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Case Report

Endovascular treatment of ruptured blister-like aneurysms: A case report and review of the literature [☆]

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ABSTRACT

A ruptured blister-like aneurysm of the internal carotid artery is a rare event with a high risk of recurrence and mortality. Selecting an appropriate treatment modality remains challenging due to a lack of consensus or specific recommendations in the literature. In this article, we present the case of a 68-year-old man who presented with ruptured blister-like aneurysms in the supraclinoid portion of the internal carotid artery. The patient was diagnosed and successfully managed using an endovascular coil embolization technique at our hospital. We aim to illustrate and share our experiences with this rare occurrence, which may assist in the treatment of similar cases in the future.

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Introduction

Blister-like aneurysm (BA) of the internal carotid artery (ICA) is a rare, small aneurysm that accounts for approximately 0.5%–2.0% of ruptured intracranial aneurysms and is associated with high morbidity and mortality rates [1,2]. BA of the ICA is defined as a small-sized aneurysm located on the dorsal wall of non-branching sites of the supraclinoid ICA, which are typically diagnosed after rupture [3,4]. The wall of the aneurysm is

thin, unstable, and fragile, with a marked tendency to rupture and recur after treatment [5,6].

BAs should be treated as soon as possible using various microsurgical techniques, such as clipping, wrapping-clipping, and surgical trapping techniques, or endovascular approaches using coils; coils and stents; multiple stents; flow-diverter stents; or vessel occlusion [3,4,7,8]. To date, no standard method exists for ruptured BA treatment and no published guidelines exist for the management of BAs. Here, we present a case of a ruptured BA in the supraclinoid ICA that

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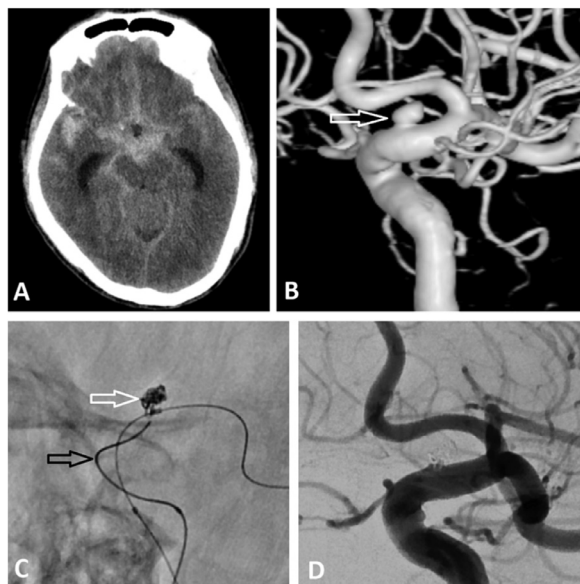


Fig. 1 – (A) Diffuse subarachnoid hemorrhage on computed tomography image pre-intervention. **(B)** 3-dimensional digital subtraction angiography (3D-DSA) image showing a blister-like aneurysm arising from the right supraclinoid ICA (arrow). **(C)** Image obtained following coil deposition (white arrow) with balloon assistance (black arrow). **(D)** DSA image after intervention demonstrating complete aneurysm occlusion.

was successfully treated with coil embolization at Hanoi Medical University Hospital, in addition to a review of the literature.

Case report

A 68-year-old male patient with a history of smoking for many years presented with symptoms of severe headache, falling while walking, nausea without vomiting, and slight fever for approximately 7 hours. At the time of admission, the patient was conscious, with a Glasgow Coma Scale score of 15 and a body temperature of 38°C, but neither a stiff neck nor any focal neurological signs were detected.

A non-contrast computed tomography (CT) scan showed both diffuse and acute subarachnoid hemorrhage (SAH) in the basal cisterns and bilateral cerebral sulci (predominantly on the right side; Fig. 1A). Digital subtraction angiography (DSA) images revealed a ruptured BA measuring 2.5 × 4.1 mm, with a neck diameter of 2.5 mm, arising from the dorsal wall and the non-branching site of the right supraclinoid ICA (Fig. 1B). Because the BA had a narrow neck with a high risk of recurrent rupture and the potential for cerebral bleeding, we opted to perform a balloon-assisted coiling technique. Two coils (Prime coils – ev3/Covidien), sized 2.5 × 40 mm and 1 × 20 mm, were successfully placed into the aneurysm with the balloon (HyperGlide, ev3/Covidien), which was not inflated in the parent vessel in front of the neck of the aneurysm (Fig. 1C). This tech-

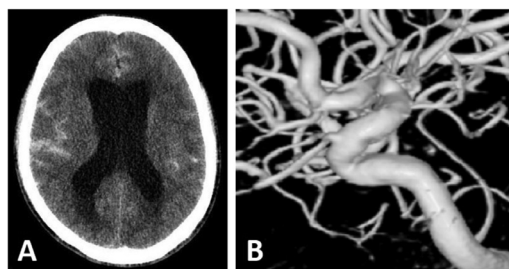


Fig. 2 – (A) Non-contrast computed tomography image, 15 hours after intervention, showing that the lateral ventricles were dilated. **(B)** Digital subtraction angiography re-examination after intervention revealed complete occlusion of the aneurysm without vasospasm of the parent artery.

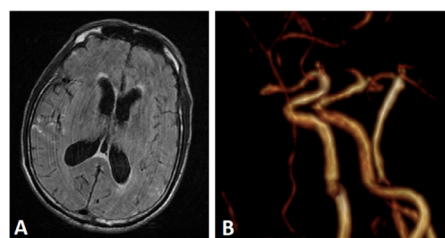


Fig. 3 – (A) Fluid-attenuated inversion recovery axial image revealed no dilation in either lateral ventricle. **(B)** Twenty days after the intervention, a follow-up 3-dimensional time-of-flight image showed no recurrence of the aneurysm.

nique was necessary to prevent the coils from protruding into the parent artery. In addition, if the aneurysm ruptured during placement, the balloon could be inflated to temporarily occlude the parent artery and allow for successful coiling. An angiogram performed immediately after embolization showed the complete occlusion of the BA (Fig. 1D), and the patient was successfully awakened after the intervention (Glasgow Coma Scale score was 15).

Approximately 15 hours following the intervention, the patient presented with decreased consciousness, with the Glasgow Coma Scale score of 11. The CT scan showed no change in the cerebral hemorrhage relative to the image before the intervention, and no cerebral parenchymal infarction was observed. However, the ventricular system appeared dilated due to a hematoma blocking the circulation of the cerebrospinal fluid (Fig. 2A). DSA re-examination was performed, and the images demonstrated the complete occlusion of the aneurysm without extravasation of the contrast agent (Fig. 2B). The patient underwent emergency external ventricular drainage, after which the patient was fully conscious, with no neurological deficits. The drain was removed after 14 days.

After 20 days of treatment, brain magnetic resonance imaging (MRI) was performed, which showed that the ventricular system was not dilated, and time-of-flight (TOF) magnetic resonance angiography did not detect an aneurysm (Figs. 3A and B).

Discussion

BA of the supraclinoid ICA is often small and wide-necked, locating at a non-branching site in the dorsal wall of the artery [4]. The patient in this report presented the typical features of a ruptured BA in the supraclinoid ICA. Due to the high risk of re-rupture and the narrow aneurysm neck, we opted to use balloon-assisted coil embolization to repair the aneurysm. Ruptured BAs lack the intima layer and collagen tissue; however, these aneurysms are typically covered by a thick thrombus, which improves the stability of the BA wall, allowing some patients to be treated with coil embolization during the late stage [9,10]. To date, the treatment and follow-up of BAs remain difficult [11].

In 2004, Tanoue et al. [10] reported a case of a ruptured BA of the supraclinoid ICA that was successfully treated with coil embolization 40 days after admission. In another report, in 2006, Ezaki et al. [9] reported a case of a ruptured BA, for which DSA images obtained 3 days after hemorrhage revealed a morphological shift in the aneurysm from a BA to a saccular type. After 19 days, the patient underwent coil embolization without complications. After 1 month, the patient was subjected to repeat angiography, and DSA images demonstrated the complete embolization of the aneurysm.

Balloon-assisted coil embolization can be performed to treat a ruptured BA during the late period of SAH [12]. The wall of the aneurysm consists of a thin fibrous adventitial layer with a focal defect of the internal elastic lamina, resulting in a high risk of rupture during the placement of the coil embolization [12,13]. The advantage of using coil embolization to treat BAs is that this approach does not require antiplatelet therapy either before or after the intervention [12]; however, coiled embolization is not considered an optimal approach for the repair of ruptured BAs. Coiled embolisms are recommended as a potential initial treatment, followed by the later placement of flow-diverter stents [12,13].

Microsurgical clipping or traditional endovascular techniques used to repair aneurysms may be associated with a high rate of recurrence and mortality [12]. Flow-diverter stents represent one option for the repair of ruptured BAs due to the endoluminal nature of arterial reconstruction. Flow-diverter stents lead to leads to stasis, thrombosis, and aneurysm regression due to the disruption of the blood flow into the aneurysm sac [14]. Flow-diverter stents provide high rates of complete occlusion, with good long-term neurological outcomes for the treatment of ruptured BAs [12]. In 2016, Linfante et al. [14] used a Pipeline Embolism Device in 10 patients to treat ruptured BA, resulting in the immediate occlusion or near occlusion of the aneurysms in 9 of 10 patients. Long-term follow-up angiography showed the continued complete occlusion of the aneurysm in these successfully treated patients. Therefore, the use of flow-diverter stents represents a safe and effective method for ruptured aneurysm treatment.

In this case, the patient was successfully treated with coils instead of a flow-diverter stent. Because of the narrow neck, with a diameter of 2.5 mm, the dome-to-neck ratio was 1.6, which made the deposition of embolizing coils possible. We performed a coil embolization of the aneurysm using a balloon to prevent coil protrusion into the lumen and provide a

mechanism for the temporary occlusion of the parent vessel if the aneurysm ruptured during the intervention. Cerebral DSA and brain MRI images revealed that the aneurysm was completely removed (Class I according to Roy-Raymond [15]). The patient will be monitored by DSA for follow-up after 6 months. We will consider using the placement of a flow-diverter stent if the aneurysm recurs.

Conclusion

Ruptured cerebral aneurysms must always be considered in patients with SAH, and a careful examination must be performed to avoid misdiagnosis. Our patient had a ruptured BA arising from the dorsal wall and non-branching site of the right supraclinoid ICA. Balloon-assisted coil embolization represents a viable technique for the treatment of narrow-necked aneurysms. Regular follow-up is necessary in such cases, and a flow-diverter stent should be considered as a potential treatment option if the aneurysm recurs in this patient.

Ethical approval

Our institution does not require ethical approval for reporting individual cases or case series.

Patient consent

Written informed consent was obtained from the patient(s) for their anonymized information to be published in this article.

Data Availability Statement

All data generated or analysed during this study are included in this article [and/or] its supplementary material files. Further enquiries can be directed to the corresponding author (Dr. Nguyen Minh Duc; bsnguyenminhduc@pnt.edu.vn).

Author Contributions

Nguyen TB and Nguyen MD contributed equally to this article as co-first authors. All authors read and approved the final manuscript.

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REFERENCES

- [1] Meling TR, Sorteberg A, Bakke SJ, Slettebø H, Hernesniemi J, Sorteberg W. Blood blister-like aneurysms of the internal carotid artery trunk causing subarachnoid hemorrhage: treatment and outcome. *J Neurosurg* 2008;108:662–671.
- [2] Lee B-H, Kim BM, Park MS, Park SI, Chung EC, Suh SH, et al. Reconstructive endovascular treatment of ruptured blood blister-like aneurysms of the internal carotid artery. Clinical article. *J Neurosurg* 2009;110:431–6.
- [3] Szmuda T, Sloniewski P, Waszak PM, Springer J, Szmuda M. Towards a new treatment paradigm for ruptured blood blister-like aneurysms of the internal carotid artery? A rapid systematic review. *J NeuroIntervent Surg* 2016;8:488–494.
- [4] Peschillo S, Cannizzaro D, Caporlingua A, Missori P. A systematic review and meta-analysis of treatment and outcome of blister-like aneurysms. *AJNR Am J Neuroradiol* 2016;37:856–61.
- [5] Sim SY, Chung J, Shin YS. Are Blood Blister-Like Aneurysms a Specific Type of Dissection? A Comparative Study of Blood Blister-Like Aneurysms and Ruptured Mizutani Type 4 Vertebral Artery Dissections. *J Korean Neurosurg Soc* 2014;56:395–9. doi:10.3340/jkns.2014.56.5.395.
- [6] Horie N, Morikawa M, Fukuda S, Hayashi K, Suyama K, Nagata I. Detection of blood blister-like aneurysm and intramural hematoma with high-resolution magnetic resonance imaging: Case report. *J Neurosurg* 2011;115:1206–9.
- [7] Charbel FT, Gonzales-Portillo G, Hoffman W, Cochran E. Distal internal carotid artery pseudoaneurysms: technique and pitfalls of surgical management: two technical case reports. *Neurosurgery* 1999;45:643–9.
- [8] Kim B-C, Kwon O-K, Oh CW, Bang JS, Hwang G, Jin SC, et al. Endovascular internal carotid artery trapping for ruptured blood blister-like aneurysms: long-term results from a single centre. *Neuroradiology* 2014;56:211–17.
- [9] Ezaki Y, Takahata H, Kamada K, Baba S, Kaminogo M, et al. Aneurysmal embolization of a blisterlike aneurysm of the internal carotid artery: a case report and review of the literature. *Surg Neurol* 2006;65:628–30.
- [10] Tanoue S, Kiyosue H, Matsumoto S, Yamashita M, Nagatomi H, Mori H. Ruptured “blisterlike” aneurysm with a pseudoaneurysm formation requiring delayed intervention with endovascular coil embolization: Case report. *J Neurosurg* 2004;101:159–62.
- [11] Ogawa A, Suzuki M, Ogasawara K. Aneurysms at nonbranching sites in the supraclinoid portion of the internal carotid artery: internal carotid artery trunk aneurysms. *Neurosurgery* 2000;47:578–86.
- [12] Ji T, Guo Y, Huang X, Xu B, Xu K, Yu J. Current status of the treatment of blood blister-like aneurysms of the supraclinoid internal carotid artery: A review. *Int J Med Sci* 2017;14:390–402.
- [13] Haji FA, Boulton MR, de Ribaupierre S. Blister-like supraclinoid internal carotid artery pseudoaneurysm in a 15-year-old male: case report and review of the literature. *Pediatr Neurosurg* 2011;47:449–54.
- [14] Linfante I, Mayich M, Sonig A, Fujimoto J, Siddiqui A, Dabus G. Flow diversion with Pipeline Embolic Device as treatment of subarachnoid hemorrhage secondary to blister aneurysms: dual-center experience and review of the literature. *J NeuroIntervent Surg* 2017;9:29–33.
- [15] Mascitelli JR, Moyle H, Oermann EK, Polykarpou MF, Patel AA, Doshi AH, et al. An update to the Raymond-Roy Occlusion Classification of intracranial aneurysms treated with coil embolization. *J NeuroIntervent Surg* 2015;7:496–502.