110 Vertebral Artery Aneurysm: A Ruptured Wide-Necked Distal Vertebral Artery Aneurysm, Treated with Cascade Net-Assisted Coil Occlusion

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Abstract

A 69-year-old female patient was transferred to our neuro-intensive care unit 35 h after a sudden collapse with a witnessed generalized epileptic seizure. Following the ictus, she was severely confused and developed oculomotor nerve palsy and hemiparesis (World Federation of Neurosurgical Societies (WFNS) grade IV), both on the left-hand side. Non-enhanced cranial CT (NCCT) revealed a large-volume subarachnoid hemorrhage (SAH) extending from the basal cisterns into both Sylvian fissures and the posterior fossa, with presence of hemorrhage layering in the third, fourth, and both occipital horns of the lateral ventricles. Computed tomography angiography (CTA) showed a lobular wide-necked aneurysm at the level of the left vertebral artery (VA/V4) segment. Complete obliteration of the ruptured aneurysm was achieved on the same day through coil occlusion, assisted by a Cascade Net (Perflow Medical). The application of the new temporary neck-bridging device Cascade Net is the main topic of this chapter.

Keywords

Vertebral artery · Temporary stent-assisted coiling · Wide-necked aneurysm · Cascade Net

Patient

A 69-year-old female patient was transferred from an outside hospital. She was drowsy (Glasgow Coma Score (GCS) 11) and showed evidence of both oculomotor nerve palsy and hemiparesis on the left-hand side. The patient had a medical history of diabetes mellitus and a 12-year history of controlled arterial hypertension.

Diagnostic Imaging

Initial noncontrast computed tomography (NCCT) and CT angiography (CTA) confirmed the presence of a ruptured distal vertebral artery/V4 aneurysm. A subsequent DSA examination revealed a wide-necked aneurysm measuring 4.1 × 4.5 mm with a neck width of 5.6 mm, widely open to the lumen of the left vertebral

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H. Henkes et al. (eds.), *The Aneurysm Casebook*,
https://doi.org/10.1007/978-3-319-77827-3_137

artery. The right vertebral artery was hypoplastic; however, no evidence of vasospasm was apparent at this stage (Fig. 1).

Treatment Strategy

The goal of the treatment was to prevent recurrent bleeding. Taking into account both the presence of a massive hemorrhage and the location of the aneurysm, an endovascular approach appeared to be the most appropriate treatment option. Given the morphology of the aneurysm with the unfavorable neck-to-sac ratio, balloon remodeling, or temporary stent deployment to assist coil occlusion were both considered feasible. The expected advantage of using a stent-derivate like Commaneci (Rapid Medical) or Cascade Net instead of a compliant balloon was that we could avoid any breaks in blood circulation. The pharmacological management included routine administration of nimodipine IV at a dosage of 2 mg/h as well as hypervolemia, hemodilution, and induced arterial hypertension ("triple-H therapy"). The intended treatment together with the potential alternatives and the respective chances and risks were explained to the patient and her relatives and informed consent was obtained in written form.

Treatment

Procedure, 18.07.2019: endovascular coil occlusion of a ruptured distal left VA/V4 aneurysm, assisted by a temporary neck-bridging device (Cascade Net)

Anesthesia: general anesthesia, 1× 5000 IU non-fractionated heparin (Heparinum WZF, WPW Polfa) IV

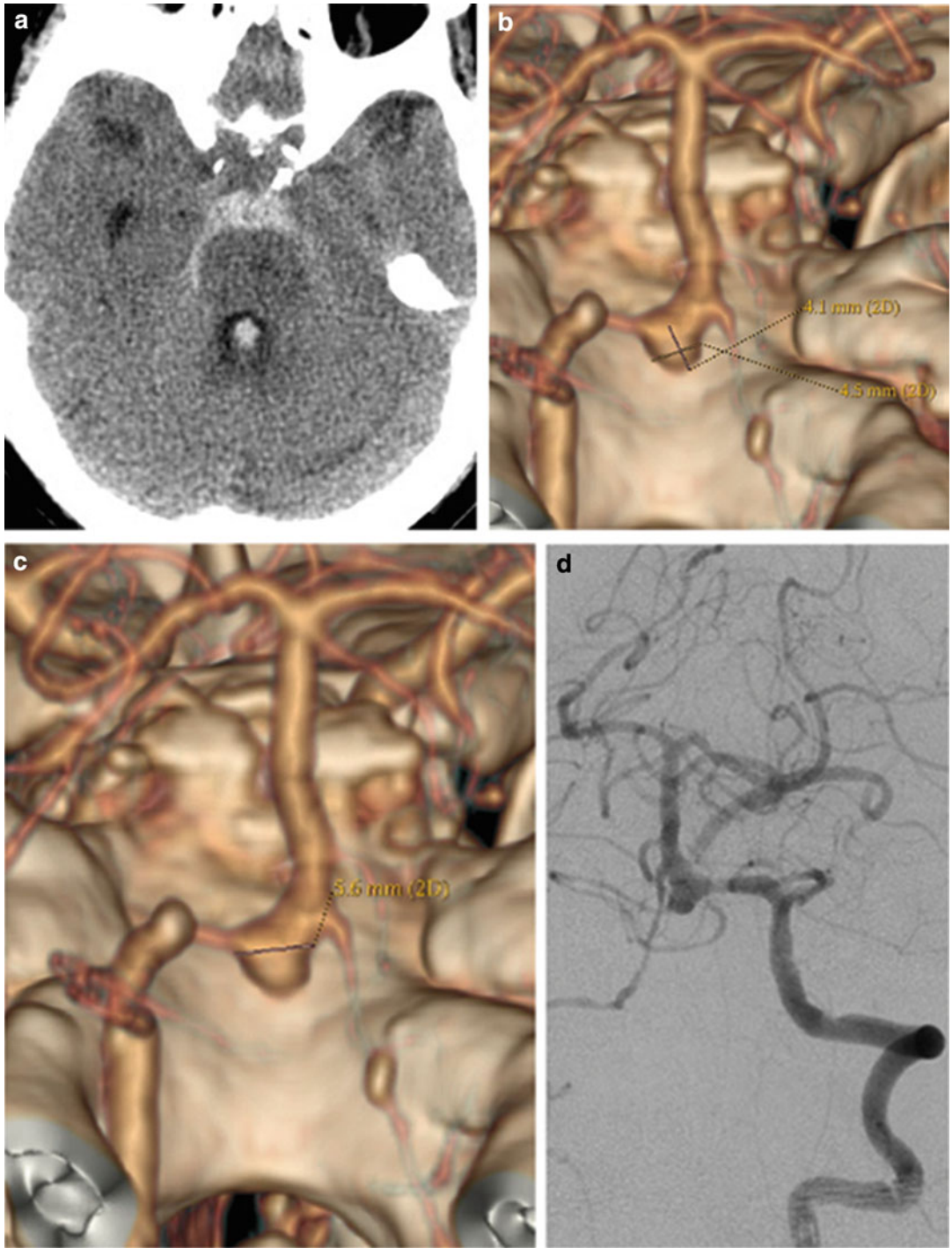
Premedication: none

Access: right common femoral artery, 6F sheath (Terumo); *guide catheter:* 6F Chaperon guide catheter (MicroVention); *microcatheter:* Echelon-10 (Medtronic) to deliver the coils and Headway 21 (MicroVention) for the Cascade device; *microguidewire:* pORTAL 14 (phenox)

Remodeling device: neck-bridging device – Cascade Net M (Perflow Medical)

Implants: 5 coils: 1× Microplex10 Cosmos Stretch Resistant 6/20 (MicroVention); 2× ED Coil 10 ExtraSoft 4/6; 2× ED Coil ExtraSoft 3.5/8 (Kaneka Medical)

Course of treatment: a 6F Chaperon guide catheter was navigated into the dominant left vertebral artery over an exchange-length guidewire. DSA, including standard and oblique projections, was performed for a better understanding of the aneurysm geometry without any superimposition of the surrounding structures. The following 3D reconstructions of the aneurysm revealed a slightly larger aneurysmal neck and unfavorable neck-sac-ratio. Under road-map guidance, an Echelon-10 microcatheter was navigated over a microguidewire and positioned inside the aneurysmal sac. A Headway 21 microcatheter was carefully navigated over a microguidewire and placed distally into the distal VA and proximal basilar artery. A Cascade Net M device was fully flushed and carefully loaded inside the Headway 21 microcatheter. A few initial loops of the first framing coil were deployed into the aneurysm sac in order to fully anchor the Echelon-10 microcatheter inside. The Cascade Net device was then completely deployed and unsheathed by slowly withdrawing the Headway 21 microcatheter. Using the grip handle of the device, the dense braid of the Cascade Net was carefully and fully expanded across the aneurysm neck. A DSA run was performed to confirm the bridging mesh was completely covering the neck while blood flow in the parent artery remained uncompromised. An occlusion attempt of the aneurysm was initiated with the aforementioned coils delivered via the Echelon-10 microcatheter, which remained in a stable position inside the aneurysm dome. The Cascade Net was manually deflated before the last coil was detached. Subsequent DSA runs confirmed complete and stable aneurysm occlusion. Neither coil protrusion nor evidence of thrombus formation or presence of distal emboli were observed on the final



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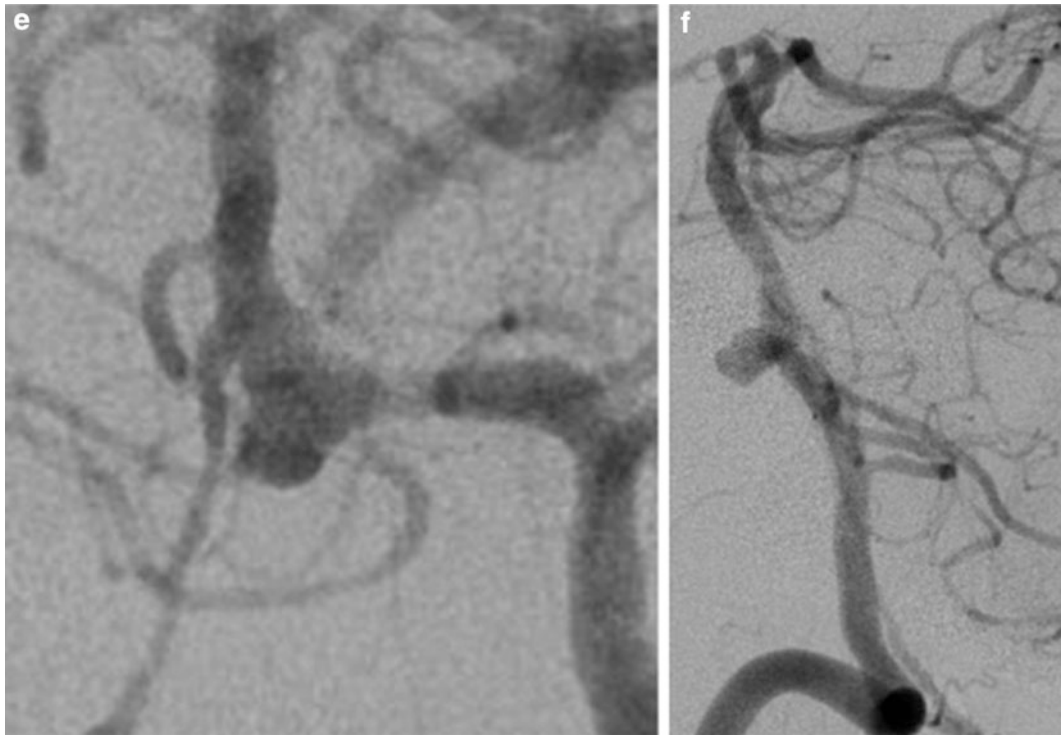


Fig. 1 Diagnostic imaging in a patient presenting with acute spontaneous SAH. Initial noncontrast computed tomography (NCCT) unveiled a large-volume SAH extending from the basal cisterns (**a**) into both Sylvian fissures and the posterior fossa with presence of hemorrhage layering in the third and fourth ventricles as well as in both occipital horns of the lateral ventricles. CTA and 3D reconstructions of these areas showed a wide-necked (**b**) distal VA aneurysm. The dimensions of said aneurysm were as follows: fundus height 4.1 mm, fundus width 4.5 mm, aneurysm neck 5.6 mm (**c**). DSA examination (posterior-anterior view (**d**), magnified image (**e**), lateral view (**f**) with left vertebral artery (VA) injections confirmed shape and size of the aneurysm

angiography. No device-related vasospasm, vessel perforation, or coil entanglement was detected. The Cascade Net was slowly recaptured into the microcatheter and withdrawn from the parent artery (Fig. 2).

Duration: 1st–12th run: 35 min; fluoroscopy time: 13 min

Complications: none

Postmedication: hyperdynamic triple – H therapy, nimodipine (Nimotop S, Bayer Vital) IV, (2 mg/h from admission then through to the 12th day after the ictus)

Clinical Outcome

The procedure was well tolerated. Shortly after the coil treatment, the patient reported a minor improvement in her neurological status. The patient was discharged home 15 days later without any new neurological deficit recorded.

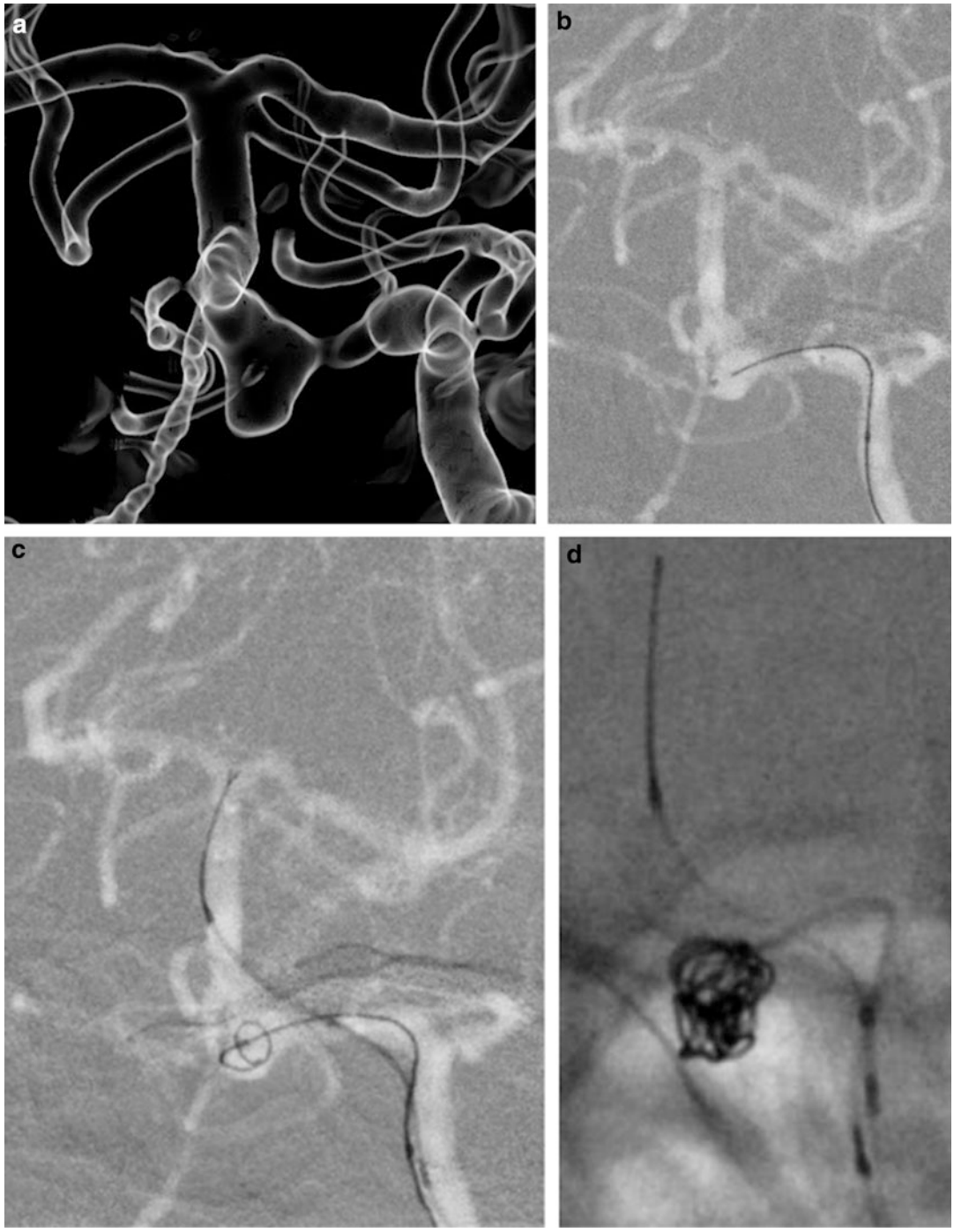
Follow-Up Examinations

The first radiological and cross-sectional follow-up examinations were performed exactly 1 month after the endovascular embolization. The diagnostic angiography showed stable coil occlusion of the ruptured aneurysm (Fig. 3).

Discussion

Presence of SAH and certain morphologic features of ruptured aneurysms may sometimes be referred to as serious obstacles to conventional endovascular techniques (Raymond and Roy

1997). Some wide-necked posterior circulation aneurysms fall within this category (Lempert et al. 2000). Safe and efficacious coil occlusion of such acutely ruptured aneurysms remains challenging due to an increased risk of periprocedural complications and significant recurrence rates,



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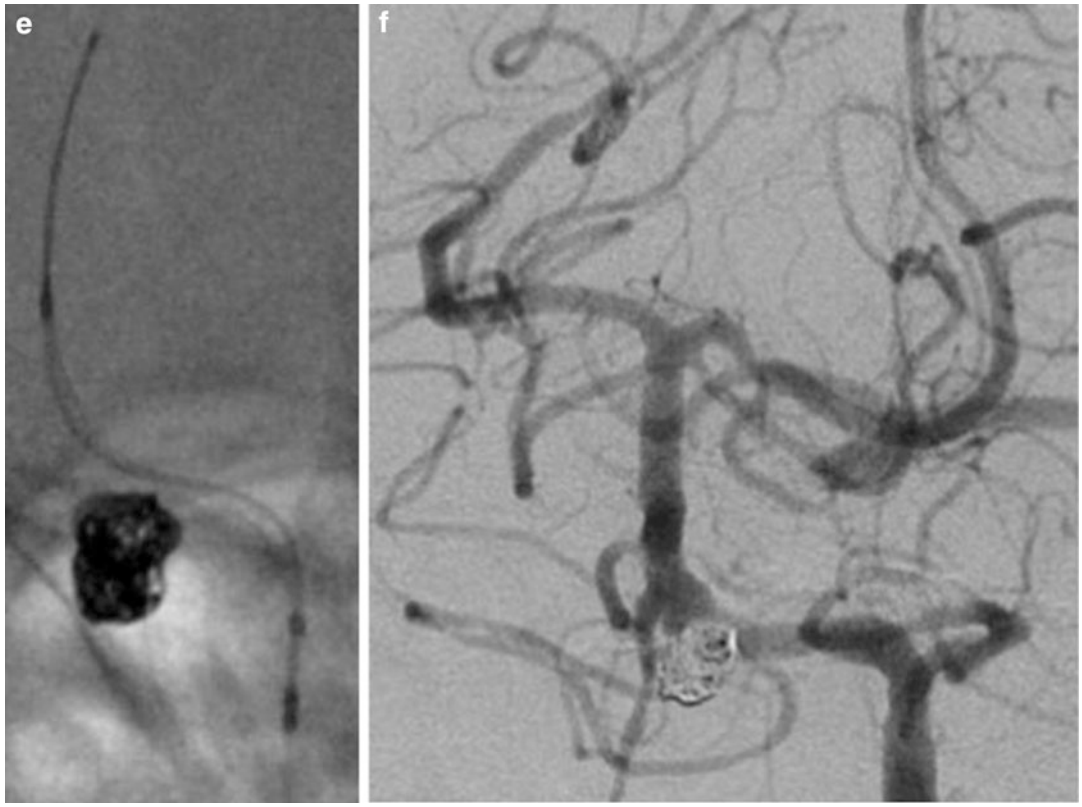

Fig. 2 Cascade-assisted coil occlusion of a ruptured distal left VA/V4 aneurysm. Rotational DSA with 3D reconstruction (**a**) showed the anatomical details of the aneurysm. The angiographic working projection (**b**), used for the catheterization of the aneurysm sac and anchoring of the intra-saccular catheter (**c**). The expanded and deflated Cascade Net across the aneurysm with subsequent coil occlusion (**c**, **d**, **e**). A final DSA run at the end of the procedure (**f**) confirmed the complete occlusion of the aneurysm

which often requires adjunctive neck-bridging devices aimed at reinforcing the intrasaccular coil mass. Temporary occlusion of the parent artery during coil obliteration of the target aneurysm (i.e., balloon-assisted technique) may permit successful occlusion rates but on the other hand poses serious risk of ischemic complications due to compromised blood flow and blockage of sidewall perforators in the occluded segment (Piotin and Blanc 2014).

The decision of whether to permanently leave a stent in place when performing endovascular occlusion for ruptured aneurysms with a low aspect ratio is affected not only by the risk of thromboembolic complications due to foreign body placement but also hemorrhagic complications due to the necessary dual antiplatelet therapy (Chung et al. 2014; Ryu et al. 2015).

Recently introduced temporary neck-bridging devices have been designed to offer the function of a remodeling balloon without stopping blood circulation in the parent artery (Fischer et al. 2017; Henkes and Weber 2015). The case described above represents a typical scenario of an acutely ruptured wide necked aneurysm and demonstrates that the method of temporarily bridging the neck with a stent-derivate can result in satisfactory and durable aneurysm occlusion despite the presence of SAH and lack of DAPT. The main goal of this approach is to reduce the complexity of the procedure and avoid metal implanted permanently in the parent artery (Müller et al. 2017).

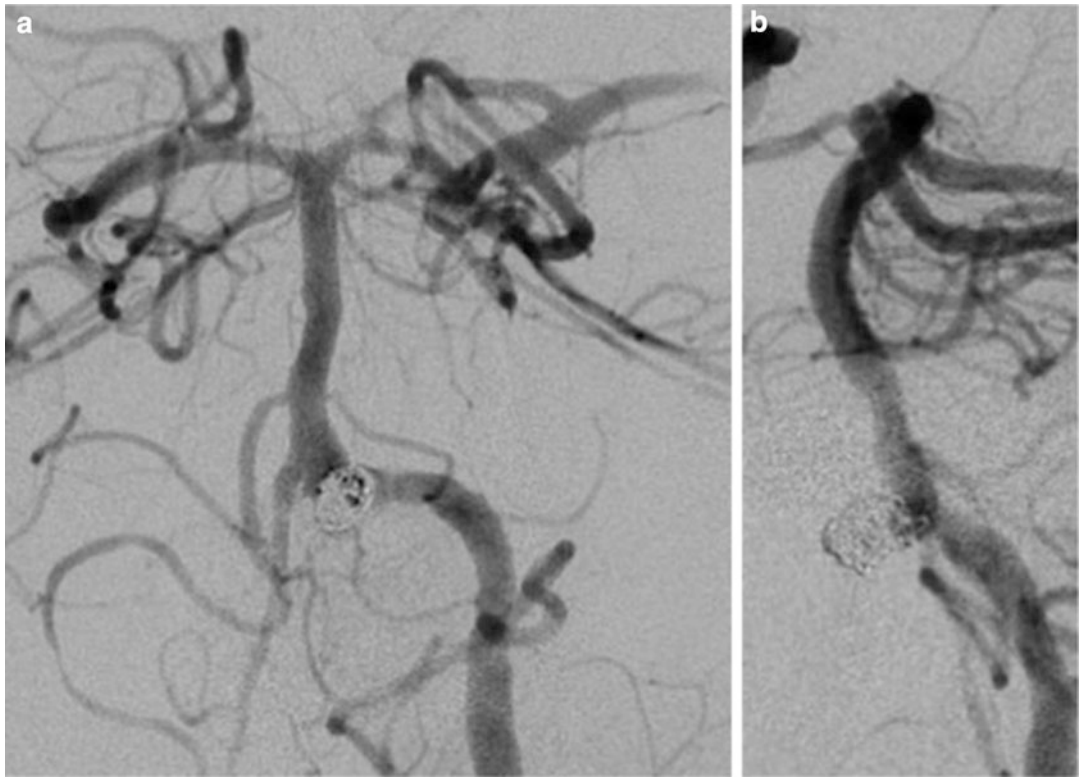

Fig. 3 Follow-up DSA (**a**, **b**) 1 month after Cascade-assisted coil occlusion of a ruptured distal V4 aneurysm, showing stable coil occlusion of said aneurysm

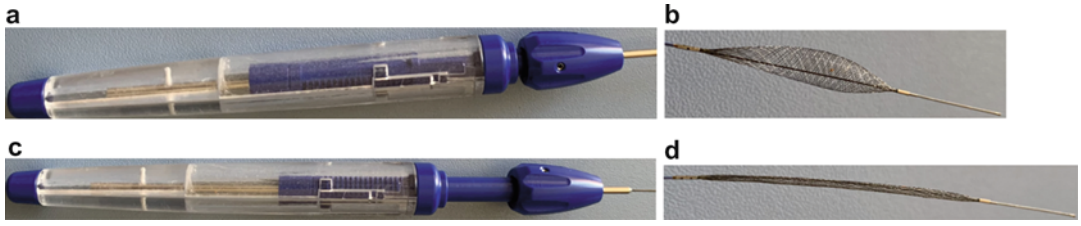

Fig. 4 Sample view of the expanded (**a**, **b**) and contracted (**c**, **d**) Cascade Net

The Cascade Net is similar to the already available Comaneci device. The device consists of a dense 42-wire braid, which offers excellent compliance with the parent vessel geometry and sufficient neck coverage during device expansion (Fig. 4). The porosity of the mesh also allows continuous blood flow in the parent vessel during complete expansion of the device. The Cascade Net model used in the above case is compatible with 0.021″ or larger ID microcatheters, which may result in navigation issues in patients with tortuous vasculature. In this particular case, the anatomy was favorable and the angle between the parent artery and the aneurysm neck allowed the neck-bridging device to be successfully positioned and deployed. The tactile feedback from the grip handle of the device provides direct feedback, allowing the operator to react immediately to the mesh and prevent interaction between the device and coil structure. The braided nature of

the device and the porosity of the mesh secured the patency of the parent artery during the 12 min required for coil insertion.

Our initial experience suggests that the use of the neck-bridging device may bring conceptual changes in the way we treat acutely ruptured and wide-neck aneurysms (Sirakov et al. 2018). We believe that this approach could improve the immediate results and may thus decrease the incidence of aneurysm and neck recurrences.

Therapeutic Alternatives

Balloon-Assisted Coil Occlusion
Comaneci-Assisted Coil Occlusion
Flow Diversion
pCONUS-Assisted Coil Occlusion
Stent-Assisted Coil Occlusion
Temporary Stent-Assisted Coil Occlusion
WEB

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