Posterior Cerebral Artery Aneurysm Associated with Unilateral Internal Carotid Artery Agenesis

—Case Report—

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Abstract

A 38-year-old housewife presented with a ruptured aneurysm associated with unilateral internal carotid artery agenesis. She had been in good health until May 31, 1994, when she was admitted to our facility immediately after sudden onset of headache and nausea. She was alert and exhibited no focal neurological deficit on admission. Cerebral angiography demonstrated an aneurysm arising from the junction of the horizontal segment of the right posterior cerebral artery and posterior communicating artery. The right internal carotid artery was totally absent. High resolution computed tomography demonstrated absence of the right carotid canal in the skull base. Neck clipping of the aneurysm was carried out through the right pterional approach on June 2. She returned home 52 days after the surgery with mild paresis of the left upper extremity and has since resumed household activities. Early surgery may be recommended in a patient with a ruptured aneurysm associated with agenesis of the internal carotid artery to prevent catastrophic rebleeding, if the initial insult is mild and subsequent vasospasm is unlikely to occur.

Key words: internal carotid artery agenesis, posterior cerebral artery aneurysm, subarachnoid hemorrhage

Introduction

Agenesis or aplasia of the internal carotid artery may be associated with cerebral aneurysm. Many such aneurysms are located in the anterior half of the circle of Willis,^{4,5,9,12,13,15-17,19-22,26} and more rarely in the vertebrobasilar system (posterior circulation).^{1-3,6,8,11,14,18,24,25} Surgical management of posterior circulation aneurysms associated with such congenital lesions has rarely been described.^{1,2,11,18,24,25} We report a case of posterior cerebral artery (PCA) aneurysm associated with agenesis of the right internal carotid artery which was treated surgically.

Case Report

A 38-year-old housewife had been in good health until May 31, 1994, when she suddenly experienced severe headache and nausea. She was admitted to

our facility immediately after onset. She was alert, fully oriented and had no focal neurological deficit.

Computed tomography (CT) demonstrated mild subarachnoid hemorrhage localized in the interpeduncular cistern. Cerebral angiography demonstrated complete absence of the right internal carotid artery. The cervical portion showed no bifurcation of the right "common" carotid artery (Fig. 1). Vertebral angiography demonstrated an aneurysm originating from the junction of the horizontal segment of the right PCA (P₁) and the posterior communicating artery (PCoMA) (Fig. 2). The PCoMA was remarkably enlarged and supplied the right middle cerebral artery. The right middle cerebral artery was also supplied by the right anterior cerebral artery via the anterior communicating artery. The left carotid artery and its branches were normally opacified. No rete mirabile or other extracranial-intracranial pathways were present. Arch aortography demonstrated no anomalies in any of the aortic branches. High resolution CT scans with 2 mm slice

Fig. 1 Right common carotid angiogram, lateral view, showing neither an internal carotid artery nor a remnant.

Fig. 2 Left vertebral angiograms, anteroposterior (left) and lateral (right) views, demonstrating an aneurysm arising from the junction of the P₁ and PComA. The enlarged PComA fills the right middle cerebral artery.

thickness demonstrated absence of the right carotid canal in the skull base (Fig. 3).

The neck of the aneurysm was clipped through the right pterional approach on June 2, 1994. Intraoperatively, the intracranial portion of the right internal carotid artery was confirmed to be absent (Fig. 4). The interpeduncular cistern was easily reached by mild retraction of the surrounding structure. The aneurysmal dome could be seen projecting posteriorly from the P₁-PComA junction. A straight ring clip, Sugita No. 31, was applied to the neck of the aneurysm, sparing a perforating artery arising from the P₁-PComA junction through the ring. Systemic arterial pressure was maintained at approximately 140/80 mmHg by continuous intravenous administration of dopamine during and after surgery. Dopamine administration was discontinued on the

Fig. 3 CT scans with 2 mm slice thickness demonstrating absence of the right carotid canal in the skull base, with the endocranial opening (arrow) and horizontal portion (double arrow) of the internal carotid canal on the left (intact) side.

10th postoperative day.

She had left hemiparesis immediately after the operation. Fortunately, no serious symptomatic vasospasm occurred and the hemiparesis gradually improved. However, postoperative CT showed a small infarct in the right anterior thalamic region, in the distribution of the right anterior thalamoperforating arteries. She returned home with mild paresis of the left upper extremity on July 24, 1994, and has since resumed light household activities.

Discussion

Agenesis and aplasia of the internal carotid artery are often confused. The term agenesis should be used only when the internal carotid artery is totally absent. In aplasia, a portion or remnant is present. The presence of a bony carotid canal is more suggestive of aplasia.¹⁰ In the embryo, the cartilaginous petrous portion begins to ossify during the 5th fetal month and ossification is almost complete by the end of the 6th month.⁷ Thus, absence of the bony carotid canal is thought to be a significant indication of embryonal development failure. We previously reported the usefulness of high resolution CT for delineating the bony carotid canal.²³ In the present case, complete absence of the internal carotid artery was confirmed by both angiography and surgery. High resolution CT demonstrated the absence of the right carotid canal in the skull base.

Servo¹⁶ found that 25% of patients with internal carotid anomalies had subarachnoid hemorrhage

Fig. 4 Photograph (*left*) and schematic drawing (*right*) of the operative view after aneurysm clipping. The intracranial portion of the right internal carotid artery is absent. The neck of the aneurysm is clipped with a straight ring clip, Sugita No. 31. AN: aneurysm, BA: basilar artery, MCA: middle cerebral artery, P₂: first portion of the PCA after P₁-PCoA junction, II: optic nerve, III: oculomotor nerve.

Table 1 Vertebrobasilar system aneurysms associated with agenesis or aplasia of the internal carotid artery

Author (Year)	Age/Sex	Agenesis side	Aplasia side	Aneurysm site	Surgery	Interval from SAH to operation	Surgical result
Hawkins and Scott (1967) ⁶⁾	37/M	—	bil	bBA	ND	—	—
Moyes (1969) ¹¹⁾	37/F	lt	—	bBA	clipping	8 days	fair
Carella <i>et al.</i> (1975) ³⁾	19/F	rt	—	rt PCA	ND	—	—
Rosen <i>et al.</i> (1975) ¹⁴⁾	37/M	bil	—	trBA	ND	—	—
Amacher <i>et al.</i> (1981) ¹⁾	15/M	bil	—	bBA	clipping	15 days	good
Yaşargil (1984) ^{24,25)}	28/F	rt	—	rt PCA	clipping	2 mos	good
Sugita (1985) ¹⁸⁾	43/M	—	lt	lt PCA	clipping	3 wks	poor
Kunishio <i>et al.</i> (1986) ⁸⁾	70/M	lt	—	bBA*	ND	—	—
Anegawa <i>et al.</i> (1987) ²⁾	52/F	bil	—	lt PCA	clipping	30 days	death
Present case	38/F	rt	—	rt PCA	clipping	3 days	fair

*The bBA aneurysm was unruptured, and the ruptured middle cerebral artery aneurysm was clipped. bBA: bifurcation of basilar artery, ND: not done, SAH: subarachnoid hemorrhage, trBA: trunk of basilar artery.

caused by an aneurysm. Why these carotid anomalies are more frequently associated with cerebral aneurysms continues to be debated. Congenital vascular anomalies tend to occur together. The coexistence of such lesions and cerebral aneurysms may support the observation that congenital factors tend to be clinically significant. However, many authors have suggested that the altered hemodynamics produced by absence of an internal carotid artery are associated with a higher frequency of cerebral aneurysm.^{11,17,22)}

In patients with congenital absence or narrowing of the internal carotid artery who lead a normal life before the ictus, the opposite internal carotid and basilar arteries apparently compensate for the arterial insufficiency on the affected side. The exter-

nal carotid artery is of minor importance in the collateral circulation.¹⁰⁾ Therefore, such patients can tolerate aneurysm surgery well. In recently reported patients who underwent clipping of anterior circulation aneurysms associated with congenital absence of an internal carotid artery, surgical results were generally good without vascular reconstruction.^{8,12,13,17,21,22)} However, vascular reconstruction, including external carotid-internal carotid bypass surgery, may be required if a parent artery has to be sacrificed.

Nine cases of posterior circulation aneurysms^{1-3,6,8,11,14,18,24,25)} associated with such congenital lesions have been reported, and five aneurysms^{1,2,11,18,24,25)} were surgically treated (Table 1). The surgical results of posterior circulation aneurysms were less

favorable than those of the anterior circulation, primarily because of the deep location of these aneurysms and the difficulty of perforating artery identification. In our patient, neck clipping of the aneurysm was carried out in the early stage because angiography had shown good collateral flow and CT demonstrated minor subarachnoid hemorrhage, indicating less possibility of symptomatic vasospasm. The parent artery was not compromised in our patient, so vascular reconstruction was not necessary. Although minimal brain retraction was required and systemic arterial pressure was maintained by continuous intravenous administration of dopamine during the perioperative period, postoperative CT showed a small infarct in the right anterior thalamic region, in the distribution of the right anterior thalamoperforating arteries. This may have resulted from postoperative vasospasm or unexpected sacrifice of these arteries.

Early surgery can be recommended in a patient with a ruptured aneurysm associated with agenesis of the internal carotid artery to prevent catastrophic rebleeding, if the initial insult is mild and subsequent vasospasm is unlikely to occur.

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