Online August 6, 2020
Journal of Neuroendovascular Therapy 2020; 14: 435–440 DOI: 10.5797/jnet.cr.2019-0116

Case Report

Overlapping Stents and Coil Embolization of Ruptured Anterior Cerebral Artery Dissecting Aneurysms in the Acute Phase

Naoto Tsuchiya,[1] Hidemoto Fujiwara,[1] Haruhiko Takahashi,[2] Ryousuke Ogura,[2] Junichi Yoshimura,[1] and Yukihiko Fujii[2]

Objective: To report a case of ruptured anterior cerebral artery dissection treated with stent-assisted coil embolization with overlapping stents.

Case Presentation: A 51-year-old woman developed subarachnoid hemorrhage the day after transient left hemiparesis. Angiography revealed a ruptured anterior cerebral artery dissecting aneurysm. We conducted stent-assisted coil embolization with the overlapping stent technique on the day after the hemorrhage. She recovered steadily without rebleeding. Six months after embolization, no recurrence was found on angiography.

Conclusion: Although an acceptable result was achieved in this case, the safety and efficacy of this procedure are unconfirmed. A larger number of cases should be accumulated.

Keywords ▶ dissection, anterior cerebral artery, overlapping stent

Introduction

To treat ruptured anterior cerebral artery dissection, surgical or endovascular trapping of the lesion should be recommended commonly. However, if collateral blood flow of a distal vessel is insufficient, simultaneous bypass surgery or preservation of antegrade blood flow is necessary. On the other hand, in patients with vertebral artery dissection or blood-blister-like aneurysms of the internal carotid artery, stent-assisted coil embolization with the overlapping stents technique has been reported with favorable results. Here, we report a case of ruptured anterior cerebral artery dissection treated with a similar treatment strategy.

[1]*Department of Neurosurgery, Nagano Red Cross Hospital, Nagano, Nagano, Japan*
[2]*Department of Neurosurgery, Brain Research Institute, University of Niigata, Niigata, Niigata, Japan*

Received: December 26, 2019; Accepted: May 17, 2020
Corresponding author: Naoto Tsuchiya. Department of Neurosurgery, Nagano Red Cross Hospital, 22-1, Wakasato-5chome, Nagano, Nagano 380-8582, Japan
Email: n.tsuchi@mac.com

Case Presentation

A 51-year-old woman developed left hemiparesis during farm work and was brought to our hospital by an ambulance. Before onset, only dull headache was noted. She had a medical history of hypertension and had been taking an antihypertensive agent for 2 years. There was no specific family history of cerebral aneurysm. On arrival, hemiparesis had improved, and no neurological symptoms were found. She was admitted and subjected to conservative treatment for a transient ischemic attack. The day after admission, severe headache, vomiting, and severe left hemiplegia developed, and CT revealed subarachnoid hemorrhage (SAH; H&K grade IV, WFNS grade III).

Imaging findings

At admission, no ischemic lesions were found on diffusion-weighted imaging. Although no aneurysm was found, stenosis of the distal A1 was suspected on MRA . On the simultaneous T1 black blood image, the wall at the distal A1 was slightly thick, and an iso-signal was detected. CT angiography immediately after the onset of SAH demonstrated a fusiform aneurysm of the right A1. Digital subtraction angiography on the same day showed similar findings (**Fig. 1**). A rapid change in the vessel shape and an intimal flap were seen; therefore, we diagnosed the lesion

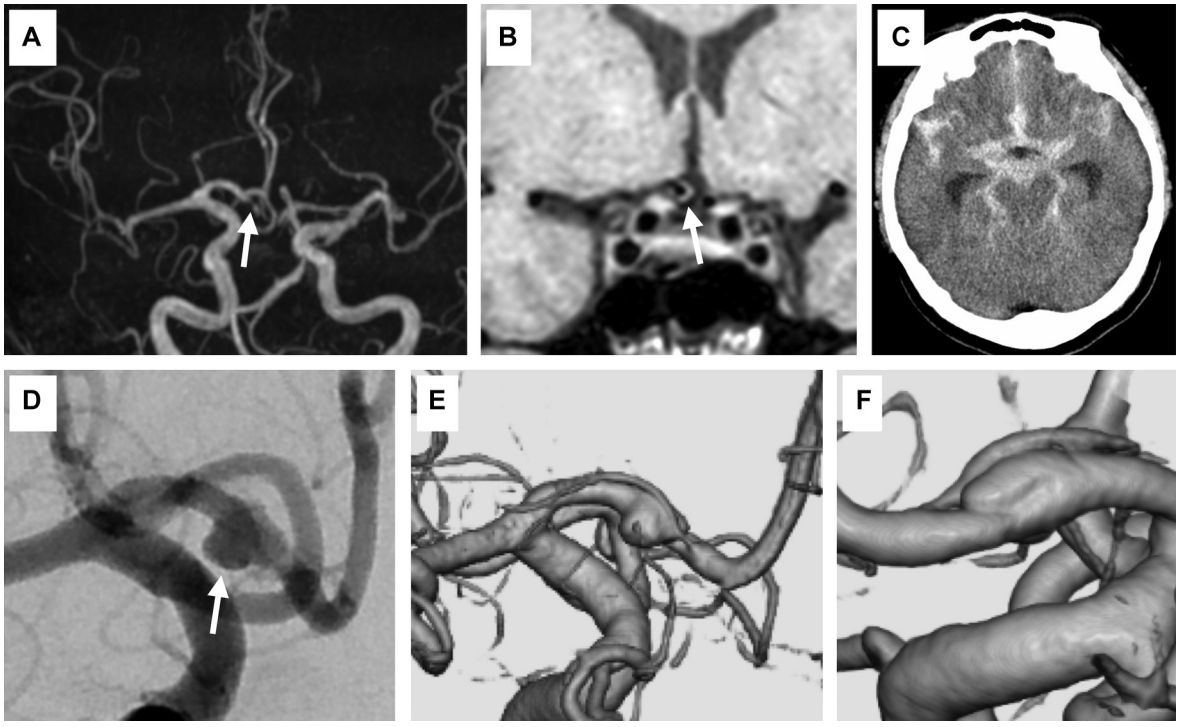

Fig. 1 (**A**) No aneurysm was found on MRA at admission. Stenosis of the distal A1 was suspected (white arrow). (**B**) Simultaneous T1 black blood image showing the iso-intense thickened wall at the distal A1 (white arrow). (**C**) CT on the following day showing diffuse subarachnoid hemorrhage in the basal cistern. (**D** and **E**) Digital subtraction angiography and 3D rotational angiography of the left internal carotid artery demonstrated an A1 aneurysm (white arrow). (**F**) Medial view of 3D rotational angiography demonstrated the intimal flap and partially remaining normal vessel wall.

as a ruptured dissecting aneurysm. Because no cross flow at the anterior communicating artery was detected on the Matas test, a bypass surgery or reconstructive procedure was required.

Treatment strategy

As delayed treatment was considered to lead to a poor prognosis because of marked hemorrhage, we decided to perform stent-assisted coil embolization the day after the hemorrhage. Considering the risks of re-rupture or enlargement of the aneurysm, flow diversion using the overlapping stent technique was conducted (**Fig. 2**). Before treatment, an emergency institutional review board meeting was held, and the treatment plan was approved.

Endovascular treatment

The treatment was performed under general anesthesia. A 9-Fr-long sheath was inserted into the right femoral artery, and heparin was administered to maintain the activated coagulation time between 250 and 300 seconds. Considering the risk of rupture, a 9-Fr Optimo guiding catheter (Tokai Medical, Aichi, Japan) was inserted to the origin of the internal carotid artery. A SHOURYU HR 7 × 7 mm (Kaneka Medix Corporation, Osaka, Japan) was inserted into the distal internal carotid artery. Using this, an additional Matas test was conducted, but no collateral pathway to the affected side of the A2 area was visualized. To obtain a "down the barrel" view, an angle from the left lower area to the right upper area at which the C-arm cannot be reached is necessary. The head was fixed in the state of 20° side flexion to the right to establish such an angle. In the "down the barrel" view, the medial inferior wall of the A1 area in which the normal structure may remain was examined, and a guidewire was inserted along this area, facilitating safe lesion-site passage. After guiding a Headway 17 45° (MicroVention Terumo, Aliso Viejo, CA, USA) to the affected-side A2 area, a J-steam-shaped Headway Duo (MicroVention Terumo) was inserted into the pseudolumen. After 300 mg of aspirin and 300 mg of clopidogrel were infused through a gastric tube, an LVIS Jr. 2.5 × 23 mm (MicroVention Terumo) was deployed in the A2 to A1 areas, with one round of a coil being exposed for catheter stabilization. Using the jailing technique, the pseudolumen was embolized with a coil. Lastly, a Neuroform Atlas 3.0 × 21 mm (Stryker Neurovascular, Fremont, CA, USA) was deployed as an overlapping stent.

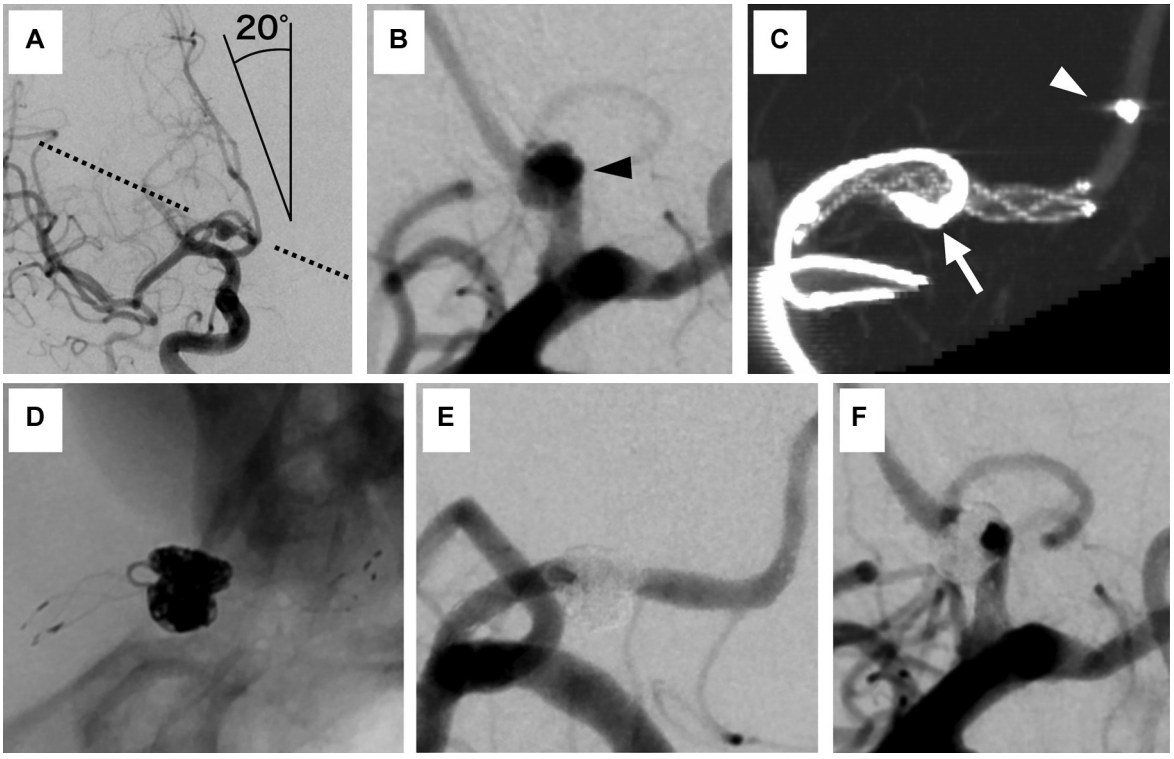

Fig. 2 (**A**) To obtain the "down the barrel" view, the patient's head was leaned to the right. (**B**) A precise angle enabled visualization of the normal wall (arrowhead). A guide wire was advanced along this side. (**C**) The first loop of the coil was inserted before stent deployment (white arrow). After deployment, the microcatheter was readvanced (white arrowhead). (**D**–**F**) The second stent was deployed after loose packing of the pseudolumen.

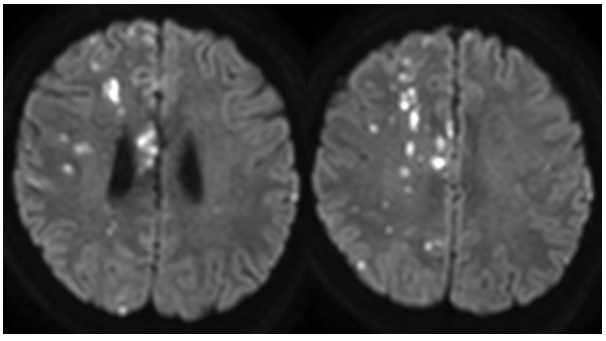

Fig. 3 Diffusion-weighted imaging after the treatment revealed multiple infarctions in the right anterior cerebral artery territory.

Postoperative course

Magnetic resonance imaging performed 3 days after the treatment revealed multiple infarctions in the anterior cerebral artery region, suggesting dissection-related ischemia and operation-related distal embolism (**Fig. 3**). Left hemiplegia and higher brain dysfunction, which had been observed since the onset of SAH, also persisted after surgery. There was no symptomatic vasospasm, and left hemiplegia and higher brain dysfunction slowly reduced. A ventriculoperitoneal shunt for normal pressure hydrocephalus was used, and the patient was referred to a rehabilitation hospital. She was discharged with a modified Rankin Scale score of 1. Recanalization was absent on angiography 6 months after the treatment.

Discussion

Dissection of the anterior cerebral artery is rare, but it is important as an etiological factor for ischemia or SAH in young people. Hensler et al. conducted a meta-analysis involving 80 previously reported patients with anterior cerebral artery dissection. They reported that the median age was 51 years, and that ischemia, SAH, and both were observed in 58 (73%), 8 (10%), and 14 (17%) patients, respectively.[1)]

In patients with ischemia, drug therapy is primarily performed, but no treatment method for those with hemorrhage has been established. Several studies suggested that conservative treatment led to a favorable prognosis in patients with SAH localized to the convexity sulci or distal interhemispheric fissure in the absence of pseudoaneurysms,[2–6)] whereas others reported trapping or proximal ligation of proximal lesions.[7,8)] However, when the collateral pathway is poor, these treatments are unsuitable, requiring bypass or

Table 1 Literature review of the reconstructive endovascular treatment with anterior cerebral artery dissection

Year	Author	Sex	Age	Clinical feature	Location	No. and type of stent	Coil	Time to treatment	Antiplatelet drugs	Ischemic complication	Rerupture	Regrowth	mRS
FD													
2018	Lozupone et al.	F	52	SAH	A2	1 FD	No	3 D	Abciximab →ASA + CLP	No	No	No	0
2016	Lin et al.	M	41	Unruptured	A2	2 FD	No	N/A	ASA + CLP	No	N/A	N/A	0
2016	Lin et al.	F	73	Unruptured	A1	1 FD	Yes	N/A	ASA + CLP	Yes	N/A	N/A	2
2016	Lin et al.	M	13	Gunshot injury	A2	1 FD	No	N/A	ASA + CLP	No	N/A	N/A	0
NBS													
2020	(Present case)	F	51	SAH	A1	2 NBS	Yes	1 D	ASA + CLP	Yes	No	No	1
2018	Takahashi et al.	F	67	SAH	A2	1 NBS	Yes	15 D	N/A	No	No	Yes	0
2016	Hensler et al.	M	46	Distal progression of dissection	A2	1 NBS	No	N/A	ASA + CLP	No	No	No	0
2015	Iwasaki et al.	M	36	Enlargement of pseudoaneurysm	A2	1 NBS	No	N/A	ASA + CLP	No	No	No	0
2014	Im et al.	M	56	SAH	A2	1 NBS	Yes	N/A	N/A	N/A	No	No	4
2013	Park et al.	M	37	cSAH, enlargement of pseudoaneurysm	A2	1 NBS	Yes	N/A	N/A	No	No	No	0

ASA: acetylsalicylic acid; CLP: clopidogrel; cSAH: cortical SAH; D: day(s); FD: flow diverter; mRS: modified Rankin Scale; N/A: not available; NBS: neck bridge stent; SAH: subarachnoid hemorrhage

reconstructive treatment using a stent. As the limitation of bypass, side-to-side anastomosis or interposition graft is required, which are not frequently adopted.

A few studies have reported reconstructive endovascular treatment for anterior cerebral artery dissection, but case reports on stent-assisted coil embolization or treatment with a flow diverter have been published. **Table 1** shows a literature review.

Takahashi et al. reported a patient in whom stent-assisted coil embolization of a subacute-phase A2 ruptured dissecting aneurysm was performed.[9] In this patient, there was no rebleeding after surgery, but there was an increase in the aneurysmal size 40 days after treatment. Bypass and trapping were conducted, suggesting that treatment using a single stent is insufficient. Im et al. also performed stent-assisted coil embolization on patients with ruptured aneurysms and reported that complete occlusion was achieved, although the prognosis was poor because of a poor preoperative condition.[6] Park et al.,[10] Iwasaki et al.,[11] and Hensler et al.[12] performed stent-assisted coil embolization on unruptured anterior cerebral artery dissection in patients with the progression of dissection or an increase in the aneurysmal size and reported favorable courses.

Concerning treatment using a flow diverter, Lozupone et al. reported successful acute-phase treatment using a flow diverter alone on ruptured dissection patients. Lin et al. treated three unruptured cases using one or two flow diverters and reported favorable courses.[13,14]

No study has reported the combination of overlapping stent and coil embolization for anterior cerebral artery dissection. This treatment can be positioned as an intermediate therapy between stent-assisted coil embolization and treatment using a flow diverter, but its safety and efficacy should be compared with those of the two aforementioned procedures.

Furthermore, a suitable choice of stent must be discussed. Lim et al. reported a method of obtaining flow diverting effects using the LVIS Blue after securing the vascular lumen with the Enterprise to prevent excessive protrusion into the dissected cavity in patients with vertebral artery dissection.[15] In the present case, the vascular diameter was small, and we did not adopt this method.

The Neuroform Atlas facilitates favorable dilation, but its protrusion into the dissected cavity may make sufficient intra-aneurysmal embolization impossible; therefore, we used the LVIS Jr. as the first stent to secure the vascular lumen and added the Neuroform Atlas as the second stent to improve metal coverage while compensating for dilative power.

Regarding endovascular treatment for dissecting aneurysms other than those of the the anterior cerebral artery, many studies have reported the endovascular treatment for vertebral artery dissection, which is more frequent. A meta-analysis of the endovascular treatment for ruptured dissecting vertebral artery aneurysms requiring preservation of the affected artery found no difference in the incidence of acute rebleeding between patients who underwent reconstructive treatment with stent-assisted coil embolization and those who underwent ligation or trapping. However, additional enlargement after stent-assisted coil embolization was more frequent than that after ligation or trapping.[16]

In patients with vertebral artery dissection, treatment with flow diversion is also selected. Cerejo et al. used a flow diverter to treat unruptured or ruptured chronic-phase vertebral artery dissection and reported favorable results.[17] One study reported favorable results of overlapping stenting with a neck-bridging stent[15] in the absence of coil embolization in patients with unruptured vertebral artery dissection. Another study suggested the efficacy of multiple-stent-assisted coil embolization in ruptured aneurysm patients.[18]

In the treatment of blood-blister-like internal carotid artery aneurysms, the efficacy of flow diversion combined with coil embolization was also reported. Concerning the number of stents, a previous study found that a higher complete occlusion rate and a lower recurrence rate were seen in patients who underwent the multiple stent procedure compared to those who underwent the single stent procedure.[19]

Thus, the efficacy of coil embolization with the overlapping stent technique for aneurysms with a fragile wall, such as dissecting aneurysms, has gradually been established. However, in anterior cerebral artery lesions, the vascular diameter is small, and stent-use-related thrombotic complications are of concern. In the present case, severe left hemiplegia persisted after the onset of SAH, but it was difficult to evaluate treatment-related cerebral infarction. There was no intraoperative thrombus formation or vascular occlusion. However, a large number of patients must be investigated in the future.

Conclusion

We reported a patient with a ruptured dissecting anterior cerebral artery aneurysm in whom stent-assisted coil embolization with the overlapping stents technique was performed.

In Japan, neck-bridging stents are indicated only for unruptured aneurysms. In the present case, off-label treatment

was performed inevitably. There are no sufficient data on the risk of stent use in the acute phase of rupture or in the overlapping stents. In the future, this should be examined in a larger number of patients.

Disclosure Statement

The authors declare no conflict of interest.

References

1) Hensler J, Jensen-Kondering U, Ulmer S, et al: Spontaneous dissections of the anterior cerebral artery: a meta-analysis of the literature and three recent cases. *Neuroradiology* 2016; 58: 997–1004.
2) Nagahata M, Seino H, Kakehata S, et al: Dilated outer diameter of the dissected artery: acute bilateral anterior cerebral artery dissection evaluated by repeat magnetic resonance cisternography. Case report. *Neurol Med Chir (Tokyo)* 2010; 50: 1095–1098.
3) Nanbara S, Tsutsumi K, Takahata H, et al. Spontaneous dissection of the anterior cerebral artery that simultaneously presented with cerebral infarction and subarachnoid hemorrhage, successfully treated with conservative management: a case report. *No Shinkei Geka* 2012; 40: 635-642. (in Japanese)
4) Suzuki K, Mishina M, Okubo S, et al: Anterior cerebral artery dissection presenting subarachnoid hemorrhage and cerebral infarction. *J Nippon Med Sch* 2012; 79: 153–158.
5) Kato Y, Hayashi T, Uchino A, et al: Fusiform dilatation of the outer contour of a dissected anterior cerebral artery revealed by magnetic resonance cisternography in a patient with simultaneous cerebral infarction and subarachnoid hemorrhage. *J Stroke Cerebrovasc Dis* 2014; 23: 1717–1720.
6) Im TS, Lee YS, Suh SJ, et al: Two cases of subarachnoid hemorrhage from spontaneous anterior cerebral artery dissection: a case of simultaneous hemorrhage and ischemia without aneurysmal formation and another case of hemorrhage with aneurysmal formation. *J Cerebrovasc Endovasc Neurosurg* 2014; 16: 119–124.
7) Ohkuma H, Suzuki S, Kikkawa T, et al: Neuroradiologic and clinical features of arterial dissection of the anterior cerebral artery. *AJNR Am J Neuroradiol* 2003; 24: 691–699.
8) Inoue T, Fujimura M, Matsumoto Y, et al: Simultaneous occurrence of subarachnoid hemorrhage and cerebral infarction caused by anterior cerebral artery dissection treated by endovascular trapping. *Neurol Med Chir (Tokyo)* 2010; 50: 574–577.
9) Takahashi Y, Endo H, Endo T, et al: Patient with recurrent anterior cerebral artery dissecting aneurysm after stent-assisted coil embolization successfully treated with A3-A3 anastomosis. *World Neurosurg* 2018; 109: 77–81.
10) Park YK, Yi HJ, Lee YJ, et al: Spontaneous anterior cerebral artery dissection presenting with simultaneous subarachnoid hemorrhage and cerebral infarction in a patient with multiple extracranial arterial dissections. *J Korean Neurosurg Soc* 2013; 53: 115–117.
11) Iwasaki M, Hattori I, Sasaki M, et al: Stent-assisted coil embolization for anterior cerebral artery dissection presented with cerebral infarction. *Surg Neurol Int* 2015; 6: 182.
12) Hensler J, Jensen-Kondering U, Ulmer S, et al: Spontaneous dissections of the anterior cerebral artery: a meta-analysis of the literature and three recent cases. *Neuroradiology* 2016; 58: 997–1004.
13) Lozupone E, Piano M, Valvassori L, et al: Flow diverter devices in ruptured intracranial aneurysms: a single-center experience. *J Neurosurg* 2018; 128: 1037–1043.
14) Lin N, Lanzino G, Lopes DK, et al: Treatment of distal anterior circulation aneurysms with the pipeline embolization device: a US multicenter experience. *Neurosurgery* 2016; 79: 14–22.
15) Lim YC, Shin YS, Chung J: Flow diversion via LVIS Blue stent within Enterprise stent in patients with vertebral artery dissecting aneurysm. *World Neurosurg* 2018; 117: 203–207.
16) Sönmez Ö, Brinjikji W, Murad MH, et al: Deconstructive and reconstructive techniques in treatment of vertebrobasilar dissecting aneurysms: a systematic review and meta-analysis. *AJNR Am J Neuroradiol* 2015; 36: 1293–1298.
17) Cerejo R, Bain M, Moore N, et al: Flow diverter treatment of intracranial vertebral artery dissecting pseudoaneurysms. *J Neurointerv Surg* 2017; 9: 1064–1068.
18) Zhao KJ, Zhao R, Huang QH, et al. The interaction between stent(s) implantation, PICA involvement, and immediate occlusion degree affect symptomatic intracranial spontaneous vertebral artery dissection aneurysm (sis-VADA) recurrence after reconstructive treatment with stent(s)-assisted coiling. *Eur Radiol* 2014; 24: 2088–2096.
19) Fang Y, Zhu D, Peng Y, et al: Treatment of blood blister-like aneurysms with stent-assisted coiling: a retrospective multicenter study. *World Neurosurg* 2019; 126: e486–e491.