Case Report / Приказ болесника

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Internal carotid artery “donut” aneurysm treated using DERIVO flow diverting stent

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Summary

Introduction Intracranial aneurysms with a radiological sign of a donut are a medical priority and have been described in a small number of cases. This radiological sign occurs in aneurysms in which there is partial thrombosis inside aneurismal sac and circular laminar flow between the aneurismal wall and the thrombus in its center. Consequently, there is a central contrast-filling defect of the aneurysm sac observed on different angiographic imaging methods.

Case outline We present a 35-year-old female patient was admitted for examination due to frequent headaches, visual disturbances on the left and loss of sight on the right eye. Digital subtraction angiography (DSA) showed an aneurysm on the right ICA measuring 25.6 × 25 mm, while neck measured 11 mm and included part of the C6 and C7 segments. Treatment decision was made that positioning of flow diverting stent across the aneurysm neck would be most beneficial in this case. After procedure, patient was discharged in same general condition as she was before admission to the hospital. Seven months after the intervention, she reported for first digital DSA control. Normal position of the left A1 was demonstrated, suggesting shrinkage of aneurysm sac. An improvement of vision on both eyes was stated.

Conclusion: We present a patient with "donut" aneurysm on the internal carotid artery, successfully treated with flow diverting stent.

Keywords: "donut" aneurysm; DERIVO stent; digital subtraction angiography (DSA)

Introduction Intracranial aneurysms with a radiological sign of a donut are a rarity and have been described in several cases. In this paper, we present a case of a “donut” aneurysm on an internal carotid artery treated with a DERIVO embolization device (DED).
CASE REPORT

A 35-year-old female patient was admitted for examination due to frequent headaches, visual disturbances on the left and loss of sight on the right eye. On non enhanced computed tomography (NECT) and computed tomography angiography (CTA) examinations, giant aneurysm with centrally positioned thrombus was diagnosed (donut shape aneurysm) on the right internal carotid artery (ICA). Digital subtraction angiography (DSA) showed an aneurysm on the right ICA measuring 25.6 × 25 mm, while neck measured 11 mm and included part of the C6 and C7 segments. Aneurysm sac was directed upwards and medially, dislocating supraclinoid segments of the left ICA. The right ICA itself was narrow in diameter throughout its whole course, especially around the neck of the aneurysm. Proximal diameter of ICA was 3.2 mm, with pre-aneurysmatic narrowing with radius drop to 1.9 mm, while distal part measured 2 mm. The right A1 segment was aplastic and the right anterior cerebral artery (ACA) was filling from the left A1 segment, which was elevated due to compressive effect of the aneurysm.

Treatment decision was made that positioning of flow diverting stent across the aneurysm neck would be most beneficial in this case. Patient was prescribed with loading dose of dual antiplatelet therapy (DAPT) four days prior to intervention, consisting of Clopidogrel (Plavix, Sanofi Winthrop Industrie, France) 75 mg twice per day, and acetylsalicylic acid (Aspirin, Bayer, Germany) 100 mg per day. Under conditions of general anesthesia, DERIVO flow diverting device (DED) (Acandis, Pforzheim, Germany) measuring 4.5 × 30 mm was then placed using both push and pull technique, in order to maximize radial force of the stent. Flow diverting effect was demonstrated immediately on post-procedural angiograms (B3 degree of occlusion by OKM classification [1]). Patient was discharged in same general condition as she was before admission to the hospital.

Seven months after the intervention, she reported for first digital DSA control. An improvement of vision on both eyes was stated. Control DSA was performed under conditions of local anesthesia on Monoplane Axiom Artis AX (Siemens, Germany). Selective right internal carotid artery catheterization was performed with 5F SIM2 diagnostic catheter (Terumo, Japan) and 7 ml of Omnipaque350 (GE healthcare, USA) contrast agent was administrated for angiograms, while for the 3D in space sequence we applied 12 ml of contrast in 2 second interval. Angiogram of left carotid artery was taken from the common carotid artery
(CCA) with 10 ml of contrast and with the application of digital compression on the right CCA. No communication between sides and normal position of the left A1 was demonstrated, suggesting shrinkage of aneurysm sac. Both ACAs were filled exclusively from the left ICA. Angiograms of right carotid circulation were performed selectively from ICA showed that the aneurysm was completely excluded from the circulation with preserved patency of the parent blood vessel. Supraclinoidally, the right ICA still remained dislocated closer to the mediosagittal line, but was gradually falling back to its normal position.

This case report was approved by the institutional ethics committee, and written consent was obtained from the patient for the publication of this case report and any accompanying images.

**DISCUSSION**

Phenomenon of “donut sign” or “donut aneurysm” was first described in 2014 by Van Rooij [2]. This radiological sign occurs in aneurysms in which there is partial thrombosis inside aneurismal sac and circular laminar flow between the aneurismal wall and the thrombus in its center. Consequently, there is a central contrast-filling defect of the aneurysm sac on different angiographical imaging methods. So far, this rarity has been described in only several cases of ruptured and unruptured aneurysms, both in carotid and posterior circulation [3–6].

Several methods have been used in treatment of this type of aneurysm: microvascular dissection and clipping, or endovascular treatment (stent assisted coiling, combined treatment with Woven Endo Bridge (WEB) and coils and FD stent in two cases) [2–4,6]. Microsurgical direct clipping giant aneurysms needs adequate craniotomy and visualization of the parent artery and its branches with minimal parenchymal retraction and minimal manipulation of the adjacent neurovascular structures. Giant aneurysms which have wide neck and complex anatomy of surrounding vessels cannot be clipped directly. In these cases it is necessary to use other therapeutical methods [7]. Proximal trapping (Hunterian ligation / proximal occlusion) is relatively simple and well established procedure technique that has been used in an attempt to divert flow away from the aneurysm and to induce thrombosis. Proximal trapping could be used only after the patient is able to successfully tolerate a balloon test occlusion (BTO). The
risk of ischemic complications exists even in patients with negative BTO, and its rate is as high as 33% [8, 9]. Bypass after complete trapping can be done as low-flow bypass (50 ml/min) or high-flow bypass (> 50 ml/min), double-barrel bypass and in situ bypass with grafts derived either from radial artery or saphenous vein. Hemorrhagic complications occurred 7.5% in patients who were treated with bypass (2.5% in patients treated with FD), and postoperative ischemic complications 15% in FD and bypass groups respectively (5% in patients treated with FD). The rate of complete aneurysm occlusion at 6 months was 42.5% in the FD group and 95% in surgical group (p < 0.0001), and early bypass thrombosis occurred in 15% [8]. He was evaluating patients postoperatively with diffusion weighted images (DWI) to detect clinically silent ischemia. Brasiliense reported silent ischemia after procedure in 62.7% cases [10].

Based on up-to-date experience, endovascular treatment has proven to be the method of choice. In cases with large aneurysms with mass effect and partial thrombosis, recanalisation after coiling is expected in high percentage of cases [2,11]. Flow diverting stents have proven to be an effective alternative to coiling, but they had several important disadvantages, such as lack of immediate effect, need for antiplatelet therapy and relatively long latency for aneurysm exclusion to take place [12, 13].

Evolution of the flow diverting devices over the years have diminished the complication rates in recent years [13]. DED is second generation flow diverting stent composed of 24 wires made of nitinol and radiopaque platinum core that are folded back at the distal end, thus providing a network consisting of a total of 48 wires. At the proximal and distal end there are 3 markers of iridium and platinum, for better visualization [14, 15]. These technical features result in improved radio opacity and occlusion rate, as well as reduced incidence of adverse events [13, 16].

In our case, immediately after implantation of the DED the flow in aneurysm sac was reduced, leading to graduate progressive aneurysm exclusion from the circulation and reduction of its compressive effect on nearby anatomical structures.

**Conflict of interest:** None declared.
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Figure 1. Pre-treatment angiograms; (A) antero-posterior, (B) lateral view of the right internal carotid artery (ICA) show giant aneurysm with "donut sign" on the right ICA which appear narrow, with pre-aneurysmatic stenosis and very thin post-aneurysmatic diameter of the vessel; right A1 is not showing; (C) antero-posterior view of the left ICA demonstrates both anterior cerebral arteries filling from the left A1, which is elevated due to compressive effect of the aneurysm.
Figure 2. Post-procedural angiograms; (A) antero-posterior and (B) lateral position view of the right internal carotid artery show stasis of the contrast inside the aneurysm sac (grade B3 by O’Kelly–Marotta classification)
Figure 3. Control digital subtraction angiography after seven months; (A) antero-posterior, (B) lateral position view of the right internal carotid artery; there is no aneurysm filling; (C) antero-posterior view of the left ICA; A1 segment is falling to its normal state due to aneurysm shrinkage