Successful “blind-alley” formation with bypass surgery for a partially thrombosed giant basilar artery tip aneurysm refractory to upper basilar artery obliteration

Case report

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Application of a clip to the upper BA is an established strategy for treating giant aneurysms at the BA bifurcation that cannot be treated by direct application of a clip to the aneurysm itself.²⁶,⁷ Accomplishment of complete aneurysmal thrombosis can virtually eliminate the risk of fatal rupture and may also reduce the compression force to the surrounding structures. Many cases of successful treatment have been reported, but in some cases clip application to the BA does not result in complete occlusion and the patient’s condition continues to deteriorate.⁷,⁹ The prognosis in such cases is poor, and to our knowledge there have been no detailed reports of successful additional surgical treatments. We report a case treated by surgical obliteration of the unilateral PCA and PCoA and construction of an STA–PCA anastomosis after an ineffective attempt at placement of a BA clip. Complete occlusion and dramatic shrinkage of the aneurysm were attained.

Case Report

History and Examination. This 29-year-old man presented with a history of progressive left oculomotor nerve palsy and transient attacks of right hemiparesis. An MR imaging study demonstrated a mass compressing the midbrain as well as remarkable perifocal edema (Fig. 1A). Digital subtraction angiography and 3D CT angiography revealed a partially thrombosed giant aneurysm arising from the BA bifurcation (Fig. 1B and C).

First Operation and Postoperative Course. Because application of a clip to the neck of the aneurysm seemed to be infeasible, surgical obliteration of the BA was planned. A balloon occlusion test was performed and a clip was placed on the BA via the right subtemporal approach. In the operative field, the aneurysm wall appeared thick and sclerotic.

After surgery, aspirin (100 mg/day) was prescribed to prevent thromboembolic complications. The patient’s left oculomotor nerve palsy gradually subsided and the transient attacks of left hemiparesis noted at admission never reoccurred after surgery. Neuroimaging studies revealed a reduction in the size of the blood flow cavity and alleviation of the perifocal edema (Fig. 2). The patient was discharged from the hospital and instructed to take aspirin (50 mg/day) for 2 months after surgery.

Three months after surgery, the patient developed rapid exacerbation of the left oculomotor palsy. An MR imaging study demonstrated a minor hemorrhage from the posterior aneurysm wall (Fig. 3A). Persistent intraaneurysmal blood flow via the bilateral PCoAs was confirmed using DS angiography (Fig. 3B), and it was determined that the left PCoA–PCA junction was involved in the aneurysm lumen (Fig. 3C).

Second Operation and Postoperative Course. Because incomplete aneurysmal thrombosis was attributed to the persistent blood flow coming from the bilateral PCoAs and flowing toward the left PCA, a procedure for splitting the flow of the left PCA was designed (Fig. 4). The left PCA and the PCoA were identified via the left subtemporal ap-
Approach. An STA–PCA anastomosis was performed, and the left PCA and PCoA were clipped near the aneurysm neck. Aspirin treatment (100 mg/day) was reinstituted and was continued for 4 months. The patient's ptosis resolved within 2 weeks after surgery. Neuroimaging examinations revealed complete aneurysmal thrombosis, a patent bypass graft, and remarkable relief of the perifocal edema (Figs. 5 and 6A). Although left-eye mydriasis and moderate impairment of adduction remained, the patient returned to his daily life. An MR imaging study performed 7 months after surgery showed complete shrinkage of the aneurysm and disappearance of the perifocal edema (Fig. 6B). These findings were reconfirmed 2 years after the treatment.

**Discussion**

Partially thrombosed giant BA tip aneurysms are among the most challenging lesions in the neurosurgical field. In addition to posing the risk of fatal rupture, they can lead to progressive neurological deficits by compressing vital structures, and the prognosis associated with their natural course has been reported to be extremely poor. In most cases, direct application of a clip to the aneurysm neck is impossible due to the aneurysm’s large size and stiff wall as well as the difficulty in detecting the critical perforating arteries. Coil embolization is infeasible because the coils can migrate into the thrombus, leading to recanalization of the lumen and progressive enlargement of the aneurysm.4-5,8 Application of a clip to the BA (Hunterian ligation) constitutes a promising therapeutic approach for giant aneurysms of the upper BA that are not amenable to direct clip application.2,6,7 In some cases, obliterating the direct inflow from the basilar trunk can lead to thrombosis of the aneurysm and reduction in its size. It is a serious problem, however, that some lesions are refractory to this treatment, and the prognosis is extremely poor in such cases.7,9

The optimal therapeutic strategy following an unsuccessful BA clip application is unclear. Endovascular treatment is no longer feasible because the main access route has been obliterated. Reconsideration of direct clip placement with or without hypothermic circulatory arrest may be a choice in nonthrombosed or minimally thrombosed lesions, but this option is not possible in cases in which a multilayered intraaneurysmal concentric thrombus renders the patient’s neck noncompliant.4 To our knowledge, there have been no detailed reports of successful additional surgery after ineffective BA obliteration for partially thrombosed giant BA tip aneurysms that were not amenable to direct clip placement.

In the present case, excellent results were obtained by making the partially thrombosed aneurysm lumen a “blind alley.” The strategy of “complete trapping” could not be used because it would have sacrificed the vital perforating vessels originating from the BA tip. We speculate that the stagnation of the blood flow allowed for complete thrombosis of the aneurysm while preserving the perforating ves-
sels, resulting in the remarkable shrinkage that was subsequently obtained. Revascularization of the PCA might have been unnecessary if leptomeningeal collateral flow could have been confirmed by balloon test occlusion of the PCA. We chose the prophylactic STA–PCA anastomosis rather than the occlusion test which would have entailed a substantial risk of thromboembolic complications due to the proximity of the thrombosed aneurysm. The single STA graft supplied sufficient blood flow for the unilateral PCA territory.

There are some limitations to this blind-alley strategy. First, due to the risk of rupture this method is not feasible for nonthrombosed or minimally thrombosed aneurysms with thin walls. In the present case, neuroimaging examinations demonstrated that thick layers of thrombus surrounded the blood flow lumen at the fundus, and the wall around the neck of the aneurysm was confirmed intraoperatively to be sclerotic and stiff. Therefore, we considered the perimural hemorrhagic change found at recurrence to be a rupture of the intramural bleeding from vascular channels within the wall rather than a typical aneurysm rupture (direct communication between the luminal aspect and the subarachnoid space). This blind-alley strategy should be considered only when the absence of a thin wall can be confirmed with confidence. Second, aneurysmal shrinkage is not always achieved after complete thrombosis. When a patient’s symptoms continue to increase because of persistent compression of vital structures, the only way to reduce

Fig. 3. Images obtained after the recurrence of complete oculomotor nerve palsy. A: An MR image demonstrating minor hemorrhage (arrow) and the surrounding edema. B: Two DS angiograms showing the persistent intraaneurysmal blood flow (arrowheads) via the bilateral PCoAs. C: A 3D-rotational angiogram revealing that the junction of the left PCoA (arrow) and PCA is involved in the aneurysm lumen (arrowhead). ACA = anterior cerebral artery; ICA = internal carotid artery; Lt. = left; MCA = middle cerebral artery.

Fig. 4. Schematic drawings illustrating blind-alley formation by flow splitting. A: Prior to the second surgery, intraaneurysmal blood flow is shown coming from the bilateral PCoAs and flowing toward the left PCA. B: After the flow-splitting procedure and obliteration of both the left PCA and the left PCoA, the partially thrombosed aneurysm lumen becomes a “blind alley.” SCA = superior cerebellar artery.
the mass effect may be direct removal of the intraaneurysmal thrombus. However, it should be emphasized that attaining total thrombosis is the first step in treating partially thrombosed giant aneurysms. When clip application to the upper BA is unsuccessful, blind-alley formation by flow splitting may be a valid choice in certain cases.

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