Suprachiasmal Carotid-ophthalmic Artery Aneurysm
—Report of Two Cases—

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Abstract

Two rare suprachiasmal carotid-ophthalmic artery aneurysms, one large and one giant, were discovered incidentally. The patients had no visual disturbances. Angiography showed superomedial projection of the sac. The aneurysms were clipped via an ipsilateral pterional approach. A suprachiasmal carotid-ophthalmic artery aneurysm is indicated when preoperative angiography reveals a superomedial carotid-ophthalmic artery aneurysm without visual disturbances. Direct surgery to clip a suprachiasmal aneurysm should be carried out to prevent rupture of these frequently large aneurysms.

Key words: carotid-ophthalmic artery, aneurysm, suprachiasmal type, direct surgery

Introduction

Carotid-ophthalmic artery aneurysms, which arise from the internal carotid artery (ICA) between the origins of the ophthalmic and posterior communicating arteries, may project in various directions.1,2,7,10) Many variations of carotid-ophthalmic artery aneurysm have been described based on the position of the aneurysm in relation to the ICA.1,10,21) The rare suprachiasmal type of aneurysm passes upward and medially toward the anterior communicating complex and rests upon the superior surface of the optic nerve and chiasm.10) Only two of 46 cases of carotid-ophthalmic artery aneurysm encountered at our institution belonged to this category.

Here, we discuss the diagnosis, surgical treatment, and nomenclature of this rare aneurysm.

Case Reports

Case 1: A 60-year-old female visited our clinic for neurological examination after her 52-year-old brother died from a subarachnoid hemorrhage. She had experienced heavy headedness and occasional nausea and vomiting. No other neurological manifestations were detected. Precontrast computed tomographic (CT) scans revealed a calcified lesion in the left parasellar area (Fig. 1), which was markedly enhanced postcontrast. The diagnosis was a giant aneurysm in the left carotid-ophthalmic region based on angiograms (Fig. 2 left, center).

Direct surgery was indicated to prevent rupture and development of visual disturbances. A left pterional approach opened the Sylvian fissure, exposing the lateral wall of a large aneurysm. The medial surface of the aneurysm was carefully dissected from the frontal lobe. The dome was thick and calcified. The left optic nerve was deeper than the aneurysm.
and the lateral side markedly compressed by the sac, although preoperative clinical perimetry had not revealed any visual field disturbance. The roof of the optic canal and the anterior clinoid process were drilled away intradurally. This and opening the dura pro pria allowed mobilization and safe retraction of the optic nerve. The dural fibrous ring at the intra- and extradural junction surrounding the ICA was cut circumferentially to free the carotid artery. Bleeding from the cavernous sinus was controlled by elevating her head and packing with Oxycel. The neck of the aneurysm was then accessible for dissection and clipping. The ophthalmic artery branched from the ICA just proximal to the aneurysmal neck. A long Sugita clip with 30 mm straight blades was applied from the anterolateral to the posteromedial side of the neck. Special care was taken to avoid occlusion or stenosis of the parent and ophthalmic arteries. For this purpose, the aneurysmal dome was punctured to decrease the size and tension. However, the calcified dome failed to collapse. Fortunately, the clip blades remained on the neck, which was not calcified. The dome was still pulsating, so a second bayonet-type clip was placed on the neck just distal and parallel to the first (Figs. 2 right and 3). After aneurysm clipping, Doppler ultrasonography was used to confirm adequate blood flow in the ICA and ophthalmic artery.

The postoperative course was uneventful except for the occurrence of a nasal visual field defect in the left eye.

Case 2: A 69-year-old male presented with a history of chronic headache. CT scans showed a hyperdense lesion in the proximal part of the Sylvian fissure (Fig. 4). Cerebral angiograms revealed a right carotid-ophthalmic artery aneurysm measuring 2 × 1.5 cm (Fig. 5 left, center). He had no visual problems or history of subarachnoid hemorrhage.

The aneurysm was clipped to prevent rupture via an ipsilateral pterional approach. The Sylvian fissure and carotid cistern were opened to expose

Fig. 2 Case 1.  left, center: Preoperative anteroposterior (left) and lateral (center) left carotid angiograms, showing a giant suprachiasmal carotid-ophthalmic artery aneurysm.  right: Postoperative lateral left carotid angiogram, showing aneurysm clipping by two long Sugita clips.

Fig. 3 Case 1. Schematic drawing of the operative field via the left pterional approach for aneurysm clipping. A: aneurysm, 1: ICA, 2: optic nerve, 3: oculomotor nerve, 4: ophthalmic artery.

Fig. 4 Case 2. CT scan, showing an aneurysm as a hyperdense lesion in the proximal part of the Sylvian fissure.
the aneurysm above the ICA with the optic nerve lying below. The surgical procedure was essentially as in Case 1, with unroofing of the optic canal, removal of the anterior clinoid process, and cutting of the carotid dural ring. The ophthalmic artery was identified proximal to the aneurysmal neck. The clipping procedure occluded the aneurysm, leaving just a small stony-hard portion of the neck. An 18 mm straight clip was placed to spare the optic nerve which ran deeper and medially. This clip did not completely occlude the aneurysm because the neck was highly sclerotic and the thickness was uneven. A second, straight ring-type clip was placed parallel to the first. A third, reinforcing clip was placed on the dome side (Figs. 5 right and 6).

The postoperative course was uneventful without neurosurgical complications.

Discussion

Kothandaram et al.\textsuperscript{10} classified carotid-ophthalmic artery aneurysms into three categories: subchiasmal, passing horizontally and medially at right angles to the parent carotid artery and compressing the undersurface of the nerve; suprachiasmal, passing upward and medially toward the anterior communicating complex and resting upon the superior surface of the optic nerve and chiasm; and parachiasmal, passing forward from the anterior wall of the parent carotid artery and over the anterior clinoid process into the anterior fossa. The suprachiasmal type is the rarest. Almeida's series included none of nine cases,\textsuperscript{11} Ferguson and Drake's one of 10,\textsuperscript{12} and Yasargil's seven of 30.\textsuperscript{21} In the past 12 years, we have encountered 46 carotid-ophthalmic artery aneurysms at our department, but only two (4.3%) were of the suprachiasmal type.

The nomenclature for proximal ICA aneurysms varies. Some authors have grouped aneurysms arising from the ventral wall of the ICA separately from carotid-ophthalmic artery aneurysms as ventral or paraclinoid aneurysms because of the considerable surgical difficulty.\textsuperscript{6,11,20} Aneurysms in the region of the carotid dural ring may originate in the cavernous sinus or the carotid cave.\textsuperscript{3,9} Rhoton\textsuperscript{16} found that saccular aneurysms arise from a curve of the parent artery at the junction with an arterial branch. Day\textsuperscript{3} classified aneurysms arising from the ophthalmic segment of the ICA into ophthalmic artery aneurysms and superior hypophyseal artery aneurysms.

In general, ICA aneurysms may arise from the medial, lateral, ventral, or dorsal walls. The rare suprachiasmal type of carotid-ophthalmic artery aneurysm develops from the dorsal wall of the ICA just distal to the origin of the ophthalmic artery. Our previous report also considered ICA dorsal wall aneurysms as unusual.\textsuperscript{13} The suprachiasmal projec-
tion of carotid-ophthalmic artery aneurysms may result from either the origin of the ophthalmic artery from the ICA lying relatively lateral to the optic nerve (due to sporadic variation of the ophthalmic artery or sclerosis of the ICA), or to the limited space below the ophthalmic artery, ICA, and optic nerve surrounded by bone which hinders aneurysm growth below the optic nerve.

Carotid-ophthalmic artery aneurysms tend to become large, as in our two cases, which were discovered incidentally. A suprachiasmal aneurysm may grow large because there are no limiting structures, and is not discovered because no visual symptoms occur at the early stage. Carotid-ophthalmic artery aneurysms are less liable to rupture than those at other sites. Day suggested a "double" protective layer that reduces liability to hemorrhage in many lesions of the ophthalmic segment. Certainly, the ventral type of carotid-ophthalmic artery aneurysm is protected from rupture by the overlying optic nerve and the lateral dural wall act similarly. Nakagawa et al. reported dorsal ICA aneurysms, which were undoubtedly different, appearing as small, wide-based, fragile, and unconnected with arterial branching.

Our two cases did not present with visual disturbances in spite of the large size. In contrast, carotid-ophthalmic artery aneurysms growing below the optic nerve do tend to produce visual defects.

Preoperative angiography showed aneurysmal sacs projecting superomedially in both our cases. A large carotid-ophthalmic artery aneurysm with superomedial projection and absence of visual disturbance indicates the suprachiasmal type. CT and sagittal magnetic resonance (MR) imaging may confirm this diagnosis by demonstrating the chiasm-aneurysm relationship.

Direct clipping of carotid-ophthalmic artery aneurysms is possible using modern surgical aids such as the diamond drill, Doppler ultrasonography, and better clips of various sizes and shapes. The surgical treatment of giant aneurysms has also been simplified by large clips with extremely high closing pressures.

The ipsilateral pterional approach with partial removal of the anterior clinoid process and unroofing of the optic canal allows securing the proximal parent artery and visualizing the ophthalmic artery and aneurysm. More importantly, complete clipping without causing stenosis of the parent artery is possible. A contralateral approach may be useful for medial-ventrally protruding aneurysms, but proximal control of the parent artery can be very difficult. A combined epi- and subdural approach has also been described for a unilateral carotid-ophthalmic artery aneurysm. A large carotid-ophthalmic artery aneurysm was successfully obliterated by clipping the aneurysmal neck and injecting cyanoacrylate into the body.

We used the ipsilateral pterional approach to expose the proximal ICA and ophthalmic artery to clarify the local anatomy. This necessitates removal of the anterior clinoid process and unroofing of the optic canal, and cutting the carotid dural ring, especially for proximal ICA aneurysms. Suprachiasmal carotid-ophthalmic artery aneurysms require careful retraction of the frontal lobe since the aneurysmal dome is usually attached. The aneurysmal sac in Case 1 was punctured to decrease the size and tension and to avoid occlusion of the parent or daughter arteries during clipping. This was not required in Case 2 since the aneurysm was sufficiently decompressed with three clips, and the optic nerve was also decompressed. Detection and securing of the optic nerve are important during dissection, as it may be very thin due to compression, or displaced deeper or into unusual locations. When the optic nerve is difficult to find, it should be identified distally near the chiasm and then traced back toward the optic canal. Every effort should be made to preserve the optic nerve both anatomically and functionally.

Case 1 developed a postoperative nasal visual field defect in the left eye, possibly related to surgical manipulation of the optic nerve. Visual disturbances, ranging from optic blindness to visual field defects, after direct surgery on carotid-ophthalmic artery aneurysms have occurred in 15-33% of patients in different series.

We planned surgical intervention in our cases to prevent subsequent rupture of the large aneurysms. The malignant course of giant aneurysms, contrary to what used to be believed, encourages surgical intervention.

The suprachiasmal carotid-ophthalmic artery aneurysm is a rare type that develops from the dorsal wall of the ICA just distal to the origin of the ophthalmic artery. ICA aneurysms may arise from the medial, lateral, ventral, or dorsal walls. This classification provides an accurate description of the aneurysmal anatomy with much less confusion to the surgeon. The suprachiasmal carotid-ophthalmic artery aneurysm can therefore be called a proximal dorsomedial ICA aneurysm. A suprachiasmal
carotid-ophthalmic artery aneurysm is strongly suspected when preoperative angiography reveals a superomedial carotid-ophthalmic artery aneurysm without visual disturbances. Postcontrast CT and sagittal MR imaging may help to confirm this diagnosis. Direct surgery for clipping of a suprachiasmal aneurysm is now feasible with recent microsurgical innovations and should be carried out to prevent rupture of these frequently large aneurysms.

References

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