

Endovascular treatment of an aneurysm arising from the minor limb of an upper basilar artery fenestration: illustrative case

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BACKGROUND An aneurysm arising in an upper basilar artery (BA) fenestration is extremely rare. The authors reported a case involving successful endovascular treatment of an aneurysm arising from the minor limb of an upper BA fenestration.

OBSERVATIONS A 65-year-old woman presented with an incidentally detected upper BA aneurysm arising from the minor limb of an upper BA fenestration. The irregularly shaped aneurysm was 6.0 × 2.7 mm in diameter, and the minor limb had several perforators. The aneurysm was nearly completely occluded with a catheter-assisted technique. The authors preserved both limbs of the BA fenestration. The postoperative course was uneventful, and the patient had an excellent clinical course with no neurological deficits or aneurysmal recanalization.

LESSONS The case is the first report of an unruptured aneurysm arising at the minor limb of an upper BA fenestration. In this case, the authors preserved the minor limb with endovascular treatment. The authors believe catheter-assisted coil embolization to be a feasible endovascular technique in such cases.

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KEYWORDS aneurysm; upper basilar artery fenestration; catheter-assisted technique

A basilar artery (BA) fenestration rarely occurs in the upper part of the artery. Furthermore, an aneurysm arising from an upper BA fenestration is extremely rare.

We herein report the first case of an unruptured aneurysm occurring in the minor limb of an upper BA fenestration that was treated using a catheter-assisted technique with a good clinical outcome.

Illustrative Case

A 65-year-old woman was admitted to our hospital for evaluation of an upper BA aneurysm that had been incidentally detected on magnetic resonance (MR) angiography. Digital subtraction angiography showed an aneurysm measuring 6.0 × 2.7 mm in diameter with an irregular shape, located proximal to the minor limb of the upper BA fenestration with several perforating arteries (Fig. 1). The aneurysm had an anterior

bleb. Endovascular coil embolization was selected for treatment of the aneurysm.

One week before the treatment, dual antiplatelet therapy using aspirin and clopidogrel was started. With the patient under general anesthesia, a 6-Fr guiding catheter (Roadmaster, Goodman) was placed in the right vertebral artery. Because the diameter of the minor limb was only 1.1 mm and had several perforating arteries, we used a catheter-assisted procedure to preserve the minor limb. We inserted a microcatheter (Excelsior SL-10, preshaped 45, Stryker Neurovascular) into the minor limb using a microguidewire (CHIKAI, Asahi Intecc Co. Ltd.) and then inserted another microcatheter (Excelsior SL-10, preshaped 90) into the aneurysm (Fig. 2A). Anticoagulation therapy was performed during the procedures. The aneurysm was embolized with detachable coils assisted by the microcatheter (Excelsior SL-10, preshaped 45; Fig. 2B).

ABBREVIATIONS BA = basilar artery; MR = magnetic resonance.

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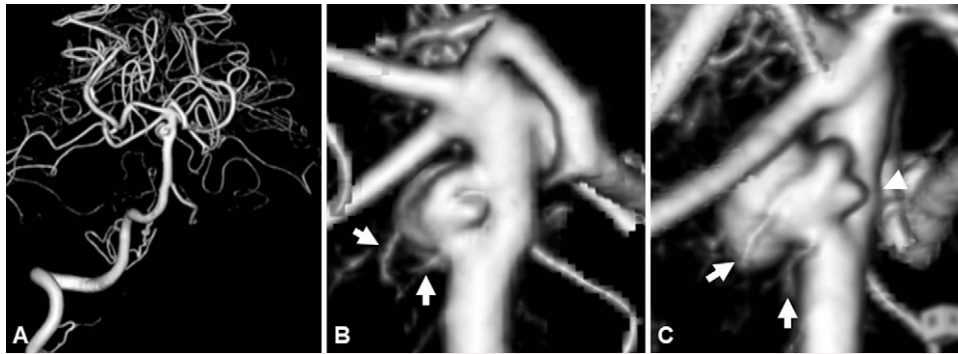


FIG. 1. Anteroposterior view (A) of three-dimensional rotational angiography of the right vertebral angiogram showing an aneurysm on the minor limb of an upper BA fenestration. Magnified anteroposterior view of panel A (B) and magnified right lateral view of panel A (C). The aneurysm projected anteroposteriorly and was 6.0×2.7 mm in diameter. Several perforators (arrows) originated from the minor limb. The anterior bleb was identified.

Postoperative angiography revealed near-complete occlusion of the aneurysm and preservation of both limbs of the fenestrated BA (Fig. 3). Diffusion-weighted MR imaging showed a small high-signal lesion in the right cerebellar hemisphere. The postoperative course was uneventful, and the patient was discharged with no neurological deficits. Dual antiplatelet therapy was continued for 1 month, followed by aspirin for 1 year. Two years after the endovascular treatment, the aneurysm was not recanalized.

Discussion

Observations

The reported incidence of BA fenestration ranges from 1.0% to 2.1% based on MR angiography^{1,2} and from 0.3% to 1.1% based on digital subtraction angiography.^{3–5} Among the three portions of the BA (upper, middle, and lower), the most frequent site of BA fenestration is the lower BA near the vertebrobasilar artery junction.^{1,3,6} In previous MR angiography studies, only 3 (1.4%) of 212² and 2 (2.9%) of 69⁵ BA fenestrations were located at the upper part of the BA. One proposed explanation of the rarity of this location is the characteristic development of the primitive BA, which

progresses by fusion of paired primitive longitudinal neural arteries, usually in the craniocaudal direction.^{1–3,7,8}

An aneurysm arising from an upper BA fenestration is extremely rare. We identified only 15 cases in the literature,^{3,9–16} including 1 case in the middle-upper part¹⁷ and our case (Table 1). Very few unruptured aneurysms have been reported, and ours is the fifth such case. In most cases, the aneurysmal neck was located at the proximal end of the fenestration. To our knowledge, this is the first case of an unruptured aneurysm arising from the minor limb of an upper BA fenestration.

Endovascular management has become the first option for treating these aneurysms.¹¹ Among 15 cases, 10 BA fenestration aneurysms were treated with endovascular procedures using simple coiling, balloon remodeling, or stent-assisted techniques (Table 1). Only our case was treated with catheter-assisted coil embolization. This technique was adopted to maintain the patency of the minor limb, which had a tiny diameter, instead of the balloon-assist or stent-assist technique. The aneurysm was successfully embolized with this method, preserving both limbs. In cases involving a vascular structure such as that in the present case, the herein-described technique may be considered an option for treatment. Zhang et al.¹⁷ reported that occlusion of the minor limb is

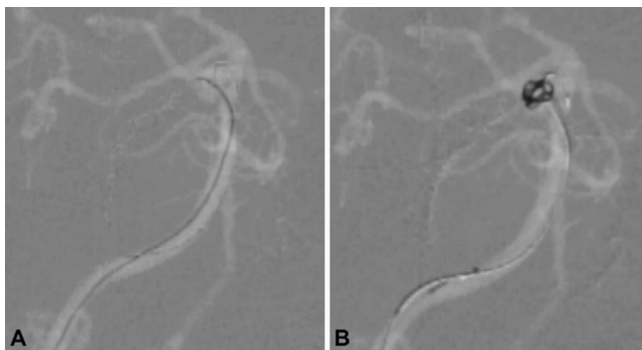


FIG. 2. Roadmap imaging of right vertebral artery angiogram, anteroposterior views. A: Another microcatheter was placed in the aneurysm after the first microcatheter was inserted into the minor limb. B: The aneurysm was embolized with a catheter-assisted technique.

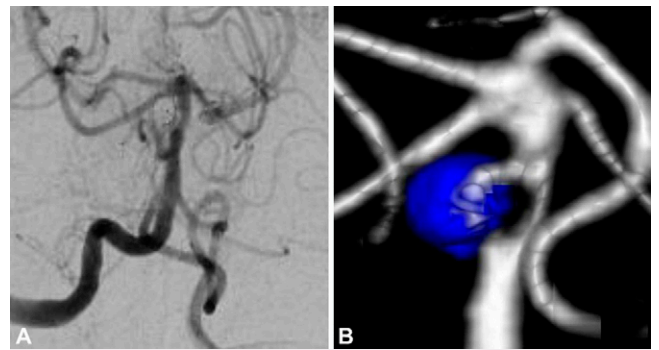


FIG. 3. Right vertebral angiography. Anteroposterior view (A) after endovascular embolization and three-dimensional rotational angiography and anteroposterior view (B) of the right vertebral artery showing near-complete occlusion of the aneurysm. Both limbs were also preserved (B).

TABLE 1. Characteristics of patients with aneurysms associated with a fenestrated distal BA

Case No.	Authors & Year	Age (yrs)/Sex	Presentation	Size of Aneurysm (mm)	Location of Aneurysm Neck	Perforating Arteries From Parent Limb	Treatment	Prognosis
1	Crompton, 1962 ¹²	ND/ND	Incidental	ND	Proximal end of fenestration	ND	ND	ND
2	Hemmati & Kim, 1979 ¹³	35/M	SAH	3	Proximal end of fenestration	ND	Conservative	GR
3	Andrew et al., 1986 ¹⁴	54/F	SAH	ND	Distal end of fenestration	ND	Wrapping	GR
4	Imaizumi et al., 1996 ¹⁵	32/M	SAH	3	Proximal end of fenestration	ND	Clipping	GR
5	Tasker & Byrne, 1997 ¹⁰	41/M	SAH	2	Proximal end of fenestration	ND	Coil embolization	ND
6	Fukushima et al., 2000 ¹⁶	59/F	SAH	4	Proximal end of fenestration	ND	Clipping	SD
7	Islak et al., 2002 ³	30/M	SAH	7	Proximal end of fenestration	ND	Coil embolization	GR
8	Islak et al., 2002 ³	41/F	Incidental	6	Proximal end of fenestration	ND	Coil embolization	GR
9	Im et al., 2007 ⁶	51/F	Incidental	9, 2 (kissing aneurysms)	Proximal end of fenestration	Small perforating arteries from both limbs	Coil embolization	GR
10	Juzskat et al., 2009 ⁹	26/M	SAH	2.6 × 1.7	Proximal end of fenestration	ND	Coil embolization	GR
11	Trivellate et al., 2016 ¹¹	52/F	SAH	ND	Proximal end of fenestration	ND	Coil/balloon remodeling	ND
12	Trivellate et al., 2016 ¹¹	54/F	SAH	ND	Proximal end of fenestration	ND	Coil/stent	ND
13	Trivellate et al., 2016 ¹¹	51/F	Incidental	ND	Proximal end of fenestration	ND	Coil/stent	ND
14	Zhang et al., 2019 ¹⁷	37/F	SAH	ND	Minor limb of fenestration	ND	Coil/stent	ND
15	Matsuo et al., 2022	65/F	Incidental	6.0 × 2.7	Minor limb of fenestration	Some perforating arteries from minor limb	Coil/double catheter	GR

GR = good recovery; ND = not described; SAH = subarachnoid hemorrhage; SD = severe disability.

relatively safe when no perforating arteries are present. However, Im et al.⁶ reported a case of small perforators originating from both the major and minor limbs of an upper BA fenestration. In the present case, the minor limb of an upper BA fenestration had several perforating arteries. Even the minor limb of the fenestrated BA should be preserved whenever an angiographically visible branch originates from the limb.

Lessons

Aneurysms at upper BA fenestrations are extremely rare. The present case is the first report of an unruptured aneurysm arising from the minor limb of an upper BA fenestration with several perforating arteries. Using a catheter-assisted technique, we attained

nearly complete occlusion of the aneurysm while preserving the minor limb, which had a tiny diameter. We believe that this method is a feasible endovascular procedure for aneurysms at upper BA fenestrations with a small parent artery, as in this case.

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Disclosures

The authors report no conflict of interest concerning the materials or methods used in this study or the findings specified in this paper.

Author Contributions

Conception and design: Hiu, Matsuo, Haraguchi, Kawahara. Acquisition of data: Hiu, Matsuo. Analysis and interpretation of data: Hiu, Matsuo, Otsuka, Haraguchi. Drafting the article: Hiu, Matsuo. Critically revising the article: Hiu, Matsuo, Ono, Izumo. Reviewed submitted version of manuscript: Hiu, Matsuo, Ono, Tsutsumi. Approved the final version of the manuscript on behalf of all authors: Hiu. Statistical analysis: Matsuo. Administrative/technical/material support: Hiu, Miyazaki. Study supervision: Hiu, Izumo, Matsuo, Tsutsumi.

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