Anomalous Origin of the Anterior Choroidal Artery

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Key words: anterior choroidal artery, anomaly, posterior communicating artery

Summary

We describe a very rare case of anomalous origin of the anterior choroidal artery. In our case the anterior choroidal artery arises from the internal carotid artery proximal to the posterior communicating artery.

Introduction

The anatomy of the anterior choroidal artery (AChA) and posterior communicating artery (PcomA) has been studied extensively. Despite several detailed anatomical reports, none has disclosed a transposition of the origins of these vessels.

Case Report

A 56-year-old woman complained of vertigo. Magnetic resonance angiography (MRA) revealed an aneurysm of the left internal carotid artery (ICA). She was admitted to our institute for the treatment of this aneurysm. Three dimensional rotation angiography (3D-RA) of the left ICA revealed the unruptured aneurysm arising from the C3 portion of the ICA and anomalous origin of the AChA.

The AChA originated from the ICA proximal to the PcomA (Figure 1). The 3D-RA was useful to establish the precise relationship between the AChA and PcomA. We attempted

endovascular embolization with platinum coils for this aneurysm. The origin of this anomalous AChA was not incorporated with the aneurysm.

Discussion

There have been some cadaveric studies focusing on the microvascular anatomy of the AChA^{1,2}. These previous reports indicate that the AChA usually originates from the ICA distal to the PcomA. Moreover, some investigations have demonstrated numerous variations in the course, size, segments, branching patterns and brain regions supplied by these vessels²⁻⁹. However, no study has demonstrated an anomalous origin of the AChA. Anomalous origin of the AChA from the ICA proximal to the PcomA must be very rare. To our knowledge, our case is the fourth case of such an anomalous AChA¹⁰⁻¹².

One case was found during routine angiography performed prior to resection of an acoustic neurinoma¹⁰.

The second was a case of subarachnoid hemorrhage resulting in rupture of an aneurysm arising from either the AChA or the PcomA whose origins from the ICA were transposed¹¹. The third was found on MRA performed for evaluation of headache¹². As far as we can ascertain, ours is the fourth case presenting an anomalous origin of the AChA.

Yasargil⁹ did note one case in his study of the anatomy of the AChA where the PcomA and AChA were seen to arise from the same level as the ICA.

There are many variations of the AChA. Some AChA arise from the ICA bifurcation, from the middle cerebral artery or posterior cerebral artery (PCA)^{2,7,13-15}.

The other variants showed double AChA, hypoplasia AChA or hyperplasia AChA⁷. Embryological mechanisms are involved in the genesis of these variants. The primitive carotid artery develops by approximately three to four weeks' gestation, crown-rump (CR) length 3 mm. At 7.5 weeks, CR 40 mm, the origins of all major intracranial branches are present¹⁶. Initially, the carotid artery bifurcates distal to the origin of the ophthalmic artery into a rostral division (RD) and a caudal division (CD). This bifurcation occurs at the level of what will later become the PcomA¹⁷.

The RD is the precursor of the AChA, anterior cerebral artery (ACA), and middle cerebral artery. The CD is the precursor of the PcomA and supplies the proximal PCA and upper basilar system (distal origin of the trigeminal artery). At a CR length of 4 to 6 mm, the intracranial carotid arterial system consists of the trigeminal artery, which supplies flow to the hindbrain, a primitive ophthalmic branch, the CD, and the RD, which consists of the primitive olfactory artery. By a CR length of 6 to 7 mm, the trigeminal artery has mostly regressed and the CD supplies the upper basilar system. At this stage, the enlarging cerebral hemispheres require an additional blood supply that was initially provided by the ACA and AChA branches of the RD. By this time, the distal AChA has developed into telencephalic and diencephalic branches, the former giving supply to the posteromedial aspects of the developing hemisphere as well as perforating branches¹⁶⁻¹⁸. As the hemispheres further develop, the ACA also produces distal telencephalic and choroidal branches, which later form an anastomosis with AChA counterparts.

In this way, the AChA supplies blood flow to areas of the telencephalon. Another set of diencephalic and mesencephalic arteries originate from the distal CD. These vessels allow for craniofugal flow into the developing upper basilar system after regression of the trigeminal artery¹⁶⁻¹⁸. As the cerebral hemispheres and choroid plexus develop, the posterior choroidal

artery (PChA) emerges as a branch of the CD, proximal to the origin of the diencephalic and mesencephalic arteries. Flow in the PChA increases with gestation age, and as a result of both hemispheric growth and the development of antegrade flow in the basilar artery, the PChA begins to acquire the posterior hemispheric territory previously supplied by the AChA¹⁸. The PChA, now supplied by both the CD and antegrade basilar flow, connects the distribution of the diencephalons (supplied by the PChA) and telencephalon (supplied by the AChA) and thereby adopts the supply of the AChA.

Hypoplasia of the plexal segment of the AChA, noted occasionally on control angiograms, may be explained by the phylogeny of this artery. According to a phylogenetic study of forebrain arteries by Abbie¹⁹, the AChA begins as a small vessel called the inferior cerebral artery of Dendy in the sphenodon, a phylogenetically lower reptile.

The small vessel runs posteriorly along the optic tract and anastomoses with the caudal division in the crocodile, a higher species of reptile.

The small vessel has no choroidal branches, and thus is not a true choroidal artery at this stage. Because both the lateral ventricle and choroid fissure assume an arcuate form in mammals, the posterior part of the AChA comes to lie alongside the anteroinferior end of the elongated choroid fissure and acquires some choroidal branches from the PCA, thus completing the AChA in the true sense. Hypoplasia of the plexal segment of the AChA, which can be visualized to the level of the lateral geniculate body, may represent an evolutionary variant in which the artery ceased to acquire choroidal branches, remaining in the reptilian stage⁸.

The normal AChA also has potential anastomoses with its neighboring arteries, especially with the PcomA and PCA^{13,20-22}. Hyperplasia of the AChA seems to represent a situation in which one of those anastomoses remains and enlarges as a main pathway of the artery, while a segment of the PCA just proximal to the anastomosis eventually attenuates.

Depending on which channel remains, different phenotypes of the hyperplasia may result⁸. As mentioned above, the AChA is from the RD of the ICA and the PcomA from the CD of the ICA.

Figure 1 Lateral view (A) of left internal carotid angiogram after coil embolization of the aneurysm showing the anomalous origin of anterior choroidal artery (AChA) (double arrows) at the level proximal to the posterior communicating artery (PcomA) (single arrow). Posterior-anterior view (B) and lateral view (C) of a three-dimensional angiogram with surface shaded display of the internal carotid artery showing the anomalous origin of the AChA (double arrows) at the level proximal to the PcomA (single arrow).

Conclusions

We described a case of anomalous origin of the AChA from the ICA proximal to the PcomA. The genesis of this anomaly is unexplained from a developmental point of view. Therefore

this anomaly might be mutation. In order to detect the relationship between the origin of the AChA and one of the PcomA, three-dimensional images were very useful. More cases of this anomaly might be found using three-dimensional images.

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