Endovascular Management of Posterior Cerebral Artery Aneurysms

Initial Experience

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Summary

The purposes of this study were to evaluate the efficacy and safety of the endovascular management of posterior cerebral artery aneurysms and compare the efficacy and safety of selective aneurysmal coiling and parent artery occlusion.

We reviewed all cases with cerebral aneurysms and attention was paid to the patients with posterior cerebral artery aneurysms. Among 550 aneurysms, eight aneurysms in eight patients were located on the posterior cerebral artery, three of which presented with SAH, whereas five presented with different degrees of headache. Seven were located at the P2 segment and one at the P3 segment. One was a giant serpentine aneurysm, two were giant sac aneurysms, two were large and three were small.

All aneurysms were successfully treated, five with selective aneurysmal coiling and three with parent artery occlusion. Two patients presenting with headache with giant aneurysms had suffered an aggravated headache for two weeks which then resolved. Others had an uneventful recovery. All patients were followed from 12 months to 56 months. Four selective aneurysmal coiling aneurysms received digital subtraction angiography, two of which needed another treatment and one was treated with parent artery occlusion, one of which recanalized slightly and one of which had further thrombosis. No re-bleeding or any other symptom occurred.

Whether selective aneurysmal coiling or parent artery occlusion was performed, endovascu-

lar management of PCA aneurysms was a safe and effective method. Under some conditions, parent artery occlusion was better than selective aneurysmal coiling.

Introduction

Posterior cerebral artery aneurysm (PCAA) is an uncommon lesion accounting for 0.7%~2.3% of all intracranial aneurysms and it has its own characteristics such as: usually involving young patients, predisposing to large and giant aneurysms, comorbid with another vascular abnormality, most locating at the P2 segment¹⁻¹¹. Because the posterior cerebral artery is close to the brain stem, cranial nerves and with many perforating arteries, direct surgical management of the posterior cerebral artery is challenging⁶⁻¹². With the development of neurointervention, there was a trend to manage this lesion with endovascular methods such as occlusion of the parent artery or selective occlusion of the aneurysm^{1-5,13-16}. This study retrospectively reviewed the cases with posterior cerebral artery aneurysm treated endovascularly to evaluate the safety and efficacy of the technique.

Materials and Methods

Patients

There were eight patients (male:female=6:2) with eight PCAAs out of 550 patients presenting with intracranial aneurysms from Septem-

ber 1996 to September 2006, aged from 12 to 60 years with a average of 39.3 years. Three patients presented with subarachnoid hemorrhage (SAH) all with grade II according to the Hunt & Hess grading and the other five patients had different degrees of headache. There was no obvious nervous deficit. Among eight aneurysms, seven located at the P2 segment and one at the junction of P3 segment. Of three ruptured aneurysms, two were small saccular (diameter <10 mm) and one was large saccular (10 mm < diameter < 25 mm); of unruptured five aneurysms, one was giant serpentine (diameter > 25 mm), two were giant saccular, one large saccular and one small saccular.

Treatment

Digital subtraction angiography (DSA) was performed for all patients before treatment. Under the principle of treatment to remove the lesion and keep the parent artery patent, an individualized strategy was devised for every patient combining the characteristics of the aneurysm with the wishes and physical condition of patients. Among eight patients, three received parent artery occlusion (PAO) including one with a serpentine aneurysm and two with giant saccular aneurysms, and five received selective aneurysmal coiling (SAC).

All procedures were performed under general anesthesia and full heparinization. A 6F guiding catheter (Envoy, Johnson & Johnson) was approached through the femoral artery. A microcatheter (Excelsior SL-10, Bostonscientific) was introduced into the aneurysms (SAC) or at 2 mm proximal to the aneurysm (PAO) under guidance of a microguiding wire (Transend, Bostonscientific). Controllable coils (GDC or Matrix coil, Bostonscientific) were deployed one by one until the disappearance of the aneurysm. The heparinization was not reversed. Before PAO, no balloon test occlusion (BTO) was performed and after PAO angiography of the ipsilateral internal carotid artery was made to verify the collateral blood supply.

Follow-up

All patients were followed up by letters, telephone, e-mail or outpatient visit. DSA was scheduled for patients with selective coiling. And the patients treated with PAO and with the result of definite disappearance of the aneurysm from the circulation were examined only with CT or MRI.

Results

Five aneurysms with selective coiling all obtained near complete occlusion and parent arteries were patent. Three aneurysms with PAO definitely separated from the circulation. Obvious collateral supply from the anterior or middle cerebral artery was found in two of three patients and was not found in the other one (Figure 3).

There was no complication for any patient. Three patients with SAH had an uneventful recovery with GOS 0. Among five patients with headache, three resolved immediately after PAO and two patients had a two-day relief, and then presented with aggravated headache. CT scan found thrombosis inside the aneurysms and there was no sign of bleeding. The symptom resolved completely 14 days later after medication with mannitol and dexamethasone.

All patients were followed from 12 to 56 months. There was no bleeding or rebleeding and the symptom of headache resolved totally for all patients. Among four of five patients with SAC followed up with DSA, further thrombosis occurred in one (Case 5) and recanalization was found in three aneurysms, two of which were major recanalization (Case 1 and Case 7) and one was slight recanalization (Case 2). One received PAO (Case 7) and the other refused (Case 1). There was no angiographic follow-up for Case 6. All patients with PAO were followed with MRI. Aneurysm volume decreased in all patients.

Illustrative cases

Case 7: A 50-year-old man presented with headache and an aneurysm of 10.8 mm*12.5 mm located at P3 segment was found on DSA. The aneurysm was selectively coiled with matrix coils and the headache relieved completely. Another DSA was performed two years after treatment. It was found that the aneurysm had recurred completely. Two weeks later, the shape of the aneurysm had changed greatly just before retreatment. Then PAO was carried out and the patient had an uneventful recovery without complications.

Case 5: A 30-year-old man presented with SAH with a P2 segment aneurysm of 13.4 mm*11.6 mm treated with SAC. The aneurysm was occluded nearly completely and there was no complication. DSA six months later found further thrombosis.

Figure 1 Case 7, 50-year-old man with right posterior cerebral artery aneurysm A) A-P angiography pre-treatment with P3 segment aneurysm. B) A-P angiography post selectively coiling, near complete occlusion. C) A-P angiography two years later demonstrating major recurrence. D) Another A-P angiography two weeks after follow-up DSA showing different shape. E) A-P angiography post parent artery occlusion. F) Fluoroscopy after the second treatment. G) Superselective angiography of the posterior cerebral artery before the second treatment. H) Late term of the ipsilateral internal carotid artery showing backwards opacification of the posterior cerebral artery.

Case 4: A 12-year-old girl suffered headache from a giant PCAAn locating at the junction of the P1 segment and P2 segment. PAO was performed and headache was relieved. But two days later, an aggravated headache occurred. CT scan disclosed thrombosis inside the aneurysm. The girl was managed with mannitol and dexamethosone and the symptom resolved completely two weeks later.

Discussion

PCA was one of most frequently involved locations by dissection lesion^{1,3,4,13-15,19}. But few pathologic examinations were available and the dissections were usually recognized according to angiographic findings. The most typical angiographic findings of vessels with dissection include vessel stenosis/occlusion, delayed filling of the parent artery beyond the aneurysm, and the pathognomonic, but rare aspect of a double

lumen with visualization of both true and false channels¹⁷⁻²⁰. Dissecting aneurysms also appear as saccular focal dilations or elongated ovoids, usually parallel to the axis of the artery and saccular focal dilation, especially if giant, can mimic a true saccular aneurysm¹⁴. Morphologic changes in giant/large aneurysms have been shown in some lesions in which repeated angiograms were performed^{17,20}. The lesions defined in the literature as fusiform, dolichoectatic, dissecting, serpentine, and/or pseudoaneurysms, often reported as different entities, seem to be the same kind of lesion¹⁷. In our series, angiographic finding in four patients were in accordance with dissecting aneurysms. Especially for Case 7, though it was treated as a saccular aneurysm, the two repeated follow-up angiograms revealed it was a dissecting lesion (Figure 1).

Removal of the lesion maintaining the normal circulation or with occlusion of the parent

Figure 2 Case 5, 30-year-old man with a right posterior cerebral artery aneurysm. A) A-P angiography before treatment. B) A-P angiography after selective coiling showing near complete occlusion. C) A-P angiography 6 months after treatment demonstrating total occlusion.

vessel were the two most common modalities of treating PCAAn by endovascular management or by surgical approach and there was no significant difference in these two modalities as regards efficacy and safety^{1-11,13-16}.

Ferrante et Al summarized the cases managed with direct surgery before 1994 and found whether keeping parent artery or not did not influence the prognosis¹. Several available reports on endovascular management of PCAAn did not show that SAC had a predominant superiority to PAO^{2-5,13-15}. These findings were mainly due to the microanatomy of the posterior cerebral artery. According to a study by Zeal

and Rohton¹², branches of the PCA had many anastomoses: anastomosis between branches of thalamoperforating arteries; anastomosis between the posterior choroidal artery and the anterior choroidal artery; anastomosis between the long circumflex artery and the superior cerebellar artery; the posterior pericallosal artery and the pericallosal artery of the anterior cerebral artery; anastomosis between branches of the inferior temporal arteries and branches of the middle temporal arteries of the middle cerebral artery and anastomosis between cortical branches of the posterior cerebral artery and cortical branches of the middle

Figure 3 Case 4, 12-year-old female patient with a right posterior cerebral artery aneurysm. A) A-P angiography before treatment showing unclear right posterior cerebral artery. B) A-P angiography after parent artery occlusion. C) Lateral angiography of the ipsilateral internal carotid artery before treatment. D) No obvious collateral in lateral angiography of the ipsilateral internal carotid artery after treatment.

Table1 Clinical and aneurysm characteristic of eight patients with posterior cerebral artery aneurysms

No/Sex/age	Aneurysm type/size	Presentation	Treatment	Complication	Angiography follow-up/result
1/M/58	Dissection/small	SAH	SAC	No	Yes/MR
2/F/33	Sac/large	SAH	SAC	No	Yes /SR
3/M/32	Serpentine/giant	Headache	PAO	No	No
4/F/12	Dissection /giant	Headache	PAO	No	No
5/M/30	Sac/small	SAH	SAC	No	Yes /FT
6/M/60	Sac/small	Headache	SAC	No	No
7/M/50	Sac/large	Headache	SAC	No	Yes /MR
8/M/39	Dissection /giant	Headache	PAO	No	No

MR: major recanalization; SR: slight recanalization; FT: further thrombosis

cerebral artery. On most occasions, these anastomoses promise enough collateral blood supply, but sometimes sacrifice of the parent vessel can lead to ischemic complications presenting with paresis and visual field defect^{4,5,7}. So it is very important to evaluate the collateral blood supply before PAO.

Until now, there has been no generally accepted and promising method. For a perforating artery, BTO had false positive results and also there was a report of false negative results⁴, which limited the use of BTO. Many operators never use BTO^{2,5}. If the PAO was the only choice of treatment and the patient received the risk in our series, we performed the PAO directly without BTO. Fortunately, there was no complication, though no improved collateral supply for Case 4. Maybe the existing adaptive collateral supply from the ICA promised enough blood.

Some studies evaluated the collateral supply of middle cerebral artery with selective Wada test^{14,16,21}. This needs further investigation to verify whether this method can be used in the posterior cerebral artery. In our opinion and according to Van Rooij², the most promising method was that collateral arteries are found in angiography of the ipsilateral internal carotid artery after experimental occlusion of the PCA and the adaptive collateral supply existed before treatment. If there was not enough collateral supply, caution must be exerted before occluding the parent artery.

Indications for selective coiling and parent artery occlusion are uncertain. In the early stage of our practice, all saccular aneurysms or referred to as "saccular aneurysms" were treated with SAC. Nowadays, attention must be paid to the etiology of lesions. If the lesion was thought of as a dissection, PAO was selected. For saccular aneurysms, if the parent artery cannot be preserved due to a wide neck with a small parent vessel, PAO was selected. SAC was chosen for small/large saccular lesions with narrow necks. Hallacq et Al. occluded the parent artery for all P2 segment aneurysms and obtained a good outcome⁵. Until now there has been no generally accepted standard on the decision to treat strategy. Which modality was chosen mainly depended on the characteristic of aneurysms and the operator's understanding of lesions. Theoretically the best way is selective coiling of aneurysms keeping the parent artery patent. But problems still exist such as aneurysmal rupture during the procedure, recurrence or rebleeding after embolization, accidental coil prolapse and unimproved occupying effect¹⁻⁴. The effect of PAO on removing aneurysms from the circulation was definite, eliminating the probability of aneurysm recurrence. But this carried the risk of ischemic complications which accounted for 0%-25% in the literature^{1,5,13-15}. Among four patients receiving DSA follow-up in our series, three recanalized and two needed retreatment. Li et Al. reported a death from rebleeding after selectively

coiling⁴. Though these results were different from the reports of Ciceri³ and Van Rooij², they indicate we must pay much attention to recanalization after endosaccular coiling. Four PAOs, including the first three treatments and one second treatment, in our series had no complications, though only three had obvious collateral blood supply. The transient aggravation of headache in two patients may be due to thrombosis inside the aneurysm which led to increased aneurysmal volume²². According to our experience of a small number of cases, selective aneurysmal coiling and parent artery occlusion were both safe and effective methods to manage PCAAn. From long-term effects, PAO was better, but more cases are needed to

confirm this finding. Now our strategy is that aneurysms located at the P1 segment and P2 segment or distal with small necks and small size are selectively coiled and other lesions treated with PAO.

Conclusions

Selective aneurysmal coiling and parent artery occlusion were both safe and effective methods to treat posterior cerebral artery aneurysm. The indications for each modality need further investigation. For some aneurysms of special type and special site such as distal or giant aneurysms, the effects of parent artery occlusion were better than those of selective aneurysmal coiling.

References

- 1 Ferrante L, Acqui M et Al: Aneurysms of the posterior cerebral artery: do they present specific characteristics? *Acta Neurochir(Wien)* 138: 840-852, 1996.
- 2 Van Rooij WJ, Sluzewski M, Beute GN: Endovascular treatment of posterior cerebral artery aneurysms. *Am J Neuroradiol* 27: 300-305, 2006.
- 3 Ciceri EF, Klucznik RP et Al: Aneurysms of the posterior cerebral artery: classification and endovascular treatment. *Am J Neuroradiol* 22: 27-34, 2001.
- 4 Li YX, Liu AH et Al: Endovascular treatment of posterior cerebral artery aneurysms: analysis of 21 patients (Chinese). *Natl Med J China* 29: 2033-2036, 2006.
- 5 Hallacq P, Pötin M, Moret J: Endovascular occlusion of the posterior cerebral artery for the treatment of P2 segment aneurysms: retrospective review of a 10-year series. *Am J Neuroradiol* 23: 1128-1136, 2002.
- 6 Honda M, Tsutsumi K et Al: Aneurysms of the posterior cerebral artery: retrospective review of surgical treatment. *Neurol Med Chir (Tokyo)* 44: 164-169, 2004.
- 7 Che Kyu Ko, Young Shin et Al: Posterior cerebral artery aneurysms: surgical result of 11 patients. *J Korean Neurosurg Soc* 39: 192-197, 2006.
- 8 Gerber CJ, Neil-Dwyer G, Evans BT: An alternative surgical approach to aneurysms of the posterior cerebral artery. *Neurosurgery* 32: 928-931, 1993.
- 9 Terasaka S, Sawamura Y et Al: Surgical approaches for the treatment of aneurysms on the P2 segment of the posterior cerebral artery. *Neurosurgery* 47: 359-366, 2000.
- 10 Sakata S, Fujii K et Al: Aneurysms of the posterior cerebral artery: report of eleven cases-surgical approaches and procedures. *Neurosurgery* 32: 163-168, 1993.
- 11 Seoane ER, Tedeschi H et Al: Management strategies for posterior cerebral artery aneurysms: a proposed new surgical classification *Acta Neurochir (Wien)* 139: 325-331, 1997.
- 12 Zeal AA, Rhoton AL: Microsurgical anatomy of the posterior cerebral artery. *J Neurosurg* 48: 534-539, 1978.
- 13 Sawlani V, Handique A, Phadke RV: Endovascular parent artery occlusion in a fusiform aneurysm of posterior cerebral artery. *Clinical Radiology* 59: 954-960, 2004.
- 14 Biondi A, Jean B et Al: Giant and large peripheral cerebral aneurysms: etiopathologic considerations, endovascular treatment and long-term follow-up. *Am J Neuroradiol* 27: 1685-1692, 2006.
- 15 Arat A, Islak C et Al: Endovascular parent occlusion in large giant or fusiform distal cerebral artery aneurysms. *Neuroradiology* 44: 700-705, 2000.
- 16 Yamashita K, Taki W et Al: Treatment of unclippable giant posterior cerebral artery aneurysms with detachable balloons: report of three cases. *Neurol Med Chir (Tokyo)* 32: 679-683, 1992.
- 17 Bazinski D, Willinsky RA et Al: Dissecting aneurysms of the posterior cerebral artery: angioarchitecture and a review of the literature. *Neuroradiology* 42: 128-133, 2000.
- 18 Berger MS, Wilson CB: Intracranial dissecting aneurysms of the posterior circulation: report of six cases and review of the literature. *J Neurosurg* 61: 882-894, 1984.
- 19 Ohkuma H, Suzuki S et Al: Neuroradiologic and clinical features of arterial dissection of the anterior cerebral artery. *Am J Neuroradiol* 24: 691-699, 2003.
- 20 Day AL, Gaposchkin CG et Al: Spontaneous fusiform middle cerebral artery aneurysms: characteristics and a proposed mechanism of formation. *J Neurosurg* 99: 228-240, 2003.
- 21 Eckard DA, O'Boynick PL et Al: Coil occlusion of the parent artery for treatment of symptomatic peripheral intracranial aneurysms. *Am J Neuroradiol* 21: 137-142, 2000.
- 22 Blanc R, Weill A et Al: Delayed stroke secondary to increasing mass effect after endovascular treatment of a giant aneurysm by parent vessel occlusion. *Am J Neuroradiol* 22: 1841-1843, 2001.

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