Ruptured Aneurysm Associated With Partially Duplicated Posterior Communicating Artery

—Case Report—

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Abstract
A 65-year-old woman presented with a ruptured saccular aneurysm associated with a rare variation of the posterior communicating artery (PcoA), partially duplicated PcoA. The PcoA with this variation forked just distal to the aneurysmal neck, and the two branches independently merged into the posterior cerebral artery. Initial clipping failed to isolate the aneurysm from one of the two branches, so the aneurysmal dome continued to pulsate and bleed. Temporary clipping of the proximal internal carotid artery revealed the fork of the two branches just distal to the aneurysmal neck. A curved Yasargil clip was used to clip the aneurysm and preserve the PcoA and branches. Careful observation of this PcoA variation is needed because the arterial structures may be hidden by the thickened arachnoid membrane.

Key words: aneurysm, duplication, fenestration, posterior communicating artery, variation

Introduction
Ruptured saccular aneurysm arising from the junction of the internal carotid (ICA) and posterior communicating arteries (PcoA) accounts for 21.3% of all ruptured intracranial aneurysms. Surgery of such PcoA aneurysms is sometimes complicated because the PcoA has many morphological variations, both in the number and form of the PcoA, such as aplasia, duplication, and fenestration, and in the perforating branches of the PcoA, such as number, diameter, and areas of supply. We present a case of ruptured saccular aneurysm associated with a rare PcoA variation, partially duplicated PcoA.

Case Report
A 65-year-old woman was admitted to our hospital complaining of headache on July 8, 2000. Brain computed tomography (CT) showed thin, diffuse subarachnoid hemorrhage, and left carotid angiography revealed a saccular aneurysm, 7 mm in diameter, arising from the junction of ICA and PcoA and projecting laterally (Fig. 1A).

Left frontotemporal craniotomy was performed on July 9 to clip the neck of the aneurysm using a pterional approach. The aneurysm was found at the ICA-PcoA junction with the dome projecting ventrolaterally. The PcoA originated from the ICA and ran dorsolaterally, close to the aneurysmal dome. A clip was applied to the neck of the aneurysm, preserving the PcoA. However, pulsation of the aneurysm did not disappear, and some bleeding was noted from the aneurysm during dissection of the surrounding tissue. Review of the angiograms suggested a variant PcoA which bifurcated into two branches, a smaller medial branch and a larger lateral branch, which independently joined the posterior cerebral artery (PCA) (Fig. 1B, C). After temporary clipping of the proximal ICA, the fork of the PcoA was observed just distal to the distal end of the aneurysmal neck. The two branches of the PcoA running dorsally were independently covered with thickened arachnoid membrane. The aneurysmal clip had been placed to cross just over the fork, with the origin of the smaller branch remaining open to the aneurysm (Fig. 2A). These findings suggested
that the bleeding from the aneurysm after clipping resulted from the inflow of blood through the smaller branch of the PcoA (Fig. 2A). A Yasargil titanium clip with 7 mm curved blades was applied to the neck of the aneurysm, preserving the PcoA and its branches (Figs. 2B and 3). The temporary clip of the ICA was removed after 18 minutes.

The patient tolerated postoperative cerebral ischemia due to vasospasm, and returned to her former daily life without neurological deficit 7 weeks after the onset.

Discussion

Duplication of the PcoA is a rare variation in which two arteries arise independently from the ICA. PcoA duplication was found in 0.25% of 200 cadaver brain dissections,15) and 0.75% of 400 autopsy cases.3) Three surgical cases of the PcoA duplication were reported in which one of the two arteries originating distally did not join the PCA but coursed indepen-
dently along the medial-basal temporal lobe and functioned as a temporal artery.\textsuperscript{15} This type of the PcoA duplication was called a persistent primitive PCA.\textsuperscript{11} Fenestrated PcoA is another rare PcoA variation, in which the PcoA forks just distal to its origin on the ICA and unites just proximal to the origin of the first perforating branch of the PcoA.\textsuperscript{15} In our case, the PcoA showed neither duplication nor fenestration, but forked just distal to the arachnoidal neck, and the two branches joined the PCA independently. The same PcoA variation was found in a cadaver dissection, and called partially duplicated PcoA.\textsuperscript{8} No surgical case of aneurysm associated with this type of PcoA variation has been reported. The PcoA is formed by secondary anastomosis between the caudal division of the ICA and the cranial end of the longitudinal neural artery at the meninges at stage 2 (5–6 mm in length).\textsuperscript{6} The bilateral longitudinal neural arteries consolidate to form the basilar artery at stage 3 (7–12 mm in length), and concomitantly or soon thereafter the PcoA replaces the primitive trigeminal artery as the supply to the arteries of the hindbrain.\textsuperscript{6} The morphological variations of the PcoA probably develop at Padget’s stage 2 or 3,\textsuperscript{6} and persist in the adult. In our case, careful, continuous dissection of the thick arachnoid covering the PcoA branches was required to clarify the arterial structures of the PcoA variation. The PcoA generally arises from the ICA in the carotid cistern, courses posteromedially, and enters the interpeduncular cistern after penetrating the diencephalic leaf of Liliequist’s membrane.\textsuperscript{5,14} Thickened arachnoid may occur around the PcoA. The sleeve of arachnoid around the origin of the PcoA was densely adherent to the dura over the posterior clinoid process,\textsuperscript{14} whereas the PcoA had its own cistern separated from the interpeduncular cistern and the thickening of the arachnoidal wall separating the two cisterns was possibly promoted by subarachnoid hemorrhage.\textsuperscript{13} Careful observation of PcoA variations is required, including duplication and fenestration, because the arteries forming the variations may be hidden by the thickened arachnoid membrane.

In our case, insufficient preoperative investigation of the cerebral angiograms was one reason that the surgery was complicated, but the PcoA and its perforating branches often remain obscure on angiograms.\textsuperscript{3} The PcoA has a mean of 7–8.5 important perforating branches, which supply the hypothalamus, optic tract, posterior limb of the internal capsule, and so on.\textsuperscript{2,4,7–9,13,15} The largest perforating branch, variously called the anterior thalamoperforating artery, the premamillary artery, or the thalamotuberal artery, varies in diameter from 0.3 to 1.0 mm, with a mean of 0.6 mm.\textsuperscript{9} Care should be taken not to misconstrue the rare PcoA variations, in particular the partially duplicated PcoA and fenestrated PcoA, as the largest perforating branch of the PcoA on preoperative angiograms. Other neuroradiological methods, for example, three-dimensional CT angiography,\textsuperscript{12} may be useful to clarify the arterial structures of the PcoA and its branches.

References

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