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Aneurysms of the Posterior Cerebral Artery: Retrospective Review of Surgical Treatment

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Abstract

A series of 10 cases of posterior cerebral artery (PCA) aneurysms were retrospectively reviewed. There were five men and five women aged 38 to 68 years (mean 57.5 years). Seven patients presented with subarachnoid hemorrhage. Two aneurysms were found incidentally during clinical examination for stroke. One aneurysm was associated with moyamoya disease. All aneurysms were saccular. The aneurysms arose from the P_1 segment in three patients, the P_1/P_2 junction in three patients, the P_2 segment in three patients, and the P_3 segment in one patient. Two patients died before operation and one patient refused surgery. Aneurysmal clipping was performed for seven patients. All aneurysms except the P_2 and the P_3 aneurysms were treated via the pterional approach. Four patients had excellent outcome, but one patient with a P_3 aneurysm developed homonymous hemianopsia due to thrombosis of the parent vessel and another patient with a P_2 aneurysm had moderate disability from the initial insult. Coil embolization has been indicated as the first choice of therapy, but PCA aneurysms are good candidates for direct clipping.

Key words: aneurysm, posterior cerebral artery

Introduction

Aneurysms of the posterior cerebral artery (PCA) are rare, accounting for about 0.7% to 2.3% of all intracranial aneurysms,[3,4,6-10,19,21,25,27,31,36,38] mainly in the fourth decade.[30] PCA aneurysms mainly arise from the anterior portion of PCA,[36,38] and tend to form larger[5,30] and dissecting type of aneurysms.[17,18,22,24] PCA aneurysms may be associated with vascular anomalies, such as moyamoya disease,[2,17] arteriovenous malformation,[36] and arterial occlusion,[11,14,28] as well as systemic diseases, such as bacterial sepsis,[1] tumor emboli, Marfan's syndrome,[29] systemic lupus erythematosis,[20] and head injury.[23] PCA aneurysms can be treated by the direct approach which utilizes clipping of the aneurysm or the more recent indirect approach which utilizes coil embolization.[4,9,34] Here we review our experience with PCA aneurysms treated by direct surgery.

Materials and Methods

Review of the case records of the Nagasaki Rosai Hospital and National Nagasaki Medical Center between January 1983 and December 2001 identified only 10 patients with PCA aneurysms among 1940 intracranial aneurysms. The clinical data of the 10 cases of PCA aneurysms are summarized in Table 1. These five men and five women were aged 38 to 68 years (mean 57.5 years). Computed tomography (CT) was performed to detect subarachnoid hemorrhage (SAH). Neurological status was evaluated on admission according to the Hunt and Kosnik (H&K) scaling.[13] Cerebral angiography was performed and the involved segments of the PCA were classified according to Zeal and Rhoton[38] into P_1, P_1/P_2 junction, P_{2a}, P_{2p}, and P_3 segments. The pterional approach was performed for P_1 and P_1/P_2 aneurysms, the subtemporal approach for P_2 aneurysm, and the occipital interhemispheric ap-

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Table 1 Summary of 10 cases

Case No.	Age/ Sex	Side	Symptom	Location*	Complication	Operation	Outcome
1	58/M	rt	infarction	P_{2a}	rt M_1 occlusion	not done	GR
2	54/M	rt	SAH (II)	P_1	not detected	pterional approach, clipping	MD (rt hemiparesis)
3	50/M	lt	infarction	P_1/P_2	intraaneurysmal thrombus	pterional approach, clipping	GR
4	66/M	rt	SAH (III)	P_1/P_2	aneurysm (lt ICA-PComA)	pterional approach, clipping	GR
5	68/F	lt	SAH (IV)	P_{2p}	multiple aneurysms (lt ICA-PComA, ICA-AChA, rt ICA-PComA, MCA)	not done	died
6	67/F	lt	SAH (IV)	P_{2a}	not detected	subtemporal approach, clipping	MD
7	52/F	lt	SAH (III)	P_3	not detected	OIH approach, clipping and coating	MD (hemianopsia)
8	38/M	rt	ICH	P_1	moyamoya disease, aneurysm (rt BA-SCA)	pterional approach, clipping	GR
9	67/F	lt	SAH (IV)	P_1/P_2	not detected	not done	died
10	55/F	rt	SAH (III)	P_1	not detected	pterional approach, clipping	GR

*According to Zeal and Rhoton.[38] AChA: anterior choroidal artery, BA: basilar artery, GR: good recovery, ICA: internal carotid artery, ICH: intracerebral hemorrhage, MCA: middle cerebral artery, MD: moderately disabled, OIH: occipital interhemispheric, PComA: posterior communicating artery, SAH: subarachnoid hemorrhage (Hunt and Kosnik grade), SCA: superior cerebellar artery.

proach for P_3 aneurysm. No aneurysms were trapped in these cases. The outcome was analyzed according to the Glasgow Outcome Scale.

Results

Seven patients presented with SAH, and all harbored small saccular aneurysms. Three patients had PCA aneurysms detected incidentally, associated with moyamoya disease manifesting as intracerebral hemorrhage (Case 8), occlusion of the right middle cerebral artery manifesting as cerebral infarction (Case 1), and a large aneurysm with intra-aneurysmal thrombus manifesting as infarction (Case 3). Two patients with SAH in H&K grade IV (Cases 5 and 9) died before surgical intervention and one patient with an unruptured P_2 aneurysm (Case 1) refused surgery. Seven patients underwent surgery. Case 7 with a P_3 aneurysm suffered homonymous hemianopsia due to parent artery occlusion, Case 2 with a P_1 aneurysm suffered hemiparesis due to delayed ischemic deficit, and Case 6 with a P_2 suffered mild dementia due to acute brain injury. The other four patients had a good recovery.

Illustrative Cases

Case 4: A 66-year-old man suffered sudden onset of headache, nausea, and vomiting on December 20, 1998, while in the lavatory. He was admitted to our hospital on the same day. His Glasgow Coma Scale (GCS) score was E2V3M5 (H&K grade III). CT revealed SAH in the right sylvian fissure, ambient cistern, and quadrigeminal cistern (Fig. 1A). Left vertebral angiography showed a ruptured saccular aneurysm on the right P_1 segment (Fig. 1B) and an aneurysm of the left internal carotid artery-posterior

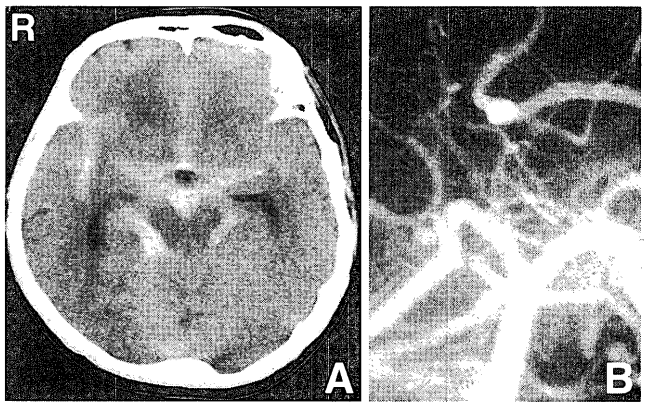

Fig. 1 Case 4. A: Computed tomography scan showing diffuse subarachnoid hemorrhage, mainly in the subarachnoid space on the right. B: Left vertebral angiogram showing a saccular aneurysm on the right P_1 segment.

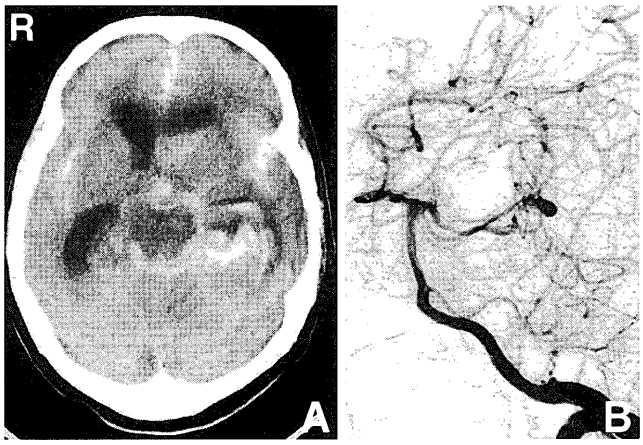

Fig. 2 Case 6. A: Computed tomography scan showing diffuse subarachnoid hemorrhage, acute hydrocephalus, and left temporal lobe hematoma. B: Left vertebral angiogram showing saccular aneurysms on the left distal P_2 segment.

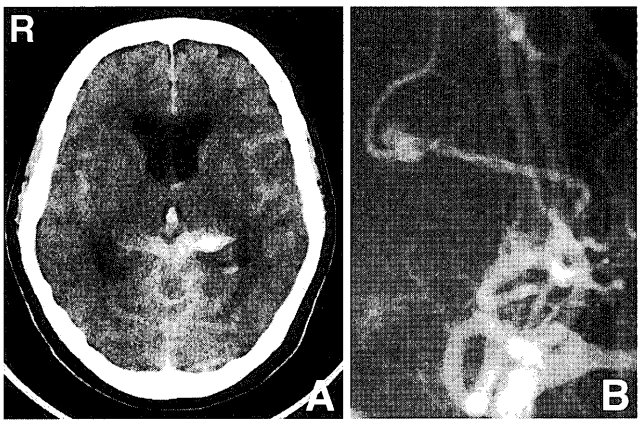

Fig. 3 Case 7. A: Computed tomography scan showing diffuse subarachnoid hemorrhage with reflux into the third and fourth ventricles. B: Left vertebral angiogram showing a saccular aneurysm on the left P_3 segment.

communicating artery. The aneurysm was successfully clipped via the right pterional approach on December 21. A right ventriculoperitoneal shunt was implanted one month later.

Case 6: A 67-year-old female was transferred from another hospital to our center on April 9, 2000. The GCS score was E2V2M4 (H&K grade IV). CT revealed SAH on the left and a hematoma with acute hydrocephalus in the left temporal lobe (Fig. 2A). Left vertebral angiography showed a left P_2 aneurysm (Fig. 2B). The aneurysm was clipped via the left subtemporal approach. She was discharged with impaired cognitive function due to the acute brain injury.

Case 7: A 53-year-old female was found unconscious in her house. She was transferred to our hospital on March 31, 1995. Her GCS score was E2V4M6 (H&K grade III). CT revealed SAH on the left (Fig. 3A). Left vertebral angiography showed a left P_3 saccular aneurysm (Fig. 3B). The P_3 aneurysm was clipped and coated via the left occipital interhemispheric approach on April 14. Postoperatively, the patient developed right homonymous hemianopsia due to occlusion of the parieto-occipital artery.

Discussion

Table 2 summarizes the reported cases of PCA aneurysms with details about clinical features.[3,4,6,7,10,25,36] The most common clinical symptom was SAH in about 65% of cases. Larger aneurysms may compress the surrounding structures, leading to visual disturbance, memory disturbance, and seizure. Most patients were treated by clipping because the coil embolization technique was still undeveloped. The pterional approach (with or without removal of the zygomatic arch) was performed for P_1 and P_1/P_2 aneurysms, the subtemporal approach for P_2 aneurysms, and the occipital interhemispheric approach for P_3 aneurysms.[3,8,12,15–17,25,27,31,36–38] We followed such guidelines in our series.

The pterional approach provides only a narrow route and operative field, but we were able to achieve clipping smoothly without zygomatectomy, opening of the choroidal fissure, or brain tissue resection.[8,12,31] The PCA perforators may disturb access to the aneurysm by both direct surgery and endovascular procedures, but there were no such problems in both our series and other series. The occipital interhemispheric approach uses the PCA to guide the operator to the aneurysm site and avoid brain over-retraction, but the aneurysm dome can obscure the operative field. Trapping, proximal ligation, and parent artery embolization are required in about 20% cases of PCA aneurysms because of the large size.[3,5,10,22,24,26,33–36] Such large or unclippable type aneurysms hinder direct surgery, especially in deep sites, such as the P_2/P_3 regions. We did not experience this type of aneurysm, but coil embolization may be a good candidate. The collateral circulation of the PCA facilitates such procedures more than at other sites.[2,36,38]

The postoperative prognosis for patients with PCA aneurysms and with SAH is relatively favorable because the good collateral circulation prevents symptomatic vasospasm, and the outcome is apparently affected by the preoperative clinical grade, as

Table 2 Reported series of posterior cerebral artery (PCA) aneurysm

Author (Year)	No. of cases	Mean age	PCA site				Nature				SAH	Surgery					Outcome*			
			P_1	P_1/P_2	P_2	P_{3-4}	B	LG	F	D		Cl	Co	T	P	E	Died	Poor	Good	Excellent
Drake and Amacher (1969)[6]	8	49.9	0	2	6	0	5	2	1	0	7	5	0	0	0	0	1	1	3	3
Yasargil (1984)[36]	14	34.1	5	3	3	3	2	8	0	0	9	7	1	5	0	0	0	2	12	0
Chang et al. (1986)[3]	10	45.4	1	3	5	1	3	1	5	0	8	5	1	3	0	0	2	2	1	5
Sakata et al. (1993)[25]	11	43.8	3	3	3	2	7	4	0	0	8	6	2	0	2	0	1	2	2	5
Ferrante et al. (1996)[7]	7	31.5	1	0	4	2	3	4	0	0	6	4	0	3	0	0	1	0	2	4
Ciceri et al. (2001)[4]	20	46.7	7	6	4	3	13	5	0	2	8	0	0	0	0	19	0	1	0	18
Hallacq et al. (2002)[10]	10	43	0	0	10	0	0	5	5	0	2	0	0	0	0	10	0	0	1	9
Present series	10	57.5	2	4	3	1	9	1	0	0	7	7	0	0	0	0	2	0	3	5
Total	90	45.4	19	21	32	12	42	30	11	2	55	34	4	11	2	29	7	8	24	45

*Outcome scales differ in each series, so the Glasgow Outcome Scale was modified. Poor includes severely disabled and vegetative survival, good is moderately disabled and good recovery, and excellent includes cases described as such. B: berry, Cl: clipping, Co: coating, D: dissection, E: endovascular surgery, F: fusiform, LG: large and/or giant, P: parent artery occlusion, T: trapping.

for anterior circulation aneurysms. In fact, two patients died from the first ictus and rebleeding in our series. Despite the good collateral circulation of the PCA, some ischemic events such as transient homonymous hemianopsia (Case 7) might occur after trapping of the aneurysm and so revascularization should be performed if not associated with any additional operative risk.[3,32] Endovascular surgery is associated with good results in aneurysms of the posterior circulation including PCA.[4,9,34,35] However, aneurysm with thrombosis, aneurysm causing hematoma, and aneurysms inaccessible by the endovascular approach due to arterial anomaly should be treated directly.

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Commentary on this paper appears on the next page.

Commentary

The authors have reported a retrospective review of aneurysms of the posterior cerebral artery (PCA) with their surgical experiences. Aneurysms of the PCA are less common than those in other locations. As the authors mentioned, a variety of treatment options exist. Anatomical features of the PCA aneurysm and the patient's clinical status including neurological status, especially visual function, may influence the treatment options. Recently, endovascular treatment using various techniques is being selectively performed.

In the case of "unclippable" aneurysm such as fusiform or giant serpentine aneurysm, proximal occlusion or trapping becomes inevitable to obliterate the aneurysm. Although a low incidence of visual field defects after PCA occlusion without any diagnostic test prior to permanent sacrifice has been reported in several series, thorough angiographic evaluation of anastomotic collaterals and balloon occlusion test with/without perfusion study is necessary to predict or avoid neurological deficit after PCA occlusion. If PCA sacrifice is needed and neurological deficits are expected, a bypass procedure may be considered. However, bypass procedures require temporary PCA occlusion and there is a risk of infarction. Eximer laser-assisted nonocclusive anastomosis can be used as a safe bypass technique. However, a safe method must be found to bypass into the more distal PCA.

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Honda et al. reported their experience of 10 cases with posterior cerebral artery (PCA) aneurysms during the last 18 years. Seven of 10 patients underwent surgical clipping. Six patients had favorable outcome, but one patient developed homonymous hemianopsia due to parent artery occlusion. All aneurysms were small in size, and surgically difficult aneurysms were not included in this series. The authors selected appropriate surgical approaches according to the aneurysm location. The patients' profiles and surgical results shown in this paper are not outstanding, and no particularly new information is shown. However, it is important to add the clinical data of PCA aneurysms to the medical literature, because the incidence of aneurysms in this location is low. Recently, there have been many reports on the usefulness of coil embolization for PCA aneurysms. Indeed, the complex aneurysms that can be considered a good candidate for endovascular therapy often occur at this site. The selection of neurosurgical or endovascular treatment should be decided by location, size and morphology of the aneurysm.

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Aneurysm arising from the posterior cerebral artery (PCA) is a very rare clinical condition. In this article, the authors analyzed 10 cases of PCA aneurysm of their own and reviewed seven reported series of aneurysms at this location. According to the location of the aneurysm on different segments of the PCA, three different surgical approaches may employed in the treatment of aneurysm. The indications, the benefits and the drawbacks of these three approaches are well elucidated in this article.

Due to the deep-seated location, surgery for the PCA aneurysm is more difficult and has higher morbidity and mortality. Compared with the treatment of anterior circulation aneurysm, coil embolization may play a more important role in treating the aneurysms of this location. However, in the present article, clipping of the aneurysm is used as the only modality of treatment.

Aneurysm of the PCA has a higher incidence of large or giant size. Although not found in the present series, an average of 30% incidence of large or giant aneurysms is found in other reported series. Whether a different hemodynamic stress or other intrinsic factors of the vascular wall of this artery cause this phenomenon should be an interesting topic to study in the future.

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