# A 28-year-old Male with Complaints of Redness in the Right Eye with Proptosis: Direct Carotid-cavernous Fistula

**Bhumireddy Vijaya Madhuri, Akash Rauniyar, Bineeta Parihar, Sonal Saran***
Department of Diagnostic and Interventional Radiology, AIIMS, Rishikesh, Uttarakhand, India

## Section 2 – Answer

### Case

A 28-year-old man presented at our hospital reporting redness in his right eye accompanied by proptosis persisting for 6 months [Figure 1]. He also complained of headaches that had gradually developed without a diurnal pattern and were partially relieved by painkillers. There were no reports of fever, neck stiffness, or projectile vomiting. A thorough neurological examination revealed no abnormalities; the patient was fully oriented in time, place, and person and exhibited normal higher mental functions. Ophthalmic assessment revealed proptosis, chemosis, and orbital bruit, with unremarkable visual acuity in both eyes.

Upon questioning, the patient disclosed a history of a road traffic accident 9 months prior, resulting in traumatic injuries, including a fractured mandible and a forehead laceration. Symptoms in the right eye began 3 months after the incident. The patient had no prior history of diabetes or hypertension, and his thyroid profile was within normal limits.

Orbital Doppler ultrasonography findings are depicted in Video 1. What is your impression?

## Interpretation

Right orbital Doppler ultrasonography shows a dilated and tortuous right superior ophthalmic vein with increased color flow. In the spectral Doppler study, arterialization of the venous flow is shown Video 1.

Magnetic resonance imaging (MRI) of the brain with angiography was performed in this patient, which revealed enlarged bilateral cavernous sinuses (CSs), containing multiple flow voids and a dilated and tortuous right superior ophthalmic vein [Figure 2]. Prominent flow voids in the right superior and inferior petrosal sinus left sphenoid-parietal sinus and few prominent flow voids in the cerebellum were also seen. Magnetic resonance (MR) angiography showed a prominent right internal carotid artery (ICA), and early filling of the right CS and its tributaries with dilated and tortuous right superior ophthalmic vein [Figure 3]. These findings were suggestive of direct carotid-cavernous fistula (CCF).

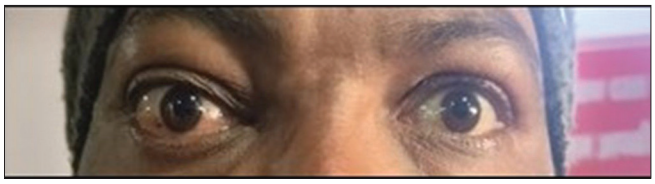

**Figure 1:** Clinical photograph showing patient's eyes appearing red with proptosis

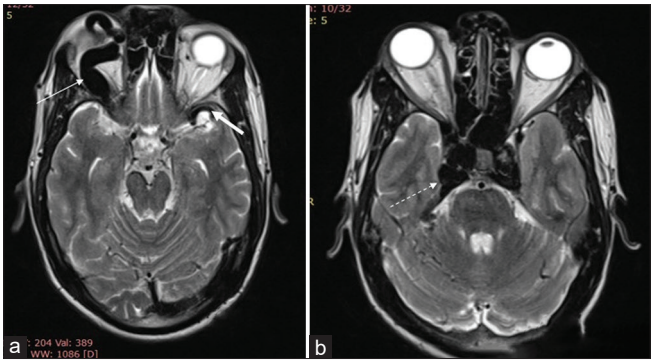


**Figure 2:** Axial T2 W images (a and b) reveal right-sided proptosis and dilated tortuous right superficial ophthalmic vein (thin arrow), dilated left sphenoparietal sinus (thick arrow), and bilateral bulky cavernous sinuses (dashed arrow)

**Received:** 29-04-2024 **Revised:** 15-05-2024 **Accepted:** 13-06-2024 **Available Online:** 10-03-2025

**Videos available on** https://journals.lww.com/jmut

**Access this article online**

Quick Response Code:

**Website:** https://journals.lww.com/jmut

**DOI:** 10.4103/jmu.jmu_51_24

**Address for correspondence:** Dr. Sonal Saran, Department of Diagnostic and Interventional Radiology, AIIMS, Rishikesh - 249 203, Uttarakhand, India.
E-mail: sonalsaranmalik@gmail.com

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

**For reprints contact:** WKHLRPMedknow_reprints@wolterskluwer.com

**How to cite this article:** Madhuri BV, Rauniyar A, Parihar B, Saran S. A 28-year-old male with complaints of redness in the right eye with proptosis: Direct carotid-cavernous fistula. J Med Ultrasound 2025;33:181-2.

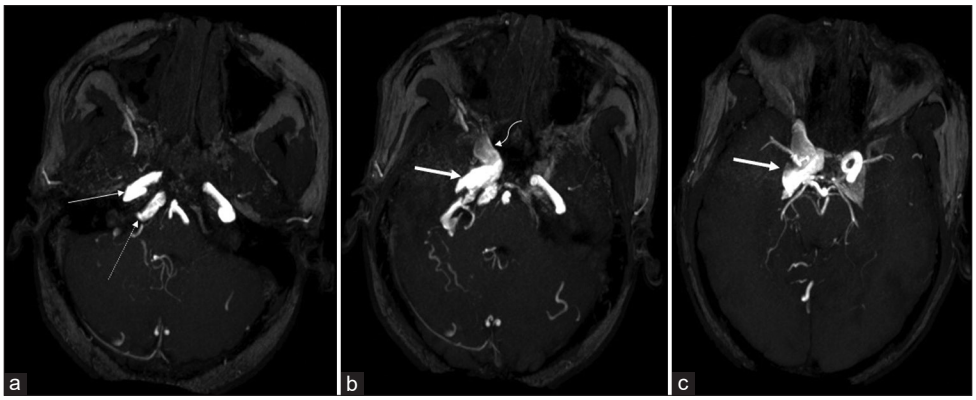


**Figure 3:** Three-dimensional time of flight magnetic resonance angiography of the brain showing a prominent right internal carotid artery (thin arrow a), early filling of right cavernous sinuses (thick arrow b and c) and its tributaries (dashed arrow) with dilated and tortuous right superior ophthalmic vein (curved arrow b)

## Discussion

CCF, an abnormal communication between the ICA and CS, typically affects young males in their third decade. It can be categorized as either high or low flow, depending on the rate of blood flow through the fistula. Direct CCF involves direct communication between the ICA and CS, while indirect CCF involves communication between the meningeal branches of the carotid arteries and the CS. Barrow's classification delineates four types of fistulas (Types A to D), with Type A representing high-flow direct fistulas between the intracavernous ICA and CS. Types B, C, and D involve low-flow indirect fistulas, where communication occurs between the meningeal branches of the ICA, external carotid artery, or both, and the CS, respectively.[1]

The majority of direct CCF cases (69%–77%) stem from trauma, with other causes including iatrogenic intervention and collagen vascular disorders. Indirect CCF causes, often unclear, may be associated with pregnancy, sinusitis, and surgical procedures likely resulting in cavernous sinus thrombosis with subsequent revascularization.[2] Clinical manifestations typically arise within days to months following traumatic CCF, with patients commonly presenting with orbital bruit, proptosis, chemosis, glaucoma, headache, and focal deficits of the third to sixth cranial nerves.[1,2]

Diagnostic imaging modalities include orbital Doppler ultrasonography, computed tomography (CT), MRI, and digital subtraction angiography (DSA). Ultrasonography reveals arterialization of venous flow, flow reversal, or thrombosis in the superior ophthalmic vein. CT and MRI depict features such as proptosis, dilated tortuous superior ophthalmic vein, enlarged ipsilateral CS with lateral wall bulging, and extraocular muscle thickening. MR angiography highlights early contrast enhancement of the cavernous sinus and superior ophthalmic vein, with additional findings such as extraocular muscle enhancement and patchy intraorbital fat enhancement. DSA serves as the gold standard for diagnosis, confirming the fistula, identifying supplying meningeal branches or ICA wall laceration in direct CCF, and evaluating flow dynamics in the cavernous sinus and other venous sinuses.[3]

Conservative management is suitable for small, asymptomatic, stable low-flow fistulas, as they may spontaneously close or respond to carotid compression therapy. For direct CCF cases with normal or minimal visual symptoms, conservative treatment may be considered; otherwise, an endovascular approach is warranted.[4] Embolization techniques, such as detachable balloons, platinum coils, liquid embolizing agents (e.g. N-butyl cyanoacrylate and ethylene-vinyl alcohol copolymer), stents, or their combinations, are commonly employed for closure.[1,5]

Our case underscores the significance of utilizing orbital ultrasonography with Doppler in assessing CCF. It is crucial for both residents and radiologists to maintain a heightened level of suspicion for this anomaly in relevant clinical contexts.

### Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent form. In the form, the patient has given his consent for his images and other clinical information to be reported in the journal. The patient understands that his name and initials will not be published and due efforts will be made to conceal his identity, but anonymity cannot be guaranteed.

### Financial support and sponsorship

Nil.

### Conflicts of interest

There are no conflicts of interest.

## References

1. Henderson AD, Miller NR. Carotid-cavernous fistula: Current concepts in aetiology, investigation, and management. Eye (Lond) 2018;32:164-72.
2. Bertolini G, Capurri G, Menozzi R. Post-traumatic carotid-cavernous fistula. Neurol Sci 2024;45:1319-20.
3. Sharma R, Ponder C, Kamran M, Chacko J, Kapoor N, Mylavarapu K, *et al.* Bilateral carotid-cavernous fistula: A diagnostic and therapeutic challenge. J Investig Med High Impact Case Rep 2022;10:23247096221094181.
4. Iampreechakul P, Tirakotai W, Tanpun A, Wattanasen Y, Lertbusayanukul P, Siriwimonmas S. Spontaneous resolution of direct carotid-cavernous fistulas: Case series and literature review. Interv Neuroradiol 2019;25:71-89.
5. Ducruet AF, Albuquerque FC, Crowley RW, McDougall CG. The evolution of endovascular treatment of carotid cavernous fistulas: A single-center experience. World Neurosurg 2013;80:538-48.