ISSN: 2149-2018

Applied Medical Research, 2021
VOL 8, NO. 1, PAGE 1 – 3
DOI: doi.org/10.47363/AMR/2021(8)192

CASE REPORT

Open Access

The Superior Ophthalmic Vein Approach for the Treatment of Carotid-Cavernous Fistulas: Our First Experience

Dante Valer[1], Rafael Morales[2], Lucía Gárate[3] and Eduardo Mendez MT[4]

[1]Endovascular Neurosurgeon, Clínica San Judas Tadeo

[2]Ophthalmologist Orbital Surgeon, Clínica San Judas Tadeo

[3]Physician, Clínica San Judas Tadeo

[4]Interventional Medical Technologist, Clínica San Judas Tadeo, Lima, Perú

ABSTRACT

Carotid cavernous fistulas (CCF) constitute between 10-15% of all intracranial vascular malformations. Clinical symptoms of indirect CCFs include chemosis, conjunctival injection, proptosis, diminished visual acuity, ophthalmoplegia, retro-orbital bruit, periorbital swelling, and hyperlacrimation, in the setting of associated cortical venous reflux, intracranial hemorrhage. Treatment of choice for symptomatic carotid cavernous and cavernous dural fistulas is neuroradiologic intervention via the femoral artery. Owing to the location of the fistula and/or to anatomic variations, a direct surgical approach via the superior ophthalmic vein may be necessary for embolization.

ARTICLE HISTORY

Received Mar 04, 2021
Accepted Mar 09, 2021
Published Mar 14, 2021

KEYWORDS

Cavernous Sinus, Carotid-Cavernous Fistula, Superior Ophthalmic Vein, Embolization, Platinum Wire, Neuroendovascular Techniques

Introductions

A carotid-cavernous sinus fistula (CCF) is an abnormal communication between arteries and veins within the cavernous sinus. Intracranial dural arteriovenous fistulae are predominantly idiopathic arteriovenous shunts located inside the duramater. They account for 10–15% of all intracranial arteriovenous malformations [1-9]. Barrow et al classified CCFs into 04 groups according to arterial feeders: direct fistulas (Barrow type A) and dural, or indirect fistulas (Barrow types B, C, and D). Direct fistulas are characterized by a direct connection between the internal carotid artery (ICA) and the cavernous sinus (Figure 1a) They are usually high flow fistulas. Causes include penetrating or blunt trauma, rupture of an ICA aneurysm within the cavernous sinus, Ehlers–Danlos syndrome type IV, or iatrogenic interventions, including trans arterial endovascular intervention, internal carotid endarterectomy, percutaneous treatment of trigeminal neuralgia, trans-sphenoidal resection of a pituitary tumour, and maxillofacial surgery [2,4]. Symptoms are typically related to the route of venous drainage and the degree of shunting. When venous drainage is diverted to the ophthalmic veins, ocular symptoms such as conjunctival injection, diplopia, glaucoma, and proptosis may occur. The natural evolution of dCCF is variable, and some may spontaneously resolve by thrombosis of the fistula [3,6].

The cavernous sinuses (CS) are dural venous channels located on either side of the body of the sphenoid bone. The CS has four walls, three of which consist of two layers of dura. The cavernous segment of the internal carotid artery (ICA) runs within the CS with CN VI running along its inferior and lateral border [4]. The major tributaries to the CS are the superior ophthalmic vein (SOV), inferior ophthalmic vein, superficial middle cerebral vein (SMCV), sphenoparietal (sphenobasal) sinus, and the contralateral sinus through the intercavernous (circular) sinus. The major egress of the CS includes the superior petrosal sinus (SPS), inferior petrosal sinus (IPS), emissary veins to the pterygoid plexus, clival plexus to the posterior fossa and paraspinal venous plexus, and the contralateral sinus through the intercavernous sinus.

However, in some patients, this access is absent due to IPS thrombosis or anatomic variation with an absent connection between the IPS and internal jugular vein. In these scenarios, endovascular access to the cavernous sinus through direct surgical access of the dilated SOV can be a useful alternative route, a technique that has been described by several authors in the literature previously [3]. Oishi et al, reported blepharoptosis and

Contact Dante Valer neuro_valer@hotmail.com Clínica San Judas Tadeo, Jr. Manuel Raygada N° 170 – San Miguel/ Department of Neurosurgery, Hospital Nacional Guillermo Almenara Irigoyen - EsSalud, La Victoria, Lima, Perú.

bilateral forehead dysesthesia in patients undergoing surgical SOV exposure [5].

Surgical Technique

Patients prior to surgery must sign an informed consent that includes a discussion of possible complications related to obtaining access and transvenous embolization: lack of feasibility; hemorrhage with orbital or retroorbital hematoma; damage to the trochlea, globe, or other orbital structures; infection; thrombosis of cavernous sinus and embolic complications. Patients are then placed under general anesthesia and positioned supine. The involved eye, ipsilateral eye brow, forehead, and cheek are prepped into the surgical field. A 2 cm incision is made medially in the skin crease above the upper eye-lid (Figure 1A), incise the orbicularis oculi muscle and open the orbital septum (Figure 1B). The orbital fat is bluntly dissected with cotton-tipped applicators until a small arterialized venous branch is discovered. That branch is followed proximally, in a posterolateral direction, to find the main trunk of the arterialized SOV.

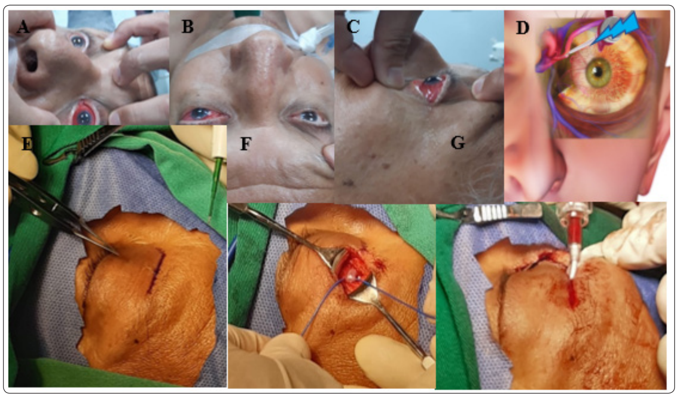

Figure 1: (A,B,C) Patient with marked left eye injection, chemosis, and proptosis from a left-sided dural CCF. The patient also has left ptosis and a dilated left pupil, consistent with an ocular motor nerve paresis caused by the fistula. Note dilation of conjunctival and episcleral vessels. (D) Schematic showing insertion an 16-gauge angiocatheter is inserted into the ophthalmic vein (E,F,G) Intra-operative aspects of left SOV microsurgical exposure and canulation.

Illustrative Case

This 70 year old man presented to our institution with a 6 months history of worsening left sided chemosis, proptosis, and diplopia. On examination, he has conjunctival injection, diplopia, glaucoma, and proptosis in the left eye. A digital subtraction angio- gram revealed a left sided Type B CCF supplied by meningeal branches of the left and right ICA with retrograde venous flow in the SOV (Figure 2). Inferior petrosal sinuses were noted to be occluded bilaterally. The decision was made to perform a surgical cutdown to expose the SOV. The vein was isolated and subsequently catheterized with an 16-gauge angiocatheter connected to a rotatory hemostatic valve (Figure 1F). An HeadwayTM Duo microcatheter(Microvention) with a 0.014-in TransendEx microguidewire (Boston Scientific, Fremont, CA), was navigated into the cavernous sinus, and the fistula was subsequently embolized using 03 electrolytic detachable CosmosTM platinum coils and o.6 ml of Precipitating hydrophobic injecting liquid (PHIL; Microvention) (Figure 3). Control angiography of the left and right ICAs confirmed complete obliteration of the fistula with no evidence of distal embolic material migration (Figure 3). After the embolization the angiocatheter was removed and we compress the vein for 15 minutes; finally, the skin was closed with interrupted 6.0 nylon sutures. The patient's postoperative course was uneventful and by the time of discharge, he displayed parcial reversal of her symptoms at the 3 month, its pendient control angiography (Figure 4A and B).

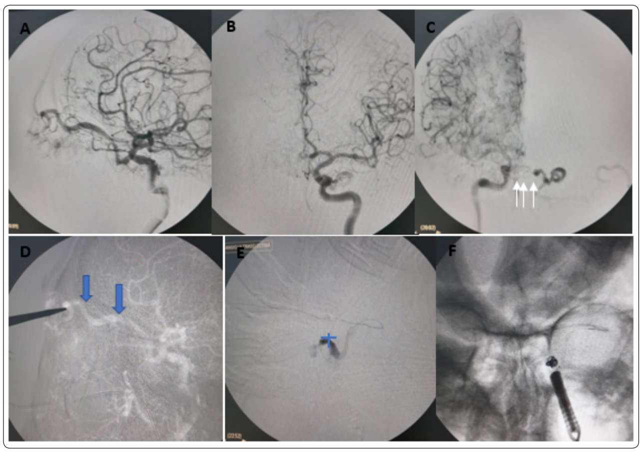

Figure 2: (A,B) Selective left internal carotid arteriogram (AP and lateral view) shows a dural CCF with drainage both anteriorly and posteriorly. (C) Cerebral angiography in anteroposterior projection after injection of the right carotid artery shows early filling of the left cavernous sinus from intracavernous branches (arrows) (D,F,F)Demonstrates acces to the cavernous sinus (+)via surgical exposure and cannulation of the SOV.

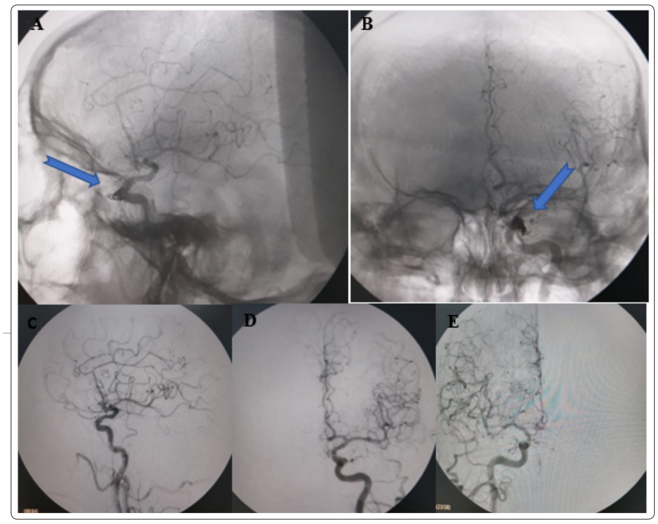

Figure 3: (A,B) After treatment, there are multiple platinum coils present within the fistula (arrow). (CDE) Post-procedure common carotid arteriogram shows obliteration of the fistula with intact ow in the ICA. Successful closure of a dural CCF using a transvenous approach via the SOV. Prior to treatment, the common carotid arteriogram shows a dural CCF draining both anteriorly and posteriorly.

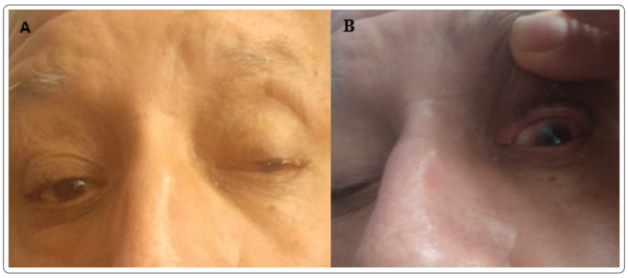

Figure 4: (A,B) Control at 03 months of endovascular treatment. Improvement in visual manifestations after successful endovascular closure of indirect CCFs. Post-treatment appearance of the patient whose pretreatment appearance is seen in Figure 1.

Discusion

Treatment of a dCCF is mandatory when the visual function is progressively compromised. Because dCCFs often have multiple small feeders from the external or internal carotid artery, TVE is usually preferred. The transvenous route through the inferior petrosal sinus is commonly used due to its short connection to the CS. If the inferior petrosal sinus route is not accessible, the anterior transfacial route to the CS through the superior ophthalmic vein is an alternative [10].

Percutaneous trans vascular approaches can be used to cure traumatic and carotid-cavernous spontaneous sinus fistulas. These procedures are usually safe and effective, particularly when the endoarterial route is used. In some patients, however, an endoarterial route is impossible and another approach must be found. A direct approach on the cavernous sinus although feasible, has significant and a transvenous route risks he inferior sinus through petrosal may be impossible. It is in this setting that an approach to the cavernous sinus through the superior ophthalmic vein is most useful, dCCFs are, in most cases, treated by endovascular cavernous sinus embolization using a transvenous approach, typically via the IPS [8,11].

Complications of SOV exposure include bleeding and difficulty in identifying the vein. Some authors have also reported injury of the levator muscle and supraorbital nerve, infection, granuloma, and damage to the troclea [7,12]. Intracranial dural arteriovenous fistulae are acquired arteriovenous shunts located inside the duramater. They account for 10–15% of all intracranial arteriovenous lesions9. Their arterial supply arises from meningeal branches of the internal or external carotid arteries, and rarely from cortical branches [13].

Despite several publications about the safety, effectiveness, and cosmetically acceptable results, the transvenous embolization of carotid cavernous fistulas and cavernous sinus dural fistulas via the superior ophthalmic vein is still not a standard procedure. In the 1980s several interdisciplinary study groups started to try transvenous embolizations via the superior ophthalmic vein. The success of these pioneers encouraged others to follow in their footsteps [9].

The indications for treatment of the carotid cavernous fistulas in our patient were double vision, severe headache, secondary glaucoma, visual impairment, visual field defect and elevated episcleral venous pressure. After surgery there were no complications in our patient. The cosmetic results were excellent with no visible scar.

The transvenous embolization of dural cavernous fistulas via the superior ophthalmic vein is a easy and convincing approach that should be considered early when conventional therapy fails. We recommend first the conventional neuroradiologic intervention to close the fistula, but if this attempt fails and there is a significant drainage to the superior ophthalmic vein, then transvenous embolization via that vessel should be performed.

Conclusion

Transvenous embolizations of dural cavernous fistulas via the superior ophthalmic vein are an effective and safe yet challenging interdisciplinary approach. Finally, and most importantly, this procedure is performed using a team consisting of an oftalmologist orbital surgeon, endovascular neurosurgeon and an interventional medical technologist it is our belief that it is the team approach that most contributes to the success of the procedure.

Conflict of interest

The authors declare no conflict of interest.

References

[1] A Chiriac, N Dobrin, Georgiana Ion, V Costan, I Poeata.l-The superior ophthalmic vein approach for the treatment of carotid-cavernous fistulas: our first experience. Romanian Neurosurgery. 2016; 30: 2.

[2] AD Henderson, NR Miller Carotid cavernous fistula: current concepts in a etiology, investigation, and management. 2018; 32: 164-172.

[3] MKS Heran, XD Volders, C Haw, J.R. Shewchuk. Imaging-Guided Superior Ophthalmic Vein Access for Embolization of Dural Carotid Cavernous Fistulas: Report of 20 Cases and Review of the Literature. 2019; 40: 699-702.

[4] Justin Dye, Gary Duckwiler, Nestor Gonzalez, Naoki Kaneko, Robert Goldberg, Daniel Rootman, et al. Endovascular Approaches to the Cavernous Sinus in the Setting of Dural Arteriovenous Fistula. 2020; 10: 554.

[5] Oishi H, Arai H, Sato K, Iizuka Y. Complications associated with trans- venous embolization of cavernous dural arteriovenous fistula. Acta Neurochir (Wien) .1999; 141: 1265-1271

[6] Masaki Komiyama, Kasutoshi Morikawa, Yoshiniko Fu, Hisatsugu Yogura, Toshihiro Yasui, Mitsuru Baba. Indirect Carotid-Cavernous Sinus Fistula: Transvenous Embolization from the Externar Yugular Vein Using a Superior Ophthalmic Vein approach. A Case Report. Department Neurosurgery, Baba Memorial Hospital, Sakai, Osaka, Japan. Surg Neurol. 1990; 33: 57-63.

[7] Stacey Quintero Wolfe, Nadia MA Cumberbatch, Mohammad Ali Aziz-Sultan, Ramachandra Tummala, Jacques J Morcos. Operative Approach Via the Superior Ophthalmic Vein for the Endovascular Treatment of Carotid Cavernous Fistulas That Fail Traditional Endovascular Access. 2010; 66: 293-299.

[8] Thomas Klink, Erich Hofmann Wolfgang, Lieb Graefe's. Transvenous embolization of carotid cavernous fistulas via the superior ophthalmic vein. Arch Clin Exp Ophthalmol. 2001; 239: 583-588.

[9] Woong Han, Jae Hoon Kim, Hee In Kang, Deok Ryeong Kim, Byung Gwan Moon, Joo Seung Kim. Transvenous Embolization of Dural Carotid Cavernous Fistula through the Supraorbital Vein. Department of Neurosurgery, Eulji University Eulji Hospital, Seoul, Korea. Journal of Cerebrovascular and Endovascular Neurosurgery. 2019; 21: 101-106.

[10] Anne M Hanneken, Neil R Miller, Gerard M Debrun, Haring JW Nauta. Treatment of Carotid-Cavernous Sinus Fistulas Using a Detachable Balloon Catheter through the Superior Ophthalmic Vein. Arch Ophthalmol. 1989; 107: 87-92.

[11] Shah A, Patel BC. Book: Superior Ophthalmic Vein Cannulation for Carotid Cavernous Fistula. Publication Details. 2020; 1-8. https://www.ncbi.nlm.nih.gov/books/NBK537177/.

[12] Eduardo Wajnberg, Gabriela Z Spilberg, Emerson L Gasparetto. Superior ophthalmic vein puncture. An alternative approach to treat complex cavernous sinus fistulae. Arq Neuropsiquiatr. 2009; 67: 523-526.

[13] Quiñones D, Duckwiler G, Gobin PY, Goldberg RA, Viñuela F. Embolization of dural cavernous fistulas via superior ophthalmic vein approach. AJNR Am J Neuroradiol. 1997; 18: 921-928.