



CASE REPORT / ПРИКАЗ БОЛЕСНИКА

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 aneurysmal sac and circular laminar flow between the aneurysmal 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 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 internal carotid artery measuring 25.6 × 25 mm, while neck measured 11 mm and included part of the C6 and C7 segments. Treatment decision was made that placing a flow-diverting stent across the aneurysm neck would be most beneficial in this case. After the procedure, the patient was discharged in the same general condition as she was before admission to the hospital. Seven months after the intervention, she reported for her first DSA control examination. Normal position of the left A1 segment was demonstrated, suggesting shrinkage of the aneurysm sac. An improvement of vision on both eyes was stated.

Conclusion: We present a patient with a “donut” aneurysm on the internal carotid artery, successfully treated with a 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 and computed tomography angiography 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 the neck measured 11 mm and included part of the C6 and C7 segments. The 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 the ICA was 3.2

mm, with pre-aneurysmatic narrowing with radius drop to 1.9 mm, while the 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 the compressive effect of the aneurysm.

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

Seven months after the intervention, the patient reported for her first DSA control examination. An improvement of vision on both

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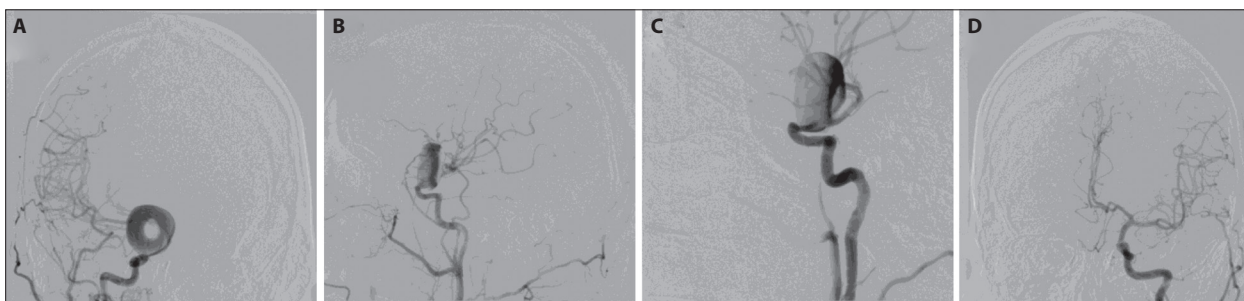


Figure 1. Pre-treatment angiograms; (A) antero-posterior, (B) lateral view of the right internal carotid artery (ICA) show a giant aneurysm with a "donut sign" on the right ICA, which appears narrow, with pre-aneurysmal stenosis and very thin post-aneurysmal diameter of the vessel; the right A1 is not 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

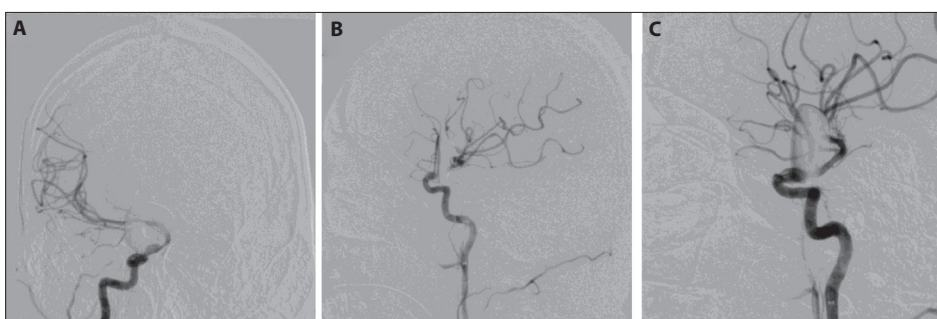


Figure 2. Post-procedural angiograms; (A) antero-posterior and (B) lateral position view of the right internal carotid artery show stasis of the contrast inside the aneurysm sac (grade B3 by O'Kelly-Marotta classification)

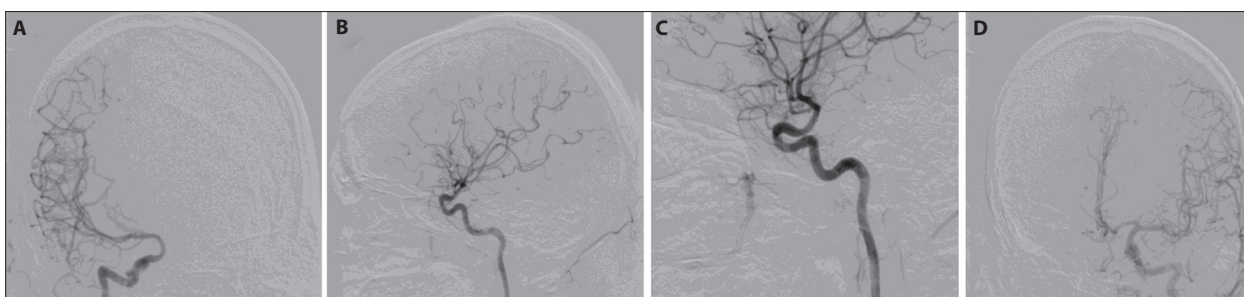


Figure 3. Control digital subtraction angiography after seven months; (A) antero-posterior, (B) lateral position view of the right internal carotid artery; there is no aneurysm filling; (C) antero-posterior view of the left ICA; A1 segment is falling to its normal state due to aneurysm shrinkage

eyes was stated. Control DSA was performed under conditions of local anesthesia on Monoplane Axiom Artis AX (Siemens, Munich, Germany). Selective right internal carotid artery catheterization was performed with 5F SIM2 diagnostic catheter (Terumo, Tokyo, Japan) and 7 ml of Omnipaque350 (GE healthcare, Chicago, IL, USA) contrast agent was administered for angiograms, while for the 3D in space sequence we applied 12 ml of contrast in two-second intervals. Angiogram of the 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 the sides and normal position of the left A1 segment was demonstrated, suggesting shrinkage of the aneurysm sac. Both ACAs were filled exclusively from the left ICA. Angiograms of the right carotid circulation performed selectively from the 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 medio-sagittal 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 et al. [2]. This radiological sign occurs in aneurysms in which there is partial thrombosis inside the aneurysmal sac and circular laminar flow between the aneurysmal 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 treating this type of aneurysm: microvascular dissection and clipping, or endovascular treatment (stent-assisted coiling, combined treatment with Woven EndoBridge and coils and FD stent in two cases) [2, 3, 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 the 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 a 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 a low-flow bypass (50 ml/min) or a high-flow bypass (> 50 ml/min), double-barrel bypass, and in situ bypass with grafts derived either from the radial artery or the saphenous vein. Hemorrhagic complications occur in 7.5% of patients treated with bypass (2.5% of patients treated with FD), and postoperative ischemic complications occur in 15% of FD and bypass groups respectively (5% of patients treated with FD). The rate of complete aneurysm occlusion at six months was 42.5% in the FD group and

95% in the surgical group ($p < 0.0001$), and early bypass thrombosis occurred in 15% [8]. Kiselov et al. [8] evaluated patients postoperatively with diffusion-weighted images to detect clinically silent ischemia. Brasiliense et al [10] reported silent ischemia after procedure in 62.7% cases.

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

Evolution of the FD devices over the years have diminished the complication rates in recent years [13]. DED is a second-generation FD stent composed of 24 wires made of nitinol and radio-opaque 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 three 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 the implantation of the DED, the flow in the aneurysm sac was reduced, leading to gradual 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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Анеуризма унутрашње каротидне артерије по типу „крофне“ третирана помоћу стента ДЕРИВО за преусмеравање протока

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САЖЕТАК

Увод Интракранијалне анеуризме са радиолошким знаком крофне су медицински приоритет и досад су описане у малом броју случајева. Овај радиолошки знак се јавља у анеуризмама где постоје парцијална тромбоза унутар анеуризматске вреће и циркуларни ламинарни ток крви између зида анеуризме и централног тромба. Последично, на различитим ангиографским визуелизационим методама постоји централни дефект у пуњењу анеуризме контрастним средством.

Приказ болесника Представљамо болесницу стару 35 година, примљену на испитивање због честих главобоља, визуелних сметњи на левом оку и губитка вида на десном оку. Дигитална суптракциона ангиографија приказала је анеуризму на десној унутрашњој каротидној артерији, која

је мерила 25,6 × 25 mm, док је промер врата био 11 mm и обухватао је део сегмената Ц6 и Ц7. Одлучено је да би позиционирање стента са ефектом преусмеравања протока преко врата анеуризме било најбоље у овом случају. Након процедуре болесница је отпуштена непромењеног општег стања. Седам месеци након интервенције болесница је примљена на прву контролну дигиталну суптракциону ангиографију. Леви сегмент А1 се вратио у нормалну позицију, сугеришући смежување анеуризматске вреће. Такође, болесница је навела побољшање вида на оба ока.

Закључак Приказујемо болесницу са анеуризмом облика крофне на десној унутрашњој каротидној артерији, успешно третираној стентом за преусмеравање протока.

Кључне речи: анеуризма по типу „крофне“; стент ДЕРИВО; дигитална суптракциона ангиографија