Posterior Cerebral Artery Aneurysm: Surgical Result of 11 Patients

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Objective: Eleven patients treated with posterior cerebral artery (PCA) aneurysm during 6.3-years period are retrospectively reviewed to determine treatment outcome.

Methods: Eleven patients with PCA aneurysm were treated from January 1998 to May 2004. Their medical records and radiologic studies were reviewed retrospectively. The records of these patients were analysed with particular reference to their demographic details, mode of presentation, and treatment outcome.

Results: Of the 11 patients, 8 patients presented with symptoms related aneurysmal bleeding. Three patients had unruptured PCA aneurysms. One or endovascular surgery was performed in 9 patients. None of these patients exhibited a third nerve palsy, visual field deficit, or hemiparesis at the time of presentation. Postoperatively, 2 made a good recovery, 2 had a moderate disability because of cerebral infarction after surgery, and 5 had a severe disability because of cerebral infarction after surgery. Of 2 conservatively treated patients, 1 was doing well but the other died as a result of brain swelling.

Conclusion: The treatment of the PCA aneurysms is difficult regardless of the aneurysmal size, site, and treatment modality. All reasonable treatment to reduce the risk of associated morbidity should be considered.

KEY WORDS: Posterior cerebral artery • Treatment outcome • Aneurysm.

Introduction

In comparison to other locations of aneurysm, posterior cerebral artery (PCA) aneurysms are a rare occurrence, accounting for about 0.7–2.3% of all intracranial aneurysms. PCA aneurysms differ from those in other sites with regard to their clinical behavior and in certain aspects of surgical technique and prognosis. In this study, we describe our experiences of the treatment of 11 cases of PCA aneurysms, and operative approaches and procedures were discussed in relation to the anatomy of PCA aneurysms.

Materials and Methods

Incidence, age, sex, and clinical status

Between January 1998 and May 2004, 1324 intracranial aneurysms were treated in our hospital. Of these, 11 patients (0.83%) affected the PCA. The male/female ratio was 4:7 and the mean age was 56 years (range 31–73 years). The records of these patients were analysed with particular reference to their demographic details, mode of presentation, and treatment outcome (Table 1).

Diagnosis and location

Aneurysms were classified as saccular or fusiform according to their appearance on angiographic studies. Location was classified according to the description by Zeal et al., as four segments of the PCA. Among 11 patients, 8 patients had solitary aneurysm only. And the rest of 3 patients had multiple vascular lesions; Case 8 had a ruptured left P3/P1 junction aneurysm in addition to a unruptured basilar tip aneurysm. Case 10 with a ruptured left P1 segment aneurysm also had the unruptured aneurysm in the middle cerebral artery. Case 9 had a ruptured right P1 aneurysm associated with an unruptured arteriovenous malformation (AVM) in the right occipital lobe.

Eight patients presented with symptoms of subarachnoid hemorrhage (SAH), confirmed by brain computed tomography.

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Table 1. Characteristics of 11 patients with PCA aneurysms

<table>
<thead>
<tr>
<th>Case</th>
<th>Age</th>
<th>Sex</th>
<th>Present</th>
<th>H-H Grade</th>
<th>Site</th>
<th>Size (mm)</th>
<th>Type</th>
<th>Treatment</th>
<th>Postoperative state</th>
<th>GOS at discharge</th>
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<tr>
<td>1</td>
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<td>F</td>
<td>SAH</td>
<td>2</td>
<td>P1/P2</td>
<td>9.3</td>
<td>Fusiform</td>
<td>Pteri + Clip</td>
<td>Hemiparesis</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>44</td>
<td>M</td>
<td>SAH</td>
<td>2</td>
<td>P1/P2</td>
<td>6</td>
<td>Saccular</td>
<td>Sub + Clip</td>
<td>CN III palsy</td>
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<tr>
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<td>HA</td>
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<td>P1</td>
<td>40</td>
<td>Fusiform</td>
<td>Pteri + Clip</td>
<td>Hemiparesis</td>
<td>3</td>
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<tr>
<td>4</td>
<td>71</td>
<td>F</td>
<td>SAH</td>
<td>2</td>
<td>P1</td>
<td>2</td>
<td>Saccular</td>
<td>Pteri + Clip</td>
<td>Hemiparesis</td>
<td>4</td>
</tr>
<tr>
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<td>30</td>
<td>F</td>
<td>SAH</td>
<td>2</td>
<td>P1</td>
<td>22</td>
<td>Saccular</td>
<td>Orbito + Trap</td>
<td>Hemiparesis</td>
<td>3</td>
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<tr>
<td>6</td>
<td>31</td>
<td>M</td>
<td>HA</td>
<td>0</td>
<td>P1</td>
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<td>Saccular</td>
<td>Embolization</td>
<td>Doing well</td>
<td>5</td>
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<tr>
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<td>61</td>
<td>F</td>
<td>SAH</td>
<td>3</td>
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<td>Hemiparesis</td>
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<tr>
<td>8</td>
<td>73</td>
<td>F</td>
<td>SAH</td>
<td>2</td>
<td>P2/P3</td>
<td>8</td>
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<td>Embolization</td>
<td>Hemiparesis</td>
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<tr>
<td>9</td>
<td>55</td>
<td>F</td>
<td>SAH</td>
<td>2</td>
<td>P1</td>
<td>10</td>
<td>Saccular</td>
<td>Embolization</td>
<td>Hemiparesis</td>
<td>4</td>
</tr>
<tr>
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<td>SAH</td>
<td>4</td>
<td>P1</td>
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<td>Conservative</td>
<td>--</td>
<td>1</td>
</tr>
<tr>
<td>11</td>
<td>34</td>
<td>F</td>
<td>HA</td>
<td>0</td>
<td>P1/P2</td>
<td>10</td>
<td>Saccular</td>
<td>Conservative</td>
<td>--</td>
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(CT) scan, while the remaining 3 cases with unruptured aneurysm presented with only headache. Cerebral angiography identified PCA aneurysms. Neurological status was evaluated on admission according to the scale of Hunt and Hess. Postoperative status was evaluated according to the Glasgow outcome scale (GOS). The size of the aneurysm was small (<12 mm) in 7 cases, large (12-25 mm) in 2 cases and giant (>25 mm) in 2 cases.

Results

Open surgery group

Five patients were managed with open surgery (2 men, 3 women; aged 30–71 years; 4 presented with SAH). None of these patients exhibited a third nerve palsy, visual field deficit, or hemiparesis at the time of presentation. The aneurysms included 3 saccular and 2 fusiform lesions. The 3 saccular aneurysms occurred on the P1 segment, at the P1/P2 junction, and on the P2 segment. The 2 fusiform aneurysms were located on the P1 segment and at the P1/P2 junction.

The surgical approaches were subtemporal approach (1 P1/P2), pericallosal approach (2 P1, 1 P1/P3), and orbitozygomatic approach (1 P1). Surgical procedures included direct clipping in 4 cases, trapping in 1 case (orbitozygomatic approach). A 44-year-old man (case 2) was admitted to our hospital with sudden onset severe headache. CT scans demonstrated a SAH. A saccular aneurysm at the P1/P2 junction of the left PCA was observed on the angiogram. It measured nearly 6 mm. It was approached via the subtemporal route, and it was clipped. Postoperatively, the patient experienced transient left third nerve palsy, but no neurological deficit was found 1 year later (Fig. 1).

Cases 1, 3, and 4 were managed with the pericallosal approach (2 P1, 1 P1/P3). All of these patients suffered from contralateral hemiparesis postoperatively, and case 4 was suffered from ipsilateral third nerve palsy.

A 30-year-old woman (case 5) was admitted with SAH. She was treated with the orbitozygomatic approach for wide exposure of the aneurysm. Angiogram revealed a 22 mm-sized saccular aneurysm in the P1 segment of the left PCA. Trapping with clips was performed via the orbitozygomatic approach. The patient deteriorated postoperatively, developing a right hemiparesis because of cerebral infarction. However, when assessed 4 year later, the patient had made a good recovery although she had walked with single cane (Fig. 2).

Endovascular surgery group

Among patients encountered after 2001, four patients with PCA aneurysm underwent endovascular surgery. Until 2001, only open
surgery was performed to treat PCA aneurysm in our hospital. Four patients were managed with endovascular surgery using Guglielmi detachable coils (GDCs) (1 man, 3 women; aged 31–73 years; 3 presented with SAH).

A 31-year-old man (case 6) was admitted for the treatment of a ruptured saccular aneurysm (12mm) in the left P3 segment. The aneurysm was embolized with GDCs. Angiogram demonstrated that detachable coil embolization resulted in no visualization of the left PCA distal to the P3 segment. But he had no neurologic deficit after embolization.

A 73-year-old woman who had a ruptured aneurysm at the left P3/P4 junction with an unruptured basilar top aneurysm (case 8) was treated with embolization of left PCA aneurysm. The PCA aneurysm was embolized almost completely with GDCs and postoperatively, the blood flow of both PCA was intact on angiogram. But, she suffered from right hemiparesis and aphasia.

A 55-year-old woman who had ruptured aneurysm on the right P3 segment with arteriovenous malformation(AVM) in right occipital lobe (case 9), suffered from left hemiparesis postoperatively (Fig. 3). Angiogram demonstrated no visualization of the left PCA distal to the P3 segment.

Treatment outcome

Of the 9 surgically treated patients, 2 made a good recovery, 2 had a moderate disability because of cerebral infarction after surgery, and 5 had a severe disability because of cerebral infarction after surgery.

Discussion

PCA aneurysms present some clinical characteristics distinguishing them from aneurysms occurring at other anatomical locations. The incidence of PCA aneurysms is rare as confirmed by previous reports. In our study, the incidence was 0.83% (11/1324). PCA aneurysms more frequently affect young patients. In our study, the mean age was 56 years and average age of patients was similar to that of patients with aneurysms at other sites.

The most common shape of aneurysm is saccular. 7 (63%) of 11 PCA aneurysms in our study were saccular type. Other characteristic of PCA aneurysms is the high incidence of giant aneurysms. In other general series of intracranial aneurysms, it varied from about 3% to 5%. In our study, the incidence of giant aneurysm was 18% (2/11). They may present with SAH. In our study, the most common mode of presentation was SAH (8/11, 72%), which is similar to other reported series. Three patients manifested coexisting vascular lesions; 1 patient had an occipital AVM, and 2 had multiple intracranial aneurysms.

The PCA is divided into four segments descriptively as it courses around the midbrain. The P1 segment arises from the basilar bifurcation to the junction with the posterior communicating artery; the P2 segment is from the posterior communicating artery to the level of the dorsum of the midbrain; the P3 segment is from the quadrigeminal cistern to anterior limit of the calcine fissure; and the P4 segment is the termination of the artery within the calcine fissure. As confirmed by other reported series, the majority of
aneurysms arise along the P1 and P2/P3 junction. In our study, 6 (54%) of 11 PCA aneurysms were found on the segment P1 or at the P2/P3 junction. In the series by Drake, et al.7, 71 (57%) of 125 lesions were located in these locations.

The surgical approaches of the PCA aneurysm are variable according to the location of the aneurysms. Aneurysms of the initial segment (P1 and P2/P3 junction) of the PCA can be approached by means of the surgical approach used for basilar top aneurysms.

The P2 segment somehow extends to the posterior part of the ambient cistern and lies in the depths of the ambient cistern hidden by the parahippocampal gyrus. Although the proper approach to aneurysms located on the P2 segment remains controversial, they should be exposed via the peritellar, subtemporal, or combined peritellar-subtemporal approach. The approach to that area via the peritellar transylvanian and the subtemporal route usually requires greater degree of retraction over the temporal lobe that consequently increases the potential for damage to the vein of Labbe and damage to the cranial nerve III and IV.

The P3 segment is located in the quadrigeminal cistern and adjacent to the junction of the hippocampal and cingulate gyri. Through the occipital interhemispheric approach, one can easily reach the most medial portion of the PCA inside the quadrigeminal cistern.

We treated aneurysms on the P1 segment, at the P1/P2 junction, and on P2 segment through a peritellar, subtemporal, and orbitozygomatic approach, ipsilateral to the lesion. The peritellar approach was favored by Yasargil whereas Drake, et al.9 used the subtemporal approach. The primary advantages of the peritellar approach20 which we have used in most cases are early proximal control with isolation of the basilar artery, posterior communicating artery, and P2 segment origin, and good visualization of the contralateral PCA to allow temporary trapping. But in the restricted space that it offers, access to the distal PCA aneurysms is severely limited.

The subtemporal approach6 may offer improved visualization of the critical chalamosperforating and peduncular perforating vessels originating from the posterior aspect of the PCA that must be preserved in all cases. However, considerable retraction of the temporal lobe may be required, especially to reach aneurysms of P2-P3 segments, and this could be complicated by postoperative temporal lobe swelling and damage to the oculomotor and trochlear nerves.

The advantages of the orbitozygomatic approach are a wide exposure, flexibility of access, and minimal retraction. Easier access to the interpeduncular and perimesencephalic cisterns is then gained by an extended decompression of the floor of the middle fossa. When the dura is opened, a good view of the free edge of the tentorium is obtained. This view is increased further by splitting the sylvian fissure and thus allowing the temporal lobe to fall backwards with minimal retraction. This measure provides ready access to the P1, P2, and P3 segments of the PCA. So the possibility of clipping of the aneurysm and sparing of the parent artery are increased.

Compared with open surgery, the endovascular treatment of these aneurysms is relatively safe and effective with low mortality and morbidity. Endovascular treatment is not associated with manipulation of the surrounding tissues. Therefore, the risks of brain infarction due to retraction or removal are theoretically reduced. However, specific thromboembolic events are related to endovascular navigation. Endovascular treatment obliterates the aneurysm or parent artery with GDCs or balloon. Saccular PCA aneurysms can be treated effectively, by use of GDCs, to obliterate the aneurysm yet preserve the parent artery. In large and giant fusiform aneurysms and true fusiform aneurysms, the combined occlusion of the sac and parent vessel appears to be the only option possible by endovascular means. For large and giant saccular P2 segment aneurysms, occlusion of the aneurysmal sac and neck may be difficult, especially in wide-necked aneurysms. We treated a giant fusiform aneurysm at the left P3 segment (case 7) with embolization of the aneurysm. The aneurysm was occluded incompletely with GDCs and postoperatively, the blood flow of left PCA distal to the aneurysm was faint on angiogram. And the patient suffered from right hemiparesis.

In cases in whom the parent artery was occluded, there was visual field defect (10–12%) without other severe neurologic deficit. The low incidence of severe neurologic deficit complicating parent artery occlusion is related to the rich anastomotic collaterals that exist between the territory of the PCA and that of other arteries.

Although well-developed collateral vascular pathways supply the distal PCA territory after its occlusion, there were contralateral hemiparesis after occlusion of the parent vessel and aneurysm in our study.

In the series presented by Hamada et al.10, of the 19 surgically (open or endovascular surgery) treated patients, 14 (73%) made a good recovery and 2 had moderate disability because of angiogram or infarction after aneurysmal trapping. One patient survived with a severe disability caused by angiogram and cerebral contusion, and two patients died because of severe angiogram. In 2000, Terasaki et al.10 reported the surgical approaches for the treatment of aneurysms on the P2 segment of the posterior cerebral artery. Open surgery was performed in 14 of the 18 patients, nine patients (64.3%) achieved a good recovery. Two patients had moderate disability with slight hemiparesis. In these 2 patients, who underwent procedures via the subtemporal approach, local brain swelling occurred.
postoperatively, probably caused by venous congestion. Two patients remained severely disabled. In our study, 9 patients were treated surgically, 2 (22%) made a good recovery, 2 had a moderate disability because of cerebral infarction after surgery, and 5 had a severe disability because of cerebral infarction after surgery.

The proximal saccular aneurysms were associated with a third nerve paresis and contralateral hemiparesis. This clinical syndrome might be anticipated, for aneurysms of the first part of the PCA have an intimate relation to the cerebral peduncle and to the third nerve as it emerges between the posterior cerebral and superior cerebellar arteries. In our study, of the 9 surgically treated patients, 7 had contralateral hemiparesis, and 2 had third nerve paresis.

**Conclusion**

Aneurysms of the PCA are interesting for reasons that include their relative rarity and the variety of approaches that may be used for their successful treatment. Although patients can be treated without causing new neurological deficits or other morbidity, many patients with these lesions are left with some degree of dysfunction caused by the complications associated with treatment. In our study, the treatment of the PCA aneurysms was difficult regardless of the aneurysmal size, site, and treatment modality. So, all reasonable treatment to reduce the risk of associated morbidity should be considered. And we will try to experience more cases and to improve treatment outcome.

**References**


**Commentary**

The authors retrospectively reviewed the results of 11 patients with posterior cerebral artery (PCA) aneurysms. They described the clinical outcome after surgical or endovascular and the difficulties of treatment. The most common complications of their series were hemiparesis due to the cerebral infarction. So, not only the complete obliteration of aneurysm, but also the preservation of patency of parent vessel is necessary to improve the clinical outcome. Sometimes, cerebral revascularization surgery should be added to the treatment. Avoidance of brain retraction injury and preservation of major venous system are also important points.

The incidence of PCA aneurysm is low, but it has specific clinical characteristics. It is characterized by high frequency of non-saccular shape, large or giant size with mass effect, multiple aneurysms, young age at onset, and abundant collateral circulation of the parent artery. Taylor et al insisted that the treatment should be determined by the anatomical location and size of the aneurysm and the presence of underlying disease and neurological deficits.

The management strategies of the PCA aneurysm in our institute are as follows: Surgical treatment is necessary for large or giant aneurysms of the distal PCA to decompress midbrain. Wrapping and clipping technique are useful for treatment.
of fusiform aneurysm. Intra-aneurysmal endovascular coiling would be useful for the proximal PCA aneurysm to avoid surgical injury of the P1 perforator or oculomotor nerve.\(^9\).

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References