

## MRI Evaluation of Carotid Cavernous Fistula – A Case Report

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### ABSTRACT

A carotid cavernous fistula is a rare condition and often difficult to diagnose. We herewith present a case of a female patient who presented with minimal proptosis in the right eye and occipital headache. Magnetic resonance imaging showed classical findings like arterialization of ophthalmic veins and tortuous prominent cavernous sinuses on right side. In such situations, magnetic resonance venography (MRV) plays a major role in the diagnosis and may reveal any cerebral thrombosis. We will be discussing the types of CCF and the MRV findings which help in the diagnosis as well as treatment planning.

**Keywords:** magnetic resonance imaging, magnetic resonance venography, ophthalmic vein, cavernous sinus.

Carotid cavernous fistula (CCF) is a special type of arteriovenous shunt that develops within the cavernous sinus. The veins in this condition are under high (arterial) pressures. These are almost always acquired lesions but the etiology can also be traumatic or non-traumatic. Herewith, we present the case of a middle-aged female patient who came to our hospital with complaints of pain and swelling in the right eye of one-month duration. Magnetic resonance imaging (MRI) showed features of dilated and prominent right superior ophthalmic vein (with arterialization) and multiple dilated cavernous sinus collaterals. MR venogram did not reveal any thrombus in the cavernous sinus and a diagnosis of CCF was made.

### CASE REPORT

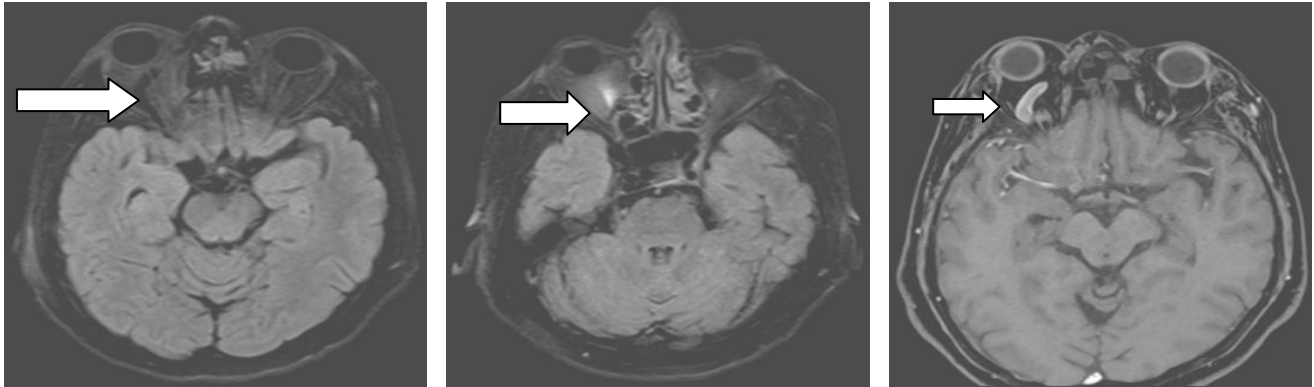
A 45-year-old female patient presented with complaints of pain, proptosis, and swelling of right eye since 1 month and associated occipital headache. Symptoms were insidious in onset, and gradually progressive in nature. No history of similar complaints in the past was present.

The patient was not a known diabetic/hypertensive. The local examination revealed swelling of right eye raised the local temperature and a bruit. No other significant clinical findings were present and systemic examination was within normal limits. Laboratory investigation e.g. complete blood picture, lipid profile, liver and kidney function tests etc were normal. A provisional diagnosis of proptosis was made and the patient was referred to the department of Radiodiagnosis for an MRI of the orbit to look for the cause of proptosis.

The following MRI sequences were done: Tesla 1 weighted image (T1WI), Tesla 2 weighted image (T2WI), Fluid-attenuated inversion recovery (FLAIR), Time of Flight Magnetic Resonance Angiogram (TOF-MRA) and Magnetic Resonance Venogram (MRV). MRI (1.5 Tesla MR Siemens Avento) evaluation revealed the following findings: (1) FLAIR sequence revealed altered signal intensity in the intracanal region (**Fig. 1a & b**). (2) MRA showed tortuous and prominent superior ophthalmic vein (SOV) and the signal intensity being the same as arterial signal intensity suggests arterialization on right side (**Fig.**

1c). (3) 3D-TOF images show multiple tortuous, dilated cavernous sinus collaterals (Fig. 2). (4) Maximum intensity projections (MIP) images demonstrated all the vessels of cerebrum showing meningeal artery forming

fistulous communication with the cavernous sinus (Fig. 3a & b). (5) MRV is done to rule out thrombosis, it revealed normal venogram (Fig. 4a, b, & c). Based on these MRI findings, a diagnosis of CCF was made.

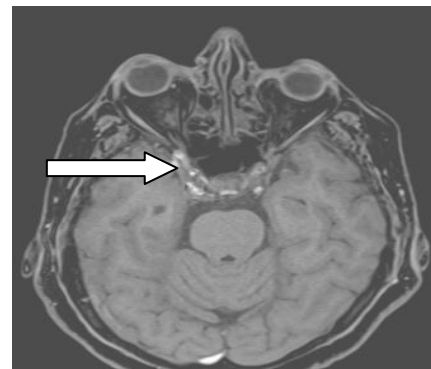


**Figure 1 a, b, & c - FLAIR axial image showing flow void and altered signal intensity in the right intraconal region and 3D-TOF axial images showing arterialization of dilated superior ophthalmic vein (Arrows).**

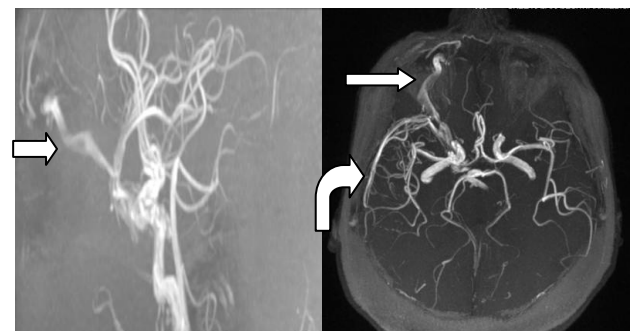
## DISCUSSION

Valveless venous communication between the cavernous sinus and superior ophthalmic vein leads to transmission of arterial pressure into the veins of orbit resulting in CCF. Bruit and suffusion of the globe, sclera and conjunctiva are the hallmarks of CCF. CCF results from abnormal communications between the carotid artery (arterial system) and the cavernous sinus (venous system). CCFs are broadly classified into 3 types [1]. In direct (type A) CCF, there is a defect in the wall of internal carotid artery (ICA) which communicates directly with the cavernous sinus (CS) resulting in a large-volume arteriovenous shunt. Indirect or type B CCF is due to communication between the branches of ICA/external carotid artery (ECA) and cavernous sinus. Third and the most common type is type C, where the communication is between meningeal branches of the ECA and the cavernous sinus forming the fistula [2].

Hirabuki et al classified CCF into 4 types depending on the level of communication between the branches of ICA and CS [3] - 1) Type A - a direct connection between the intracavernous ICA and CS, 2) Type B - dural shunt between intracavernous branches of the ICA and CS, 3) Type C - dural shunts between meningeal branches of the ECA and CS, and 4) Type D - features of both type B and C.



**Figure 2 - 3D-TOF axial image showing tortuous dilated collaterals along the wall of right cavernous sinus (Arrows)**



**Figure 3 a & b - MRA Images showing arterialization of dilated prominent superior ophthalmic vein on the right side (Arrows). Meningeal branch of external carotid (Curved Arrow)**

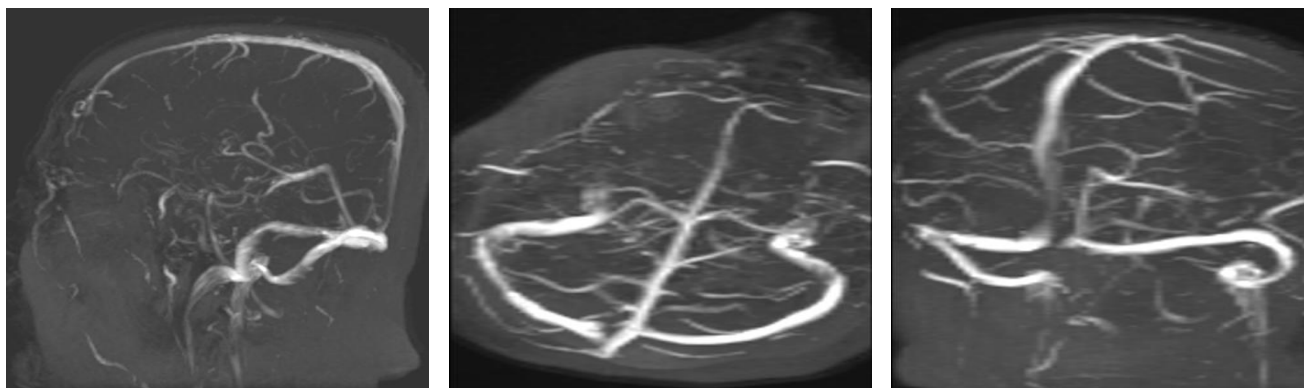


Figure 4 a, b & c - MRV in axial, coronal and sagittal images showing normal flow and no thrombosis is seen

Majority of the time, it is ipsilateral but can be contralateral in 10% cases. Less commonly, bilateral involvement can be seen due to intercavernous sinus connections. Trauma to the head and skull (craniocephalic) is the most common cause of CCF followed by spontaneous development due to rupture of an aneurysm [4,5]. CCFs are common in men in the age between 20 and 30 years [6]. Very often, CCF occur secondary to cavernous sinus thrombosis with revascularisation, pregnancy, surgical procedures in the region, and sinusitis.

MRI is the investigation of choice in the detection and diagnosis of CCF. Features of CCF like dilatation of superior ophthalmic vein, proptosis, and extraocular muscle thickening can be easily identified on MRI. With MR angiography, early contrast enhancement of the cavernous sinus and superior ophthalmic vein, and venous drainage of the fistula can be identified. Many treatment options are available like carotid compression therapy; transarterial balloon embolization; detachable coils and surgical ligation.

## CONCLUSION

We would like to reiterate the importance of MR and MR venography as the diagnostic modalities of choice as they can demonstrate not only the level of communication between ICA and CS but also rule out/ confirm the venous thrombosis as the possible cause of CCF.

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