Flow diverters in the treatment of symptomatic large or giant cerebral aneurysms: preliminary results

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Aims and objectives

Traditional endovascular treatment of aneurysms (coiling, stent-assisted coiling, balloon remodeling) has become the treatment of choice in most saccular aneurysms with results comparable to surgical clipping and a lower complication rate. Nevertheless, large/giant or wide-necked saccular aneurysms and fusiform aneurysms remain a challenge for the interventional neuroradiologist and endovascular technique.

In the '90s, some studies [1, 2] suggested that the deployment of a stent in the parent artery, with the aim of assisting the coiling in the aneurysm's sac, could determine a "diversion" of the blood flow within the parent artery by itself, because of the modification of the regional hemodynamics, thus promoting the thrombosis in the aneurysm. Also, it was observed the progressive "repavement" of the stent with endothelium, leading to a reconstruction of the parent artery [3, 4]. Since then, a few stents with flow diversion characteristics were developed, with the goal of obtaining devices that could operate the exclusion of the aneurysm with or without the associated coiling of the sac.

Flow diversion is today an important tool for treatment of cerebral aneurysms, particularly large and giant aneurysms. The indications are still being defined and considering the patient age, location, size of aneurysms and clinical presentation.

The aim of this study is to review our single-centre experience with flow diverter stent, to assess the efficacy of this endovascular technique in relieve symptomatic aneurysms.
Methods and materials

PATIENTS

We retrospectively reviewed patients with unruptured intracranial aneurysms who underwent endovascular treatment with flow diverters between April 2013 and August 2015 at our institution. We identified 25 patients (16 asymptomatic and 9 symptomatic). Nine patients (mean age 55 ± 10 years; 6 females, 3 males) with specific neurologic symptoms and unruptured aneurysms (mean size 21 ± 7 mm) were treated; 3 patients referred progressive visual loss, 4 symptoms related to compression of cranial nerves (III-IV-VI deficit), 2 suffered of multiple TIA episodes, followed by a disorder of speech and vertigo.

The aneurysms were located in the cavernous or ophthalmic segment of the internal carotid artery (6), in the basilar tip (2), and in vertebral artery (1).

All the aneurysms had a high probability of recurrence with traditional endovascular technique. Therapeutic alternatives were discussed between neurosurgeons and interventional neuroradiologists multidisciplinary meetings.

DEVICES AND TECHNIQUE

3D rotational angiography was performed to determine the best working projections.

All treatments were performed under general anesthesia. Endovascular access was obtained by a standard transfemoral approach; following access, patients were heparinized with an intravenous bolus of 5000 UI. A 6-French ENVOY catheter was then placed within the introducer to reach proximal internal carotid artery or in the vertebral artery as distal as possible, allowing navigation with microcatheters.

Flow Re-Direction Endoluminal Device (FRED) was positioned in 4 patients, Pipeline embolization device (PED) in 3 patients, Silk flow Diverter (SFD) in 2 patients. In 6 patients, 1 or more coils was placed in the aneurysm’s sac before the positioning of the flow diverter or with "jailing" technique.
MEDICAL TREATMENT

All patients were premedicated with 75 mg of clopidogrel and 75 or 150 mg of aspirin daily for at least 5 days before the procedure. Dual antiplatelet therapy was maintained for at least 3 months for all patients, and discontinued if the follow-up magnetic resonance imaging (MRI) study did not demonstrate recurrence or complications. Single antiplatelet therapy was continued 6-12 months after the procedure.

With the aim of relieving mass-related symptoms, 4 patients received 4 mg of dexamethasone daily for 1 week, and then for another week the dose was tapered and discontinued.

FOLLOW-UP AND CLINICAL OUTCOME

All patients underwent MRI examination 1-3 months after the procedure, and a conventional angiography after 3-6 months if any unsuspected finding was observed. Another MRI study was performed 12 months after the intervention.

A senior neurosurgeon or neurointerventionalist recorded the clinical course and the evolution of symptoms.
Results

All devices could be navigated to the target area and could be deployed across the aneurysm neck. In all except one case a single device was implanted. In one case the control MRI study showed a suspected displacement of the stent, and therefore an angiographic examination was performed to confirm the finding; a few days later, because of the neck was uncompletely covered, a second flow diverter stent was placed with "telescoping technique" within the first device.

Considering the retreatment, complete aneurysm neck coverage and adequate vessel wall apposition was obtained in all cases. Shrinking of aneurysmatic sac was obtained in 7 cases; 2 aneurysms remained unmodified, though a further follow-up might show some changes.

8 out of 9 patients referred relieve of symptoms; only one patient with deficit of the III cranial nerve did not refer any improvement. In one case of a patient with dysarthria, the follow-up MRI showed resolution of the oedema at the pons correlating with the relieving of symptoms.
Fig. 1: Case 1: 54 year-old man with convergent strabismus. Angiographic study on AP (a) and 3D rotational angiography (b) shows a giant aneurysm in the cavernous segment of the internal carotid artery with a 26x17 mm sac. A flow diverter stent is positioned in the parent vessel with a complete neck coverage and aneurysm's exclusion (c, d). MRI follow-up 1 month (e) and 6 months (f) after the intervention demonstrates the aneurysm's shrinking, and a progressive relief from symptoms was obtained.

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Fig. 2: Case 2: 62 year-old woman with progressive visual loss. Digital subtraction angiography on AP (a) and LL (b) projections shows a giant aneurysm in basilar tip with a 26x17 mm sac. The aneurysm was initially treated with coiling and flow diverter (c,d). In the MRI images acquired 3 months after the procedure (e) the stent is apparently displaced and migrated cranially; the finding is subsequently confirmed with an angiographic study (f). Few days later, after multidisciplinary discussion, a new flow diverter stent is positioned within the former with "telescoping technique", obtaining a complete neck coverage and aneurysm exclusion (g, h). MRI controls demonstrate progressive aneurysm shrinking (i, j).
Fig. 3: Case 3: 49 years-old woman with dysarthria and angiographic finding of wide-neck aneurysm (15x9 mm) of the distal vertebral artery, as shown in a 3D (a), AP (b) and LL (c) angiographic images. After a coiling of the sac, flow diverter stent is positioned in the parent vessel with a complete neck coverage and aneurysm's exclusion (d, e, f). Pre-procedure MRI (g) and 3 months follow-up (h) demonstrates the aneurysm's shrinking associated to the resolution of the oedema in the brainstem.

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Conclusion

Our preliminary results showed that the treatment of symptomatic aneurysms with flow diversions may be a safe and effective therapeutic option in reducing symptomatic disorders of patients with large/giant or wide-neck aneurysms that are difficult to treat with standard neurointerventional techniques. However, more studies and randomized trials are needed in order to precisely define the indications of this technique.