Case Report

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Direct carotid cavernous fistula treated with transvenous approach: a case report

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Introduction: Carotid cavernous fistulas are uncommon vascular abnormalities marked by anomalous connections between the carotid artery and the cavernous sinus. The authors present a case of a direct carotid cavernous fistula and its successful treatment in a 42-year-old female.

Case presentation: A 42-year-old female presented with right eye painful swelling and visual disturbance. She had no known comorbidities or history of injury. Examination showed proptosis, chemosis, and orbital bruit. Carotid angiography confirmed a carotid cavernous fistula, which was managed endovascularly. The patient fully recovered after treatment.

Discussion: Carotid cavernous fistula occurs spontaneously or as a result of trauma or other vascular abnormalities. Common clinical manifestations include proptosis, chemosis, and orbital bruit, with vision loss being a feared complication. Diagnosis is typically confirmed through angiography, with digital subtraction angiography being the gold standard. Endovascular treatment is usually effective, although surgical management may be necessary in certain cases.

Conclusion: Carotid cavernous fistula is a rare but potentially sight-threatening neurological condition. Treatment with a transvenous approach is effective for the management of direct carotid cavernous fistula.

Keywords: angiography, carotid artery, carotid cavernous fistula, case report, cavernous sinus

Introduction

Carotid cavernous fistulas (CCFs) are rare, abnormal connections between the carotid artery and cavernous sinus. They can be either direct (high flow) or indirect (low flow) communication, which can provoke a pathological arteriovenous shunt[1].

According to Barrow's classification, CCFs can manifest in the following ways: direct (high flow) communication of the carotid artery and cavernous sinus (Type A), indirect communications of the cavernous sinus with branches of the cavernous carotid artery (Type B), dural branches of the external carotid artery (Type C), or both the branches of the external and internal carotid arteries (Type D)[1]. Carotid cavernous fistulas are potentially sight-threatening.

The primary treatment approach for CCFs involves embolization via either transarterial or transvenous routes. Although secondary options such as open surgery or radiosurgery are still employed, they typically serve as adjunctive or alternative therapeutic strategies[2,3]. The endovascular approach is favored over surgery due to its minimally invasive nature with fewer complications and a cure rate exceeding 80%[2]. Transarterial obliteration is frequently employed in the treatment of direct high-flow CCFs[4]. Transvenous embolization is preferred for direct CCFs inaccessible via the transarterial route and for indirect CCFs[5].

We report a case of a direct CCF in a patient that was treated with a transvenous approach. This case has been reported in line with the SCARE criteria[6].

HIGHLIGHTS

- Carotid cavernous fistulas are rare vascular anomalies characterized by abnormal connections between the carotid artery and cavernous sinus.
- Forty-two-year-old female presented with painful right eye swelling and visual disturbance, without any known comorbidities or history of injury. Clinical examination revealed proptosis, chemosis, and orbital bruit.
- Carotid angiography confirmed the presence of a high-flow fistulous connection between the internal carotid artery and the cavernous sinus.
- Treatment was performed via a transvenous approach with exclusive coiling of the primary venous sac using balloon assistance, resulting in complete resolution of symptoms.

Case report

A 42-year-old female with no known comorbidities presented to the outpatient department with a complaint of right eye swelling for 2 months. The swelling was acute in onset, gradually

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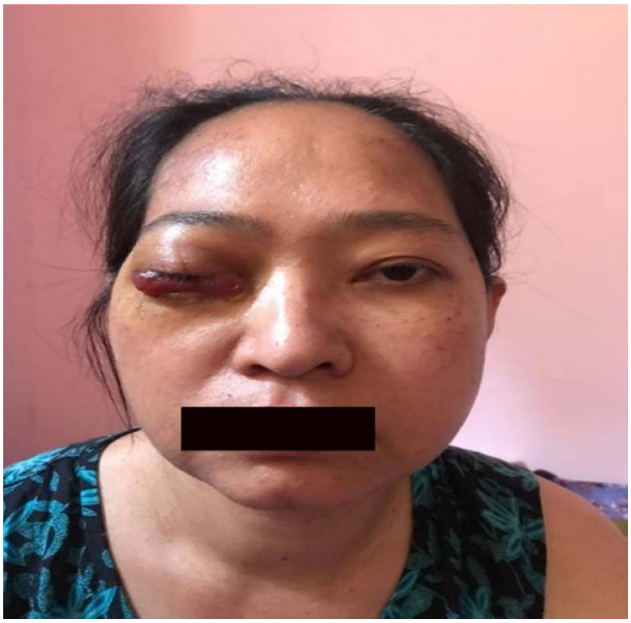

Figure 1. Initial presentation of the patient showing exophthalmos, chemosis and ocular redness.

progressive, and painful. The swelling was associated with difficulty in vision, and there was no history of trauma.

At the time of presentation, the swelling was painless, and she was unable to see from the affected eye. The ophthalmological examination revealed acute symptoms consistent with a direct cavernous carotid fistula (CCF). Notably, there was evident pulsatile exophthalmos, accompanied by an audible orbital bruit. Furthermore, the presence of chemosis and ocular redness indicated venous congestion within the orbit. (Fig. 1) Additionally, the patient reported experiencing diplopia, pulsatile tinnitus, and occasional headaches, further corroborating the diagnosis of a CCF. The pupils measured 2 mm in diameter on both sides and exhibited reactivity to light. No other neurological findings were observed. There were no significant past medical histories, familial predispositions, or psychosocial factors.

Computed tomography (CT) scan and MRI revealed dilated superior ophthalmic vein and orbital congestion. The MRI findings revealed proptosis, a dilated superior ophthalmic vein, and a bulky ipsilateral cavernous sinus, accompanied by additional flow voids observed in T2-weighted imaging. Additionally, the patient exhibited a focal parenchymal bleed in the right temporal region, attributed to cortical venous reflux. Digital subtraction angiograhy (DSA) confirmed the presence of a high-flow fistulous connection between the internal carotid artery and the cavernous sinus. This was demonstrated by the rapid filling of the cavernous sinus following internal carotid arterial injection. (Figs. 2A, B

Treatment was performed via the primary transvenous route with exclusive coiling of the primary venous sac using balloon assistance. A total of six long platinum coils were utilized. (Fig. 3) The intervention involved both venous and arterial punctures. From the arterial side, a balloon was navigated and placed at the site of the rent in the cavernous segment of the internal carotid artery (ICA). Simultaneously, from the venous side, coiling was performed. Following the treatment, all symptoms completely resolved. (Figs. 4, 5) No any adverse events were encountered on follow-ups.

Discussion

CCFs are rare and potentially sight-threatening abnormal connections between carotid artery and cavernous sinus. CCFs may occur spontaneously or result from secondary causes such as trauma, vascular aneurysms, malformations, or venous thrombosis. Direct CCFs are frequently caused by head trauma, rupture of intra-cavernous aneurysms, or head surgery[7–9]. In our case, the CCF had developed spontaneously.

Common clinical findings in cases of direct CCF develop suddenly and include orbital bruit (80%), proptosis (72%), chemosis (55%), abducens nerve palsy (49%), conjunctival injection (44%), among other rarer findings[10]. The risk of

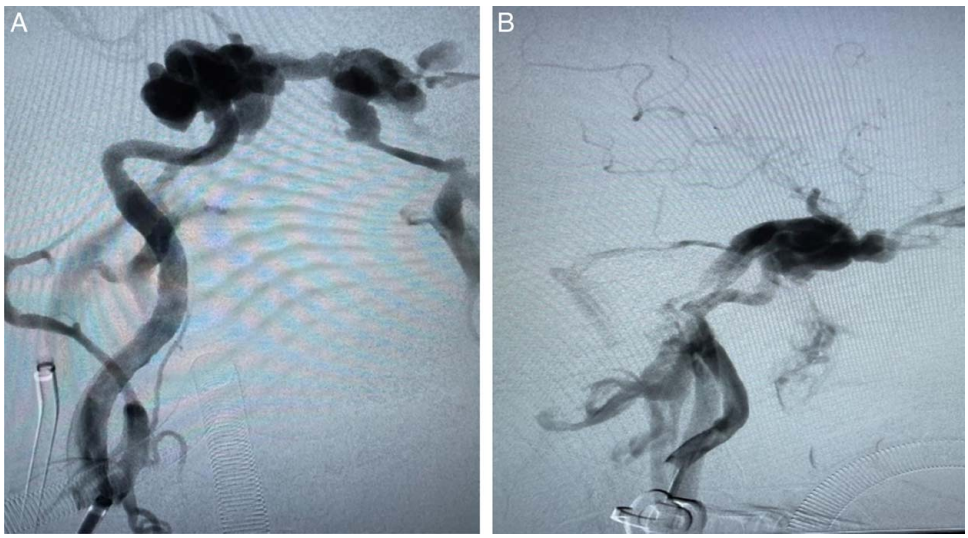

Figure 2. (A, B) Digital subtraction angiography showing carotid cavernous fistula.

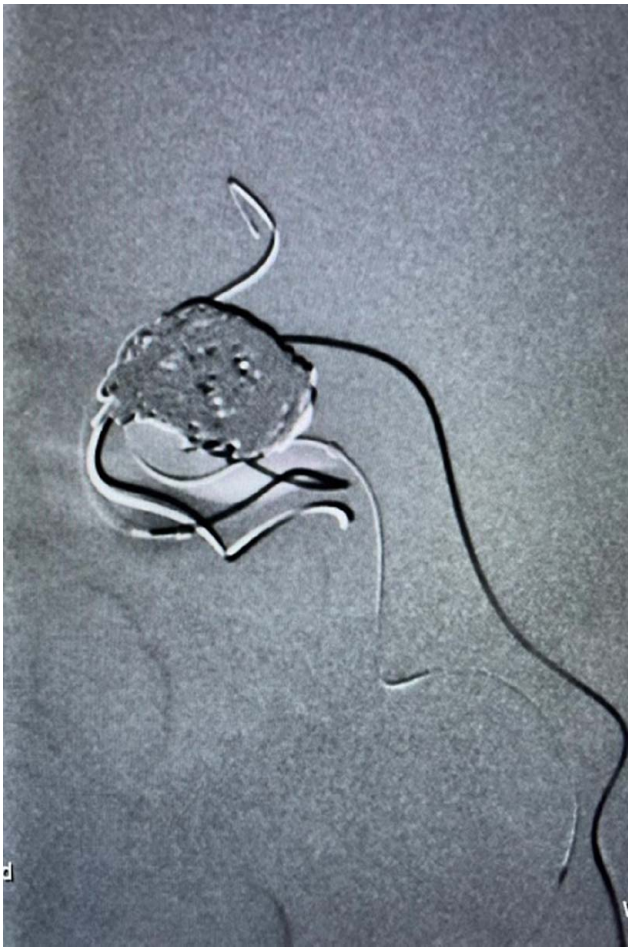

Figure 3. Coiling of primary venous sac using balloon assistance.

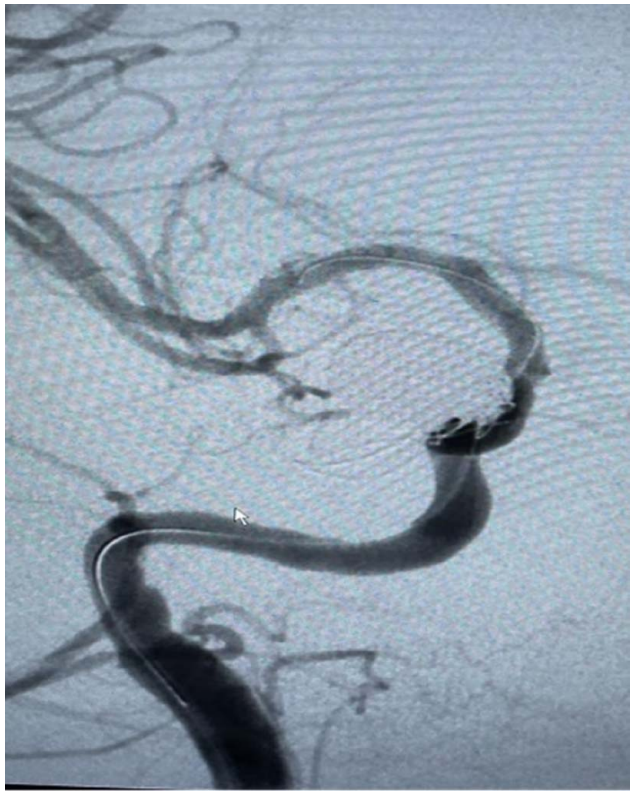

Figure 4. Digital subtraction angiography after successful coiling.

permanent neurological disability is lower in younger patients, with an overall risk of 4%[11].

Vision loss is one of the most feared complications of CCFs. Sight-threatening complications may occur in direct CCF due to severe exposure keratopathy, corneal ulcerations, and possibly central retinal artery occlusion[12]. Currently, there is no available data on the incidence of vision loss if direct CCF is not properly and timely treated. The differential diagnoses of CCFs include cerebral aneurysms, vascular malformations of the eyes, inflammation of the orbits, retro-orbital cellulitis, thyroid exophthalmos, retrobulbar hemorrhage, tumor of the lacrimal gland, cavernous sinus thrombosis, and vasculitis[13].

Due to the significant variability in the presentation of CCFs, the differential diagnosis depends on clinical signs and symptoms. It's essential to consider other diagnoses such as cavernous sinus thrombosis, superior orbital fissure syndrome, orbital apex syndrome, retrobulbar hemorrhage, and thyroid eye disease. In our case, the patient exhibited a triad of clinical features including exophthalmos, bruit, and chemosis. Furthermore, MRI revealed a dilated superior ophthalmic vein, bulky cavernous sinus, and additional flow voids on T2-weighted images, raising suspicion of CCF. This suspicion was confirmed through DSA.

Angiography provides the definitive diagnosis of carotid cavernous fistula[14]. Specific signs on imaging can be demonstrated by various modalities including color Doppler ultrasonography, CT angiography, and MR angiography. However, the gold standard remains Digital Subtraction Angiography (DSA) due to its superior capability to accurately localize lesions for endovascular management.

Endovascular treatment is typically effective for carotid cavernous fistulas. If the endovascular approach is deemed inappropriate or ineffective, surgical management becomes an option. Direct repair of the fistula within the cavernous sinus is possible[15]. Similar to our case, successful treatment of direct CCFs via a transvenous approach has been reported by Mastuda *et al.*[16], Lin *et al.*[17], and Hamano *et al.*[18]. Transvenous coil embolization demonstrates the highest occlusion rate compared to other transvenous techniques and embolic agents. In our patient, a transvenous approach was selected, and exclusive coiling of the primary venous sac using balloon assistance with six long platinum coils was performed.

Conclusion

CCF is a rare and dangerous neurological condition. Given the potential severity of complications associated with CCFs, including vision loss, early recognition and intervention remain paramount. The resolution of symptoms following treatment by the transvenous approach highlights the effectiveness of the chosen intervention. Additionally, the absence of adverse events during follow-up underscores the safety and efficacy of the endovascular approach in managing direct CCFs.

Figure 5. Postoperative appearance of the patient during follow-up.

Ethical approval

This is a case report, therefore, it did not require ethical approval from ethics committee.

Consent

Written informed consent was obtained from the patient for publication of this case report. A copy of the written consent is available for review by the editor-in-chief of this journal on request.

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Author contribution

All authors: writing the paper, collection of data, revising it critically for important intellectual content, review and editing

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