The Hybrid Neurosurgeon: The Japanese Experience

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Introduction

In Japan, hybrid neurosurgeons who perform both open surgical clipping as well as endovascular embolization for the treatment of intracranial aneurysms are common. Over 90% of Japanese board-certified neuroendovascular therapists are board-certified neurosurgeons. Reasons for this situation include the fact that cerebral angiography and management of stroke patients are primarily performed by neurosurgeons. Although many Japanese neurosurgeons can perform surgical clipping of middle cerebral artery (MCA) or internal carotid-posterior communicating artery aneurysms and coil embolization of cerebral aneurysms using simple techniques, only a limited number of neurosurgeons are able to perform surgical clipping and endovascular procedures for anterior communicating artery (A-com), paraclinoid internal carotid artery (ICA), or posterior circulation aneurysms using both treatment modalities equally and safely.

Materials and Methods

The senior author's personal experience of more than 500 cases each of surgical clipping and endovascular embolization over the past 25 years included 110 cases of basilar tip aneurysms and 104 cases of paraclinoid ICA aneurysms.

Results

The safety and efficacy of both treatments appears to be the same, while the durability of surgical clipping is superior to

that of endovascular embolization. Among the 110 basilar tip aneurysms, 18 patients were treated by surgical clipping and 94 were treated by endovascular embolization. The initial results of endovascular therapy seemed to be better than those of surgical clipping, although the rate of retreatment was higher (Table 1). Among the 104 cases of paraclinoid ICA aneurysm, 23 patients were treated by surgical clipping and 81 were treated by endovascular embolization. The results of both treatments seemed to be same, while surgical clipping had apparently good long-term durability (Table 2).

Illustrative Cases

Case 1 A 67-year-old woman had a non-ruptured large basilar tip aneurysm associated with Moyamoya disease. The bilateral posterior cerebral arteries (PCA) were incorporated in the aneurysm (Fig. 1a). As surgical clipping for such an aneurysm was thought to be extremely difficult, horizontal stent-assisted coil embolization via the right posterior communicating artery was performed. A micro-catheter was

Table 1 Treatment of basilar tip aneurysms

	Clipping (16 cases; 1 large)	Coil embolization (94 cases; 9 large)
Morbidity	1/16 (6.3%)	2/94 (2.1%)
Mortality	1/16 (6.3%)	3/94 (3.1%)
Late re-rupture	0	2/94 (2.1%)
Retreatment	0	10/94 (10.6%)

Table 2 Treatment of paraclinoid IC aneurysms

	Clipping (23 cases; 8 large)	Coil embolization (81 cases; 11 large)
Morbidity	2/23 (8.7%); minor	4/81 (4.9%)
Mortality	0	0
Regrowth	0	3/81 (3.7%)
Retreatment	0	10/81 (12.3%)

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advanced to the right P-com and turned medial to the right P1 of PCA, across the aneurysmal orifice, ultimately reaching the left P2 of the PCA. A Neuroform Atlas stent (Target Therapeutics, CA, USA) was deployed across the entire orifice (Fig. 1b). Coil embolization was then completed without significant difficulty. Complete obliteration of the aneurysm with preservation of the bilateral PCA was achieved (Fig. 1c). The patient had a good clinical course without any neurological deficits.

Case 2 An 80-year-old woman had a left IC-ophthalmic large aneurysm (Fig. 2a) that demonstrated remarkable recanalization and regrowth following incomplete coil embolization (Fig. 2b). Three years later, she became blind due to severe compression of the bilateral optic nerves.

Case 3 A 41-year-old woman had a large left IC-ophthalmic aneurysm with mass effect (Fig. 3a). She had bilateral visual

Fig. 1 (a) 3D CTA demonstrating a non-ruptured large basilar tip aneurysm associated with Moyamoya disease. The bilateral posterior cerebral arteries (PCAs) are incorporated in the aneurysm. (b) A

Neuroform Atlas stent was deployed across the entire orifice. (c) A post-embolization angiogram demonstrating complete obliteration of the aneurysm with preservation of the bilateral PCAs

Fig. 2 (a) MRI demonstrating a left IC-ophthalmic large aneurysm. (b) MRI obtained 3 years later showing remarkable recanalization and regrowth of the aneurysm following incomplete coil embolization

Fig. 3 (a) 3D CTA demonstrating a large left IC-ophthalmic aneurysm. (b) An intraoperative photograph demonstrating an aneurysm and the left optic nerve through standard left pterional craniotomy. (c) The aneurysm was punctured, and suction decompression was performed.

(d) Reconstructive clipping was performed using three fenestrated clips, sparing all branches. (e) Postoperative 3D CTA demonstrating complete obliteration of the aneurysm with preservation of the ICA flow

field defects. Through standard left pterional craniotomy, the aneurysm and left optic nerve were exposed (Fig. 3b). After extradural one-block anterior clinoidectomy, the proximal IC and ophthalmic arteries were secured. Temporary clips were applied to the proximal IC, distal IC, and ophthalmic artery. The aneurysm was punctured, and suction decompression was performed. After decompression, the superior hypophyseal artery was dissected (Fig. 3c). Reconstructive clipping was performed using three fenestrated clips while sparing all of the branches (Fig. 3d). The patency of the branches was confirmed by indocyanine green video-angiography. Postoperative three-dimensional computed tomography angiography (3D CTA) revealed complete obliteration of the aneurysm with preservation of the ICA flow (Fig. 3e). Her right-side visual field defect improved after the clipping.

Discussion

In training programs in Japan for hybrid neurosurgeons, trainees start their training program as a resident in the department of neurosurgery, where they learn about general neurosurgical practices and perform cerebral angiography as well. The trainees finish the programs for both neurosurgery and neuro-endovascular treatment simultaneously, after which they take examinations and are finally certified for both programs at the fifth year of the senior resident program. Thereafter, they gain further experience in both treatments. While Japanese hybrid neurosurgeons who perform both open surgical clipping and endovascular embolization for the treatment of intracranial aneurysms are common, relatively few neurosurgeons are able to perform surgical clipping and endovascular procedures for difficult cerebral aneurysms, such as those of the A-com, paraclinoid ICA, or posterior circulation. Ideally, hybrid neurosurgeons need to have skills to treat such difficult aneurysms using both treatment modalities equally and safely.

The senior author has performed more than 500 cases each of surgical clipping and endovascular embolization over the past 25 years. The safety and efficacy of both treatments appears to be the same, while the durability of surgical clipping is superior to that of endovascular embolization [1–7]. Technical advances in coils and intracranial stents has meant that the treatment choice for cerebral aneurysms has changed over the years, especially that for basilar tip aneurysms. Over the past 15 years, the frequency of surgical clipping for basilar tip aneurysms has decreased, and the procedure may eventually be abandoned for this type of

aneurysm. However, surgical clipping still offers several advantages in the treatment of paraclinoid ICA aneurysms. In the senior author's personal experience of treating paraclinoid IC aneurysms both surgically and endovascularly, the results of surgical clipping seemed to be the same as endovascular treatment with good long-term durability. Even when using a flow-diverting stent, endovascular treatment is still associated with some morbidity or the recanalization/regrowth of aneurysms.

According to the senior author's personal impression, neurosurgeons tend to overestimate the efficacy and safety of endovascular treatment instead of long-term durability, while endovascular interventionists tend to exaggerate the invasiveness of modern surgical clippings. Endovascular interventionists are overconfident regarding the feasibility of the treatment, as this approach can be easily performed with the aid of satisfactory initial morphological results, although the long-term durability of the endovascular treatment seems less satisfactory than that of clipping. Hybrid neurosurgeons can make reasonable decisions concerning the choice of treatment for cerebral aneurysms, as they perform both treatments and understand the benefits and drawbacks of each modality [8].

Conclusions

Although many Japanese neurosurgeons can perform surgical clipping of MCA or IC-P-com aneurysms and coil embolization of cerebral aneurysms using simple techniques, only a limited number of neurosurgeons are able to perform surgical clipping and endovascular procedures for A-com, paraclinoid ICA, or posterior circulation aneurysms. Ideally, hybrid neurosurgeons should be able to treat such difficult aneurysms using both treatment modalities equally and safely, allowing them to make reasonable decisions on the choice of treatment for cerebral aneurysms.

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