Spontaneous resolution of perforator aneurysms of the posterior circulation

Report of 3 cases

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The authors present the cases of 3 patients with ruptured perforator aneurysms of the posterior circulation. Patients were 39, 55, and 59 years old. None of the patients had relevant past medical or family history. All presented with World Federation of Neurosurgical Societies Grade I and Fisher Grade 2 or 3 subarachnoid hemorrhage. Initial angiography results were normal. A second cerebral angiogram in each case revealed a small (< 3 mm) aneurysm of perforator arteries of the posterior circulation. Patients were successfully managed conservatively. None of the patients developed symptomatic vasospasm, rebleeding, or hydrocephaly. Control angiograms at 3 months showed spontaneous resolution of the aneurysm in all cases. Rupture of perforator aneurysms of the posterior circulation is a rare condition and it may be underdiagnosed because of limitations of imaging techniques. Treatments can lead to complications in highly functional territories and should be considered wisely, especially due to the fact that the causes and natural history of such aneurysms are unknown and spontaneous healing remains a possibility.

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Key Words • vertebrobasilar • perforator artery • aneurysm • negative angiogram • vascular disorders

Perforator aneurysms of the posterior circulation represent a rare cause of subarachnoid hemorrhage (SAH). Since first described by Ghogawala et al. in 1996, 17 cases have been reported. Since the beginning of 2012, at our institution we have encountered 3 ruptured perforator aneurysms of the posterior circulation. Those cases are reported in detail below.

Case Reports

Case 1

History and Examination. A 55-year-old man with no past medical or surgical history was admitted to the hospital for a severe headache (World Federation of Neurosurgical Societies [WFNS] Grade 1). A head CT scan showed diffuse SAH (Fisher Grade 3; Fig. 1A). Initial angiography was normal. On the eighth day after hemorrhage a second angiogram was obtained that revealed a slow-filling aneurysm of 1.7 mm arising immediately after the origin of a thalamoperforating artery (anteromedial group of perforator arteries of the interpeduncular fossa; Fig. 1B).

Management and Follow-Up. Conservative care was chosen for the patient following a failed catheterization of the perforator artery. Cerebral angiography at 2 weeks showed a slight increase in the size of the aneurysm (2.2 mm). The patient was discharged 25 days after admission with no neurological symptoms. Digital subtraction angiography 3 months later showed complete resolution of the aneurysm (Fig. 1C). The patient did not present any clinical signs of recurrence after a follow-up period of 6 months (modified Rankin Scale [mRS] score = 0).

Case 2

History and Examination. A 39-year-old woman with no past medical or surgical history was admitted to the hospital for a severe headache (WFNS Grade 1). A head CT scan revealed perimesencephalic SAH (Fisher Grade 2; Fig. 2A). Magnetic resonance imaging of the brain was normal, as were initial angiography results. A second angiogram obtained 8 days after SAH revealed

Abbreviations used in this paper: mRS = modified Rankin Scale; SAH = subarachnoid hemorrhage; WFNS = World Federation of Neurosurgical Societies.
a slow-filling aneurysm of 1.5 mm arising immediately after the origin of an anteromedial mesencephalic perforator artery of the interpeduncular fossa (Fig. 2B).

Management and Follow-Up. Conservative care was chosen as the treatment strategy. Cerebral angiography at 2 weeks after SAH showed a slight increase in the size of the aneurysm (3 mm) with partial thrombosis. The patient was discharged 25 days after admission with no neurological signs. Digital subtraction angiography obtained 3 months later showed complete resolution of the aneurysm (Fig. 2C). The patient did not present with any clinical signs of recurrence after a follow-up period of 12 months (mRS score = 0).

Case 3

History and Examination. A 59-year-old man with a history of thyroidectomy and hormone replacement therapy was brought to the hospital for a severe headache (WFNS Grade I). A head CT scan showed diffuse SAH (Fisher Grade 3; Fig. 3A). The initial angiogram was normal. A second angiogram obtained 8 days after hemorrhage revealed a slow-filling aneurysm of 1 mm arising a few millimeters after the origin of the right superior lateral pontine artery (Fig. 3B).

Management and Follow-Up. Conservative care was chosen. The patient was discharged 25 days after admission with no neurological signs other than a partial loss of hearing in the right ear. Digital subtraction angiography 3 months later showed complete resolution of the aneurysm (Fig. 3C). The patient did not present with any clinical signs of recurrence after a follow-up period of 6 months. He fully recovered the loss of hearing in his right ear (mRS score = 0).

None of the patients had relevant past medical or
family history (no high blood pressure, diabetes, lipid disorders, smoking, autoimmune or infectious disease, or history of head trauma). All patients were treated preventively for vasospasm in accordance with our department protocol: a nimodipine intravenous dose of 2 mg per hour, replaced on Day 3 by an oral dose of 360 mg per day for a total duration of 21 days, and 2 liters per day of intravenous glucose and saline. Patients were also started on 40 mg of atorvastatin. None of the 3 patients developed symptomatic vasospasm, rebleeding, or hydrocephaly.

**Discussion**

Ruptured perforator aneurysm of the posterior circulation is a rare condition, with 20 cases reported in the literature, including those described in this series (Table 1). However, 2 of the aneurysms in the cases reported are slightly different from the others, i.e., 1 posttraumatic pseudoaneurysm and 1 high-flow aneurysm associated with an arteriovenous malformation.\(^2,12\) If we exclude those 2 cases, the ages of the patients ranged from 27 to 68 years (median 55 years).

The hemorrhagic pattern after rupture of a posterior circulation perforator aneurysm is variable. Forty-five percent of the time (8/18) the hemorrhage is located in the perimesencephalic or prepontine region. Such an aneurysm could represent a certain portion of the 15% to 20% of patients suffering from SAH without an aneurysm or other vascular lesion found on initial imaging.\(^11\) Perforator arteries have a low flow that could favor partial or complete thrombosis of the aneurysmal sac. This phenomenon could explain diagnostic difficulties encountered with an initial negative angiogram in 55% (11/20) of the cases.\(^3,4,8,9,12\) The imaging protocol needs to be rigorous with repeated angiograms, immobile patients, and conventional and 3D rotational angiograms. Bilateral injection of vertebral arteries can avoid flow artifacts in the basilar artery. The exact timing of the initial angiogram in cases of negative CT angiography is debated. Even if the discovery of perforator aneurysms of the posterior circulation did not lead to any invasive treatment because of spontaneous healing, it might still be useful to repeat the angiogram to have a positive diagnosis and avoid unnecessary follow-up explorations or seek alternative causes.

Basilar perforator arteries are divided into 3 groups: caudal, middle, and rostral. All perforator aneurysms reviewed in this article were of the middle or rostral perforators. The anatomy of posterior circulation aneurysms as well as their relationship to the parent vessel is difficult to delineate because of the small size of both the aneurysm and perforator artery. This may explain why the shape of the aneurysm is often not described.\(^3,5,6,8–10\) Two facts may suggest an intracranial dissection: 1) the shape of the aneurysm often described as dolichoectatic (fusiform), or with a large base; and 2) variation in the size of the aneurysm between closely repeated angiograms (as in Case 2).\(^12\)

Treatment of posterior circulation perforator aneurysms is challenging. Just as in 1 of the cases presented in this paper, basilar perforators can be inaccessible to catheterization\(^3,4,8\) due to their small diameter, distal localization, and low blood flow. Surgery is often chosen as the first line of treatment,\(^4–6,8,12\) including direct clipping, clipping of the parent vessel of the aneurysm, excision, trapping, wrapping, and coagulation. Endovascular techniques consist of coiling, stenting, or embolization.\(^3,9\) Until recently,\(^3\) no complications were reported, even when patency of the parent perforator vessel was not preserved.\(^5\) Multiple interconnections exist between perforators along the basilar artery, but are far from being constant. This can be found in 50% of cases for caudal perforators, 67% for middle perforators, and 42% for rostral perforators.\(^7\) It is not possible to evaluate the functional significance of basilar perforator arteries according to their size or localization.\(^1\) Occlusion of basilar perforator arteries remains hazardous.

The natural history of posterior circulation perforator aneurysms is unknown. As previously reported for patients treated conservatively,\(^3,10\) we observed spontaneous healing of the aneurysm over time. All 7 aneurysms reported that evolved in this manner had similar characteristics, such as their very small size (< 3 mm), as well as
### TABLE 1: Characteristics of previously reported cases of perforator aneurysms of the posterior circulation

<table>
<thead>
<tr>
<th>Authors &amp; Year</th>
<th>Age (yrs), Sex</th>
<th>Fisher Grade</th>
<th>Bleed Pattern</th>
<th>Detection on Initial Angiogram</th>
<th>Size (mm)</th>
<th>Origin of Perforator on Basilar Artery</th>
<th>Location of Aneurysm From Origin of Perforator Artery</th>
<th>Treatment</th>
<th>Preservation of Feeder</th>
<th>Complications</th>
<th>FU (mos)</th>
<th>Time Until Aneurysm Disappearance ‡</th>
<th>GOS Score</th>
</tr>
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<tbody>
<tr>
<td>Ghogawala et al., 1996</td>
<td>56, F</td>
<td>3</td>
<td>diffuse</td>
<td>no</td>
<td>3</td>
<td>distal 1/3</td>
<td>proximal</td>
<td>surgery</td>
<td>yes</td>
<td>transient 3rd nerve palsy, vertebral dissection, brain hemorrhage</td>
<td>6</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Hamel et al., 2005</td>
<td>44, M</td>
<td>3</td>
<td>diffuse</td>
<td>yes</td>
<td>6</td>
<td>mid 1/3</td>
<td>proximal</td>
<td>surgery</td>
<td>unknown</td>
<td>tension pneumocephalus, CSF leak</td>
<td>7</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Sanchez-Mejia et al., 2007</td>
<td>27, M</td>
<td>2</td>
<td>prepontine</td>
<td>no</td>
<td>6</td>
<td>distal 1/3</td>
<td>proximal</td>
<td>surgery</td>
<td>no</td>
<td>none</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>68, M</td>
<td>3</td>
<td>diffused</td>
<td>no</td>
<td>5</td>
<td>mid 1/3</td>
<td>distal</td>
<td>surgery</td>
<td>no</td>
<td>none</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2, M</td>
<td>1</td>
<td>prepontine</td>
<td>yes</td>
<td>4</td>
<td>distal 1/3</td>
<td>distal</td>
<td>surgery</td>
<td>no</td>
<td>none</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Park et al., 2009</td>
<td>54, F</td>
<td>1</td>
<td>perimesencephalic</td>
<td>yes</td>
<td>1</td>
<td>distal 1/3</td>
<td>proximal</td>
<td>conservative</td>
<td>yes</td>
<td>transient 3rd nerve palsy, hemiparesis from spasm</td>
<td>16</td>
<td>7–16 mos</td>
<td>5</td>
</tr>
<tr>
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<td>67, M</td>
<td>2</td>
<td>perimesencephalic</td>
<td>yes</td>
<td>1</td>
<td>distal 1/3</td>
<td>proximal</td>
<td>conservative</td>
<td>yes</td>
<td>none</td>
<td>15</td>
<td>3–15 mos</td>
<td>5</td>
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<tr>
<td></td>
<td>53, M</td>
<td>2</td>
<td>perimesencephalic</td>
<td>yes</td>
<td>1</td>
<td>distal 1/3</td>
<td>proximal</td>
<td>conservative</td>
<td>yes</td>
<td>none</td>
<td>1</td>
<td>5</td>
<td></td>
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<tr>
<td>Mathieson et al., 2010</td>
<td>51, M</td>
<td>2</td>
<td>diffuse</td>
<td>no</td>
<td>6</td>
<td>distal 1/3</td>
<td>proximal</td>
<td>surgery</td>
<td>no</td>
<td>none</td>
<td>none</td>
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<tr>
<td>Chen et al., 2012</td>
<td>66, M</td>
<td>3</td>
<td>prepontine</td>
<td>yes</td>
<td>7</td>
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<td>distal</td>
<td>endovascular</td>
<td>yes</td>
<td>none</td>
<td>24</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>26, F</td>
<td>3</td>
<td>diffuse</td>
<td>yes</td>
<td>10</td>
<td>mid 1/3</td>
<td>proximal</td>
<td>endovascular</td>
<td>yes</td>
<td>none</td>
<td>18</td>
<td>4</td>
<td></td>
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<tr>
<td>Nyberg et al., 2013</td>
<td>45, M not stated</td>
<td>3</td>
<td>perimesencephalic</td>
<td>no</td>
<td>&lt;3†</td>
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<td>proximal</td>
<td>endovascular</td>
<td>yes</td>
<td>none</td>
<td>14</td>
<td>7 wks–2 mos</td>
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<td></td>
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<td>perimesencephalic</td>
<td>no</td>
<td>2–3</td>
<td>mid 1/3</td>
<td>proximal</td>
<td>endovascular</td>
<td>yes</td>
<td>none</td>
<td>4</td>
<td>9 wks–3 mos</td>
<td>5</td>
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<tr>
<td>Gross et al., 2013</td>
<td>52, M</td>
<td>3</td>
<td>diffuse</td>
<td>yes</td>
<td>4</td>
<td>distal 1/3</td>
<td>proximal</td>
<td>surgery</td>
<td>no</td>
<td>transient 3rd nerve palsy</td>
<td>12</td>
<td>5</td>
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<tr>
<td>Ding et al., 2013</td>
<td>58, M</td>
<td>3</td>
<td>diffuse</td>
<td>yes</td>
<td>2</td>
<td>mid 1/3</td>
<td>proximal</td>
<td>endovascular</td>
<td>yes</td>
<td>quadriparesis, rt facial palsy, dysarthria</td>
<td>none</td>
<td>3</td>
<td></td>
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<tr>
<td></td>
<td>55, M</td>
<td>3</td>
<td>diffuse</td>
<td>no</td>
<td>1.8</td>
<td>distal 1/3</td>
<td>proximal</td>
<td>conservative</td>
<td>yes</td>
<td>none</td>
<td>19</td>
<td>1–6 mos</td>
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<tr>
<td></td>
<td>62, M</td>
<td>4</td>
<td>diffuse</td>
<td>no</td>
<td>1.9</td>
<td>distal 1/3</td>
<td>proximal</td>
<td>endovascular</td>
<td>no</td>
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<td>22</td>
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<td>current series</td>
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<td>3</td>
<td>diffuse</td>
<td>no</td>
<td>1.7</td>
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<td>proximal</td>
<td>conservative</td>
<td>yes</td>
<td>none</td>
<td>6</td>
<td>17 days–3 mos</td>
<td>5</td>
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<tr>
<td></td>
<td>39, F</td>
<td>2</td>
<td>perimesencephalic</td>
<td>no</td>
<td>1.5</td>
<td>distal 1/3</td>
<td>proximal</td>
<td>conservative</td>
<td>yes</td>
<td>none</td>
<td>12</td>
<td>16 days–3 mos</td>
<td>5</td>
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<tr>
<td></td>
<td>59, M</td>
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<td>diffuse</td>
<td>no</td>
<td>1</td>
<td>distal 1/3</td>
<td>proximal</td>
<td>conservative</td>
<td>yes</td>
<td>none</td>
<td>6</td>
<td>8 days–3 mos</td>
<td>5</td>
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</tbody>
</table>

* FU = follow-up; GOS = Glasgow Outcome Scale.
† Based on imaging provided.
‡ Conservative treatment.
Spontaneous resolution of perforator aneurysms

their location on the proximal part of a rostral perforator artery. The median duration until disappearance of the aneurysm was 3 ± 5.87 months. If we suppose that rupture of a posterior circulation perforator aneurysm represents a part of “nonaneurysmal perimesencephalic hemorrhage,” the rather favorable prognosis of such a subtype of SAH could also support this phenomenon.

Only 1 case of rebleeding has been described for posterior circulation perforator aneurysms.12 No decisive conclusions can be drawn from such a small series. Nevertheless, considering all the data noted above, treatment of ruptured posterior circulation perforator aneurysms should be considered cautiously. Conservative management could possibly be a valid option, at least initially, and complementary treatment could be achieved only for aneurysms that do not resolve spontaneously after a period of time that has not yet been defined.

Conclusions

Rupture of a posterior circulation perforator aneurysm represents a rare cause of SAH. It may not be diagnosed on initial imaging; therefore, imaging techniques need to be rigorous (conventional angiogram, 3D angiogram, immobilize the patient, complete filling of the arterial network, and repeated examinations). Causes and the natural history of such aneurysms are unknown and spontaneous healing remains a possibility. Treatments can lead to complications in highly functional territories and should be considered cautiously. Preservation of the parent vessel should be achieved.

Disclosure

The authors report no conflict of interest concerning the materials or methods used in this study or the findings specified in this paper.

Author contributions to the study and manuscript preparation include the following. Conception and design: Chavent. Acquisition of data: Chavent, Lefèvre, Thouant, Kazemi. Analysis and interpretation of data: Chavent, Cao. Critically revising the article: all authors. Reviewed submitted version of manuscript: all authors. Approved the final version of the manuscript on behalf of all authors: Chavent. Study supervision: Mourier, Ricolfi.

References


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