Splitting and penetration of the optic nerve by an aneurysm arising from the anterior wall of internal carotid artery: case report

K Kanamaru, F Ishida, W Taki

Abstract
Aneurysms arising from the anterior wall of the internal carotid artery (ICA) are uncommon. There have not been any reports demonstrating the anatomical relation of such aneurysms to the optic nerve. An aneurysm arising from the anterior wall of the ICA splitting and penetrating the optic nerve is reported. A 73 year old woman presented with severe headache due to subarachnoid haemorrhage. She had never experienced a visual disturbance. At surgery, the aneurysm was shown to arise from the anterior wall of the left internal carotid artery and to split and penetrate the left optic nerve. The aneurysm was not related to arterial bifurcation of any branches and was safely neck clipped. Given the evidence of a split and penetration of the optic nerve, the pathogenesis of such an aneurysm may be due to the persistence of an embryonic vessel.

Keywords: cerebral aneurysm, anterior wall of internal carotid artery, optic nerve, embryonic vessel

Case report
A 73 year old woman presented with an abrupt loss of consciousness while taking a short bus trip. Brain CT showed a dense thick subarachnoid haemorrhage. Left internal carotid angiography disclosed a large aneurysm arising from the anterior wall of the ICA with superior projection (fig 1A). The aneurysm mimicked an anterior communicating artery aneurysm. However, surgical findings confirmed a saccular aneurysm arising from the anterior wall of the left ICA splitting and penetrating the left optic nerve (fig 1B). Clipping was performed uneventfully. Postoperative angiography showed complete neck clipping (fig 1C). During the postoperative course, the patient became severely disabled due to florid, unremitting vasospasm that was refractory to volume expansion and papaverine injections into the ICA.

Discussion
Aneurysms arising from the anterior wall of the ICA are usually not related to arterial division. Yasargil reported three cases of this unusual type of aneurysm arising from the dorsal or medial wall of the distal ICA among a series of 319 cases of ICA aneurysms. In many patients with this particular type of aneurysm, the initial angiogram soon after subarachnoid haemorrhage shows only a small bulge from the anterior wall of the ICA. This bulge may progress to a saccular appearance within a few weeks. In the present patient, it is unlikely that the small bulge had grown sufficiently to penetrate the optic nerve in such a
short time. Cerebral arteries rarely penetrate cranial nerves, such as optic nerves, oculomotor nerves, trochlear nerves, and abducens nerves. In the case of the optic nerve, the optic tract was perforated by the A1 segment. The optic chiasma was also penetrated by an anterior communicating artery aneurysm. There has been only one report that described splitting of the optic nerve by a carotid-ophthalmic artery aneurysm. The present study represents the first case of an aneurysm arising from the anterior wall of the ICA which split and penetrated the optic nerve. An anomalous artery sometimes originates from the ICA at the branching of the ophthalmic artery, passes inferiorly to the optic nerve, and ascends anteriorly to the optic chiasm to join the ACA near, or at the anterior communicating system. The anomaly might be explained by persistence to the time of full development of a vascular anastomotic loop normally present only in the embryo. Two embryonic anastomotic loops which have the necessary characteristics were suggested by Padget.

Most aneurysms originate at the bifurcation of parent arteries and become degenerative lesions due to haemodynamic stress. Despite the lack of substantiation, aneurysms have been alleged to arise from persistent vestigial vessels at the apex or crotch of arterial forks. In addition, some residual vestigial vessels from the premordial capillary plexus may be persistent without acquisition of their connective tissue sheaths. If aneurysms arise from such defective tissue, it is possible that sac walls might not be able to differentiate into the connective tissues of the arterial wall. Indeed, a particular type of aneurysm, the “blister-like” aneurysm arising from the anterior wall of the ICA, is characterised by the disappearance of the internal elastic lamina and media at the border between the eccentrically sclerotic and normal carotid wall. It remains to be elucidated whether such defects occurred due to haemodynamic stress or a congenital wall defect. Notwithstanding, the aneurysm had clearly split and penetrated the optic nerve, indicative of embryonic origin. How haemodynamic stress or degeneration could cause such an unusual anatomical situation cannot be explained.

In conclusion, split and penetration of the optic nerve by an aneurysm are rare entities. The most likely explanation is that the
aneurysm arose from a vessel already penetrating the optic nerve.

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