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Endovascular treatment of extradural internal carotid artery aneurysm with a flow diverter stent

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Abstract

Extradural internal carotid artery aneurysms are rare and the indications for treatment are not well defined. We report successful management of two high extradural internal carotid artery aneurysms treated with flow diverter stents. The endovascular repair of extradural internal carotid artery aneurysms is effective because with surgical treatment there is always the possibility of cranial nerve injury.

Keywords

Internal carotid artery, ICA, extradural, flow diverter, aneurysm, digital subtraction angiography, DSA

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Introduction

Extradural internal carotid artery (ICA) aneurysms are rare and the indications for treatment are not well defined (1). They may lead to neurologic symptoms such as transient ischemic attacks (TIA) or ischemic stroke. They might also appear as a pulsatile mass or related cranial nerve dysfunction. The percentage of clinically silent aneurysms is not known.

Various causes of extradural ICA aneurysms can be listed. They can be atherosclerotic, mycotic, post-traumatic, dissecting, congenital, associated with cystic medial necrosis, and develop after irradiation or carotid endarterectomy (2).

Conservative treatment has been widely chosen for the silent aneurysms although there are no strong scientific data to support this. Surgery has been the golden standard of treatment for the majority of symptomatic patients (96%) and a minority of patients have been treated with the endovascular approach (1,3). The aims for treatment are to relieve symptoms such as cranial nerve palsy and to prevent rupture and thrombo-embolic complications. If the aneurysm is large or extends towards the skull base, or there are adherences, it might be challenging to perform surgery (3). Therefore, other treatment options should be investigated.

Flow diverter (FD) stents are stents with a braided mesh with a densely covered surface. When they cover the aneurysm neck, thrombosis is induced by stasis of flow within the aneurysmal sac. The adjacent branch vessels remain open due to the pressure gradient between the parent artery and covered branches.

The available information on extradural ICA aneurysm treatment in the literature is limited because of its rarity. Therefore, we present our experience of two patients with extradural ICA aneurysms treated with FD stents.

Case report

Case 1

Patient 1 was a 69-year-old woman. She had suffered hemiparesis due to intracerebral bleeding in the area of the left putamen, thalamus, and external capsula. Etiology of the bleeding was hypertension. Computed tomography angiography (CTA) and digital subtraction angiography (DSA) revealed incidental saccular aneurysms on both sides of the petrosal part of

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the ICA. Her aneurysms were considered to be a possible source of embolus. Right-sided aneurysm (13 × 13 mm) was planned to be treated first to protect the right hemisphere of the brain (Fig. 1a).

Case 2

Patient 2 was a 44-year-old man with lowered vision and possible compression of the aneurysm to the optic nerve. His saccular cavernous ICA aneurysm was 19 × 16 mm in diameter in CTA (Fig. 2a and 2b).

Technical details

We obtained local research approval from the hospital. The need for informed consent was waived by the respective research committee because of the retrospective nature of the study (T011/014/18).

Both the procedures were performed under general anesthesia using a biplane angiographic system (Artis zee biplane; Siemens, Erlangen, Germany) and three-dimensional (3D) rotational angiography.

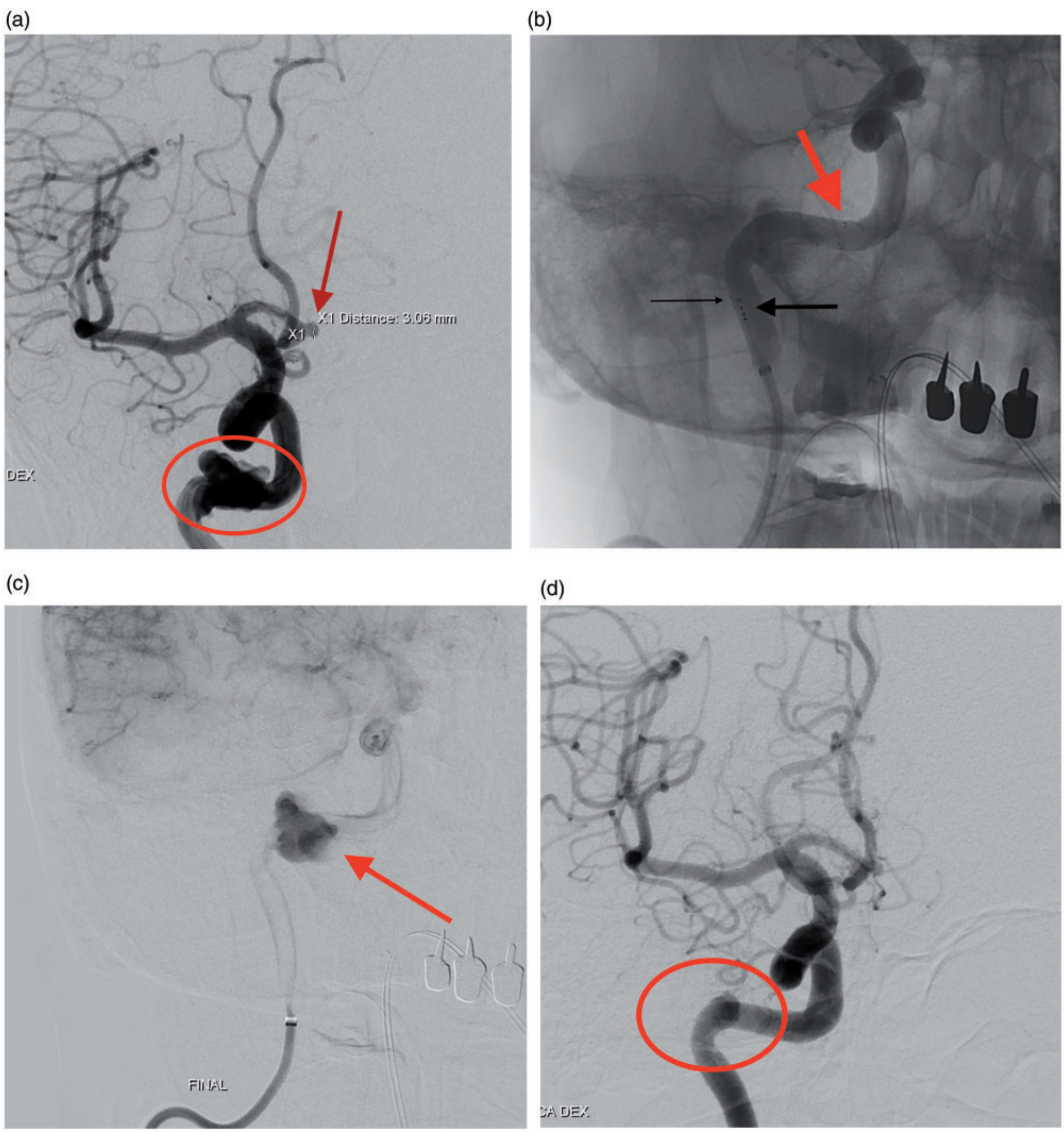

Fig. 1. (a) Digital subtraction angiogram (DSA) image demonstrates a lobulated aneurysm (red circle) in the petrosal part of the right internal carotid artery (ICA) (patient 1). There is also a small aneurysm in the anterior communicans artery (red arrow). (b) Unsubtracted image with partly opened flow diverter. Distal tip of the microcatheter (thin black arrow) is still beyond the "point of no return" (black arrow) for resheathing. Red arrow points the distal part of the flow diverter. (c) Subtracted image in the venous phase shows contrast stagnation in the aneurysm (red arrow). (d) Right ICA DSA at six-month follow-up already showed remarkable shrinkage of the aneurysm (red circle).

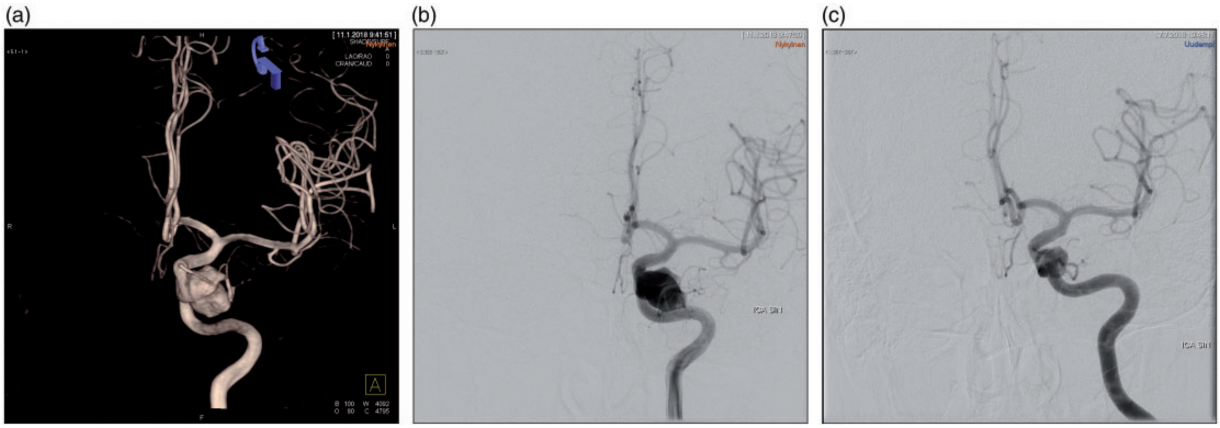

Fig. 2. (a) Three-dimensional digital subtraction angiography (DSA) image shows the large cavernous aneurysm of patient 2. (b) Subtracted frontal image of the left internal carotid artery before endovascular treatment. (c) DSA frontal image at six-month follow-up showed remarkable shrinkage of the aneurysm.

A 6-F Navien® (Medtronic Neurovascular, Irvine, CA, USA) intracranial support catheter was introduced through a long Neuron Max® sheath (Penumbra, Inc., Alameda, CA, USA) into the carotid artery. A Headway® 27 microcatheter (Microvention Inc., Aliso Viejo, CA, USA) was advanced across the aneurysm neck with a Synchro® 0.014 (Stryker Neurovascular, Fremont, CA, USA) guidewire under roadmap guidance.

The Fred® FD (Microvention Inc., Aliso Viejo, CA, USA) was delivered through the microcatheter. It was unsheathed by slowly pulling the delivery microcatheter back as the delivery wire was simultaneously gently pushed forward (Fig. 1b). The device size was chosen according to the proximal parent vessel diameter. Sizing was performed based on artery measurement, acquired from 3D rotational angiography data. Correct apposition to the vessel wall was assessed using angiographic images. Contrast stagnation of both aneurysms was achieved with a single device (Fig. 1c).

After the intervention, an 8-F Angio Seal® closure device (Medtronic Inc., Minneapolis, MN, USA) was used at the puncture site for hemostasis.

Patient-activated clotting time (ACT) was doubled with a heparin bolus. ACT was controlled at 30–45-min intervals, whether the patient was a smoker or not. After the procedure, heparinization was not antagonized or maintained.

Dual antiplatelet therapy with 100 mg aspirin and 75 mg clopidogrel was started five days before the procedure in both patients. Platelet function was evaluated by VerifyNow® just before the endovascular treatment when the patient arrived at the neuroangiography suite. Clopidogrel was continued with a daily dose of 75 mg for six months, along with daily aspirin 100 mg for at least 12 months.

Results

Both patients had uneventful postoperative course and were discharged home on postoperative day 1. After six months, a control DSA was performed.

In patient 1, DSA demonstrated that the contrast-filled lumen of the aneurysm was significantly smaller than it had been preoperatively (6×4.5 mm) (Fig. 1d). Treatment of the left-sided aneurysm is planned within six months.

In patient 2, DSA demonstrated that the contrast-filled lumen of the aneurysm was significantly smaller than it had been preoperatively (10×9 mm) (Fig. 2c). The patient no longer feels any pressure behind the eye. It is planned that the following control will be carried out with magnetic resonance angiography (MRA), two years after the procedure.

Discussion

It has been shown that endovascular stenting with bare metal stents of dissected extracranial ICA is safe and effective in selected groups of patients, even with dissections with pseudoaneurysms (4,5). However, these stents are rather rigid and thus it is not always possible to navigate close to the skull base. A limited number of case reports has been published concerning the extradural pseudoaneurysm treatment with FDs (6).

Gross et al. reported a case series of 10 petrous part ICA aneurysms. Their treatment modalities included stent-assisted coiling, FD stenting with coiling, and even ICA sacrifice and bypass. The anatomic location of aneurysms in their study group resembles ours, as do the good radiological results of FD-treated aneurysms (7).

Better long-term results in occlusion of carotid-ophthalmic aneurysms with FDs than with standard coil-based techniques have been shown in several studies (8,9). Flow diversion has thus become an accepted endovascular treatment modality for large and giant wide-necked proximal ICA aneurysms. In such aneurysms, reperfusion or incomplete coiling lead to poorer long-term occlusion.

Welleweerd et al. reported long-term results of seven consecutive symptomatic patients with surgically inaccessible extracranial ICA aneurysms (10). They were treated with a bare stent without adjunctive coiling. Both intracranial stents and carotid stents were used. They anticipated that additional interventions, such as coil placement, would be necessary in perhaps half of the patients but finally only one patient needed additional coiling due to residual flow in the aneurysm. All of the aneurysms in this study were dissecting aneurysms. Stenting itself might change the direction of flow and promote the thrombosis in the aneurysmal or dissection sac. This has been shown before in other studies as well (11–13).

FD stents have a much lower pore density compared to bare stents. When deployed adequately, the FD stent covers about 30% of the arterial wall surface. Microcatheter navigation through the cell interstices and coil embolization is not possible after FD stenting due to the low pore density of the device. The rate of aneurysmal occlusion is increased if coil embolization is performed during FD embolization. A complete collapse of the aneurysm sac might be achieved if no coils are used in conjunction with FD. This is of benefit when dealing with symptoms caused by mass effect due to the aneurysm size.

We wanted to carry out definitive treatment without further interventions because coiling of partially thrombosed aneurysm increases the risk of thromboembolic complications. The main indication for treatment of these aneurysms was not to prevent bleeding but to prevent ischemic complications and reduce the mass effect of the aneurysm.

In a short time, the medical companies have brought onto the market longer and larger FD devices (up to 6 mm in diameter) and these have opened up new ways to treat even aneurysms in anatomic positions not treatable with these devices before. The use of FD stents needs a learning curve like all endovascular devices. One of the main issues is to perform adequate sizing of the vessel to achieve good wall opposition of the FD.

The endovascular repair of extradural ICA aneurysms is effective because with surgical treatment there is always the possibility of cranial nerve injury.

In conclusion, FD was shown to work well in the treatment of these two high extradural ICA aneurysms. We believe that FD stents should be considered when planning the treatment of an extradural carotid artery aneurysm.

Declaration of conflicting interests

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