Distal Posterior Cerebral Artery Ruptured Aneurysm: A Rare Case Report and Review of Literature

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Abstract
Distal posterior cerebral artery aneurysms consist of a rare vascular entity whose treatment approach remains challenging. Few studies exist scarcely in the literature reporting cases of P4 ruptured aneurysms. In this study, we present the case of a 49-year-old female patient who was admitted to our Neurosurgery Department with the World Federation of Neurological Surgeons grade IV, Fischer grade IV subarachnoid hemorrhage due to a right distal posterior cerebral artery aneurysm. She successfully underwent surgery via a posterior occipital interhemispheric approach. The patient recovered well from surgery, and the following days, she was successfully extubated and had a significant neurological improvement. However, she died during her rehabilitation due to sepsis and severe acute respiratory distress syndrome.

Introduction
Aneurysms of the posterior cerebral artery (PCA) account for 1 to 2% of all intracranial aneurysms and 15% of all aneurysms of the vertebrobasilar circulation.¹,² These aneurysms are usually located on the P1 and P2 segments and rarely on the P3 and P4 segments (only 5% of PCA aneurysms are located distally).³

Surgical approaches and careful anatomic dissection of the PCA are technically demanding due to the complexity of its perforating branches and its close relationship with the cranial nerves and the brainstem. Endovascular techniques for aneurysms arising from PCA segments offer a reliable alternative to the surgical approaches when they are not feasible.

Herein, we present a case of a 49-year-old woman who presented with intracerebral and subarachnoid hemorrhage due to a ruptured distal PCA aneurysm.

Case Report
A 49-year-old woman was admitted to the emergency department with Glasgow Coma Scale 7/15 (E:1, V:1, M:5) and right-sided anisocoria with pupils reactive to light. She was immediately intubated. Patient's symptoms before emergency admission were a thunderclap headache along with neck pain and subsequent loss of consciousness.

The initial diagnostic workup included a computed tomography (CT) of the brain that revealed a right occipital intracerebral hematoma and subarachnoid hemorrhage Fischer Grade scale IV. Further evaluation with a brain computed tomography angiography revealed a right 6-mm distal PCA saccular aneurysm, namely at the junction of the parieto-occipital artery (PoA) and the splenial artery (►Figs. 1 and 2). The patient was emergently operated via a posterior occipital interhemispheric approach.
for the hematoma evacuation and aneurysm clipping (~Figs. 3 and 4). Postoperatively, she was transferred to the intensive care unit, and the following days she was extubated successfully and had a significant neurological recovery. However, a few days later the patient died due to acute respiratory distress syndrome and septic shock.

**Discussion**

The PCA is divided into four anatomic segments. The P1 or precommunicating segment extends from the basilar bifurcation to the posterior communicating artery, the P2 or postcommunicating segment extends from the posterior communicating artery to the posterior edge of midbrain within the crural cistern (P2A) and the ambient cistern (P2P), the P3 or quadrigeminal segment extends from the posterior edge of midbrain to the anterior edge of the calcarine sulcus, and, finally, the P4 segment consists of the terminal cortical branches of the PCA. From these segments arise multiple branches that supply distinct anatomic areas, namely brain stem, thalamus, third ventricle, and temporal and occipital lobes.

The terminal trunk of the PCA consists of the PoA and the calcarine artery (CA), and this terminal division usually occurs at the P3 segment. The artery with the largest diameter is considered the terminal branch, and Zeal and Rhoton reported the terminal branch as the PoA in 56.0% and the CA in 44.0%.

PoA is present in almost all hemispheres, and it is consistently arising as a single branch and runs in the parieto-occipital fissure to mainly supply the posterior parasagittal region, cuneus, and precuneus. CA is also present in almost all hemispheres as a single branch and travels through the calcarine fissure to supply an area of the primary visual cortex bordered by the cuneus at the top of the fissure and the lingual gyrus at the bottom of the fissure.
PCA aneurysms can be treated with different surgical approaches regarding the location of the aneurysm in relation to the PCA segment. P1 and P2 aneurysms are usually treated with the standard pterional approach, and P2 and P3 aneurysms are mainly treated via the subtemporal approach. The occipital interhemispheric approach is mostly used for aneurysms involving P3 and P4 distribution areas. Via this procedure, although the surgeon has adequate control on P3 into the quadrigeminal cistern, aneurysm’s dome may be a barrier for temporary occlusion of the parent artery. For this reason, adequate occipital sulcus dissection is essential for complete exposure of the PCA in length. In the occipital interhemispheric approach, the surgeon must be familiar with the area’s anatomy. PoA, calcarine artery, parieto-occipital sulcus, cuneus and precuneus, and splenium of the corpus callosum are the main landmarks. PoA is expected to course across the parieto-occipital sulcus at different depths; thus, it is safer to recognize this artery from its origin (usually at P4 segment) and follow that posteriorly.

Table 1 Studies reporting cases of ruptured distal posterior artery aneurysms

| Case                | Age | Symptoms                  | CT findings | Treatment               | Surgical approach                  |
|---------------------|-----|---------------------------|-------------|-------------------------|------------------------------------|
| Burton et al 1968   | 14 y| Headache, blurred vision, coma | ICH         | Proximal electrocautery | Occipital craniotomy                |
| Ishikawa et al 1974 | 40 y| Headache, Hemianopia       | ICH         | Aneurysm resection      | Via hematoma cavity                 |
| Pia and Fontana 1977| 43 y| Blindness, hemiparesis, coma| ICH-IVH     | –                       | Occipital lobectomy                 |
| Tanaka et al 1980   | 40 y| Headache, vomit           | SAH-IVH     | Aneurysm resection      | Temporo-parieto-occipital transventricular |
| Ishibachi-Onuma 1989| 69 y| Headache, vomit, hemianopia| ICH-IVH     | Clipping                | Occipital interhemispheric          |
| Statham et al 1990  | 45 y| Headache, hemianopia, coma | SAH-IVH     | Clipping P2 segment     | Subtemporal                         |
| Barker 1992         | 42 y| Headache, grand mal seizure, coma | ICH-IVH     | Clipping                | Via hematoma cavity                 |
| Orita et al 1994    | 63 y| Gait, aphasia coma         | ICH         | Coated                  | Occipital interhemispheric          |
| Orita et al 1994    | 73 y| Anisocoria                 | ICH-IVH     | Clipping                | Via hematoma cavity                 |
| Ito 1998            | 57 y| Headache, visual impairment| ICH-IVH     | Clipping                | Occipital interhemispheric          |
| Ramakrishnamurthy 1999 | 50 y| –                         | SAH-ICH     | Clipping                | Occipital                           |
| Hashimoto et al 2000| 73 y| Headache, nausea           | ICH         | Clipping                | –                                  |
| Cici 2001           | 52 y| –                         | SAH         | Coiled                  | –                                  |
| Andreou et al 2007  | 23 y| Visual field deficit       | –           | Parent artery occlusion | –                                  |
| Yamahata et al 2010a| 75 y| Headache, nuchal rigidity, nausea | SAH        | Clipping                | Occipital interhemispheric          |
| Mulero et al 2016   | 40 y| Headache, hemianopia       | ICH         | Coiled                  | –                                  |

(Continued)
(distally) via the parieto-occipital sulcus. Of course, the surgeon has to be aware of any anatomical variation of PoA (duplication, atypical origin, perforators, and branches). Special attention should be given to PoA anastomoses with the precuneal artery complex and the calcarine artery. Preoperative evaluation of these arteries for surgical planning through a digital subtraction angiography could be very useful.

In this study, we reviewed the current literature for similar cases with ruptured distal PCA aneurysms of the P4 segment treated via various surgical approaches. So far, 19 studies including ours have revealed cases of ruptured P4 aneurysms (Table 1). Moreover, 36% of the cases were treated via an occipital surgical corridor, while five out of seven occipital approaches were interhemispheric. Orita et al reported that transventricular and transhematoma approaches should be preferred over the interhemispheric one when extensive cerebral edema exists. Multiple underlying pathologies have been identified while reviewing the bibliography. Barker presented a case of a ruptured P4 aneurysm associated with a grade III astrocytoma, while Tanaka et al reported three cases of distal PCA aneurysms following Moyamoya phenomenon. Furthermore, other causative factors reported in the literature include bacterial infection and trauma and should also be taken into consideration during the diagnostic work-up of such patients.

### Conclusion
Distal PCA aneurysms consist of a rare and challenging vascular entity. They require careful diagnostic work-up as they are frequently associated with multiple etiologies and also proper planning to choose the appropriate surgical corridor or endovascular technique.

### Conflict of Interest
None declared.

### References
1. Gerber CJ, Neil-Dwyer G. A review of the management of 15 cases of aneurysms of the posterior cerebral artery. Br J Neurosurg 1992;6(06):521–527
2. Sakata S, Fujii K, Matsushima T, et al. Aneurysm of the posterior cerebral artery: report of eleven cases—surgical approaches and procedures. Neurosurgery 1993;32(02):163–167
3. Orita T, Tsurutani T, Izumihara A, et al. Distal posterior cerebral artery aneurysms—three case reports. Neurol Med Chir (Tokyo) 1994;34(10):692–696
4. Zeal AA, Rhoton AL Jr. Microsurgical anatomy of the posterior cerebral artery. J Neurosurg 1978;48(04):534–559
5. Kalamatianos T, Mavridis IN, Karakosta E, et al. The parieto-occipital artery revisited: a microsurgical anatomic study. World Neurosurg 2012;11:1662–1666
6. Burton C, Velasco F, Dorman J. Traumatic Aneurysm of a Peripheral Cerebral Artery. J Neurosurg 1968;28(05):468–74
7. Ishikawa M, Waga S, Moritake K, et al. Cerebral bacterial aneurysms: report of three cases. Surg Neurol 1974;2(4):257–261
8. Pia HW, Fontana H. Aneurysms of the posterior cerebral artery. Locations and clinical pictures. Acta Neurochir (Wien) 1977;38(1-2):13–35
9. Tanaka Y, Takeuchi K, Akai K. Intracranial ruptured aneurysm accompanying moyamoya phenomenon. Acta Neurochir (Wien) 1980;52(1-2):35–43
10. Ishibashi Y, Onuma T. Peripheral branch (P4 segment) aneurysm of the posterior cerebral artery: a case report. No Shinkei Geka 1989;17(7):659–662
11. Statham P, Johnston R, Coutinho C, et al. Double giant fusiform aneurysms of the posterior cerebral artery. Surg Neurol 1990;33(1):48–51
12. Barker CS. Peripheral cerebral aneurysm associated with a glioma. Neuroradiology 1992;34(01):30–32
13. Orita T, Tsurutani T, Izumihara A, et al. Distal posterior cerebral artery aneurysms—three case reports. Neurol Med Chir (Tokyo) 1994;34(10):692–696
14. Ito N, Shiokawa Y, Ide K, et al. 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 1998;26(7):639–643
15. Ramakrishnamurthy TV, Purohit AK, Sundaram C, et al. Distal calcarine fusiform aneurysm: a case report and review of literature. Neurol India 1999;47(4):318–320
16. Hashimoto Y, Takayama K, Inoue M, et al. A case of distal posterior cerebral artery aneurysm associated with occlusion of the internal carotid artery. No Shinkei Geka 2000;28(8):725–729
17. Cicere EF, Kucznick RP, Grossman RG, et al. Aneurysms of the posterior cerebral artery: classification and endovascular treatment. AJNR Am J Neuroradiol 2021;22(1):27–34
18. Andreou A, Ioannidis I, Mitsos A, et al. Endovascular treatment of peripheral intracranial aneurysms. AJNR Am J Neuroradiol 2007;28(2):355–361
19. Yamahata H, Tokimura H, Hirabaru M, et al. Aneurysm on the cortical branch (P4 segment) of the posterior cerebral artery. Case report. Neurol Med Chir (Tokyo) 2010;50(12):1084–1087
20. Mulero P, Nuñez E, Utiel E, et al. Atypical presentation of a distal cerebral aneurysm: Location and outcome in a young woman. Neurologia 2016;31(9):641–642
21. Kawabata M, Kono K, Terada T, et al. Distal posterior cerebral artery aneurysm at the P4 segment: a case report. No Shinkei Geka 2014;42(9):873–878