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Case report

FLOW DIVERTER DEVICE IN THE ACUTE SETTING OF RUPTURED BLISTER LIKE ANEURYSM: A CASE REPORT

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ABSTRACT

Blister-like aneurysms (BLA) are a rare half-dome-shaped aneurysm, with a broad-based appearance, originating more often from a non-branching site of the supraclinoid internal carotid artery (ICA). They are sometimes difficult to recognize due to their morphological changes and high tendency to rupture. BLAs are often undiagnosed and may be detected only after repeated angiograms in the case of acute subarachnoid hemorrhage (SAH). BLA are life-threatening and no consensus has so far been reached on the best management strategy. We describe a patient with a BLA in the left ICA successfully treated by flow-diverting device using intraoperative abciximab bolus, with successful results. Recently, the use of flow-diverting device (FDD), has offered a very promising option for treatment even for ruptured BLA, with high long-term occlusion and low complication rates. However, double antiplatelet therapy is required and still represents a major constraint in a case of SAH, so that standardized multicenter studies are still needed.

1. Introduction

The term "blister" was introduced in 1988 by Takashi derived from the Japanese word "chimame" to describe a half-dome-shaped aneurysm, with a broad-based appearance, originating from a non-branching site of an artery [1]. Blister-like aneurysms (BLAs) have been more often reported in the supraclinoid tract of the internal carotid artery (ICA)[1] and represent about 0.9%–6.5% of ICA aneurysms [1,2].

Diagnosis is challenging, due to the aneurysm's proximity to skull base structures, its small size, wall irregularity and frequent morphological changes [3], as a result, BLAs are often undiagnosed and may be reported only after repeated angiograms [1,3].

BLAs are prone to rupture, accounting for 0.5-2.0% of ruptured intracranial aneurysms [3,4], with typically the patient presents with acute subarachnoid hemorrhage (SAH). They are marked by a high tendency to re-rupture.

Histological examinations have revealed a focal arterial wall defect of the internal elastic lamina and media, covered and protected by a thin layer of fibrous tissue and adventitia, similar to pseudoaneurysms [1,2].

BLAs are life threatening and to avoid rebleeding they should be treated as early as possible [4]. Surgical approach has been dropped in favour of endovascular treatments (ET), with evidence of a lower morbidity and mortality rate [1,3].

In particular, flow diverter device (FDD) offered a very promising option for treatment of BLAs [5], with an increasing number of studies showing high long-term occlusion and low complication rates [4,5]. The device's efficacy was approved for use in unruptured ICA segment aneurysms [5], but no consensus has been reached for its use in acute ruptured aneurysms.

We describe a patient with BLA in the left ICA, successfully treated with flow-diversion, during an acute phase of SAH.

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2. Case presentation

A 44-year-old man, with unremarkable medical history, was admitted to the ER because of the rapid onset of severe headache (thunderclap headache). Brain computed tomography (CT) examination revealed the presence of subarachnoid bleeding with a left hemisphere distribution, appearing predominantly on the left lateral sulcus, neither aneurysms nor vascular malformations were detected on CT angiography (CTA) (Figure1).

The following day, the patient underwent brain digital subtraction angiography (DSA). Left ICA angiography demonstrated a small hemispherical bulge at the dorso-medial wall of the left supraclinoid ICA, with an irregular bleb over the dome. Because of its typical location and shape, this lesion was diagnosed as a ruptured BLA (Figure 2).

Considering the peculiar fragility of the wall of BLA, following a multidisciplinary discussion, surgical aneurysm clipping was avoided and the patient gave informed consent to undergo endovascular treatment. Since the patient was in the acute stage of SAH, although flow diversion device (FDD) insertion was planned, no antiplatelet pretreatment therapy was administered.

The procedure was performed in a hybrid operating room after induction of general anaesthesia. Anticoagulation was ensured through continuous infusion of heparin at a rate of 1000 U/hour during the procedure. Femoral access and triaxial support were used, with a long sheath (Neuron Max® 088, Penumbra), intermediate catheter (Catalyst 5, Stryker), and delivery micro catheter (XT 27, Stryker). 3D rotational angiograms to confirm aneurysm size and location were performed. Derivo (Acandis) was chosen, as a self-expandable embolization device (4,5 x 20 mm), to perform the endovascular reconstruction of the parent vessel. The left middle cerebral artery was navigated using a microcatheter and a micro wire, the FDD was advanced, under fluoroscopic guidance, over the prepositioned wire and deployed into the left distal ICA (Figure 3a).

After FDD positioning, intravenous bolus (20 ml: 0,25mg/kg) of abciximab (ReoPro, Eli Lilly Italia S.p.A.) was administered, followed by a slow intravenous infusion (0,125 mcg/kg/min) for 12 hours, after which the patient underwent dual antiplatelet therapy (Aspirin 100 mg and Clopidogrel 75 mg) for 3 months, followed by 100 mg aspirin alone, which is currently being continued indefinitely.

Post-embolization DSA revealed the FDD well positioned and patent, covering the ruptured BLA with contrast agent stasis inside the small bleb, as a result of initial aneurysm flow exclusion (Figure 3b). The post-embolization CT showed neither ischemia nor cerebral hemorrhage.

Patient was monitored postoperatively in the neurointensive care unit, and standard post subarachnoid care protocol was ensured. The postoperative clinical course was unremarkable.

The follow-up DSAs performed at 1 week (Figure 4a) and 1 month demonstrated an almost complete occlusion of the BBA with a residual defect irregularity of the vessel wall in the ruptured portion of the ICA.

A three-month follow-up DSA (Figure 4b), revealed persistent occlusion of the BBA, with an improvement in the vessel wall in the ruptured portion of the ICA.

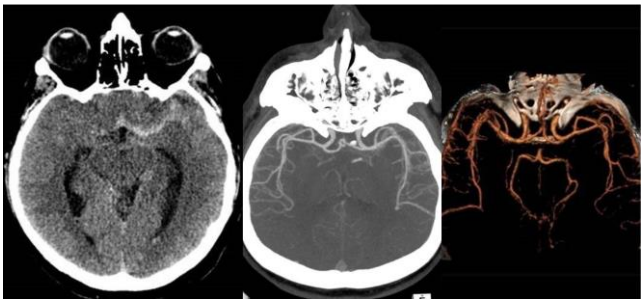

Figure 1. Non contrast head CT (left) demonstrating SAH in the suprasellar cistern and left sylvian fissure. CT angiography (middle) demonstrating no left ICA wall defects nor aneurysms. Volume Rendering (VR) reconstruction (right) confirmed the absence of significant vascular anomalies.

Figure 2. Antero-posterior (left) and oblique-left (right) left ICA DSA: showed a millimetric left supraclinoid ICA blister aneurysm.

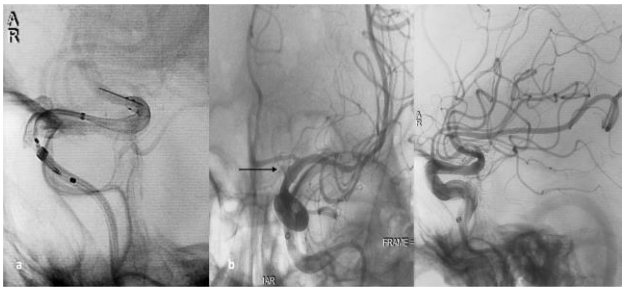

Figure 3 A, B and C. Oblique-left ICA intra-operative DSA shows advancing over the prepositioned wire of the Derivo flow-diverter device and its deployment into left distal ICA under fluoroscopic guidance (a). AP (b) and oblique cerebral angiograms (c) obtained immediately post-treatment of the left supraclinoid ICA blister aneurysm treated with Derivo flow-diverter, well positioned and patent.

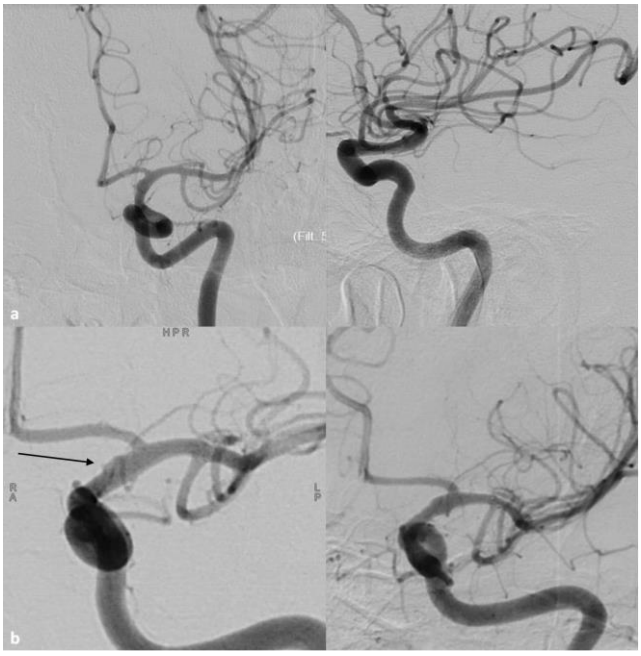

Figure 4 A and B. One-week follow-up cerebral angiograms (AP, lateral-left ICA DSA) showing an almost complete occlusion of the BBA with no more detection of the bleb even with a residual defect irregularity of the vessel wall in the ruptured portion of the ICA (top row). Three-month (AP, oblique left ICA DSA) angiography revealed the persistent occlusion of the BBA, with an improvement in the vessel wall in the ruptured portion of the ICA, with no significant subintimal thickening intra stent (bottom row).

3. Discussion

Flow diverter devices

Historically, ruptured blister aneurysms have been challenging to treat with ET, as they are associated with high rates of complete occlusion and good mid- to long-term neurological outcomes [3].

In particular, flow diverter device guarantees endoluminal arterial reconstruction, by redirecting the blood flow along the normal course of the parent artery and may disrupt the pulsatile flow into the aneurysm, inducing progressive intra-aneurysmal stasis, and thrombosis; moreover, once incorporated, it provides a scaffold for neo-intimal overgrowth of the parent artery [3,4].

The use of FDD such as the pipeline embolization device (PED; Medtronic Neurovascular) and Silk (Balt Extrusion) are becoming widely accepted for the treatment of BBA [1,2,5].

We chose Derivo FDD, which consists of Nitinol composite wires with Platinum core leading to increased x-ray visibility for its improved self-expanding characteristics and its reduced thrombogenicity [6].

Clinical outcomes

Even for the treatment of ruptured BLAs, the use of flow-diverting stents, has been reported to be associated with high rates of complete occlusion (80%- 100% on follow-up angiograms) and good long-term neurological outcomes, with no procedural complications and no new aneurysmal ruptures [1-5].

Despite these promising results, it is important to note that their use is not completely risk-free, with occlusion of side/perforating branches, vasospasm, stent thrombosis and intraoperative rebleeding, representing the most dangerous events reported in the literature [1,3,5].

In the largest systematic review regarding a series of ruptured BLAs treated with flow-diversion (31 studies with 265 procedures for ruptured blister-like aneurysms), a 17% incidence of procedural complications was reported, 11.5% perioperative stroke, and a 7.6% perioperative intracerebral hemorrhage for a combined 12.6% and 8.7% periprocedural morbidity and mortality, respectively [4].

The persistence or growth of the BLAs often occurs after the placement of flow-diverting stents probably due to stent mismatching or insufficient expansion [1,3]. Furthermore, even when properly placed, since FDDs do not necessarily provide immediate aneurysm occlusion, delayed rerupture of blister aneurysms have been reported sometimes with fatal outcome [1], but no significant difference has been shown in the rate of rebleeding when compared with other ET [1,4,5].

Dual Antiplatelet Therapy (DAPT)

Furthermore, FDDs deployment entails the need for dual antiplatelet therapy (DAPT) to minimize the risk of thrombotic complications within the stent itself and in distal locations [3].

However, DAPT is associated with a risk of hemorrhagic complications in the acute phase of ruptured aneurysms [3], long term neurologic outcomes in BLAs treated with FDDs were superior to other endovascular treatments (such as coiling or stent assisted coiling) 80% with good clinical outcomes, and morbidity and mortality lower than with surgical treatment, even in the presence of DAPT [5].

All previously reported blister aneurysm flow-diversion treatment series, reported DAPT with aspirin and clopidogrel, prior to flow-diverter placement with systemic heparinization regimen [3].

Moreover, in order to avoid thrombotic acute complication and attempt lysis of an acute intra-arterial clot during ET of cerebral aneurysms, the two mainly used molecules with high affinity for the platelet glycoprotein IIb/IIIa receptor are Abciximab and Tirofiban, with similar safety and recanalization rates [7].

Some authors use and assert the safety of tirofiban together with DAPT as a standard protocol for patients with intracranial aneurysms who have undergone flow diversion [8]; while Abciximab is given if clots are seen on the stent on angiograms (done on 5- to 10-minute intervals for at least 30 minutes) to avoid thrombotic complications.

Some authors support standalone intraprocedural abciximab bolus safety, citing the same rate of complications when compared with pre-treatment with DAPT for unruptured intracranial aneurysm stenting [9], but no evidence is available of its use for a ruptured aneurysm.

To the best of our knowledge, we were the first to use Abciximab bolus in the acute phase of SAH, without the DAPT pre loading (to avoid an increasing hemorrhagic risk), with successful results, but further studies are needed to confirm its safety in the acute setting.

Recently some authors have supported the acute administration of an ATP analog, IV CANGRELOR (with or without oral ticagrelor), as a feasible antiplatelet treatment option for acute neuroendovascular procedures (NVP) [10].

4. Conclusions

FDDs have been employed for ruptured BLA in acute cases thereby avoiding direct manipulation through endovascular parent vessel reconstruction. However, DAPT is required and still represents a major constraint in the case of SAH. Nowadays, no consensus has so far been reached on the best management strategy, and more evidence from larger cohorts is still needed.

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