Interoptic course of the anterior cerebral artery associated with anterior cerebral artery aneurysm

Case report

HOWARD J. SENTER, M.D., AND DANIEL J. MILLER, M.D.

Department of Surgery, Section of Neurosurgery, The Western Pennsylvania Hospital, Pittsburgh, Pennsylvania

A ruptured anterior cerebral artery aneurysm is reported in a patient in whom a solitary anterior cerebral artery arose from the proximal carotid artery and ascended between the optic nerves.

KEY WORDS • aneurysm • anterior cerebral artery • optic nerve

Anomalies of the anterior circle of Willis are quite common and some variations are extremely rare. A case is reported of an anterior cerebral artery (ACA) aneurysm associated with a solitary ACA arising from the origin of the ophthalmic artery and coursing between the two optic nerves. Angiographic and surgical documentation of this anomaly has been reported only four times before. Preoperative recognition of this aberrant artery is crucial for planning a microsurgical approach and obtaining proximal control without damaging either perforating vessels or the optic chiasm.

Case Report

This 48-year-old left-handed man was admitted with sudden onset of headache and a left hemiparesis. His father had died aged 48 years of a ruptured cerebral aneurysm.

Examination. The patient had a stiff neck, left hemiparesis, and a left homonymous hemianopsia. Cerebrospinal fluid was xanthochromic and blood-tinged, although a computerized tomography scan was normal.

Three weeks after admission, when the patient's clinical status had improved, three-vessel arteriography was performed. A large saccular aneurysm was seen arising at the origin of both A2 segments. A solitary ACA arose from the intradural right carotid siphon, coursing medially, inferior to the right optic canal, and rising on the midline to bifurcate into both a left and a right ACA (Fig. 1). An isolated left middle cerebral circulation and an isolated vertebrobasilar circulation were also noted.

Operation. Surgery was performed on the 24th day after admission. A right frontotemporal pterional approach was selected because of the anatomy of the aneurysm, the desirability of having proximal control, and concern that perforators from the common A1 segment might be injured if mobilization of the solitary ACA was required.

The right carotid artery was small and continued without branches until the lenticulostriate perforators of the middle cerebral artery were seen. The ACA rose vertically between the right and left optic nerves, abutting the anterior chiasm and distributing multiple perforating vessels to supply both optic nerves and chiasm (Fig. 2). The ACA bifurcated into both A2 segments and both frontopolar arteries. No left A1 segment was seen, nor either recurrent artery of Heubner. The broad neck of the aneurysm was clipped. The postoperative course was uneventful and a follow-up arteriogram on the 7th postoperative day revealed successful obliteration of the aneurysm.

Discussion

The majority of anomalies found in the circle of Willis occur in its anterior distribution. A low bifurcation of the internal carotid artery, at the level of the ophthalmic artery just as it becomes intradural, is a rare anomaly. Bifurcating at this level, the ACA must
Aneurysm of anomalous anterior cerebral artery

Fig. 1. Right carotid angiogram. Left: Anteroposterior view showing the low origin of the solitary anterior cerebral artery (diagonal arrow). Horizontal arrow points to the vertical segments of the anterior cerebral artery ascending between the two optic nerves. Right: Lateral view. Arrows identify the same two areas.

pass medially below either the ipsilateral optic nerve or the optic chiasm. The subsequent course of the ACA is not well defined in the literature: 1) it can turn superiorly, behind the optic chiasm; 2) it can turn superiorly, anterior to the optic chiasm, between the optic nerves; 3) it can continue on and pass beneath the contralateral optic nerve, then turn cephalad lateral to it; or 4) it can course directly beneath the optic chiasm, turning superiorly along its contralateral side. Four previous cases of this anomaly have been diagnosed arteriographically and confirmed at surgery. Four of the five reported cases (including our own) have been associated with an ACA aneurysm. There is also a high incidence of other abnormalities of the circle of Willis associated with this rare anomaly. Seven additional cases have been reported in which this anomaly was found on routine postmortem or with arteriography alone. In only one case was the abnormality bilateral, and in only one was it associated with multiple aneurysms. The true incidence of this entity is unknown.

Two explanations have been offered as to the etiology of this anomaly. The first claims a persistence of the primitive prechiasmatic arterial anastomosis. The blood supply to the chiasmal region is embryologically supplied by the superior hypophyseal branches of the internal carotid artery, the prechiasmatic branch of the ophthalmic artery, and the chiasmal branches of the ACA. The second theory proposes an error in development of the ophthalmic artery, with persistence and enlargement of an embryological anastomotic loop between the primitive dorsal ophthalmic and the primitive ventral ophthalmic arteries. The association of an absent circle of Willis might support a more

Fig. 2. Intraoperative photograph, showing the anterior cerebral artery coursing between the optic nerves (1); the left and right optic nerves (2); the proximal and distal branches of the right middle cerebral artery (3); the aneurysm (A); right A2 segment (B); and lenticulostriate branches of the right middle cerebral artery (C). R = the retractor on the right frontal and temporal lobes.
generalized embryological error than has been suggested.

Patients having this ACA anomaly have presented with a wide variety of symptoms. In most cases, symptoms were secondary to the associated aneurysm. Three patients have presented with symptoms leading to a diagnosis of subarachnoid hemorrhage. Patients may also develop symptoms due to compression of an optic nerve or the chiasm by the anomalous vessel itself. A mass in the suprasellar or presellar region may cause symptoms, and the anomaly may then be found incidentally on angiography. Finally, this aberrant ACA may be completely asymptomatic.

There are at least four commonly performed surgical approaches to the anterior communicating artery complex. The pterional approach used here and in three of the four previous cases seems an ideal way to be in control on either side of the optic chiasm, with minimal risk of chiasm infarction.

References

Manuscript received July 6, 1981.
Address reprint requests to: Howard J. Senter, M.D., Suite 401, Mellon Pavilion, 4815 Liberty Avenue, Pittsburgh, Pennsylvania 15224.