Combined surgical and endovascular treatment of a recurrent A₃–A₃ junction aneurysm unsuitable for stand-alone clip ligation or coil occlusion

Technical note

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Recurrent aneurysms of the anterior circulation that are distal to the anterior communicating artery (ACoA) but proximal to the callosomarginal–pericallosal bifurcation can pose a treatment challenge. The authors present one such case, in which the patient was treated with pericallosal artery–pericallosal artery (PerA–PerA) side-to-side bypass, followed by endovascular obliteration of the proximal A₃ parent vessel. This patient, in whom an ACoA aneurysm had been treated with clip ligation 5 years previously, presented with a new, mid-A₃, right-sided aneurysm with the outflow artery arising from the dome of the lesion.

The treatment plan included two steps: an interhemispheric transcallosal approach for PerA–PerA side-to-side anastomosis; and endovascular coil embolization of the right A₃ branch feeding the aneurysm. Postprocedure angiography demonstrated no ipsilateral aneurysm filling and excellent bilateral distal outflow from the anterior cerebral artery (ACA).

The use of PerA–PerA side-to-side bypass for the treatment of an ACA aneurysm, followed by parent vessel occlusion, offers an elegant solution for the treatment of A₃ aneurysms that are not amenable to stand-alone clip ligation or coil occlusion. Such combined methods are invaluable in the management of complex cerebral aneurysms.

KEY WORDS • anterior cerebral artery aneurysm • intracranial bypass • intracranial coil embolization

Distal revascularization followed by parent vessel ligation for the treatment of aneurysms has been well described.^{10–13,15} For anterior circulation aneurysms, this method typically requires a local donor vessel such as the superficial temporal artery¹⁶ or a saphenous vein or radial artery interposition graft.^{3,14} Proximal vessel sacrifice is usually performed after a viable bypass is created.

In this report, we describe a patient in whom the aneurysm was distal to the ACoA and proximal to the bifurcation of the PerA–CMA. This uncommon anatomical location permits an elegant solution without the need for exogenous donor artery or vein harvest, or the disruption of normal flow distal to the aneurysm. We believe this unique treatment strategy warrants detailed description because it is a reasonable multimodality technique in special circumstances.

Abbreviations used in this paper: ACA = anterior cerebral artery; ACoA = anterior communicating artery; CMA = callosomarginal artery; PerA = pericallosal artery.

CLINICAL MATERIAL AND METHODS

This 51-year-old woman with an ACoA aneurysm that had been treated with clip ligation 5 years previously presented with new onset of chronic headaches (Figs. 1 and 2). Angiography revealed a new right-sided aneurysm located on the A₂ segment of the ACA, with the outflow artery arising from the dome (Fig. 1). The treatment plan included two steps, as follows: 1) a bifrontal interhemispheric approach for PerA–PerA (A₃–A₃) in situ side-to-side anastomosis (Fig. 2); and 2) endovascular coil embolization of the right A₂ branch that fed the aneurysm.

RESULTS

Temporary intraoperative clip occlusion of the ipsilateral A₂ segment proximal to the bypass demonstrated good distal filling of the ipsilateral PerA and CMA from the contralateral ACA circulation. Postoperative angiography demonstrated a patent ACoA and subsequent filling of the aneurysm from the bilateral ACA circulation (Fig. 3). Gu-

Fig. 1. Three-dimensional angiographic image demonstrating a broad-based, right-sided, distal A_2 aneurysm incorporating the distal A_2 and the A_2 - A_3 junction.

glielmi detachable coil embolization was performed 4 days after the bypass procedure. Postprocedure angiography demonstrated no aneurysm filling from the ipsilateral A_1 , sluggish partial refilling from retrograde A_2 flow through the anastomotic connection, and excellent bilateral distal ACA flow (Figs. 4 and 5). The aneurysm is expected to thrombose progressively due to sluggish flow. The patient tolerated parent vessel and aneurysm embolization with no new neurological deficits.

DISCUSSION

Unilateral treatment with either coil embolization or direct clip ligation is the standard therapy for aneurysms. Nevertheless, factors such as previous clip placement, a broad-based aneurysm neck, circumferential parent vessel involvement of the lesion, and a location distal to the ACoA rendered single-therapy treatment untenable in this case. Use of extracranial-intracranial or in situ bypass procedures in the treatment of complex aneurysms has been well described in the literature.^{2,3,9-12} Although anterior circulation aneurysms distal to the ACoA and proximal to the CMA-PerA bifurcation are relatively rare,^{6,7} this technique may also be applicable to complex aneurysms of the A_1 segment, the A_1 - A_2 junction, or the ACoA complex.

To our knowledge, the use of an in situ PerA-PerA bypass followed by coil embolization of a recurrent PerA aneurysm has not been previously described in the peer-reviewed literature. Anson, et al.,¹ have detailed the use of an A_3 - A_3 side-to-side bypass followed by direct clip ligation at the time of initial surgery for a PerA aneurysm incorporating the parent vessel. Javedan, et al.,¹⁰ presented a patient with a giant ACoA aneurysm treated at initial presentation with bypass and coil occlusion. Yokoh, et al.,¹⁷ and Ito⁸ have reported on the use of complex bypass anastomosis techniques in the ACA circulation.

Fig. 2. Intraoperative photographs. *Upper:* View showing preparation of an A_2 - A_2 bypass, which requires dissection of the bilateral PerAs, repositioning of the vessels side by side, and placement of a plastic dam beneath them as a working platform. *Center:* After arteriotomies are fashioned, the back walls of the vessels are sutured together with running 10-0 nylon sutures. *Lower:* View obtained after completion of the anastomosis, with temporary clips still in place. Note that a single temporary clip can occlude both PerAs.

In our case, the recurrent aneurysm would have required reopening a previous dissection, with the undesirable risk of navigating through surgical scar tissue and adhesions. Because the surgical avenue for the in situ anastomosis was separate from the previous craniotomy, microdissection of the PerAs was unimpeded by scar tis-

Fig. 3. Angiographic projections obtained after the A₃–A₃ anastomosis, revealing aneurysm filling on the right (A) and left (B) internal carotid arteries from bilateral A₁ segments. Note that the bypass site is difficult to identify.

sue. Although clip ligation of the parent vessel is feasible, complementary use of endovascular coil embolization circumvented the need for revision surgery and its potential risks.⁵

The basic surgical procedure for the anastomosis is illustrated in Fig. 2. It is important to test the patency of the anastomotic connection at the time of surgery (before embolization of the parent vessel), because it is difficult to assess whether the anastomosis is viable by standard angiography alone. In our case example, a temporary clip on the right A₃ segment proximal to the anastomosis revealed

Fig. 4. Posttreatment angiography performed with selective injection of the right A₂ segment after embolization demonstrates filling of the proximal right A₂ segment, but complete obliteration of the distal A₂ and the aneurysm.

excellent bilateral A₃ blood flow distal to the anastomosis by using Doppler flowmetry, indicating a patent bypass. We favor early parent vessel occlusion following bypass to encourage the development of the bypass itself.^{4,11}

Fig. 5. *Left:* Right internal carotid artery injection obtained after right A₂ and aneurysm coil obliteration, demonstrating no filling of the distal right A₂ during the early arterial phase. The ACoA is patent; note the cross-filling from the left A₃ to the right A₃ (arrow). There is early reflux through the right A₃ segment proximal and distal to the anastomosis. *Right:* Late arterial phase image demonstrating prominent bilateral ACA opacification. Note that the right A₂ and A₃ segments now have retrograde filling back to the embolized segment (arrows). There is some slow, residual filling of the aneurysm because of this retrograde flow (arrowheads).

CONCLUSIONS

The use of PerA–PerA side-to-side bypass for the treatment of a wide-necked, recurrent, A₂–A₃ junction ACA aneurysm, followed by parent vessel occlusion, offers an elegant solution for the treatment of A₂ aneurysms that are not amenable to primary clip ligation or coil occlusion. As this case demonstrates, combined procedures in which microvascular bypass and endovascular coil embolization are used are invaluable in the management of complex cerebrovascular lesions.

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