CASE REPORT

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POST TRAUMATIC CAROTICO-CAVERNOUS FISTULA-A CASE ILLUSTRATION

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ABSTRACT

Carotid-cavernous fistulas (CCFs) are abnormal vascular connections between the carotid arterial system and the cavernous sinus. They are most often caused by trauma. The Barrow classification divides CCFs into four types based on anatomy and flow dynamics. Type A, a direct high-flow shunt between the internal carotid artery (ICA) and the cavernous sinus, is commonly seen in young males following head injuries, while Types B, C, and D are lower-flow dural variants involving the branches of the ICA and/or external carotid artery (ECA).

An 18-year old male presented with progressive swelling and vision loss in the left eye, two months after a motorcycle accident. Clinical examination revealed proptosis, chemosis, dilated conjunctival vessels, and an audible orbital bruit. Imaging confirmed a high-flow fistula between the intracavernous ICA and the left cavernous sinus, consistent with a Barrow Type A CCF. Limited access to endovascular treatment due to financial constraints posed a major challenge to definitive care.

This case illustrates the classical presentation of a post traumatic CCF and detailed appropriate investigations to make a diagnosis. It also highlights the treatment limitations faced in low-resource settings, where access to specialized care may be delayed or unavailable.

INTRODUCTION

Carotid-Cavernous fistula (CCF) are vascular shunts that develop between the Internal carotid artery branches and the cavernous sinus. This aberrant connection allows the flow of blood from the arteries into the sinuses.[1] It can occur as a direct connection between the internal carotid artery (ICA) and the cavernous sinus or as an indirect connection between the ICA and its branches with the sinus also referred to as a dural fistula.[2]

Various classifications of CCF are currently in use, which consider the aetiology, anatomy of the communicating branches and haemodynamic status.[1,3] These classifications have direct implications on the management options and prognosis.[3] Aetiologically, they are divided into traumatic or spontaneous CCF. The traumatic form is seen in two-thirds of cases and is associated with base of skull fractures while the spontaneous form is seen in women and the elderly.[3,4] The anatomical parts of the carotid system communicating with the cavernous sinus define direct and the dural types of CCF. Fistula between the internal carotid artery and the cavernous sinus is defined as direct, while a shunt between the meningeal branches of both internal and external carotid and the cavernous sinus

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is considered as dural CCF.[3,5] Direct CCFs are often post- traumatic but can also result from ruptured aneurysms, Type IV Ehlers Danlos and iatrogenic interventions. Dural CCFs are associated with hypertension, fibromuscular dystrophy and ICA dissection. [2] Haemodynamic status determines the high or low flow classification [6].

Demonstrated clinical features result from the degree of pressure exerted on important structures within the cavernous sinus which include cranial nerves III (oculomotor nerve), IV (trochlear nerve), V1 (ophthalmic nerve), V2 (maxillary nerve), VI (abducens nerve) and the vascular tributaries of the cavernous sinus.[6] The transmission of high arterial pressure through the various tributaries i.e., the superior-inferior spheno-parietal veins anteriorly, superior petrosal and inferior petrosal sinuses and basilar plexus posteriorly, pterygoid plexus inferiorly, spheno-parietal sinus laterally and cavernous sinus accounts for the symptomatology.[7]

We report a rare case of a left unilateral, high-flow post traumatic carotico-cavernous fistula in an 18-year-old man, highlighting its distinctive high-flow vascular pattern on detailed diagnostic Imaging, opportunities and challenges of therapeutic intervention in sub-Saharan region where endovascular treatment options are limited.

CASE REPORT

An 18-year-old male presented to the neurosurgery on-call team with progressive visual deterioration in the left eye following a road traffic accident (RTA) involving a head-on collision between two motorcycles approximately two months prior to presentation having sustained direct impact to the left side of the head upon falling from the motorcycle.

Post-trauma, he developed gradual but progressive left peri orbital swelling accompanied by a corresponding decline in vision on the ipsilateral eye with no immediate loss of consciousness reported. There were associated injuries to the left upper limb and mandible.

There was no history of pre-existing visual deficits, chronic medical conditions, or known hereditary disorders.

On examination, the patient was conscious and alert. Left eye ectropion with peri-orbital oedema, proptosis, chemosis, with bulbar injection and dilated conjunctival vessels. Pupil sluggishly reactive. Mild central disc pallor, intra ocular pressure of 30mmHg and a bruit on auscultation. The right eye showed normal vision: 6/6 (20/20), pupil 3mm and reactive to light.

Full blood count and differentials showed normocytic normochromic RBCs with packed cell volume of 36%, normal WBC and platelet count. There were also normal Urea, electrolyte and creatinine with unremarkable Liver function test.

Duplex Ocular ultrasound showed dilated left superior Ophthalmic vein with an arterialized low resistance spectral wave pattern. The remaining intra-ocular structures appear preserved. The right globe and surrounding structures were within normal limits.

Cerebral computed tomography (CT) showed marked proptosis of the left eye, with enlargement of the extraocular muscles and significant peri-orbital soft tissue congestion compared to the right side. Post-contrast CT demonstrated a dilated left cavernous sinus with increased calibre and tortuosity of the left ophthalmic vein. Time-of-Flight (TOF) magnetic resonance imaging revealed a high-flow shunt between the intracavernous portion of the left internal carotid artery and the left cavernous sinus, with arterialisation consistent with a unilateral, Type A left carotid-cavernous fistula.

Fig 1&2 showing proptosis and Chemosis

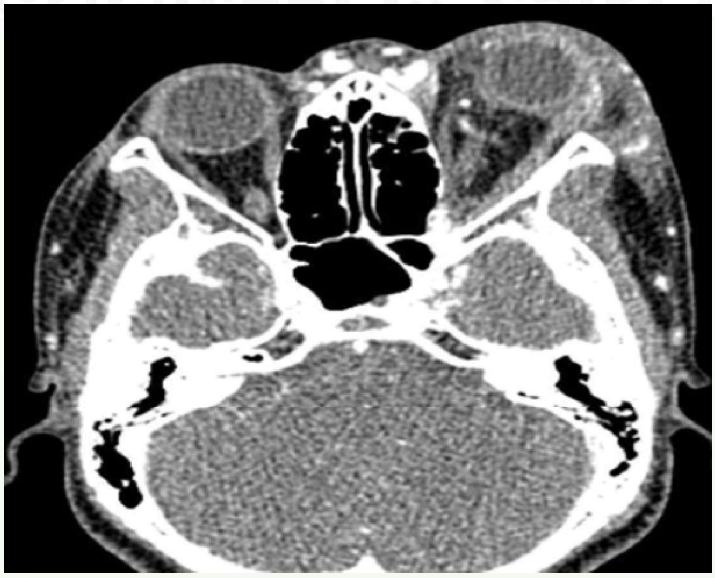

Fig 3. Axial Post contrast CT showing severe proptosis, thickened IO muscles and periorbital soft tissue congestion on the left compared to the right.

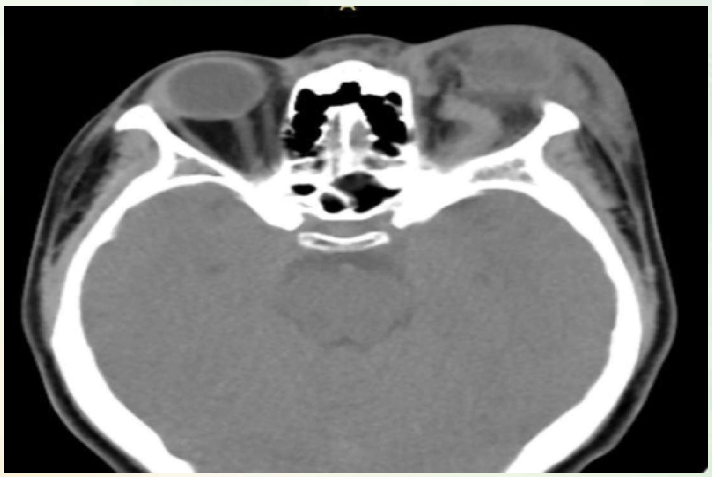

Fig 4. Non contrast Dilated tortuous left SOV

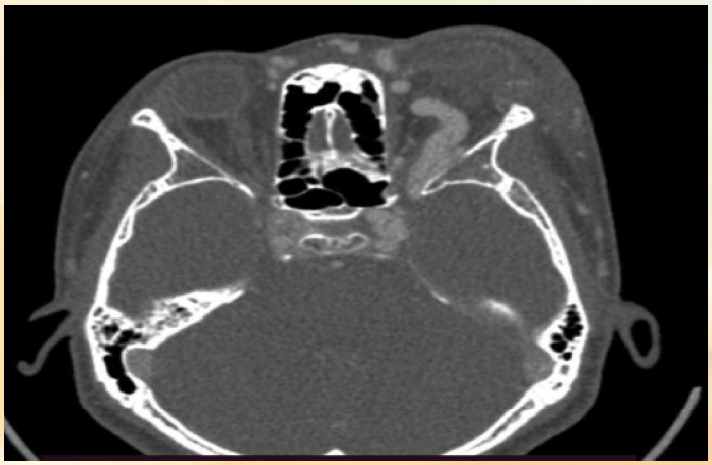

Fig 5. Enlargement of the left cavernous sinus and associated tortuous dilatation of the left superior ophthalmic vein showing similar attenuation with ICA bilaterally.

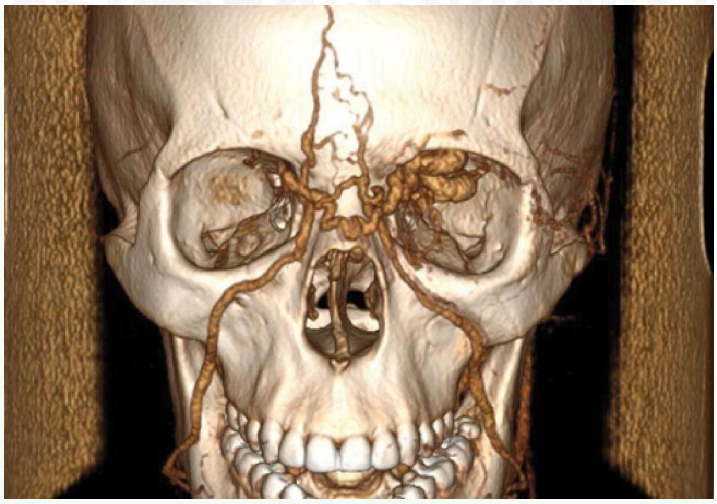

Fig 6. 3D volume Reconstruction CT showed Serpentine dilated Superior Left Ophthalmic vein

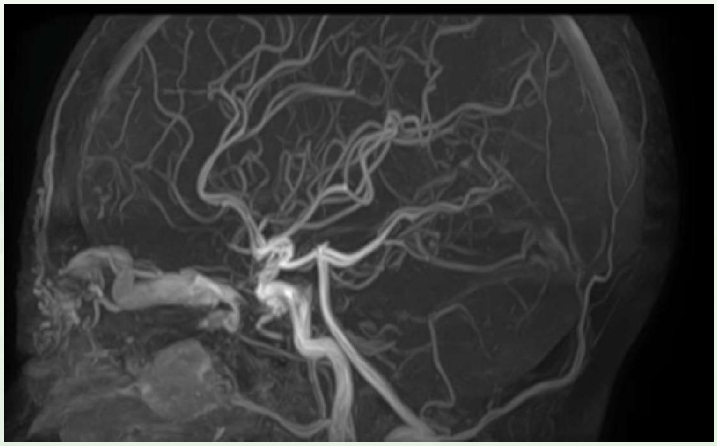

Fig 7. Sagittal TOF MR Angiography showed high flow communication between the Left ICA and the cavernous sinus with arterialised signal.

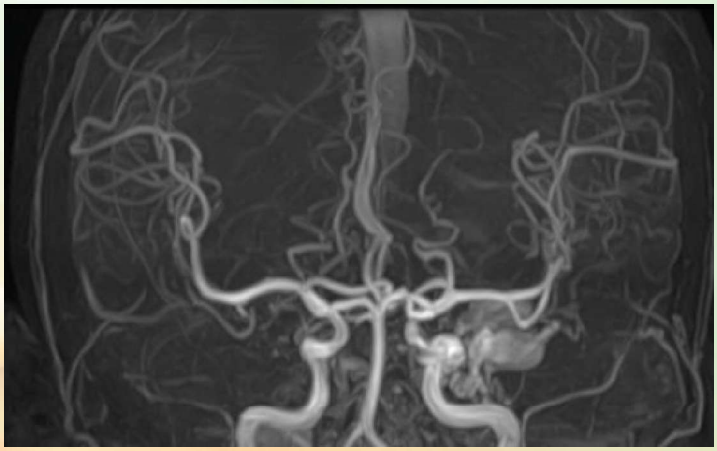

Fig 8. Arterialised Left cavernous sinus on TOF MR Angiography.

DISCUSSION

Carotid cavernous fistula is an abnormal connection between the carotid arterial system and the cavernous venous system. They are most often traumatic which

is the cause of the index patient.[8]

The angiographic anatomical classification of CCFs by Barrow et al determines the various management modalities. Type A is a direct connection between the ICA and the cavernous sinus, type B between dural branches of ICA and cavernous sinus, Type C between dural branches of external carotid and type D between the dural branches of both ICA and ECA. [6,9] Type A is haemodynamically high flow and accounts for about a quarter of cases while Type B, C and D are low flow comprising of ¾ of cases. [10] High flow direct CCFs are common in young males from trauma, rupture of an internal carotid artery aneurysm within the cavernous sinus commonly associated with underlying connective tissue disorder (Ehlers-Danlos syndrome Type IV) or iatrogenic intervention. [3,5,11]

Diagnosis involves detailed clinical history, examination and investigations. Doppler ultrasound, angiography, thin slice computed tomography and MR angiography are essential in evaluating CCF. [3,12] Clinical features depend on the nature of the fistula and pressure gradient. They include proptosis, chemosis, diplopia, pain and visual loss.[3,13] Direct CCF presents with chemosis, pulsatile exophthalmos and ocular bruit which were demonstrated in this patient.[14] High pressure arterial flow into the sinus increases pressure within the ocular veins causing oedema of the extra-ocular muscles leading to proptosis. [3,4,14] This case shows similar clinical features consistent with a high flow (Type A) CCF. Complications of high flow CCFs include intracerebral haemorrhage, subarachnoid haemorrhage, epistaxis, cranial nerve palsies and loss of vision. [15]

Neuroanatomic neuroimaging plays an important role in making a diagnosis. Computed tomography and computed tomography angiography or magnetic resonance imaging and magnetic resonance angiography of the brain are essential in diagnosis, classification and assessing complications.[6] Cerebral angiogram is the gold standard investigation that delineates the fistula filling the cavernous sinus, draining pattern and reflux.[2]

The main target of treatment is occluding the fistula without compromising the ICA blood flow. Spontaneous fistula occlusion has been reported in 20-40% of low flow dural fistula.[1] Conservative manual carotid massage has achieved occlusion of fistula in a third of patients. This is recommended in low flow type CCFs and hence not beneficial for the index patient.[16] Surgery is considered a definitive treatment with a high success rate and is generally reserved for non-acute high-flow and low-flow fistulas. This may involve surgical ligation of branches of the internal carotid artery. Concomitant intracranial and extracranial occlusion of the affected carotid artery has been shown to be more effective in treating direct CCF as in this index patient than proximal ICA occlusion or common carotid artery (CCA) ligation. Stereotactic radiosurgery, another surgical option, has a reported success rate of approximately 80% in achieving fistula occlusion. [17] These interventions were offered to the patient because of their high success rates but remain more invasive compared with intravascular embolization.

Trans-arterial endovascular embolization demonstrates an 80–90% success rate and is the preferred treatment for acute high-flow CCF. This can be achieved with coil or liquid embolization or through stent grafting of the ICA.[2,7,9,11] This treatment modality was offered to the patient, as it provides the best outcome while being less invasive and associated with lower morbidity.

CONCLUSION

We present a case of an 18-year-old man who developed progressive deterioration of vision on the left eye following a motorcycle accident. He was diagnosed with unilateral, high-flow, post-traumatic Type 'A' carotid-cavernous fistula after detailed imaging including CT, MRI and duplex ultrasound all demonstrating the extent of venous congestion and arterial shunting. Endovascular embolization was offered and recommended as the definitive treatment option, with the potential to restore vascular dynamics and preserve vision. However, due to financial constraints, the patient was unable to undergo the procedure. The patient remains under outpatient follow-up while efforts are ongoing to secure the necessary funds. His story underscores not only the importance of timely diagnosis and intervention in high-flow CCFs but also the significant impact of resource constraints on patient outcomes in low and middle-income settings.

CONFLICT OF INTEREST

There is no conflict of Interest.

CONSENT-Written consent obtained

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