Aneurysm on the Cortical Branch (P_4 Segment) of the Posterior Cerebral Artery

—Case Report—

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Abstract

A 75-year-old woman presented with a rare aneurysm on the distal portion (P_4) of the posterior cerebral artery (PCA) causing subarachnoid hemorrhage (SAH) and manifesting as sudden onset of headache, nuchal rigidity, and nausea. Computed tomography on admission revealed thin SAH in the left parietooccipital sulcus. Cerebral angiography demonstrated a small saccular aneurysm on the cortical branch of the left PCA. The aneurysm was successfully clipped via the occipital interhemispheric approach. Distal PCA aneurysms frequently affect middle-aged persons and tend to be small, with good clinical course but may cause visual field defects. Direct aneurysm clipping is recommended for patients without visual defect from the onset. Parent artery occlusion by the endovascular technique should be considered for patients with visual loss caused by the initial hemorrhage.

Key words: aneurysm, distal posterior cerebral artery, subarachnoid hemorrhage, clipping

Introduction

Aneurysms arising at the posterior cerebral artery (PCA) are rare,^{8,24)} accounting for only 0.7–2.2% of cases in major published series.^{5,21)} Most PCA aneurysms arise at the P_1 or P_2 segments of the PCA. Only 13% of all PCA aneurysms are located distal to the P_3 segment^{17,26)} and aneurysms of the P_4 segment are extremely rare.^{6,8,17)} However, distal PCA aneurysms may comprise only about 5% of all PCA aneurysms.¹⁴⁾

We treated a 75-year-old woman with subarachnoid hemorrhage (SAH) originating from a ruptured aneurysm arising at a cortical branch of the distal PCA.

Case Report

A 75-year-old woman suffered sudden onset of headache and nausea that persisted for 6 days. On admission, neurological examination found no abnormalities and her visual field was intact. Her medical history was negative for trauma, previous neurological disease, collagen vascular disease, and infection. Computed tomography (CT) revealed a thin high density area in the left parieto-occipital sulcus (Fig. 1). Sagittal T_1 -weighted magnetic resonance imaging performed on the day after admission also demonstrated

Fig. 1 Computed tomography scan on admission showing subarachnoid hemorrhage in the left parieto-occipital fissure.

hyperintensity in the left parieto-occipital fissure (Fig. 2). Three-dimensional (3D) CT angiography showed a small aneurysm at the distal portion of the left PCA (Fig. 3 left). Cerebral angiography disclosed a small aneurysm on the cortical branch (P_4) of the left PCA (Fig. 3 center, right). Surgery was delayed intentionally until the 8th day of

Received January 25, 2010; Accepted May 7, 2010

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Fig. 2 Sagittal T₂-weighted magnetic resonance image demonstrating subarachnoid hemorrhage in the parieto-occipital sulcus.

Fig. 5 Postoperative three-dimensional computed tomography angiogram revealing the curved titanium clip and obliteration of the aneurysm (arrow).

Fig. 3 Left: Three-dimensional computed tomography angiogram on admission showing a small aneurysm (arrow) at the distal portion of the left posterior cerebral artery. Center, right: Left vertebral angiograms, anteroposterior (center) and lateral (right) views, showing a saccular aneurysm (arrow) on the P₄ segment of the posterior cerebral artery.

Fig. 4 Intraoperative photograph (left) and sketch (right) demonstrating the saccular aneurysm (arrow) and distal branch of the P₄ segment. Bip: bipolar, Prox PCA: proximal posterior cerebral artery, Spa: spatula, Suc: sucker, V: vein, shaded arrows: direction of blood flow.

hospitalization.

Left occipital craniotomy was performed with the patient in a left semi-prone position. The aneurysm was exposed in the parietooccipital fissure through the craniotomy on the lambda.²⁰⁾ The saccular aneurysm was located at the bifurcation of the parent artery (Fig. 4). The

aneurysm neck was clipped using a titanium light-curved clip. Postoperative 3D CT angiography showed disappearance of the aneurysm on the distal PCA (Fig. 5). Her postoperative course was uneventful and she was discharged 30 days after admission with no neurological deficits.

Discussion

Table 1 summarizes the reported cases of aneurysms of the P₄ segment.^{2,3,7,9-13,15,16,22-24)} The 16 patients, 8 males and 7 females (one not disclosed), were aged 14 to 75 years (mean 52 years), although PCA aneurysms tend to occur in younger patients. Nine aneurysms were saccular and 2 were fusiform (5 not reported). Fourteen of the 15 distal PCA aneurysms had diameters less than 12 mm, although the incidence of large and giant aneurysms is high among PCA aneurysms.^{4,8,15,19,25)}

The most common clinical manifestation of PCA aneurysm is SAH,^{5,8,15)} whereas ventricular or intracerebral hemorrhage is often the initial clinical manifestation of distal PCA aneurysm, possibly due to the location of P₄ aneurysms in the deep sulci.^{13,26)} Therefore, patients with P₄ aneurysms often present with visual field defects that tend to persist after successful treatment.¹³⁾ In fact, 10 of the 16 patients with P₄ aneurysms were discharged with some degree of visual field defect.

P₄ aneurysms are associated with vascular diseases such as moyamoya disease²³⁾ and arterial occlusion,¹³⁾ and with infection,^{11,24)} tumor emboli,²⁾ systemic lupus erythematosus,¹³⁾ and head injury.³⁾ Eight of the 16 patients presented with other vascular diseases, 4 patients with congenital aneurysm, and the etiology was not reported in 4 patients. Our patient had no etiological abnormality, indicating a congenital saccular aneurysm.

Appropriate surgical approaches to PCA aneurysms take into account the aneurysm location: the pterional approach is used for P₁ and P₂ aneurysms, the subtemporal approach for P₂ and P₃ aneurysms, and the occipital interhemispheric approach for P₃ and P₄ aneurysms.^{13,18)} Transhematoma and transventricular approaches may be

Table 1 Review of patients with P₄ aneurysms of the posterior cerebral artery

Case No.	Author (Year)	Age (yrs)/ Sex	Clinical presentation	H&K grade	Aneurysm (side/size/type)	Surgery (approach/procedure)	Outcome
1	Burton et al. (1968) ³⁾	14/M	ICH, trauma	NA	rt/small/NA	occipital craniotomy/proximal electrocautery	MD, quadrantic hemianopia
2	Ishikawa et al. (1974) ¹¹⁾	40/M	ICH, mycotic infection	NA	lt/small/NA	transhematoma/resection	MD, hemianopia
3	Pia and Fontana (1977) ¹⁵⁾	43/F	ICH, IVH, congenital aneurysm	4	lt/small/saccular	occipital lobectomy	NA, hemianopia
4	Tanaka et al. (1980) ²³⁾	40/M	SAH, moyamoya disease	2	lt/small/saccular	transventricle/resection	MD, hemianopia
5	Ishibashi and Onuma (1989) ¹⁰⁾	69/F	ICH, IVH, congenital aneurysm	2	lt/small/saccular	OIHA/clipping	MD, hemianopia
6	Statham et al. (1990) ²²⁾	45/F	incidental, SAH (ruptured P ₂)	3	lt/giant/fusiform	subtemporal approach/proximal clipping	MD, hemianopia
7	Barker (1992) ²⁾	42/M	ICH, IVH, tumor	4	rt/small/saccular	transhematoma/clipping	NA
8	Orita et al. (1994) ¹³⁾	63/M	ICH, lt ICA occlusion	4	lt/small/saccular	OIHA/coating	NA
9		73/F	ICH, IVH, SLE	4	lt/small/saccular	transhematoma/clipping	D
10	Ito et al. (1998) ¹²⁾	57/M	SAH, ICH	2	lt/small/saccular	OIHA/clipping	MD, hemianopia
11	Ramakrishnamurthy et al. (1999) ¹⁶⁾	50/F	SAH, ICH	1	lt/small/fusiform	OIHA/clipping	NA
12	Eckard et al. (2000) ⁷⁾	NA/NA	SAH	NA	rt/NA/NA	coil PAO	MD, hemianopia
13	Hashimoto et al. (2000) ⁹⁾	73/M	ICH, SAH, rt ICA occlusion	2	rt/small/saccular	OIHA/clipping	MD, hemianopia
14	van Rooij et al. (2006) ²⁴⁾	27/M	SAH, endocarditis	4	NA/small/NA	coil PAO	D
15		64/F	SAH, congenital aneurysm	2	NA/small/NA	coil PAO	MD, hemianopia
16	Present case	75/F	SAH, congenital aneurysm	2	lt/small/saccular	OIHA/clipping	GR

D: death, GR: good recovery, H&K: Hunt and Kosnik, ICA: internal carotid artery, ICH: intracranial hemorrhage, IVH: intraventricular hemorrhage, MD: moderate disability, NA: not available, OIHA: occipital interhemispheric approach, PAO: parent artery occlusion, SAH: subarachnoid hemorrhage, SLE: systemic lupus erythematosus.

appropriate for P₄ aneurysms in a tight brain.¹³⁾ The occipital interhemispheric approach can reach the most medial portion of the PCA inside the quadrigeminal cistern and also the terminal branches.^{21,25)} However, the aneurysm dome may obscure the operative field and the proximal portion of the parent artery may be located behind the aneurysm. Therefore, sufficient dissection of the occipital sulci is essential for complete exposure of distal PCA aneurysms. Intraoperative navigation may be useful for obtaining the correct orientation if the aneurysm is deeply embedded in the sulci.

Several surgical procedures for treating the P₄ aneurysm have been described, including clipping of the aneurysm neck, proximal clipping, resection, cautery, and parent artery occlusion.^{2,3,7,9-13,15,16,22-24)} Seven cases were treated by clipping, but the other 10 cases used other procedures including trapping because of associated vascular diseases such as moyamoya disease, infection, and so on. The first line of treatment should be decided based on consideration of the etiology.

Three of the 16 patients underwent endovascular treatment using parent artery occlusion.^{7,24)} One patient with acquired immunodeficiency syndrome and endocarditis died of infection on the 2nd day after coil embolization,

and 2 presented with visual field defects from SAH onset caused by intracerebral hematoma of the occipital lobe. After parent artery occlusion, these patients made an uneventful recovery with no change in neurological status. The potential risk of coil embolization is ischemia in the territory of the parent vessel. Unlike other sites, areas fed by the PCA receive rich collateral flow.⁸⁾ Nonetheless, 3 of 6 patients who underwent parent artery occlusion of PCA aneurysms via endovascular techniques developed neurological deficits after treatment.¹⁾ Therefore, endovascular parent artery occlusion may be an acceptable treatment choice in patients with pre-treatment visual field deficits.

Aneurysms of the distal PCA (P₄ segment) are rare and exhibit specific clinical features compared with aneurysms at other PCA sites. These aneurysms often occur in middle-aged patients, tend to be small, and the prognosis is favorable although some patients may experience persistent visual field defects after treatment. We suggest direct aneurysm clipping in patients without visual defects from the time of SAH onset. Parent artery occlusion by endovascular techniques may be appropriate in patients with visual loss from SAH onset.

Acknowledgments

We are grateful to Ms. U. Petralia for editorial assistance.

References

- 1) Andreou A, Ioannidis I, Mitsos A: Endovascular treatment of peripheral intracranial aneurysms. *AJNR Am J Neuroradiol* 28: 355–361, 2007
- 2) Barker CS: Peripheral cerebral aneurysm associated with glioma. *Neuroradiology* 34: 30–32, 1992
- 3) Burton C, Velasco F, Dorman J: Traumatic aneurysm of a peripheral cerebral artery. Review and case report. *J Neurosurg* 28: 468–474, 1968
- 4) Chang HS, Fukushima T, Takakura K: Aneurysms of the posterior cerebral artery: Report of ten cases. *Neurosurgery* 19: 1006–1011, 1986
- 5) Ciceri EF, Klucznik RP, Grossman RG, Rose JE, Mawad ME: Aneurysms of the posterior cerebra artery: Classification and endovascular treatment. *AJNR Am J Neuroradiol* 22: 27–34, 2001
- 6) Drake CG, Amacher AL: Aneurysms of the posterior cerebral artery. *J Neurosurg* 30: 468–474, 1969
- 7) Eckard DA, O'Boynick PL, McPherson CM, Eckard VR, Han P, Arnold P, Batcitzky S: Coil occlusion of the parent artery for treatment of symptomatic peripheral intracranial aneurysms. *AJNR Am J Neuroradiol* 21: 137–142, 2000
- 8) Ferrante L, Acqui M, Trillo G, Lunardi P, Fortuna A: Aneurysms of the posterior cerebral artery: do they present specific characteristics? *Acta Neurochir (Wien)* 138: 840–852, 1996
- 9) Hashimoto Y, Takayama K, Inoue M, Fujishige M, Yamaura A, Nakagawa T: [A case of distal posterior cerebral artery aneurysm associated with occlusion of the internal carotid artery]. *No Shinkei Geka* 28: 725–729, 2000 (Japanese)
- 10) Ishibashi Y, Onuma T: [Peripheral branch (P4 segment) aneurysm of the posterior cerebral artery: A case report]. *No Shinkei Geka* 17: 659–662, 1989 (Japanese)
- 11) Ishikawa M, Waga S, Moritake K, Handa H: Cerebral bacterial aneurysms. Report of three cases. *Surg Neurol* 2: 257–261, 1974
- 12) Ito N, Shiokawa Y, Ide K, Takahashi H, Yamakawa K, Saito I: [A case of ruptured P4 segment aneurysm of the posterior cerebral artery: Therapeutic pitfalls encountered when dealing with the multiple intracranial aneurysms]. *No Shinkei Geka* 26: 639–643, 1998 (Japanese)
- 13) Orita T, Tsurutani T, Izumihara A, Kajiwaru K: Distal posterior cerebral artery aneurysms. *Neurol Med Chir (Tokyo)* 34: 692–696, 1994
- 14) Pia HW: Aneurysms of the posterior cerebral artery, in Pia HW, Langmain C, Zierski J (eds): *Cerebral Aneurysms. Advances in Diagnosis and Therapy*. Berlin, Heidelberg, New York, Springer-Verlag, 1979, pp 123–127
- 15) Pia HW, Fontana H: Aneurysms of the posterior cerebral artery. Location and clinical findings. *Acta Neurochir (Wien)* 38: 13–35, 1977
- 16) Ramakrishnamurthy TV, Purohit AK, Sundaram C, Rajender RY: Distal calcarine fusiform aneurysm: A case report and review of literature. *Neurol India* 47: 318–320, 1999
- 17) Sakata S, Fujii K, Matsushima T, Fujiwara S, Fukui M, Matsubara T, Nagatomi H, Kuromatsu C, Kamikaseda K: Aneurysms of the posterior cerebral artery: report of eleven cases—surgical approaches and procedures. *Neurosurgery* 32: 163–167, 1993
- 18) Sanai N, Tarapore P, Lee AC, Lawton MT: The current role of microsurgery for posterior circulation aneurysms: A selective approach in the endovascular era. *Neurosurgery* 62: 1236–1253, 2008
- 19) Sawada M, Hashimoto N, Yamamoto S, Tsukahara T: Distal posterior cerebral artery aneurysm associated with multiple aneurysm. *Acta Neurol Scand* 98: 204–208, 1998
- 20) Seeger W: *Microanatomical Aspects for Neurosurgeons and Neuroradiologists*. Wien, Springer-Verlag, 2000, pp 24–25
- 21) Seoane ER, Tedeschi H, Oliveira ED, Siqueira MG, Calderon GA, Rhoton AL Jr: Management strategies for posterior cerebral artery aneurysms; A proposed new surgical classification. *Acta Neurochir (Wien)* 139: 325–331, 1997
- 22) Statham P, Johnston R, Coutinho C, Hadley D: Double giant fusiform aneurysms of the posterior cerebral artery. *Surg Neurol* 33: 48–51, 1990
- 23) Tanaka Y, Takeuchi K, Akai K: Intracranial ruptured aneurysm accompanying moyamoya phenomenon. *Acta Neurochir (Wien)* 52: 35–43, 1980
- 24) van Rooij WJ, Sluzewski M, Beute GN: Endovascular treatment of posterior cerebral artery aneurysms. *AJNR Am J Neuroradiol* 27: 300–305, 2006
- 25) Yasargil MG: *Microneurosurgery, II*. Stuttgart, New York, Georg Thieme Verlag, 1984, pp 260–269
- 26) Zeal AA, Rhoton AL: Microsurgical anatomy of the posterior cerebral artery. *J Neurosurg* 48: 534–559, 1978

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