Treatment Strategy for Aneurysms of the Posterior Cerebral Artery

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Summary

The authors carried out a retrospective review of the records of 12 patients with aneurysms of the posterior cerebral artery (PCA). Four were asymptomatic, 1 presented with a mass effect, and 7 with a subarachnoid haemorrhage (SAH). Of the 7 ruptured aneurysms, 3 were embolized and 2 were clipped. However, 2 patients died from rebleeding before any treatment. Of the 5 unruptured aneurysms, 1 was embolized with coils but the remaining 4 have been conservatively observed. No aneurysms have ruptured during the follow-up period, and 3 have thrombosed spontaneously. According to our results, the PCA aneurysms should be treated aggressively in the early phase. Although the preservation of the anatomical integrity of the PCA should naturally be one of the prime objectives, PCA occlusion may sometimes be inevitable when treating large or fusiform aneurysms. On the other hand, conservative therapy is one of the options for the treatment of incidentally encountered unruptured ones, because these have the possibility of spontaneous thrombosis.

Introduction

Aneurysms of the posterior cerebral artery (PCA) are relatively rare compared with those in other locations in intracranial circulation. Some reports have indicated that the incidence of PCA aneurysms is approximately 1% of all

intracranial aneurysms¹⁻³. Due to their deep location and intricate relationships with the brain stem and surrounding structures, the surgical treatment of aneurysms of this region is complex and sometimes associated with high morbidity rates⁴. Moreover transarterial embolization (TAE) with the preservation of the parent artery is often difficult because large sessile aneurysms are not unusual in this area^{5,6}. On the other hand, as the incidence of unruptured aneurysms has increased with the introduction of magnetic resonance imaging (MRI) and magnetic resonance angiography (MRA), the strategy for managing these lesions has become very important⁵.

In these cases, the choice of available treatments including surgical intervention, endovascular techniques and conservative management is still a matter of discussion. Treatment strategy may depend on the type of aneurysms and their presentation. The authors retrospectively summarized the clinical characteristics and outcomes of 12 patients with aneurysms of the PCA. The purpose of this study is to clarify the best way to treat PCA aneurysms.

Patients and Methods

We retrospectively reviewed our experience with 12 consecutive PCA aneurysms managed from 1990 to 2001 at Nagoya University Hospital and affiliated hospitals. Table 1 shows a

summary of all patients including 5 males and 7 females, ranging in age from 31 to 74 (mean 53). Initial presentations were subarachnoid haemorrhage (SAH) in 7 patients, mass effect in 1, and none in 4. Of the patients with SAH, 3 were Hunt and Hess grade I, 2 were grade II, and 2 were grade III. The size of the 12 aneurysms was small (< 12 mm) in 3, large (12–15 mm) in 8, and giant (> 25 mm) in 1. The configuration was saccular in 4, thrombosed in 6 and fusiform in 2. Mycotic peripheral aneurysms are not included in this study because their management strategy is completely different from that of the others^{8,9}.

The classification of the PCA segment followed that of that of Yasagil^{4,10}; P1 portion extends from the bifurcation of the basilar artery to the point where it joins the posterior communicating artery (P com A); P2 extends from the junction with the P com A to the origin of the anterior temporal artery; P3 extends from the origin of the anterior temporal artery to the bifurcation of the calcarine and parietooccipital arteries; and P4 consists of branches distal to P3. We excluded basilar tip-P1 junction aneurysms. Consequently, 4 aneurysms were located on the P1-P2 junction, 3 on the P2 and 5 on the P2-P3.

Results

According to the Glasgow Outcome Scale, the outcome was excellent in 7 patients, good in 2, and 3 patients died. All 3 deaths involved patients with ruptured aneurysms, 2 of whom died from the rerupture of aneurysms while waiting for the embolization, and the remaining one from a pulmonary embolism after clipping.

Ruptured Cases

Five of 7 patients underwent radical treatment including direct surgery in 2 and TAE in 3. Both aneurysms of the patients undergoing surgery were successfully clipped. Endosaccular packing with Guglielmi detachable coils (GDCs) was performed in 1 case and the PCA as well as aneurysms were endovascularly trapped in the other 2 (figure 1), both of whom developed transient neurological deficits after the treatment but recovered within several days. All but one of these 5 patients obtained favorable outcomes; one died from a pulmonary embolism occurred postoperatively.

Two patients, one with a dissecting aneurysm (case 3) and the other with a giant serpentine aneurysm (case 7) were not radically treated. Both patients died from rerupture, one at 16 days (case 3) after the initial bleeding, and the other (case 7) 10 years later.

Unruptured Cases

One patient underwent TAE and 4 were conservatively treated. One (case 8) presented with left hemiparesis due to the mass effect of a large P2-P3 aneurysm that was initially packed with coils but had regrown 2 years later. Finally, the PCA was trapped with coils.

Four aneurysms not receiving radical treatment included 3 large thrombosed aneurysms and 1 small saccular aneurysm. The reasons for the lack of radical treatment were the patient's refusal in 3 cases and spontaneous resolution in 1 (case 10). Spontaneous resolution was observed in 3 aneurysms, all of which were large and thrombosed. In particular, one patient (case 10) presented with a large dissecting aneurysm at P1-P2 portion, which the second angiogram 2 weeks after onset showed to be shrinking. A follow-up angiogram a year later revealed that the parent artery as well as the aneurysm was completely thrombosed without neurological deficits (figure 2). These 4 aneurysms had been uneventful at the time of inquiry.

Discussion

Aneurysms of the PCA present some clinical and surgical characteristics distinguishing them from other cerebral aneurysms. The average age of patients is 10 to 20 years younger than for other cerebral aneurysms¹, the incidence of patients with PCA aneurysm under 20 being 18.0% versus 1.6–2.0% for other sites^{11,12}. Although our series included a 31-year-old female, the mean age was higher than the average in previous reports. The most common clinical presentation of these aneurysms was SAH, however, symptoms caused by a mass effect (especially visual disturbances including a homonymous hemianopsia and oculomotor palsy) were also frequently encountered^{6,13}. Some authors have stated that PCA aneurysms tend to be larger than other aneurysms³. Ferrante et al¹⁴ reported that in comparison to those localized elsewhere, PCA aneurysms are more frequently large, more often present with

Figure 1 Case 4: A large dissecting aneurysm of right P2 presented with SAH. A) The vertebral angiogram shows a multilobular aneurysm at right P2 thought to be a dissecting aneurysm. B) The vertebral angiogram obtained after TAE with parent artery occlusion reveals that the lumen of the aneurysm and the parent artery were completely occluded. C) Late phase of the right internal carotid angiogram obtained after parent artery occlusion demonstrates a collateral flow from leptomeningeal anastomosis (arrows). However, transient hemiparesis and dysesthesia developed after parent artery occlusion.

symptoms caused by a mass effect, and appear at an earlier age.

Terasaka et Al¹⁵ reported an overall morbidity and mortality rate of 35.7% and found it noteworthy that direct surgical treatment of these aneurysms may be more morbid than those of the anterior circulation. This is because of their deep location and the difficulty of perforating artery identification¹⁶. However, most ruptured cases following conservative treatment have a very poor prognosis because of the likelihood of rerupture, primary damage, and vasospasm such as occurred in 2 patients with fetal rerupture in our series. Therefore, direct or endovascular treatment in an early phase after onset should be recommended for patients with ruptured aneurysms to prevent catastrophic rebleeding and vasospasm.

Selective complete exclusion from the cerebral circulation, using either surgical or endovascular techniques, is the optimal treatment for intracranial aneurysms. With smaller saccular aneurysms, it is possible to spare the PCA, its branching arteries, and their perforators without great difficulty³. However, some aneurysms may be difficult to treat with traditional surgical techniques or by placement of intra-aneurysmal coils because of their location, size, and morphology, e.g., fusiform or dissecting aneurysms^{5,17}. Pia and Fontana reported 40 cases of PCA aneurysms, 8 of which were fusiform or giant⁶. All of these aneurysms were treated with parent vessel occlusion.

It is impossible to ignore the potential danger of ischemic complications, since those related to occlusive therapy occur in about 20% of cases¹⁸. In our series, 2 of 3 patients treated with PCA occlusion showed transient neurological deficits. However, some authors have

mentioned that infarction is a complication rarely seen after occlusion of the parent vessel because of the good collateral supply of the PCA 13. It is actually impossible to predict accurately whether a patient can tolerate abrupt occlusion of the PCA 19. Moreover, a bypass to the PCA (whether with a superficial temporal artery or with a vein graft) is not an easy operation and requires a fair amount of temporal lobe retraction as well as a prolonged occlusion time^{3,6}. Given the terrible natural history of ruptured aneurysms of the PCA and the surprising ability of the brain to tolerate vessel occlusion 20, 21, PCA occlusion without vascular reconstruction should be considered for acute ruptured aneurysms, which were thought to be impossible to treat with preservation of the parent artery.

Four unruptured aneurysms were conservatively treated in our series. In 3 of them, intrasaccular spontaneous thrombosis developed and 2 aneurysms completely disappeared without any new neurological symptoms.

Spontaneous intra-aneurysmal thrombosis is a well-documented phenomenon that has been noted in approximately 50% of giant aneurysms²²⁻²⁴. Pozzati et al reported that the incidence of total thrombosis in giant aneurysms is between 13% and 20%²⁵. Such a high incidence of thrombosis formation is related to the ratio between aneurysmal volume and aneurysmal neck size²⁶. Additionally, there is a directly proportional relationship between the small diameter of feeding vessels and intra-aneurysmal thrombosis²⁷. Situations occur in which the PCA is smaller in diameter than the

Table 1 Summary of the 12 patients

Case No	Age/ Sex	Presentation	Location	Size	Treatment	Complication	Follow up	Outcome
1	62/F	SAH	P1-P2	Small	TAE (saccular packing)	-	no change (6 years)	Excellent
2	74/M	SAH	P2	Small	Clipping	pulmonary embolism	-	Dead
3	40/F	SAH+IVH	P1-P2	Large	Conservative	-	rerupture (16 days)	Dead
4	55/F	SAH	P2	Large	TAE (trapping)	dysesthesia and hemiparesis (transient)	-	Good
5	61/F	SAH	P2-P3	Large	Clipping	-	-	Excellent
6	40/M	SAH	P2-P3	Large	TAE (trapping)	homonymous hemianopsia (transient)	-	Excellent
7	54/M	SAH	P2	Giant	Conservative	-	rerupture (10 years)	Dead
8	72/M	Mass effect	P2-P3	Large	TAE (saccular packing)	- (2 years) and 2nd TAE (trapping)	coil compaction	Good
9	64/F	Incidental	P1-P2	Small	Conservative	-	no change	Excellent
10	44/F	Incidental	P1-P2	Large	Conservative	-	progression of spontaneous thrombosis	Excellent
11	31/F	Incidental	P2-P3	Large	Conservative	-	progression of spontaneous thrombosis	Excellent
12	56/M	Incidental	P2-P3	Large	Conservative	-	progression of spontaneous thrombosis	Excellent

F = female; M = male; SAH = subarachnoid haemorrhage; IVH = intraventricular haemorrhage; TAE = transarterial embolization

Figure 2 Case 10: A large unruptured aneurysm at left P1-P2 in a 44-year-old female presenting with headache. A) The initial vertebral angiogram shows a large, irregular-shaped aneurysm arising at right P1-P2. B) The second vertebral angiogram taken a week later reveals shrinkage of the aneurysm, suggesting the progression of thrombosis. C,D) Repeated angiograms obtained three weeks and a year after the initial angiogram, respectively, demonstrate the progression of thrombosis (C) and, finally, the aneurysm and the parent artery are seen to be completely occluded (D).

other intracranial main trunks, and the aneurysms are larger in size. Therefore, PCA aneurysms are likely to be spontaneously thrombosed.

In our experience, conservative therapy is one of the treatment options when expecting spontaneous thrombosis for incidental PCA

aneurysms. However, a completely thrombosed giant aneurysm has a potential for recanalization and should be considered an unstable lesion^{28,29}. Longer-term follow-up might be necessary to observe the spontaneous recanalization of completely thrombosed aneurysms as well as coiled ones²⁵.

Conclusions

In our experience, ruptured PCA aneurysms should be aggressively treated early because of their poor prognosis. Although saccular packing with coils is the preferred method, trapping of the parent artery together with the aneurysm may often be needed to obtain a complete cure in some fusiform or wide-neck aneurysms if the patient can tolerate occlusion of the PCA.

On the other hand, as far as incidental cases

are concerned, conservative therapy is one of the treatment options when expecting spontaneous thrombosis if surgical or endovascular treatment would be difficult.

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References

- 1 Ciceri EF, Klucznik RP et Al: Aneurysms of the posterior cerebral artery: classification and endovascular treatment. *Am J Neuroradiol* 22: 27-34, 2001.
- 2 Drake CG: Giant posterior cerebral aneurysms: 66 patients. In: Drake CJ, Peerless SJ, Hruesniemi JA (eds): *Surgery of Vertebro-basilar Aneurysms*; London, Ontario, Experience on 1767 Patients. Springer Verlag: 230-248, New York 1996.
- 3 Sakata S, Fujii K et Al: Aneurysm of the posterior cerebral artery: report of eleven cases, surgical approaches and procedures. *Neurosurgery* 32: 163-167, 1993.
- 4 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.
- 5 Kitazawa K, Tanaka Y et Al: Specific characteristics and management strategies of cerebral artery aneurysms: report of eleven cases. *J Clin Neurosci* 8: 23-26, 2001.
- 6 Pia HW, Fontana H: Aneurysms of the posterior cerebral artery. Locations and clinical pictures. *Acta Neurochir (Wien)* 38: 13-35, 1997.
- 7 Hunt WE, Hess RM: Surgical risk as related to time of intervention in the repair of intracranial aneurysms. *J Neurosurg* 28: 14-20, 1968.
- 8 Meena AK, Sitajayalakshmi S et Al: Mycotic aneurysm on posterior cerebral artery: resolution with medical therapy. *Neurol India* 48: 276-278, 2000.
- 9 Cloft HJ, Kallmes DF et Al: Endovascular treatment of ruptured, peripheral cerebral aneurysms: parent artery occlusion with short Guglielmi detachable coils. *Am J Neuroradiol* 20: 308-310, 1999.
- 10 Yasargil MG, Antic J et Al: Microsurgical pterional approach to aneurysms of the basilar bifurcation. *Surg Neurol* 6: 83-91, 1976.
- 11 Locksley HB: Natural history of subarachnoid haemorrhage, intracranial aneurysms and arteriovenous malformations. Based on 6368 cases in the cooperative study. *J Neurosurg* 25: 219-239, 1966.
- 12 Suzuki J, Hori S et Al: Intracranial aneurysms in the neurosurgical clinics in Japan. *J Neurosurg* 35: 34-39, 1971.
- 13 Gerber CJ, Neil-Dwyer G: A review of the management of 15 cases of aneurysms of the posterior cerebral artery. *Br J Neurosurg* 6: 521-527, 1992.
- 14 Ferrante L, Acqui M et Al: Aneurysms of the posterior cerebral artery: do they present specific characteristics? *Acta Neurochir (Wien)* 138: 840-852, 1996.
- 15 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.
- 16 Ide M, Jimbo M et Al: Posterior cerebral artery aneurysm associated with unilateral internal carotid artery agenesis. Case report. *Neurol Med Chir (Tokyo)* 33: 825-829, 1995.
- 17 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.
- 18 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.
- 19 Chang HS, Fukushima T et Al: Aneurysms of the posterior cerebral artery: report of ten cases. *Neurosurgery* 19: 1006-1011, 1986.
- 20 Hodes JE, Aymard A et Al: Endovascular occlusion of intracranial vessels for curative treatment of unclippable aneurysms: report of 16 cases. *J Neurosurg* 75: 694-701, 1991.
- 21 Ross IB, Weill A et Al: Endovascular treatment of distally located giant aneurysms. *Neurosurgery* 47: 1147-53, 2000.
- 22 Griffiths PD, Gholkar A et Al: Oculomotor nerve palsy due to thrombosis of a posterior communicating artery aneurysm following diagnostic angiography. *Neuroradiology* 36: 614-615, 1994.
- 23 Whittle IR, Dorsch NW et Al: Spontaneous thrombosis in giant intracranial aneurysms. *J Neurol Neurosurg Psychiatry* 45: 1040-1047, 1982.
- 24 Piepgras DG, Khurana VG et Al: Occult rupture of a giant vertebral artery aneurysm following proximal occlusion and intrasaccular thrombosis. Case report. *J Neurosurg* 95: 132-137, 2001.
- 25 Pozzati E, Nuzzo G et Al: Giant aneurysm of the pericallosal artery. Case report. *J Neurosurg* 57: 566-569, 1982.
- 26 Ohta H, Sakai N et al: Spontaneous total thrombosis of distal superior cerebellar artery aneurysm. *Acta Neurochir (Wien)* 143: 837-843, 2001.
- 27 Spallone A, Peresedov VV et al: Spontaneous cure of ruptured intracranial arterial aneurysms. *Surg Neurol* 367-370, 1981.
- 28 Lee KC, Joo JY et Al: Recanalization of completely thrombosed giant aneurysm: case report. *Surg Neurol* 51: 94-98, 1999.
- 29 Atkinson JL, Lane JJ et Al: Spontaneous thrombosis of posterior cerebral artery aneurysm with angiographic reappearance. Case report. *J Neurosurg* 79: 434-437, 1993.

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