

INTRAOPERATIVE AWAKENING FOR VISION EXAMINATION DURING OPHTHALMIC ARTERY ANEURYSM CLIPPING: TECHNICAL CASE REPORT

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OBJECTIVE AND IMPORTANCE: We present a case of a patient with an ophthalmic artery aneurysm in which the ophthalmic artery originated from the body of the aneurysm, requiring sacrifice of the ophthalmic artery to achieve complete aneurysm obliteration. We awakened the patient intraoperatively to assess optic nerve function after clipping and were able to confirm optic nerve function. Controlled intraoperative awakening proved a valuable adjunct to intraoperative angiography in determining the immediate consequences of sacrifice of the ophthalmic artery.

CLINICAL PRESENTATION: The patient was a 55-year-old right-handed woman with a 3-month history of episodic blurriness in her left eye; imaging demonstrated an unruptured 5-mm left ophthalmic artery aneurysm in which the ophthalmic artery originated from the body of the aneurysm.

INTERVENTION: Complete obliteration of the aneurysm required clip placement across the neck of the aneurysm, incorporating not only the aneurysm but also the ophthalmic artery. Aware that sacrifice of the ophthalmic artery was likely, we awakened the patient after clipping and before dural closure to evaluate her optic nerve function. Once fully awake, the patient was able to execute simple commands and conclusively confirm light perception in both of her eyes. She was then reanesthetized, and intraoperative angiography showed successful aneurysm obliteration and parent artery patency.

CONCLUSION: The ophthalmic artery can be sacrificed during aneurysm clipping without loss of vision in many cases, most likely because of adequate collateral filling from the external carotid artery. Certainty about the visual consequences of sacrifice of the ophthalmic artery, however, is difficult to obtain preoperatively or intraoperatively. Intraoperative awakening for evaluation of optic nerve function served as a useful technique to assess the acute results of interruption of ophthalmic artery flow in this case.

KEY WORDS: Intraoperative awakening, Ophthalmic aneurysm, Ophthalmic artery

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When clipping ophthalmic artery aneurysms, the surgeon must sometimes sacrifice the ophthalmic artery to obtain complete obliteration of the aneurysm. In most cases, anastomoses from the external carotid artery circulation are adequate to reconstitute the ophthalmic artery territory. Although angiographically proven retinal collateralization is often evident in such cases, there is still some uncertainty as to whether radiographic restoration equates to functional visual preservation. We present a case of an ophthalmic artery aneurysm in which the origin of the ophthalmic artery was incorporated into the body of the aneurysm and was sacrificed by clip placement. We used controlled intraoperative awakening directly

after clip placement before closing of the dura and before intraoperative angiography to examine the patient's visual fields, which confirmed functional visual preservation.

CASE REPORT

History

This 55-year-old right-handed woman was referred for neurosurgical evaluation after experiencing four episodes of blurry vision in her left eye over the preceding 3 months. Each episode was accompanied by a sensation of "heaviness" in her head and lasted between 15 and 20 minutes. She reported no visual problems between these events. She was otherwise

healthy, with the remainder of her medical history remarkable for her mother having had an intracerebral aneurysm of unknown type.

Examination

Neurological examination was normal, revealing full extraocular movements of both eyes and no deficits in Cranial Nerves II to XII. The pupils were equally reactive, and her visual fields were full to confrontation with no quadrant deficits and good acuity and no reported diplopia. The remainder of her physical examination was unremarkable.

Cranial magnetic resonance imaging showed an approximately 5-mm ophthalmic artery aneurysm displacing the optic nerve. Catheter-based angiography demonstrated a 5-mm left ophthalmic artery aneurysm pointing superiorly, with a 4-mm neck and with the ophthalmic artery origin incorporated into the body of the aneurysm (Fig. 1).

Operation and Intraoperative Awakening

The risks of clipping the aneurysm, including potential loss of vision in her left eye after sacrifice of the left ophthalmic artery, were fully explained. The patient was particularly concerned about the possible risk of monocular blindness. Preoperative discussion resulted in a plan of intraoperative awakening for functional evaluation of her vision. If loss of vision was evident after clipping, the clip would be backed up to reestablish ophthalmic artery flow. The patient understood the consequences of harboring an aneurysmal remnant. We considered preoperative balloon test occlusion but decided that the risk of aneurysm rupture during occlusion, given the incorporation of the artery in the aneurysm, was an unacceptable risk. She thus elected to proceed with surgical treatment, with an intraoperative awakening technique developed to evaluate vision directly after clipping of the aneurysm. Anesthesia was induced in a standard manner with nitrous oxide, thiopental, and vecuronium, and the patient was maintained on a combination of remifentanyl and intermittent pancuronium and fentanyl. We planned on using intraoperative visual

evoked potentials but found that the anteriorly projecting craniotomy skin and muscle flap interfered with correct equipment positioning and thus proceeded without this monitoring. During surgery, the ophthalmic artery was clearly seen to originate from the body of the aneurysm. A side-angled Aesculap clip (Aesculap Co., Tuttlingen, Germany) was easily placed at the base of the aneurysm, incorporating the ophthalmic artery origin. After clip placement, the anesthesia was reversed with neostigmine, glycopyrrolate, and nalbuphine, at which time the patient began breathing spontaneously and moving all extremities. She was asked to show her right thumb on two occasions, and she followed these commands easily. She was then instructed to hold up the same thumb if she could see light being shined into her left and right eyes alternately. She responded briskly on each occasion to clearly indicate her light perception; the contralateral eye was carefully covered so as not to affect the examination. We were thus satisfied that her vision had been at least grossly preserved after clipping, and she was reanesthetized with a combination of sevoflurane, nitrous oxide, and remifentanyl. The duration of intraoperative awakening was 20 minutes, and no complications occurred.

An intraoperative angiogram then demonstrated complete obliteration of the aneurysm and patency of the internal carotid artery, with no filling of the left ophthalmic artery. Reconstitution of the left retinal choroidal blush was observed on injection of the left external carotid artery (not shown). The dura and tissue layers were then closed in the standard manner.

Postoperative Course

Postoperatively, the patient had full vision in both eyes. She had an uneventful hospital course and was discharged on the third postoperative day. A formal postoperative angiogram obtained before discharge demonstrated complete aneurysm obliteration (Fig. 2A) and a choroidal blush supplied by branches of the left external carotid artery (Fig. 2B). One year later, she continues to have full vision. It is of interest to note that, after surgery, she has not had a recurrence of the left eye blurriness that she described before surgery.

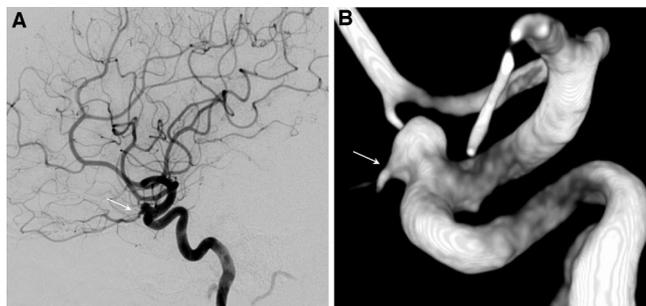


FIGURE 1. Angiogram showing preoperative left internal carotid artery injection (A) demonstrates an ophthalmic artery aneurysm with the origin of the left ophthalmic artery in the body of the aneurysm (white arrow). B, three-dimensional angiography more clearly shows the left ophthalmic artery originating from the body of the aneurysm (white arrow).

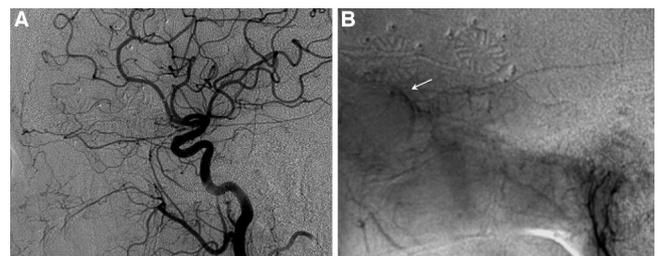


FIGURE 2. A, angiogram showing postoperative injections of the left common carotid artery in the later phase showing obliteration of the aneurysm and no flow in the left ophthalmic artery. B, late-phase left external carotid artery injection demonstrating the retinal choroidal blushing supplied by branches of the external carotid artery (white arrow).

DISCUSSION

Visual loss after disruption of ophthalmic artery flow may result from insufficient vascular supply to the retina from the collateral circulation or from interference with small branches to the optic nerve arising near the point of occlusion. Named branches from the ophthalmic artery include the central retinal, anterior falcine, ethmoidal, ciliary, and recurrent meningeal arteries. The muscular and extraorbital branches of these vessels anastomose extensively with numerous branches from the external carotid artery (8). Under most circumstances, it is possible to rely on reversal of flow through these functional anastomoses to supply the visual system after ophthalmic artery occlusion. These connections account for the virtual lack of retinal strokes associated with internal carotid artery occlusions.

Despite arteriographic evidence of extensive anastomoses, however, intentional sacrifice of the ophthalmic artery causes some uncertainty as to whether vision will be compromised. The patient in this case favored surgical intervention for clip obliteration of her aneurysm but nevertheless continued to voice significant concern over the possibility of visual deterioration. Preoperative management options in this scenario included performing a balloon test occlusion across the neck of the aneurysm to assess the functional consequences of sacrifice of the ophthalmic artery during surgery. With the current state of technology, balloon test occlusion in a case such as this, in which sacrifice of the aneurysm may have significant neurological sequelae, is commonly performed, and the feasibility of ophthalmic artery balloon test occlusion has been described, with advantages including the assessment of appropriate collateral filling of the retinal choroid during interruption of ophthalmic arterial flow (6, 7). We weighed this benefit against the risks of balloon test occlusion in this case. In this particular patient, the aneurysm was on the left, and test occlusion there carries with it the risk of global aphasia and/or hemiplegia, which, if it occurred, would have immediately ended the test, thereby not allowing sufficient time for a conclusive vision test. In addition, the test occlusion would have required an occlusive inflation, which is higher than what is needed for coil-assist and increases the risk of balloon intrusion into the neck of the aneurysm. We thus decided against this preoperative maneuver, given these risks, and elected to proceed directly to surgery with a plan to assess gross visual preservation by intraoperative assessment of light perception after aneurysm clipping. The timing of our intraoperative awakening examination before dural closure and before intraoperative angiography was such that the aneurysm clip could have been repositioned should vision have been compromised, in keeping with our patient's stated wishes that vision be preserved with or without complete aneurysm obliteration.

Intraoperative awakening after clip placement, followed by examination of optic nerve function at a point at which clip repositioning could be executed, was at least a comforting adjunct to intraoperative angiography in this case. At the same

time, we could visualize the segment of the ophthalmic artery to be sacrificed, so as to make sure that no small unnamed branches supplying the optic nerve were incorporated into the clip.

Intraoperative neurological assessment is common in tumor surgery and some functional procedures (1, 2, 9) but is uncommon in aneurysm surgery. The Drake tourniquet has been applied and then closed in awake patients during proximal ligation of giant posterior circulation aneurysms (4, 5). To the best of our knowledge, this is the first report of intraoperative awakening for visual field assessment after clipping of an ophthalmic artery aneurysm. In selected cases in which the ophthalmic artery is incorporated into the body of the aneurysm and is to be intentionally sacrificed to achieve complete aneurysm obliteration, variations of this method combined with intraoperative angiography may provide valuable immediate feedback to facilitate a successful functional and anatomic outcome.

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COMMENTS

Chen et al. present a novel method of assessing vision intraoperatively during clipping of a carotid-ophthalmic artery aneurysm, in which deliberate sacrifice of the ophthalmic artery origin was deemed necessary. Other methods of intraoperative functional monitoring, such as the use of somatosensory evoked potentials, brainstem auditory evoked potentials, and motor evoked potentials, have considerable usefulness for confirming intact sensory, auditory, and motor pathways, but our experience at Stanford suggests that visual evoked responses are not reliable in monitoring the visual pathways, especially the retina, intraoperatively. Intraoperative wake-up tests are currently used during certain types of spinal surgery, and awake craniotomies to map functional

language areas are also frequently used. However, the use of intraoperative awakening to assess vision is novel.

As the authors point out, the retina has luxuriant collaterals, and usually, occlusion of the ophthalmic artery origin (either surgically or endovascularly) is well tolerated, with no adverse visual consequences. Nonetheless, most cerebrovascular surgeons have experienced the extremely rare, but very distressing, occurrence of unilateral visual loss or blindness after clipping ophthalmic or paraclinoid artery aneurysms. In my own practice, I have sometimes deliberately left a small residual aneurysm base so as to spare the ophthalmic artery origin and preserve antegrade flow to the retina. Although it is not clear that this technique of intraoperative awakening would allow for more sophisticated visual fielding testing, it may be quite useful in confirming gross vision, including light perception and movement.

Gary K. Steinberg
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The authors report a case in which a patient was awakened intraoperatively for visual assessment. This vignette illustrates how individualized management decisions must be to include not only patient safety, but also patient wishes. In this case, adequate collateral existed to supply the ophthalmic territory despite its being included in the clip occlusion. We have had good luck in testing visual tolerance of ophthalmic artery occlusion using nondetachable balloons. In our view, this would be the first line of provocative testing in this kind of patient, but the present treatment resulted in a successful outcome.

Richard Parkinson
H. Hunt Batjer
Bernard Bendok
Chicago, Illinois

The authors describe a somewhat bold maneuver for evaluating retinal/ocular blood flow during aneurysm surgery on ophthalmic segment lesions. In an effort to completely occlude the aneurysm base, which inevitably involves occluding the ophthalmic artery, they propose awakening the patient temporarily to assess light perception. My policy in this sort of lesion has been to preserve the ophthalmic artery whenever

possible. This may mean an occasional, purposeful adjustment of the clip application to allow enough of the neck of the aneurysm that is common to the origin of the ophthalmic artery to remain so that the ophthalmic artery remains patent. I am not aware of reports that this policy results in a substantial number of aneurysm recurrences. However, I would certainly not argue that complete occlusion of the neck of an aneurysm, especially during direct surgery, is not the ideal. Therefore, a more automated and potentially more reliable assay of retinal blood flow would be valuable in this situation. I have often wondered whether fluorescein angiography of the retina could be assayed in a more quantitative way so as to be used intraoperatively. Perhaps the use of the scanning laser ophthalmoscope in conjunction with intraoperative intravenous fluorescein would be a way to gain a more objective quantifiable assessment of retinal blood flow and might be useful intraoperatively.

Steven Giannotta
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The authors present an interesting case in the treatment of an ophthalmic artery aneurysm, in which they use a wake-up test to assess vision in the patient's eye and potentially modify their treatment on the basis of those results. They were surgically managing a small, 5-mm ophthalmic artery aneurysm in a patient who was symptomatic with intermittent visual symptoms on the appropriate side. Weaknesses of the wake-up test include the patient's ability to assess only light perception and an apparent preoperative decision to withdraw the clip slightly to maintain flow should the patient have failed the vision test. Obviously, this would have left a residual aneurysm in a patient who is starting with a small aneurysm in the first place. Reasons for using the wake-up test were justified in the article, whereby they excluded other techniques that could have been performed preoperatively.

Interestingly, the authors have applied a well-known intraoperative assessment technique to cerebrovascular surgery. We will need to consider this in our own treatment armamentaria.

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