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Case Report

Recanalization of a chronic occlusion flow-diverter device in a patient with a paraclinoid giant aneurysm recurrence. Clinical observation ☆

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ABSTRACT

Paraclinoid internal carotid artery (ICA) aneurysms are associated with a high mortality rate, which gradually increases without intervention. Surgical clipping or coiling of large aneurysms with inadequate neck and adductor artery expansion will not guarantee a successful outcome. Carotid surgical trapping or endovascular occlusion of the adductor artery can help to isolate the aneurysm from circulation, but it comes at the expense of sacrificing a major blood vessel responsible for significant cerebral perfusion. Currently, a technique has been developed to redirect blood flow and stimulate gradual thrombosis in the aneurysm cavity to reduce pressure on its walls. However, in cases of recurrent aneurysm and stent thrombosis in these patients, it is necessary to consider destructive surgery. The 65-year-old patient, who had a history of migraine, was diagnosed with a large aneurysm. He was initially treated with the Pipeline Flex stent from Medtronic, but after 5 months, he experienced 2 transient ischemic attacks. Subsequent CT scans revealed no signs of brain damage, but a brain CTA revealed the recurrence of an internal carotid artery paraclinoid aneurysm with the occlusion of the pipeline device and contrast flowing parallel to the aneurysm wall. This case is an example of successful recanalization of an occluded flow diverter device in a patient with recurrent internal carotid aneurysm.

☆ Competing Interests: The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Introduction

According to some authors, the detection rate of background paraclinoid aneurysms is low, up to 5.4%. These aneurysms may have a mortality rate of more than 60% within 2 years of follow-up, and more than 85% over the next 5 years [1-4]. Inability to clip the neck of some large aneurysms or the inability to gain open surgical access results in the need to occlude the carrying vessel above and below the aneurysm sac. Surgical "trapping" is associated with acute brain vascular insufficiency risks during operation and in the long-term [1].

The flow-diverting device is used in such cases, but it‘s associated with difficulties in the catheterization of vessels after an aneurysm and suboptimal deployment of the device [5,6]. Typical complications of this procedure include target artery blockage and aneurysm reoccurrence [7]. Thrombotic complications are caused by inadequate inhibition of platelet aggregation or delayed hypersensitivity reactions, and less commonly by stent malposition [5–10]. The recurrence of an aneurysm is associated with sac growth or flow diverter migration. This may be due to a delayed response to overextension or shortening [5,11]. In the event of implantation in a tortuous section along the shortest path, conditions for deformation and malposition may occur. A common type of failure that can occur when these mechanisms are combined is the device collapsing due to axial torsion [12,13].

The occlusion rate of the targeted artery, due to various factors, when using flow diversion techniques, ranges between 3% and 5% [14].

We present a successful endovascular treatment for a recurrent giant paraclinoid aneurysm using a pipeline shield stent.

Case presentation

The patient is a 65 years old woman suffering from a periodical migraine headache for a long time with feeling of pulsation in the right eye. Computed tomography revealed the saccular aneurysm 2.1 × 2.0 × 1.9 cm of the right carotid artery ophthalmic segment (Fig. 1). According to the CTA measurements, the aneurysm neck was 4 × 9.5 mm. Prior to surgery, and for the following 12 months, the patient was prescribed ticagrelor 90 mg twice daily and aspirin 100 mg daily.

Two days later, the patient was admitted to the neurosurgical unit. Subtraction cerebral angiography has confirmed the presence of an aneurysm in the right ophthalmic artery segment (Fig. 2).

After technically complex catheterization of the tortuous siphon and right carotid artery communication segment, a stent (Pipeline Flex, Medtronic, 5 × 20 mm) was implanted to cover the saccular aneurysm neck (Fig. 3). During the direct angiography the stent contours and contrast stagnation within the aneurysm were determined in different phases. Following a 5-day hospitalization, the patient was discharged at home for dynamic follow-up observation without any focal or cerebral symptoms.

Within the five-month period the patient suffered two episodes of transient ischemic attack at the 3rd and 4th months. Against the background of hypotension episodes the emergency physician noted incoming hemianopsia on the right with loss of the medial field of vision, as well as left-sided hemiparesis and hemihypesthesia. Additionally, they noted the onset of left hemianopia, also with loss of central vision, along with left side hemiparesis, and loss of sensation. However, the patient did not consent to emergency hospitalization.

The patient with a history of the condition was admitted to our clinic. After a cerebral CTA a reocurring aneurysm of the right ICA was diagnosed (Fig. 4). In computerized 3D imaging, it can be observed that contrast leakage occurs through the wall of a flow diverter, and that the lumen of an aneurysmal dilated artery is filled, as well as the sac of the aneurysm and the cerebral arteries. It has been noted that the distal end of the stent is located within the aneurysm sac, with inadequate fixation to the native artery beyond the aneurysm and is angled at approximately 90 degrees to this vessel. It is noteworthy that there is a stenosis in the center of the stent, up to 70%. This could be interpreted as a collapse due to axial torsion.

The patient did not consent to open neurosurgical intervention and was scheduled to undergo the implantation of an additional flow diverting device to occlude a functioning aneurysm. However, the direct angiography has revealed a first diverter device occlusion at the junction between the proximal and middle segments (Fig. 5).

There was detection of an aneurysm cavity and distal native arterial filling through the stent mesh before occlusion. A test with a Sceptor (MicroVention) occlusive balloon of 4 × 15 mm during observation for 30 minutes did not result in neurological complications, likely due to hypertrophy of the right posterior communicating artery. However, episodic transient ischemic attacks indicate a high ongoing risk of acute cerebral ischemia following reconstructive surgery. After providing appropriate information, the patient was offered occluded stent recanalization and complete exclusion of the aneurysm from the bloodstream using an additional flow diverting stent.

Operation description

The patient underwent combined endotracheal anesthesia. A wire chekai (Asahi) of 0.014 was left in the right vertebral artery to facilitate the immediate delivery of an Sceptor (MicroVention) balloon catheter of 4 × 15 mm for the aneurysm rupture destructive intervention case. The guide catheter Cello 9 Fr (Medtronic), was installed for antegrade carotid catheterization, and the catheter, Navien A+ (Medtronic), and microcatheter Rebar-18 (Medtronic) were inserted coaxially into it. Recanalization of the stent performed by the wire Whisper LS (Abbott Vascular) 0.014″ 300 cm (Fig. 6). The wire was replaced by 0.014″ 300 cm Chekai (Asahi) after postaneurysmic vessel catheterization. The microcatheter was replaced by Marksman 3 Fr (Medtronic) and was placed to a proximal segment of the middle cerebral artery. The similar Pipeline Flex stent (Medtronic) 5 × 20 millimeters, with its distal portion located in the middle of the artery, was deployed. Following this, the entire structure was lowered in the di-

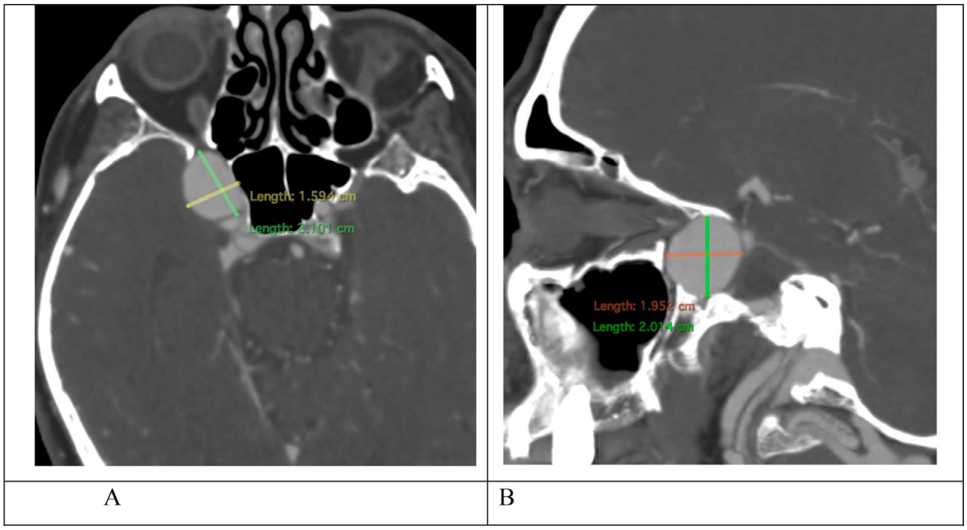

Fig. 1 – Computed tomographic angiography. (A) frontal projection, (B) lateral projection. The right carotid artery ophthalmic segment aneurysm is marked with size identification. Arterial phase. The layer thickness 1 mm.

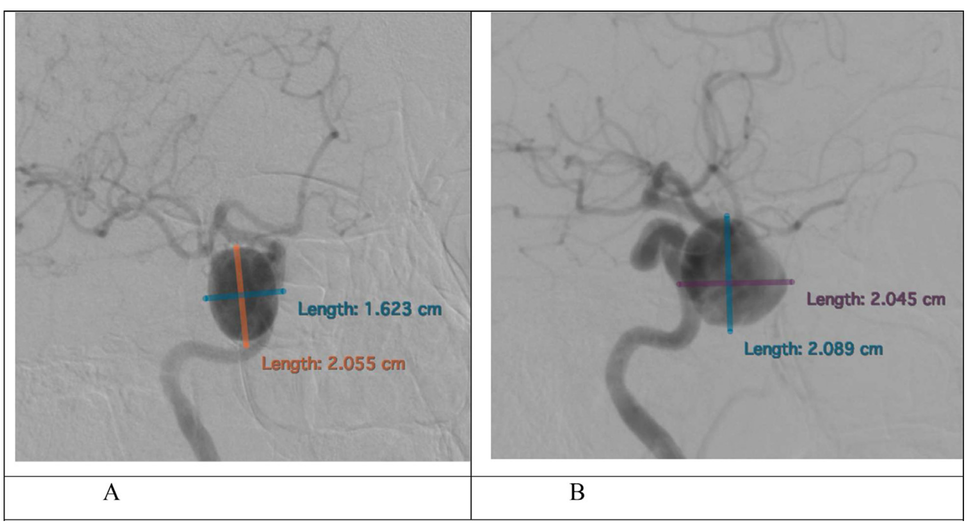

Fig. 2 – The right internal carotid artery direct subtraction angiography. (A) frontal projection, (B) lateral projection. Arterial phase. The ophthalmic segment saccular aneurysm is marked with size identification.

rection of the proximal artery until the distal portion of the Pipeline fell below the ostium of the posterior communicating artery.

After that, the remaining portion of the pipeline was fully deployed, transitioning to the previously inserted stent and covering the narrowed section without overstretching. Next, dilation was performed at the site of the collapsed stent segment using the occlusive balloon (Sceptor, MicroVention), 4×15 mm. Final angiography demonstrated adequate stent opening and patency, as well as persistent stagnation in the aneurysm cavity 10 minutes after implantation.

After another 6 months follow up, the control angiography demonstrated the patency carotid basin with in-stent restenosis up to 40% and aneurysm complete shutdown from the circulation (Fig. 7). The patient did not note any signs of neurological deficit.

Discussion

The pathogenesis of flow diverter occlusion is based on insufficient platelet function inhibition or vasospasm [5–10]. The analysis of complications by Chalouhi N. has shown that stent malpositioning can be added to the list of potential complications [5,6,13]. The landing zone, if it is not long enough, can cause stent stretching and shortening during implantation. This can lead to aneurysm recurrence due to the stent prolapsing into the aneurysm [5,11]. The distal parts of catheters exhibit an uncoordinated response to manipulations in the anatomy of the carotid siphon, a phenomenon known as the "Simmons effect". This explains the cause of such a disruption in implantation technology [6]. However, in the study on braided stents, collapse due to axial twisting has been

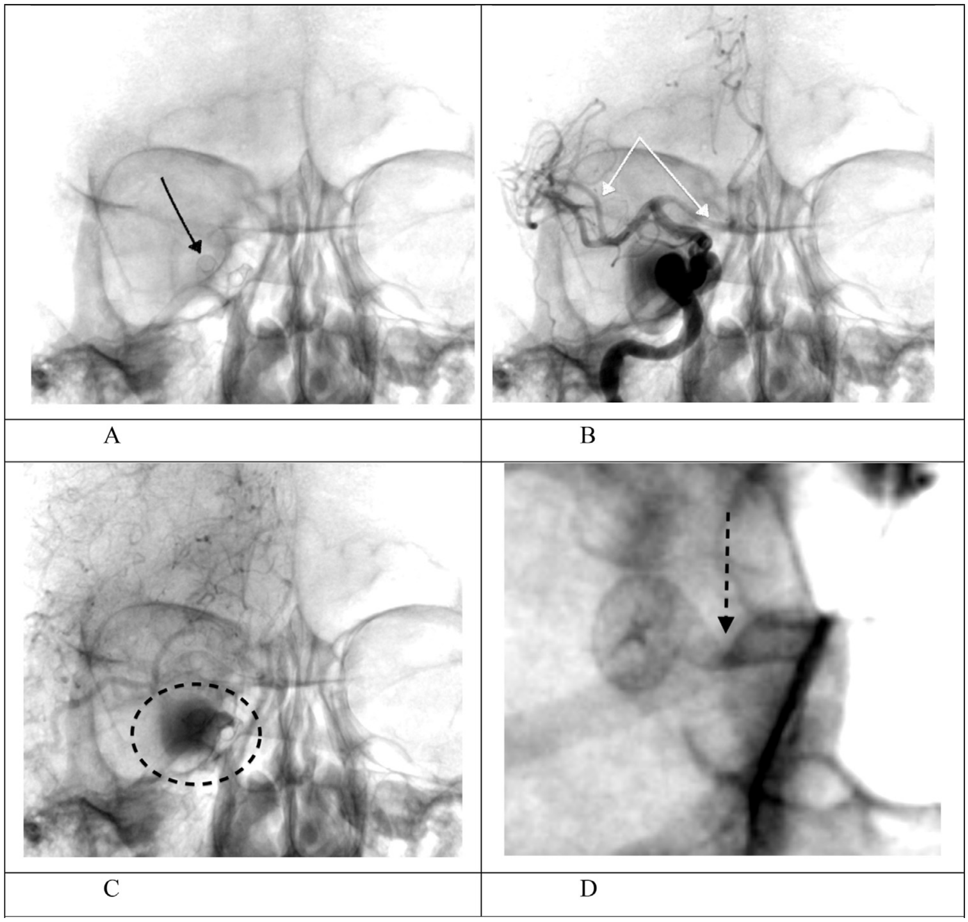

Fig. 3 – Direct subtraction angiography of the right internal carotid artery immediately after implantation of a diverter stent in the direct projection (A–C) and in the right oblique projection (D). (A and D) 1 second. (B) 3 seconds, (C) 8 seconds. The contours of the stent are highlighted with a black solid arrow, the preserved cerebral blood flow is indicated with a white solid arrow, the stagnation of contrast in the aneurysm cavity of the ophthalmic segment of the right carotid artery is highlighted with a black dotted circle. The collapsed stent defect is indicated by a black dotted arrow.

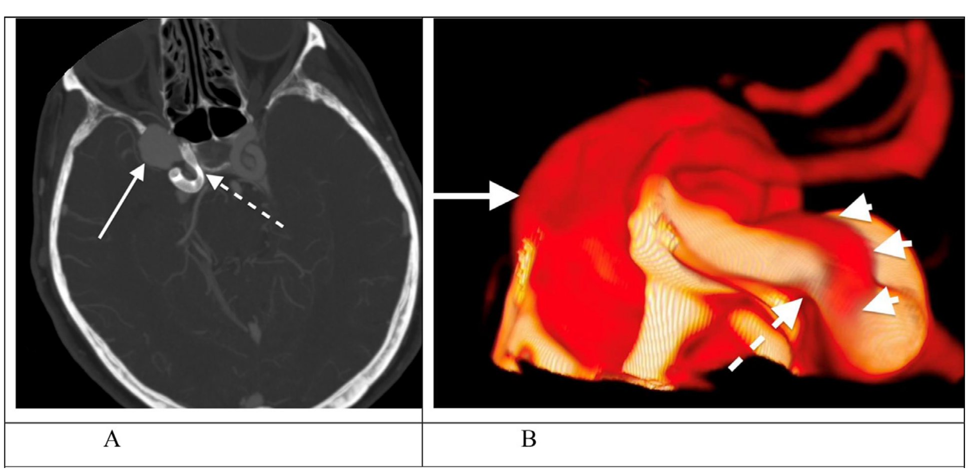

Fig. 4 – Computed tomography angiography in the arterial phase 5 months after the aneurysm initial exclusion. (A) axial projection, (B) 3D reconstruction. Recurrent aneurysm is indicated by a white solid arrow, non-intraluminal contrast through the pores of the stent is indicated by short white arrows, a collapsed stent is indicated by a white dotted arrow.

Fig. 5 – The right internal carotid artery direct subtraction angiography 5 months after primary stenting. Right oblique projection. Right carotid artery ophthalmic segment aneurysm recurrence is indicated by white solid arrows. Non-intraluminal contrast filling of the aneurysmally dilated adductor arterial segment is indicated by short white arrows. Diverter stent occlusion is indicated by a black solid arrow.

demonstrated as another possible cause of vessel occlusion and aneurysm recurrence [12]. In the case under consideration, after the initial intervention, the stent experienced a narrowing, likely due to the same mechanism, which may have resulted in local thrombosis and obstruction. In our opinion, the blood pressure in the area caused the stent to move back up from the distal landing zone, leading to the dislocation of the device into the aneurysm cavity. If the carotid artery becomes occluded, the risk of a stroke will persist despite a positive balloon test result. We performed chronic stent occlu-

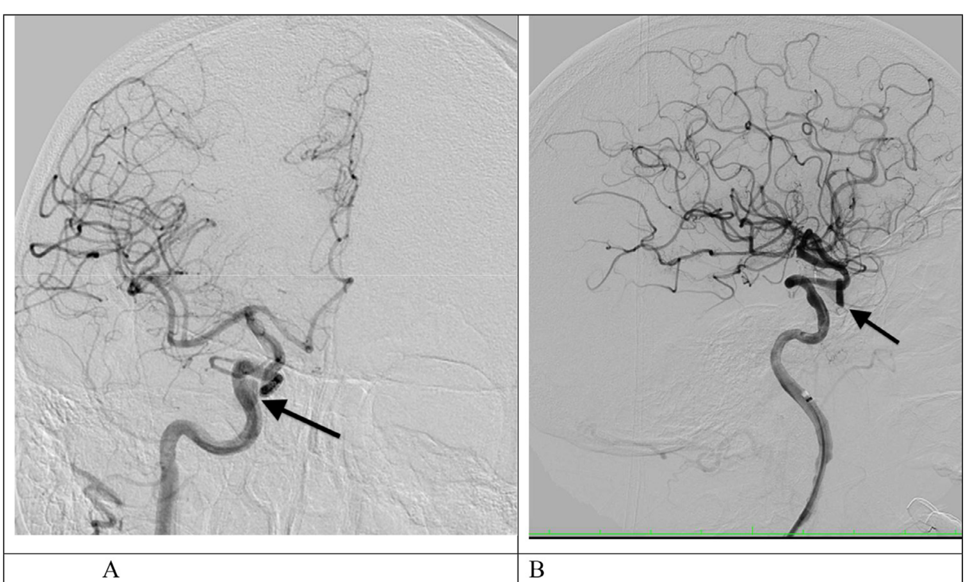

Fig. 6 – The right carotid direct subtraction angiography after recanalization and repeated stenting. (A) forward projection, (B) right lateral projection. The black solid arrows indicate the contrast stagnation in the aneurysm cavity after repeated stenting.

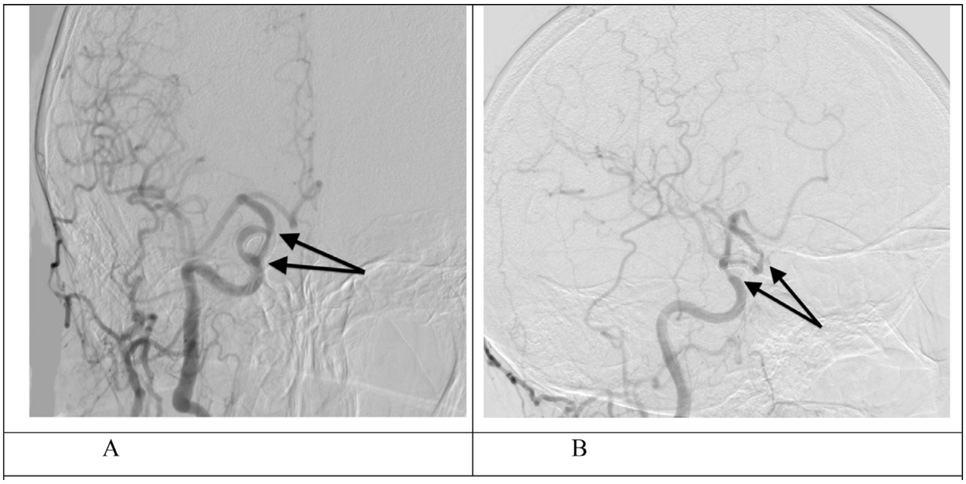

Fig. 7 – Direct subtraction carotid angiography 6 months after secondary stenting. (A) forward projection, (B) right lateral projection. Black solid arrows indicate the implantation zone of a streaming stent with restenosis.

sion recanalization and successfully completed the closure of the recurrent aneurysm using a second flow diverter, without signs of distal embolism or neurological complications. No repeated occlusion of the arterial segment was observed during the 6-month follow-up period. The second stent was identical to the first and did not result in any occlusion. Therefore, we ruled out a delayed hypersensitivity reaction as the cause of the initial occlusion. We have not found any reports on the experience of chronic stent occlusion recanalization in the literature on complications associated with the use of flow-diverters. However, our views on the mechanisms of delayed occlusion and stent migration are based on international publications.

Therefore, occlusion of a collapsed stent with a high weave density increases its resistance to forward blood flow, which increases the risk of migration and leads to aneurysm recurrence. Endovascular recanalization of a chronically occluded collapsed flow diverter in the carotid artery is a feasible alternative to destructive surgery.

Patient consent

The authors declare the informed consent of the patient for the publication of the clinical case.

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