Superior Ophthalmic Vein Cannulation Through a Lateral Orbitotomy for Embolization of a Cavernous Dural Fistula

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Many embolization procedures have been described for the treatment of cavernous dural fistulas, including direct superior ophthalmic vein cannulation. Sometimes thrombosis of the superior ophthalmic vein or an anatomic variant will not allow its cannulation. Herein, we describe a case of a cavernous dural fistula in which an anteriorly narrowed and thrombosed superior ophthalmic vein was cannulated in the deep orbit through a lateral orbitotomy.

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Cavernous dural fistulas are usually embolized through a transfemoral arterial or venous approach. When these techniques fail, the possibility of embolization performed directly through the superior ophthalmic vein is a well-known option. We present a technique via lateral orbitotomy, which is a useful option when the direct eyelid-crease approach to the superior ophthalmic vein fails.

CASE REPORT AND TECHNIQUE

A 61-year-old man with known mitral valve prolapse and no head trauma had a 6-week history of acute-onset conjunctival injection and pain in his right eye at initial admission. Best-corrected visual acuity was 20/25 OD and 20/20 OS. Color vision was normal with a mild afferent pupillary defect in the right eye. There was 5 mm of proptosis in the right eye with a 2-mm lateral displacement and resistance to retropulsion (Figure 1A). Right eye movement was slightly limited in upgaze and abduction. His intraocular pressure was 18 mm Hg OD and 11 mm Hg OS. Slitlamp examination revealed chemosis, dilated episcleral veins, and dilated retinal vessels in the right eye. Examination results in the left eye were unremarkable. Computed tomographic angiography demonstrated a prominent right superior ophthalmic vein. Catheter angiography showed a cavernous dural arteriovenous fistula fed by dural branches of the right internal and external carotid arteries. The diagnosis of low-flow cavernous dural fistula, Barrow type D, was made. An attempt at transfemoral embolization through the inferior petrosal sinus was not achieved owing to compartmentalization of the cavernous sinus. A facial vein approach was attempted and was not successful owing to tortuosity of the veins. The procedure was concluded at this point.

Two weeks later, the patient noticed decreased vision in his right eye (visual acuity was 20/25 OD); he had an increased afferent pupillary defect due to a choroidal effusion. We attempted to perform a direct cannulation of the superior ophthalmic vein through an upper eyelid-crease incision to introduce a coil. After exposing the superior ophthalmic vein, a 20-gauge angiocatheter was used to puncture the vein and gain access to introduce the guide wire, which advanced for a few millimeters before there was some resistance due to previously noticed narrowing. A second attempt was done more posterior in the superior ophthalmic vein and was again unsuccessful. The procedure was aborted at this point. On the fifth day of follow-up, best-corrected visual acuity had decreased to 20/70 OD, and the fundus had...
noticeable intraretinal hemorrhage and congestion (Figures 1B and C).

Repeat computed tomographic angiography showed that the anterior portion of the superior ophthalmic vein had thrombosed, probably induced by the surgical manipulation (Figure 2A). A lateral orbital approach to reach the most posterior portion of the superior ophthalmic vein within the orbital apex was planned to achieve coiling. A superior eyelid-crease incision was made and extended temporally to expose the superior and lateral orbital rim. A superolateral marginectomy was performed. This allowed direct visualization of the superior orbital fissure. The periorbita was then incised between the lateral and the superior rectus muscles. With blunt dissection through the orbital fat, an enlarged arterialized superior ophthalmic vein was found. A silk suture was passed around it. A pediatric 3F Check-Flo Performer Introducer Set (Cook Medical, Bloomington, Indiana) was used to cannulate the superior ophthalmic vein, with the cannula’s distal tip near the entry point to the cavernous sinus; the silk suture was tied to stabilize the cannula. The orbital rim was repositioned with 2 titanium plates, and the incision was sutured. The proximal end of the cannula was fixed to the skin with a suture, and the patient, who was under general anesthesia, was then transferred to the angiography unit (Figure 1D). Through a 5F sheath placed in the right common femoral artery, a diagnostic catheter was placed in the right internal and external carotid arteries and used for control injections (Figure 2B). Injections through the 3F cannula placed in the superior ophthalmic vein demonstrated a persistently patent dural fistula (Figure 2C). A renegade microcatheter (Boston Scientific, Natick, Massachusetts) was placed through the 3F cannula directly to the zone of arteriovenous shunting. Thereafter, 3 Micronester Coils (Cook Medical) were placed with dense packing in this area; the renegade catheter and the 3F cannula were removed. Control injections confirmed cure of the fistula (Figure 2D).

At the sixth day of follow-up, best-corrected visual acuity was 20/40 OD, with reduction of the patient’s hyperopic shift, 3 mm of proptosis, and slight limitation of upgaze. His intraocular pressure was 10 mm Hg OD. At 1 month of follow-up, his best-corrected visual acuity was 20/20 OU, proptosis resolved with mild residual limitation in upgaze in his right eye, and his intraocular pressure was 10 mm Hg OD (Figure 1E).

**COMMENT**

When other options are not feasible, embolization of a cavernous dural fistula through the superior ophthalmic vein via an eyelid-crease incision has proven to be a good procedure.1-6 Some indications for a direct superior ophthalmic vein approach include when arterial or transvenous approaches are not possible or fail to completely close the fistula, wanting to avoid complications associated with occlusion when there is predominant internal carotid artery supply, and patients with atherosclerosis in whom carotid compression can be contraindicated.7 The transcnnutaneous eyelid-crease approach to the superior ophthalmic vein may have some difficulties, such as small veins, variations in location of the superior ophthalmic vein, and clotting of the vein, which can make it impossible to place the catheter.7

In this case, an eyelid-crease superior ophthalmic vein approach was performed after an unsuccessful percutaneous embolization attempt. During the surgical procedure, the cannulation was impossible owing...
to stenosis of the superior ophthalmic vein and a more posterior attempt was performed during the same operation, which was not achieved. When clotting of the superior ophthalmic vein occurs, it may result in spontaneous resolution of the cavernous dural fistula. Some authors discourage further dissection within the orbit; others recommend intraconal cannulation of the superior ophthalmic vein by the same approach. In this case, an intraconal superior ophthalmic vein cannulation was attempted, which did not succeed, and the secondary clotting resulted in worsening of the patient's symptoms. Secondary clotting (as the embolization procedure) may initially worsen the symptoms, but if the thrombosis propagates posterior enough, it may spontaneously close the fistula, which did not occur in this case. We therefore decided to do a lateral orbitotomy to reach the posterior aspect of the superior ophthalmic vein as it enters the superior orbital fissure. This resulted in successful cannulation and embolization of the cavernous dural fistula.

After an unsuccessful anterior cannulation approach, it is advisable to observe the patient and see if any induced thrombosis may resolve the fistula. If, as in this case, there is deterioration in the eye clinically, such as retinal congestion, elevated intraocular pressure, or decreased visual acuity, with imaging studies demonstrating a patent fistula, an embolization procedure should be attempted to avoid irreversible damage to vision.

We favor this approach in rare cases in which superior ophthalmic vein cannulation is not possible, because it is associated with less morbidity than an unroofing of the orbit through a transcranial approach. It also allows direct visualization of the superior ophthalmic vein in the posterior orbit thereby avoiding the poor visualiza-

tion associated with an eyelid-crease approach (without bone removal) to the posterior superior ophthalmic vein. Thus, it reduces the risks of uncontrolled bleeding and damage to structures during deep orbit dissection.

To our knowledge, this is the first time a lateral orbital wall removal was performed to cannulate the superior ophthalmic vein. This approach is best performed in medical centers where experienced interventional neuroradiologist and orbital surgeons have developed a cooperative team.

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REFERENCES

Figure 2. A, Axial computed tomographic angiography showing a thrombosed anterior portion of right superior ophthalmic vein (arrow). B, Lateral angiogram of internal carotid artery before coiling showing an enlarged superior ophthalmic vein (small arrow) and the cavernous dural fistula (large arrow). C, Direct contrast injection through the venous catheter indicating the site of the fistula (arrow). D, Lateral angiography of the internal carotid artery after the coiling showing the coils (arrow) obliterating the fistula site and blocking the shunt to the superior ophthalmic vein.