Infraoptic Course of Both Anterior Cerebral Arteries

Cheol Ji, M.D., Jae-Geun Ahn, M.D.
Department of Neurosurgery, St. Paul’s Hospital, College of Medicine, The Catholic University of Korea, Seoul, Korea

A 28-year-old woman was referred to our hospital with a sudden, very severe headache. Brain computed tomographic angiography showed a saccular cerebral aneurysm at the bifurcation of the left middle cerebral artery and infraoptic courses of both anterior cerebral arteries. The anterior cerebral arteries were seen to arise from the ipsilateral internal cerebral arteries at the level of the origin of the ophthalmic artery, passed underneath the ipsilateral optic nerve, and turned upward at ventral portion of the optic chiasm.

Infraoptic course of the proximal anterior cerebral artery is an extremely rare anomaly and is often associated with cerebral aneurysms. We report the clinical features, radiological findings, and possible genesis of this anomaly with a literature review.

KEY WORDS: Anterior cerebral artery · Infraoptic course · Optic chiasm.

INTRODUCTION

Although variations in the anterior cerebral artery/anterior communicating artery complex are common, an infraoptic course of the A1 segment of the anterior cerebral artery, which originates from the internal cerebral artery at the level of the ophthalmic artery, passes below the ipsilateral optic nerve, and ascends anterior to the optic chiasm, is an extremely rare anomaly\(^1,2,4-11,13-19\). Although rare, the condition should be considered as an entity. The incidence of associated berry aneurysm\(^1,4-7,10,11,14,15,18\) and other intracranial vascular anomalies\(^7,8,19\) is high. The clinical features, radiological findings, and possible genesis of this anomaly are presented here.

CASE REPORT

A 28-year-old woman was admitted to our hospital after developing a sudden severe headache. The physical examination revealed moderate neck stiffness.

Brain computed tomography (CT) on admission showed a diffuse subarachnoid hemorrhage in suprasellar, ambient and both Sylvian cisterns (Fig. 1). Brain CT angiography showed that both anterior cerebral arteries originated from the ipsilateral internal carotid arteries at level of the ophthalmic artery. Then, both anterior cerebral arteries coursed under and medial to the respective optic foramen and ran cephalad (Fig. 2). Brain CT angiography also revealed a saccular aneurysmal dilatation at the bifurcation of the left middle cerebral artery. Transfemoral four-vessel angiography demonstrated low bifurcation of both internal carotid arteries. Both anterior
cerebral arteries arose from the internal carotid arteries bilaterally at the level of the ophthalmic artery, coursing medially and superiorly and rising at the midline (Fig. 3). A left frontopterional craniotomy was performed via transsylvian approach. The aneurysm was approached first, dissected free from adherent clots, and clipped adequately. After the carotid and chiasmatic cisterns were opened, a low bifurcation of the left internal cerebral artery was observed, the left proximal A1 segment coursed under the left optic nerve and the both distal A1 segments ran anterior to the optic chiasm (Fig. 4).

DISCUSSION

Although variations of the anterior cerebral artery/anterior communicating artery complex are common, the presence of an infraoptic course of the proximal precommunicating segment of the anterior cerebral artery is an extremely rare anomaly1,2,4,9-11,14-18. Robison13) first described this anomaly from an anatomic dissection in 1959. The first angiographic demonstration was done by Isherwood and Dutton5). Until now, approximately 30 cases of this anomaly have been identified18). Normally, the anterior cerebral artery arises as the medial component of the carotid bifurcation and courses over the superior surface of the optic chiasm (70%) or nerves (30%)12). In ours and the other reported cases1,2,4,9-14,16-18, the infraoptic course of the A1 segment has a characteristic appearance on angiography; an apparent low bifurcation of the internal cerebral artery at the level of the ophthalmic artery or just above, and a horizontal-medial course of the proximal anterior cerebral artery as it passes under the ipsilateral optic nerve before turning superiorly to the anterior communicating artery.

A unilateral anomalous infraoptic course of the anterior cerebral artery is more common than anomalies of both anterior cerebral arteries4). With a unilateral infraoptic course of the anterior cerebral artery, the absence or hypoplasia of the contralateral anterior cerebral artery is common4,11,14,15,18). To our knowledge, only four cases of the infraoptic courses of both anterior cerebral arteries, including our case, have been reported18). This anomalous vessel is frequently accompanied by other intracranial vascular anomalies secondary to embryogenic disorders, such as a variant of the carotid-basilar artery anastomosis7,19), a fused pericallosal artery8), or a plexiform anterior communicating artery8). In our case, however, we found no other intracranial vascular anomalies.

Similar to the other variations in the circle of Willis, the prevalence of cerebral aneurysm is much higher with an infraoptic course of the anterior cerebral artery1,4,6,10,11,14,15,18). The most common site of aneurysm is at the anterior cerebral artery/anterior communicating artery complex1,4,6,10,11,14,15,18). This might be because the anomalous anterior cerebral arteries supply the majority of the anterior circulation bilaterally and are frequently associated with an azygous A2 segment of anterior cerebral artery4,11,14,15,18). In our case, however, both anterior cerebral arteries passed under the
ipsilateral optic nerve and were well developed.

It is reasonable to speculate that the common origin of the ophthalmic artery and the anomalous A1 segment is proof of a close relationship to the development of the adult ophthalmic artery.

Odake\cite{11} thought that the artery could not be considered an abnormal anterior cerebral artery because a normally positioned ipsilateral anterior cerebral artery was present in several cases. Therefore, he described the anomaly as a carotid-anterior cerebral artery anastomosis, as Nutik and Dilenge\cite{10} advocated.

Several theories regarding the origin of this anomalous vessel have been proposed. Early bifurcation of the internal cerebral artery\cite{13}, enlargement of the prechiasmal anastomosis\cite{10,14}, a persistent intrauterine communication between primitive dorsal and ventral ophthalmic arteries\cite{10,11}, and anastomosis between branches of the primitive olfactory and primitive maxillary arteries have been postulated as embryologic explanations\cite{10,14}.

CONCLUSION

Infraoptic course of the anterior cerebral artery is an extremely rare anomaly and is frequently associated with other intracranial vascular anomalies secondary to embryogenic disorders. If an infraoptic course of the anterior cerebral artery is noted, we recommend to search other possible vascular anomalies.

References

1. Bollar A, Martinez R, Gelabert M, Garcia A: Anomalous origin of the anterior cerebral artery associated with aneurysm-embryological considerations. Neuroradiology 30: 86, 1988
2. Brismar J, Ackerman R, Roberson G: Anomaly of anterior cerebral artery-A case report and embryologic considerations. Acta Radiol Diagn (Stockh) 18: 154-160, 1977
3. Dawson BH: The blood vessels of the human optic chiasma and their relation to those of the hypophysis and hypothalamus. Brain 81: 207-217, 1958
4. Fujimoto S, Murakami M: Anomalous branch of the internal carotid artery supplying circulation of the anterior cerebral artery. Case report. J Neurosurg 58: 941-946, 1983
5. Isherwood I, Dutton J: Unusual anomaly of anterior cerebral artery. Acta Radiol Diagn (Stockh) 9: 345-351, 1969
6. Kessler LA: Unusual anomaly of the anterior cerebral artery. Arch Neurol 36: 509-510, 1979
7. Lehmann G, Vincentelli F, Ebogosi A: Anomalies of the circle of Willis: Infraoptic pathway of the anterior cerebral artery: report of a case. Neurochirurgie 26: 243-246, 1980
8. McCormick WF: A unique anomaly of the intracranial arteries of man. Neurology 19: 77-80, 1969
9. Milenkovic Z: Anastomosis between internal carotid artery and anterior cerebral artery with other anomalies of the circle of Willis in a fetal brain. J Neurosurg 55: 701-703, 1981
10. Nutik S, Dilenge D: Carotid-anterior cerebral artery anastomosis. Case report. J Neurosurg 44: 378-382, 1976
11. Odake G: Carotid-anterior cerebral artery anastomosis with aneurysm: case report and review of the literature. Neurosurgery 23: 654-658, 1988
12. Perlmutter D, Rhoton AL Jr: Microsurgical anatomy of the anterior cerebral-anterior communicating-recurrent artery complex. J Neurosurg 45: 259-272, 1976
13. Robinson LR: An unusual human anterior cerebral artery. J Anat 93: 131-133, 1959
14. Rosenom J, Ahlgren P, Ronde F: Pre-optic origin of the anterior cerebral artery. Neuroradiology 27: 275-277, 1985
15. Senter HJ, Miller DJ: Intercapillary course of the anterior cerebral artery associated with anterior cerebral artery aneurysm. Case report. J Neurosurg 56: 302-304, 1982
16. Sheehy JP, Kendall BE, Thomas DG: Infraoptic course of the anterior cerebral artery associated with a pituitary tumor. Surg Neurol 20: 97-99, 1983
17. Singer RJ, Abe T, Taylor WH, Marks MP, Norbash AM: Intracavernous anterior cerebral artery origin with associated arteriovenous malformation: a developmental analysis: case report. Neurosurgery 40: 829-831; discussion 831, 1997
18. Spinnato S, Pasqualin A, Chioffi F, Da Pian R: Infraoptic course of the anterior cerebral artery associated with an anterior communicating artery aneurysm: anatomic case report and embryological considerations. Neurosurgery 44: 1315-1319, 1999
19. Teal JS, Rumbaugh CL, Segall HD, Bergeron RT: Anomalous branches of the internal carotid artery. Radiology 106: 567-573, 1973