



Case Report

Successful use of an LVIS device to treat unruptured distal aneurysm of the superior cerebellar artery at a vascular bifurcation

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ABSTRACT

Background: Aneurysms of the distal superior cerebellar artery (SCA) account for only a small proportion of all cerebral aneurysms. Reports of the use of flow diverters (FDs) started to appear in 2013. We obtained good results from placement of a low-profile visualized intraluminal support device (LVIS) to treat unruptured distal aneurysm of the SCA at a vascular bifurcation.

Case Description: A 65-year-old man presented at our hospital with sudden peripheral facial nerve palsy and suspected subarachnoid hemorrhage. Investigational cerebral angiography revealed an aneurysm at the bifurcation of the caudal and rostral trunks of the SCA. An LVIS was placed with the aim of obtaining flow diversion, and cerebral angiography 6 months after this procedure showed disappearance of aneurysm with preservation of the distal SCA.

Conclusion: Twelve cases of the use of FDs to treat aneurysms of the SCA have been reported previously. However, none of those reports described FD use to treat an aneurysm at a vascular bifurcation, as in the present case. Our results suggested that LVIS placement with the aim of obtaining flow diversion may be useful for the treatment of aneurysms at such sites.

Keywords: FRED, Neuroendovascular, Flow-diverter, Aneurysm

INTRODUCTION

Aneurysms of the superior cerebellar artery (SCA) account for only a small proportion of all cerebral aneurysms, and aneurysms of the distal SCA are even more uncommon.^[2] Treatment options for SCA aneurysms include endovascular treatment and open surgery,^[3] but reports of the use of flow diverters (FDs) started to appear in 2013.^[1,4-10,12,14] Unlike conventional endovascular treatment devices, FDs do not require insertion of a catheter into the aneurysm to deposit coils or other embolic material, but instead represent innovative devices that restrict blood flow into the aneurysm, thus sparing the parent vessel while preventing aneurysm rupture or growth.^[11]

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We inserted a low-profile visualized intraluminal support device (LVIS) (MicroVention, Tustin, CA, USA) with the aim of obtaining flow diversion to treat an unruptured distal aneurysm of the SCA at a vascular bifurcation. Six months later perfusion to the bifurcating vessels was maintained while the aneurysm had been completely obliterated. We, therefore, report this case together with a discussion of the literature.

CASE DESCRIPTION

Patient

A 65-year-old, male.

Chief complaint

Facial nerve palsy.

Case history

The patient noticed a sudden right facial palsy. CT at a local hospital revealed a hyperdense area in the right lateral pons, and the patient was referred to our hospital with suspected SAH.

Examination on admission

Right facial nerve palsy was observed. The patient had no headache, Kernig's sign, and nuchal rigidity. Lumbar puncture showed that a cerebrospinal pressure of 10 cmH₂O and CSF was colorless and clear.

Neuroradiology findings

No aneurysm was obviously identifiable on MRI. A spherical, space-occupying lesion appearing hyperintense on T2WI and FLAIR and isointense on T2*WI was observed in the right lateral pons [Figure 1]. DSA conducted the same day showed an aneurysm measuring 8.3 mm in maximum diameter in the lateral pontomesencephalic segment (S2) of the SCA. The caudal and rostral trunks of the SCA bifurcated from the aneurysm [Figure 2].

Treatment strategy

Cranial CT findings were considered indicative of an aneurysm, and lumbar puncture results eliminated the possibility of subarachnoid hemorrhage. Because the maximum aneurysm diameter exceeded 8.3 mm and the patient had suddenly developed peripheral facial nerve palsy, a possible mass effect of the aneurysm could not be ruled out, although this association was unclear, and treatment for an enlarging aneurysm was considered indicated. Occlusion of the parent vessel at a site upstream of the aneurysm or

occlusion of the vessels bifurcating from the aneurysm was considered as treatment options. However, given the risk of ischemic complications, the decision was made to place an LVIS with the aim of obtaining flow diversion while sparing both the parent vessel and the vessels bifurcating from the aneurysm.

Ethical considerations

The cerebral endovascular treatment, including the off-label use of LVIS, was approved by the review board at Fukuoka Neurosurgical Hospital, and consent was obtained from the patient after he had been provided with a full explanation of the significance and purpose of the treatment and its risks and complications. Publication of this case report was approved by the hospital review board, and consent was obtained from the patient and his family.

Endovascular treatment

The right femoral artery was punctured and a 6-Fr short sheath was put in place. A 6-Fr Roadmaster (Goodman, Aichi, Japan) was introduced into the V2 portion of the left vertebral artery. A SHOURYU HR 4 mm × 10 mm balloon catheter (Kaneka Medix, Osaka, Japan) was placed in the V3 portion of the left vertebral artery in case of rupture. A Headway 21 (MicroVention/Terumo, Tustin, CA, USA) was inserted, and introduced into the right proximal SCA using a Radifocus guide wire M (GT WIRE) 90° (MicroVention/Terumo). After confirming the aneurysm and the course of the parent vessel, the Headway 21 was introduced into the SCA caudal trunk distal to the aneurysm, which was in the direction of progression of the Headway 21. However, selection of the SCA caudal trunk proved impossible with the GT WIRE 90° because of the curve of microwire tip is very strong, so the aneurysm was secured with a CHIKAI 0.014-inch (Asahi Intecc, Aichi, Japan) with the tip shaped into a double angle, and the Headway 21 was introduced [Figure 3]. A 3.5 mm × 17 mm LVIS was deployed from the Headway 21 so as to cover the neck of the aneurysm. To obtain the flow diversion effect of LVIS, LVIS was deployed from 6 mm distal to 6 mm proximal to the aneurysm so that the effective length of the LVIS fully covered the aneurysm neck. As an eclipse sign was clearly evident on confirmatory contrast enhancement, the procedure was concluded [Figure 4].

Postprocedure course

No postprocedure neurological abnormalities were evident, and the patient was, therefore, discharged with a modified Rankin Scale score (mRS) of 0. Cerebral angiography conducted 6 months after the procedure showed that perfusion in the SCA caudal trunk and rostral trunk was preserved while complete obliteration of the O'Kelly-Marotta

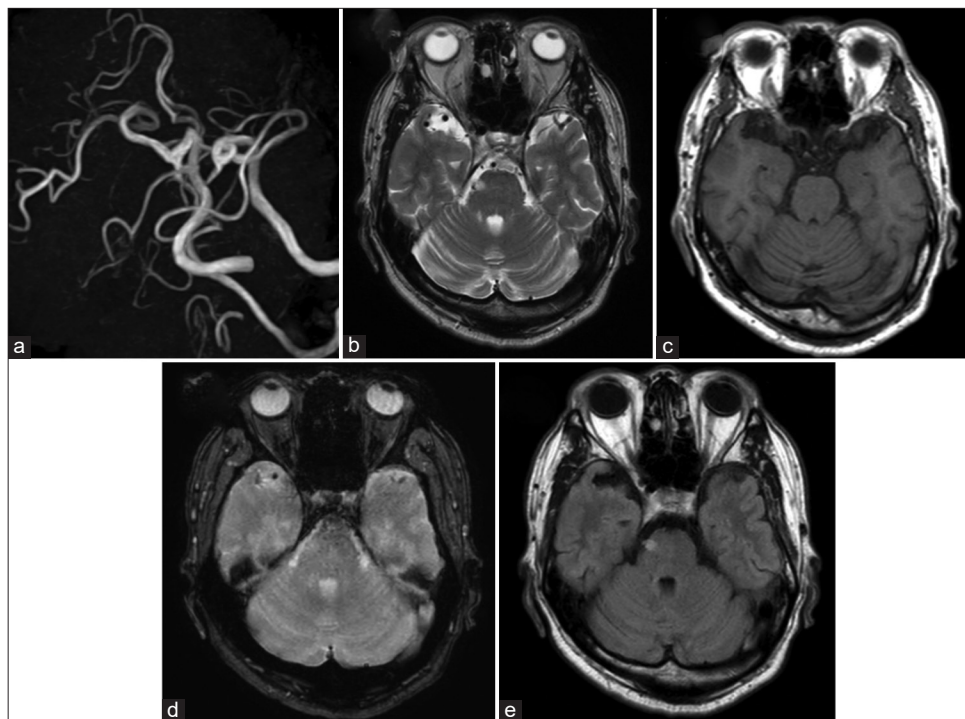


Figure 1: Imaging findings on admission to our hospital. (a) MRA. There are no signs of an aneurysm or other lesion. (b) T2WI. A spherical hyperintensity is evident in the right pons. (c) T1WI. No obvious signs are seen in the right pons. (d) T2*WI. The hyperintensity evident on T2WI is somewhat hyperintense, excluding the possibility of bleeding. (e) FLAIR. A spherical hyperintensity is evident in the right pons.

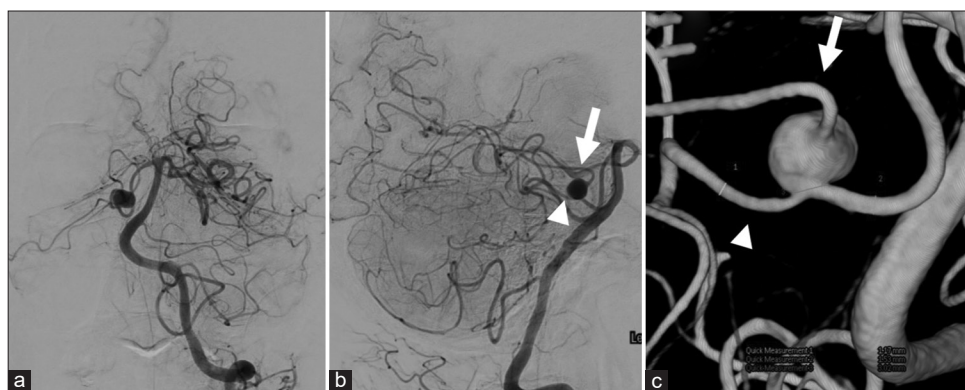


Figure 2: Imaging before the procedure. (a) DSA Frontal view; (b) DSA lateral view; (c) 3D-RA. The arrows in (b) and (c) indicate the rostral trunk, and the arrowhead in (b) and (c) indicate the caudal trunk. Maximum diameter of the aneurysm is 8.3 mm, diameter of the aneurysm neck is 3 mm, diameter of the vessel distal to the aneurysm is 1.1 mm, and diameter of the vessel proximal to the aneurysm is 1.5 mm.

grading scale (OKM) grade D aneurysm was observed [Figure 5].

DISCUSSION

Aneurysms located on the SCA account for only 1.7% of all cerebral aneurysms, and aneurysms of the distal SCA are even more uncommon, at 0.2%.^[2] Consensus regarding the method of treatment at this location has yet to be reached, and cases of parent vessel occlusion by endovascular therapy, combination stenting and coil embolization, and open surgeries including

bypass surgery and clipping have all been reported.^[3] However, problems include the risk of ischemic complications and the level of technical difficulty.

Since 2013, scattered reports have described treatment with the aim of obtaining a flow-diverting effect, as in the present case. To the best of our knowledge, 12 such cases have been reported [Table 1].^[1,4-10,12,14] The stents used were the Pipeline (PED; Medtronic, Dublin, Ireland), the Flow-Redirection Endoluminal Device Jr (MicroVention), the SILK FD (Balt Extrusion, Montmorency, France), the Low-profile Visualized

Intraluminal Support device Jr (MicroVention), and the p64 flow modulation device (phenox GmbH, Germany). The LVIS used to treat our patient was not used in any of those reported cases. All seven patients for whom postprocedure mRS was

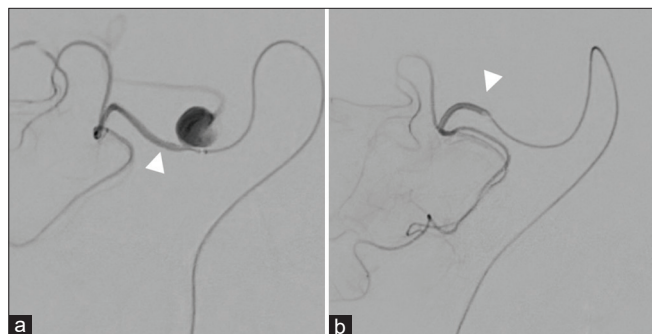


Figure 3: Intra-procedure cerebral angiography. (a) Intra-procedure DSA. The Headway21 is inserted and introduced into the vessel proximal to the aneurysm. (b) The caudal trunk of the superior cerebellar artery (arrowhead in (a) and (b)) is selected using the Headway21 is introduced.

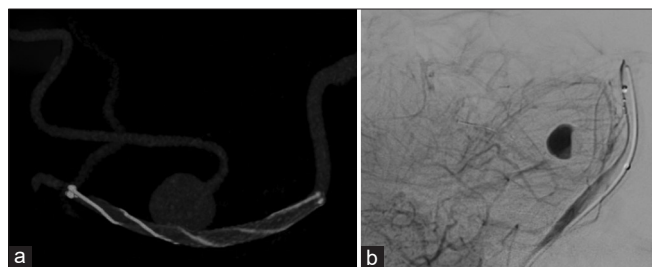


Figure 4: Postprocedure imaging (a) postprocedure cone-beam CT. A 3.5×17 -mm low-profile visualized intraluminal support device (LVIS) has been deployed to cover the neck of the aneurysm without cutting off perfusion in the caudal or rostral trunk of the superior cerebellar artery. (b) Postprocedure cerebral angiography. After LVIS placement, an obvious eclipse sign is evident in the aneurysm. Sufficient flow diversion effect was considered likely to be achieved, and the procedure was concluded.

reported showed mRS 0 or 1, indicating good results. All six patients for whom the aneurysm obliteration rate was given were OKM Grade C or D, representing a consistently high aneurysm obliteration rate that again indicated good results. Two patients with unruptured cerebral aneurysms underwent the same treatment (16.6%), in both cases for an aneurysm in the anterior pontomesencephalic segment (S1) of the SCA. Treatment of the S2 of the SCA was performed for two patients (16.6%) with ruptured aneurysms, who recovered without ischemic complications, but the aneurysm was not associated with vascular bifurcation in either of these patients. No previous reports have described the use of an FD or of stent placement with the aim of obtaining a flow-diverting effect to treat an unruptured cerebral aneurysm at the bifurcation of the caudal trunk and the rostral trunk of S2 of the SCA, and this represents the first reported case.

We considered the combined occlusion of the aneurysm parent vessel and the bifurcating vessels in the present case, but were wary of the risk of ischemic complications due to vascular occlusion. In fact, a case in which open decompression was conducted after SCA occlusion treatment has been reported,^[3] and it is difficult to consider this an effective treatment method. In a comparison of parent vessel occlusion and parent vessel-sparing endovascular treatment for distal SCA aneurysm, good results were observed for patients in whom the parent vessel was preserved.^[3] This result also suggests that maintaining healthy vascular perfusion is an important issue. From the perspective of sparing the parent vessel, LVIS placement with the aim of obtaining flow diversion appears extremely effective for SCA aneurysms at vascular bifurcations.

In our patient, the SCA caudal trunk, as the vessel distal to the aneurysm, was chosen as the parent vessel for LVIS placement because it ran in the same direction as the direction of advancement of microcatheter. The SCA rostral trunk coursed at right angles to the direction of advancement

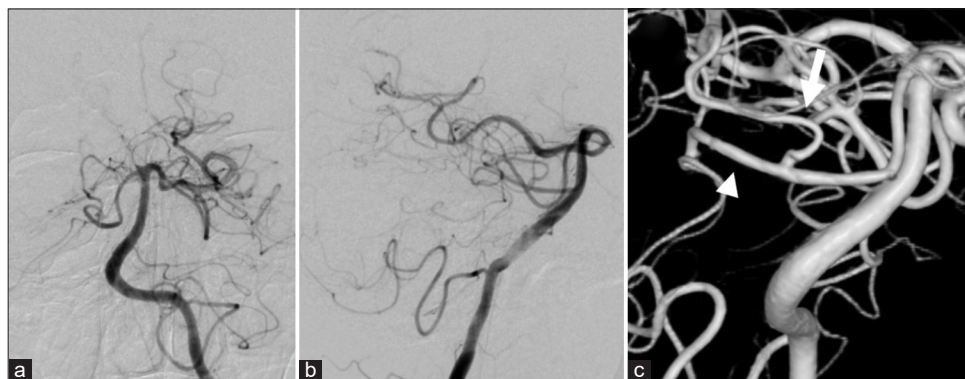


Figure 5: Imaging at 6 months postprocedure. (a) DSA Frontal view; (b) DSA lateral view; (c) 3D-RA. The aneurysm is completely obliterated, and assessed as O'Kelly-Marotta grading scale Grade D. Perfusion in the rostral trunk (arrow) and caudal trunk (arrowhead) of the superior cerebellar artery bifurcating from the aneurysm is preserved.

Table 1: Summary of reported cases of SCA aneurysm treated with FDs or stents.

S. No.	Authors	Age, years	Sex	Ruptured/unruptured	mRS at discharge or follow-up	Location of aneurysm in SCA	Maximum aneurysm diameter, mm	Stent	OKM
1.	Briganti <i>et al.</i> ^[5]	62	F	Ruptured	0	S1	N/A	PED	D
2.	Briganti <i>et al.</i> ^[5]	N/A	N/A	N/A	N/A	N/A	N/A	N/A	C
3.	Kan <i>et al.</i> ^[9]	52	N/A	Unruptured	0	S1	4	PED	D
4.	Laukka <i>et al.</i> ^[10]	53	F	Ruptured	1	S1	4	LVIS Jr	D
5.	Tahir <i>et al.</i> ^[14]	31	F	Ruptured	0	S2	18	LVIS Jr	N/A
6.	Acik <i>et al.</i> ^[11]	51	F	Unruptured	0	N/A	4	SFD	D
7.	Bender <i>et al.</i> ^[4]	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
8.	Hohenstatt <i>et al.</i> ^[7]	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
9.	Hohenstatt <i>et al.</i> ^[7]	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10.	Serulle <i>et al.</i> ^[12]	67	F	Ruptured	0	S2	4.2	PED	D
11.	Hartmann <i>et al.</i> ^[6]	70	M	Ruptured	0	S1	N/A	PED	N/A
12.	Kalman <i>et al.</i> ^[8]	64	M	Ruptured	N/A	S1	N/A	p64 FMD	N/A
13.	Present case	65	M	Unruptured	0	S2	8.3	LVIS	D

FDs: Flow diverter, N/A: Not applicable, OKM: O'Kelly-Marotta grading scale, SCA: Superior cerebellar artery, S1: Anterior pontomesencephalic segment, S2: Lateral pontomesencephalic segment

of microcatheter, and was therefore not chosen as the parent vessel because introduction of microcatheter was considered too difficult to introduce. Because microcatheter manipulation in distal vessels is difficult, selecting a vessel into which they can be introduced as easily as possible may contribute to the success of treatment.

In our patient, we used an LVIS with the aim of obtaining a flow-diverting effect. However, it must be remembered that although *Chao* has described the flow-diverting effects of LVIS devices,^[15] evidence remains lacking.

In the present case, we used the eclipse sign in the aneurysm as a sign to conclude the procedure. The presence of layered stagnation of the contrast agent in the aneurysm, known as the “eclipse sign,” following FDs placement is said to be more common in aneurysm patients with a high postprocedure obliteration rate.^[13] Our patient was good obliteration at 6 months after the procedure, suggesting that the eclipse sign may offer a useful criterion for judging when to conclude FDs placement with the aim of obtaining flow diversion at such sites.

CONCLUSION

Our results suggested that LVIS placement with the aim of obtaining flow diversion in the treatment of unruptured distal SCA aneurysms with a vascular bifurcation may provide good flow-diverting effects without causing divided vessel occlusion, and may achieve complete aneurysm obliteration.

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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