The Journal of TRAUMA® Injury, Infection, and Critical Care

Endovascular Management of a Traumatic Ophthalmic Artery Aneurysm

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J Trauma. 2007;63:192–194.

Traumatic intracranial aneurysms are rare and account for less than 1% of cerebral aneurysms in the adult population. Despite their low incidence, the risk of delayed rupture with intracranial hemorrhage is high and mandates treatment.[1] Surgical treatments with aneurysm clipping or parent vessel sacrifice have disadvantages given patient comorbidities after head trauma. Endovascular coiling offers definitive treatment particularly for lesions that are inaccessible to surgery. We report such a result in a patient with a traumatic intracanalicular ophthalmic artery aneurysm treated via endovascular means.

CASE REPORT

A 31-year-old man sustained a gunshot wound to the right face. He initially presented with a GCS of 14. After urgent tracheostomy, cerebral angiography was requested for arterial embolization of uncontrollable facial bleeding. The right internal maxillary and posterior auricular arteries were embolized using 500 to 700 μm embospheres (BioSphere Medical, Rockland, MA) and 3-mm to 2-mm platinum coils (Cook Medical, Bloomington, IN). Reflux of contrast into the right internal carotid artery during a right external carotid artery injection revealed an intracanalicular ophthalmic artery aneurysm (Fig. 1).

Immediately after angiography, the patient developed left hemiplegia and dilation of the right pupil. A computed tomography of the head (CT head) was performed and revealed a parenchymal hematoma in the right temporal lobe. A bullet fragment was also identified within the right temporal lobe without penetration across the cerebral midline (Fig. 2). Urgent right temporal lobectomy and hematoma evacuation were performed. There was no evidence of injury to the middle cerebral and posterior cerebral arteries or to the cavernous sinus from the bullet.

A repeat cerebral angiogram performed on hospital day 22 revealed the previously identified 2-mm ophthalmic artery aneurysm (Fig. 3). A CT head indicated no evidence of recurrent intracerebral hemorrhage and exhibited changes consistent with the earlier craniotomy (Fig. 4). Given that the aneurysm was presumed to be of traumatic cause, showed no regression, and represented a high risk for rupture, endovascular coil embolization of the aneurysm was attempted. Before this, ophthalmologic consultation confirmed that the right pupil was 4 mm in diameter and had an afferent defect. Visual fields could not be assessed because the patient could not cooperate. Fundoscopy of the right eye was clear except for mild exposure keratitis, and the patient was cleared for aneurysm treatment.

For embolization, a 6 French sheath was advanced into the left common femoral artery. Through the sheath, a 6 French Envoy catheter (Cordis Corporation, Miami Lakes, FL) was advanced into the right common carotid artery. The catheter was then advanced into the right internal carotid artery via angiographic roadmapping. A Rapid Transit (Cordis Corp., Miami Lakes, FL) microcatheter over a Gold Tip Glidewire (Terumo Medical, Ann Arbor, MI) was then advanced into the distal ophthalmic artery. The catheter was gently withdrawn to the level of the aneurysm, which was embolized using 2-mm $\times$ 2-cm Nexus Helical Super-soft coils (eV3 Neurovascular, Irvine, CA). A total of three coils were placed; the majority of the coil mass remained within the aneurysm. A single coil loop from the second and third coils did protrude from the aneurysm and into the distal and proximal ophthalmic artery. After detachment of the third coil, a right internal carotid artery run demonstrated absent filling of the aneurysm and the ophthalmic artery (Fig. 5). The patient was given a 2,000-unit bolus of intravenous unfractionated heparin during this procedure to maintain an activated clotting time of $\geq$250 seconds. Anticoagulation was reversed at procedure termination with 20 mg of intravenous protamine.

At 3 months, the patient remained severely disabled with a GOS of 3. His neurologic status was unchanged since the embolization on hospital day 22. The patient was able to follow commands on the right side and had antigravity strength of the right upper and lower extremities. He had,

Submitted for publication December 14, 2006.
Accepted for publication March 6, 2007.

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DOI: 10.1097/TA.0b013e31805824e2

Fig. 1. *Reflux of contrast into the right internal carotid artery during a right external carotid artery injection identifies a 2-mm ophthalmic artery fusiform, intracanalicular aneurysm.*

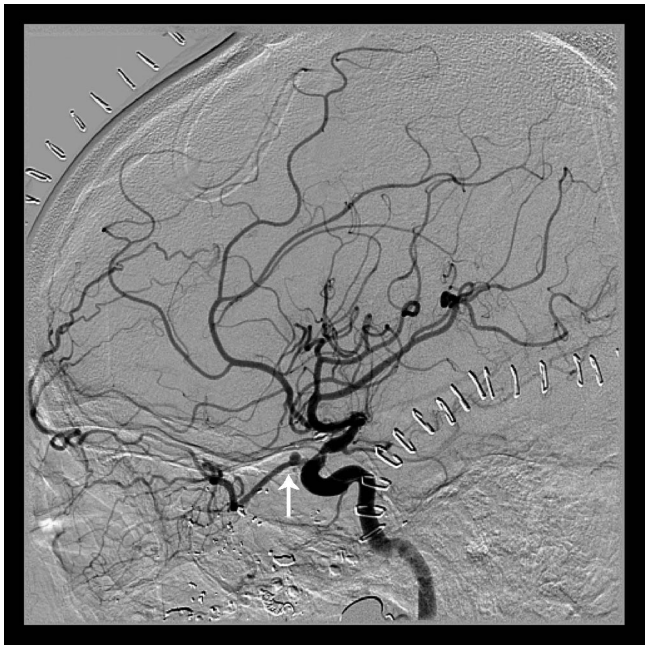

Fig. 3. *A right internal carotid artery angiogram on hospital day 22 revealing the ophthalmic artery aneurysm more clearly (white arrow).*

Fig. 2. *Computed tomography of the head after angiography revealing a right temporal hematoma and bullet fragments (white arrow) within the parenchyma.*

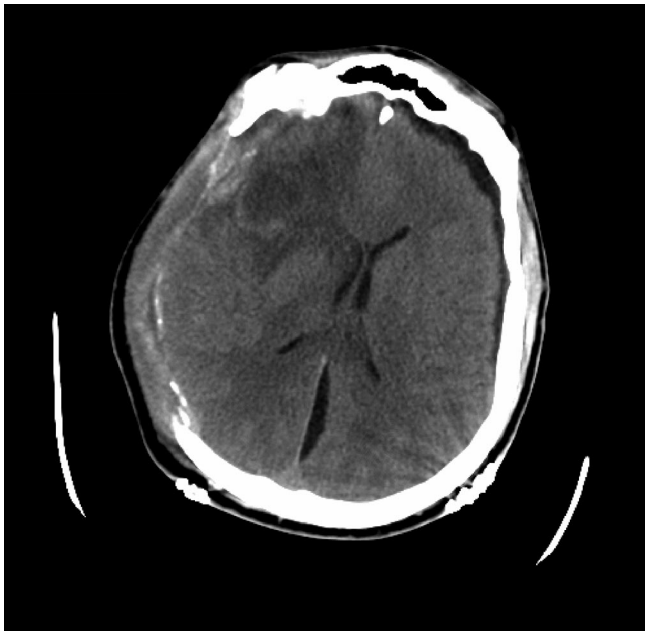

Fig. 4. *Computed tomography of the head on hospital day 22 before aneurysm embolization. A hemicraniectomy has been performed with outward swelling of the parenchyma. There is no further evidence of recurrent intracerebral hemorrhage.*

however, left hemiplegia with spasticity. Repeat ophthalmologic examination confirmed a fixed afferent papillary defect. Visual fields and extra-ocular motility examinations were not performed. As a result of persistent exposure keratitis, the patient required a right eye blepharoplasty.

DISCUSSION

This case report is, to our knowledge, the first endovascular treatment of an intracanalicular ophthalmic artery aneurysm related to a high velocity missile head wound.

Traumatic intracranial aneurysms can occur with closed head injury, skull fracture, iatrogenic surgical trauma, and

Fig. 5. *A right internal carotid artery angiogram postcoil embolization demonstrates obliteration of the ophthalmic artery aneurysm and ophthalmic artery occlusion.*

blunt or penetrating wounds. They have a low incidence after high-velocity missile head wounds. In one series, 8 of 223 (3.6%) consecutive patients with shrapnel wounds had a traumatic aneurysm detected by angiography at an average of 17 days after injury. A statistically significant predictor for finding these aneurysms was the presence of missile fragments in the temporal, tempoparietal, or pterional regions. Presence of a traumatic aneurysm also had a statistically increased likelihood in patients presenting with a parenchymal hematoma after trauma.[2] Surveillance angiography has been recommended for these patients, as was used for our patient with both findings on CT head. Other studies have reported traumatic aneurysm formation within hours of head trauma with rupture rates ranging from 50% to 80% in some series.[3,4]

The treated intracanalicular ophthalmic artery aneurysm in our report was discovered incidentally during right external carotid artery embolization. These aneurysms are rare and must be distinguished from ophthalmic segment aneurysms, which arise from the internal carotid artery between the ophthalmic and posterior communicating arteries. Most reported aneurysms of the ophthalmic artery have been described as fusiform in appearance and cause compression of the optic nerve rather than rupture.[5] Traumatic ophthalmic artery aneurysms, on the other hand, have presented with intracerebral hemorrhage with visual complaints,[6] and so we made the decision to treat our patient's aneurysm because of its presumed cause and natural history. Because our patient had an afferent papillary defect in the right eye, we were less concerned that treatment would result in blindness and proceeded with an endovascular approach to avoid a second craniotomy for the patient.

As stated earlier, the risk for rupture of traumatic intracranial aneurysms is high. Traditional surgical approaches have included aneurysm clipping, trapping, surgical wrapping, and bypass, and have shown significant benefit over conservative therapy, but existing case series still report a high mortality rate (approximating 20%) with treatment.[6,7] In the literature, two traumatic ophthalmic artery aneurysms have been treated with internal carotid artery and ophthalmic artery occlusions, respectively, with both cases reporting significant postsurgical morbidity.[8,9] Two relatively recent traumatic ophthalmic artery aneurysms were described in patients with shrapnel wounds. One patient presented with a delayed frontal lobe hematoma and the other patient was asymptomatic. Both underwent clipping and achieved a GOS of 2, representing an improvement in surgical results compared with earlier treatment.[6]

The advent of endovascular therapy allows for a multidisciplinary approach.[10] Limited case reports in the literature suggest that endovascular treatment with coil embolization is feasible and result in less postoperative morbidity.[11] This first endovascular treatment of a traumatic ophthalmic aneurysm represents another example of coil embolization as a possible first-line treatment option for these high risk lesions.

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