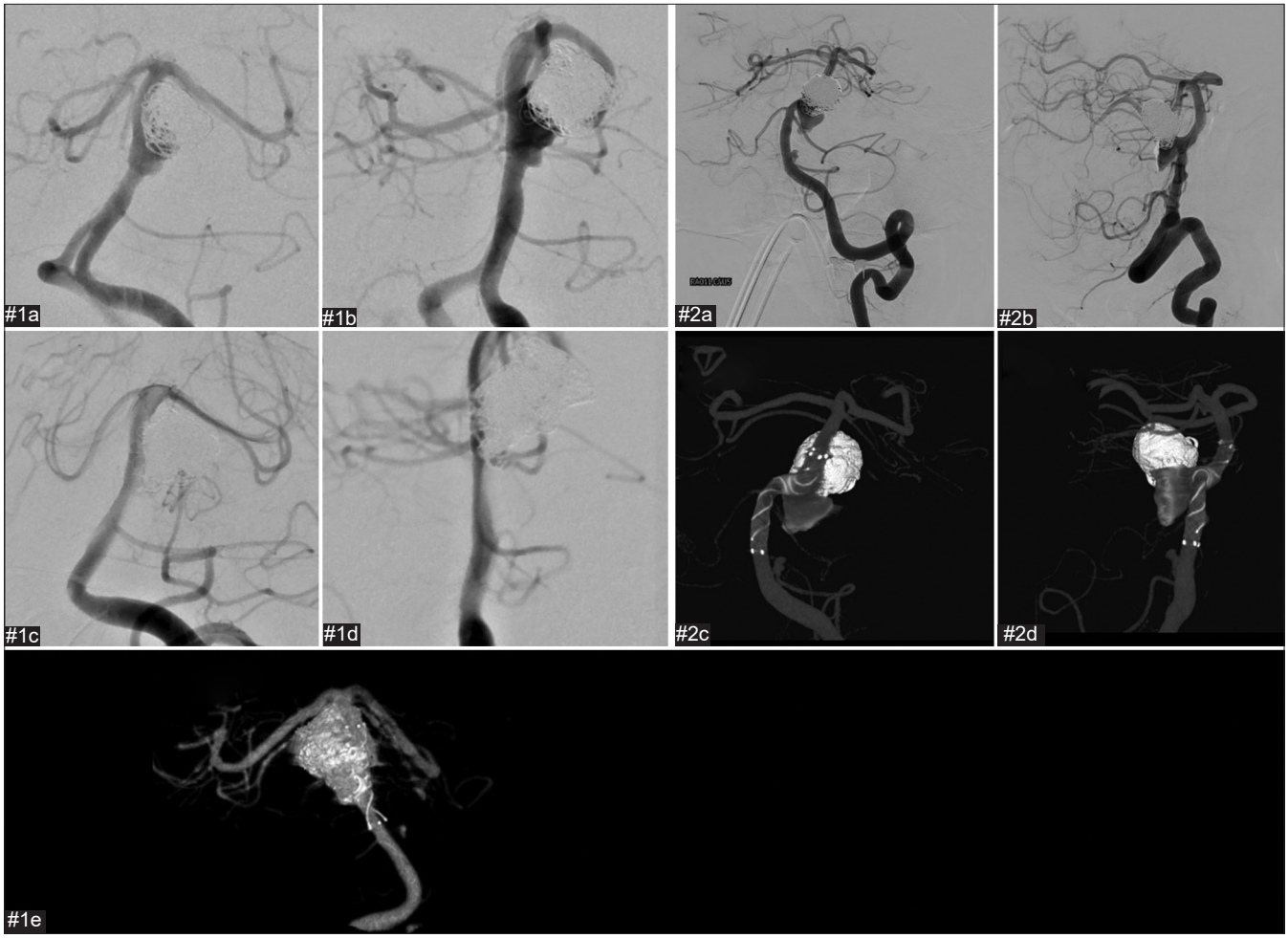
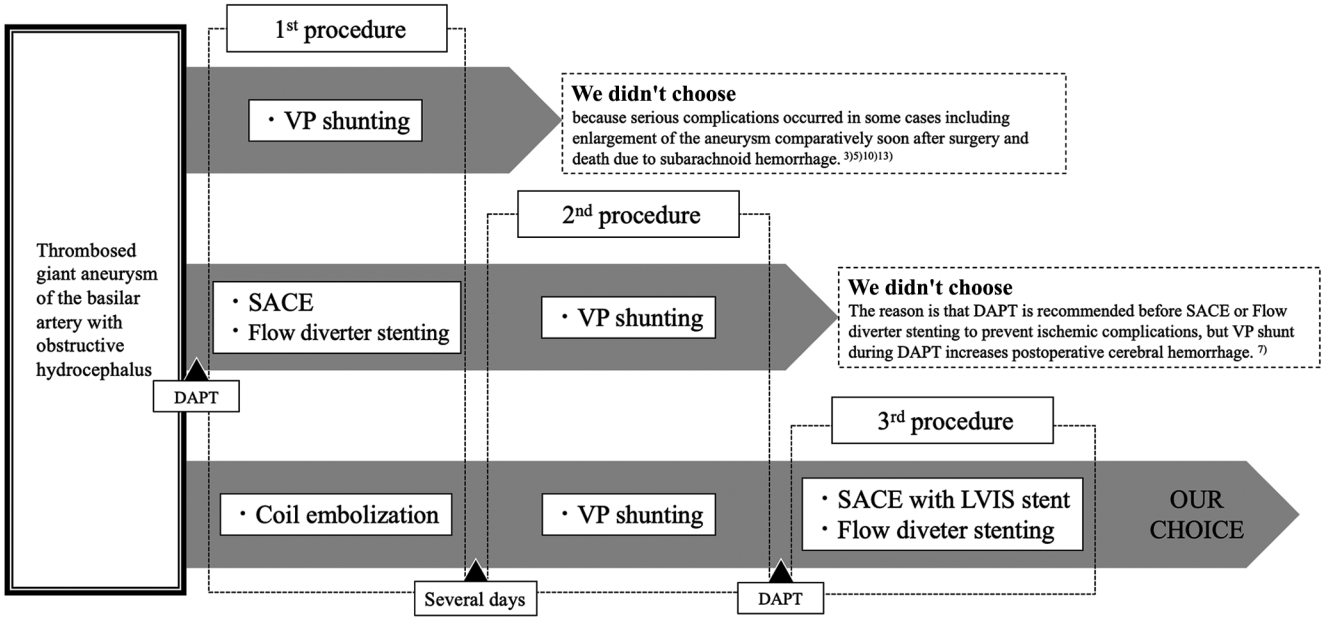


Figure 3: Postoperative and preoperative images of the second coil embolization and stent employment for cases #1 and #2. The proximal part of the aneurysm has enlarged compared to immediately after the initial procedure. We considered that the aneurysm had enlarged as a result of coil embolization of the thrombosed aneurysm. #1(a) Preoperative frontal digital subtraction angiography (DSA). #1(b) Preoperative lateral DSA. #1(c) Postoperative frontal DSA. #1(d) Postoperative lateral DSA. #1(e) Cone-beam computed tomography (CT). #2(a) Preoperative frontal DSA. #2(b) Preoperative lateral DSA. #2(c) Postoperative frontal image in cone-beam CT. #2(d) Postoperative lateral image in cone-beam CT.

Figure 4: (a) Frontal digital subtraction angiography (DSA) at 11 months postoperatively in case #1. (b) Lateral DSA at 11 months postoperatively in case #1. No recurrence of the aneurysm has been identified.

we considered that VP shunting by itself is risky. A case of basilar aneurysm with hydrocephalus has been reported, in which good results were obtained by VP shunting after coil embolization.[16] As a result, in these cases of giant thrombosed aneurysm with associated hydrocephalus, we decided to start with coil embolization to prevent aneurysm rupture, before embarking on hydrocephalus surgery. Coil embolization alone of a thrombosed aneurysm entails a high risk of causing aneurysm enlargement as a result of coil compaction.[8] We investigated the use of SACE before shunt surgery to increase the embolization rate of aneurysms. Although DAPT is recommended before SACE to prevent ischemic complications, Hudson reported that shunting with DAPT increased postoperative cerebral hemorrhage.[7] Given the existence of a case report of successful flow diverter use for the treatment of a basilar aneurysm,[2] we aimed to achieve permanent cure by placing a FRED for flow diverter or an LVIS stent in expectation of an FD effect with DAPT after the first coil embolization [Table 2].

Table 2: Details of staged surgery. We decided to implement 3-step treatment strategy for several reasons.



DAPT: Dual antiplatelet therapy, LVIS: Low-profile visualized intraluminal support device, SACE: Stent assisted coil embolization, VP shunting: Ventriculoperitoneal shunting

SAPT was started before the first coil embolization, and DAPT before the second cerebral endovascular treatment was administered over 10 days after the shunt operation. Consensus regarding the method of duration of DAPT before cerebral endovascular treatment has yet to be reached. Because DAPT should be started 5–7 days before using a flow diverter stent[9] and because platelets do not synthesize new proteins during their 7–10 days lifespan,[14] at our hospital. After shunt surgery, DAPT was continued for over 10 days before cerebral endovascular treatment.

In both patients, cerebral angiography 2 weeks after coil embolization revealed enlargement of the aneurysm due to coil compaction. We subsequently placed either a flow diverter or an LVIS stent expected to have an FD effect in addition to further coil embolization, with good results. The metal coverage rate of the LVIS stent is 18–29%,[15] second only to that of flow diverters, and a similar FD effect to that of flow diverters is therefore expected.[4] It must be noted, however, that evidence for the FD effects of LVIS stents is lacking. Therefore, in this study, coil embolization was also performed when using LVIS stent.

CONCLUSION

We conducted coil embolization before VP shunting, followed shortly after by placement of a FRED for flow diverter or LVIS stent expected to have FD effects, to treat two patients with giant thrombosed aneurysm with associated obstructive hydrocephalus, without the occurrence of any hemorrhagic or ischemic complications. Staged surgery including placement of a FRED for flow diverter or LVIS stent expected to have FD effects may represent an effective treatment option.

Declaration of patient consent

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

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Nil.

Conflicts of interest

There are no conflicts of interest.

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