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Dear. Dr. Fevzi Yilmaz

The article that you have submitted to the Ulusal Travma ve Acil Cerrahi Dergisi (Turkish Journal of Trauma & Emergency Surgery) entitled 'Yuz Bolgesine Atesli Silah Yaralanmasi Sonrasi Gorme Kaybi Ile Basvuran ve Endovaskuler Tedavi Sonrasi Semptomlari Duzelen Gecikmis Karotikokavernoz Fistul Olgusu - A case of Delayed Carotid Cavernous Fistula After Facial Gunshot Injury presented as loss of vision with Symptom Resolution After Endovascular Closure Procedure' has been accepted for publication following peer review.

We wish you success and hope to communicate with you again.

Recep Guloglu, MD
Editor for the Turkish Journal of Trauma and Emergency Surgery

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### A case of Delayed Carotid Cavernous Fistula After Facial Gunshot Injury presented as loss of vision with Symptom Resolution After Endovascular Closure Procedure

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**Abstract**

Carotid cavernous fistulas are abnormal connections between the carotid artery and the cavernous sinus. Blunt and penetrating head injuries can result in a caroticocavernous fistula. Although its occurrence is rare, the diagnosis can be made in the emergency department. This case demonstrates a 26-year-old man who presented with the complaints of pain, redness, blurred and loss of vision in right eye and swelling of his upper face which had been occurred due to a gunshot injury from his face 35 days ago.

**Key words:**Carotid cavernous fistula, gunshot injury, endovascular intervention, endovascular treatment.

**Introduction:**

Posttraumatic Carotid Cavernous Fistulas (CCFs) are direct communications between the Internal Carotid Artery (ICA) and the Cavernous Sinus (CS) and are frequently encountered as a complication of closed head trauma although few reports pointed to a penetrating object or gunshot injuries (1). They are usually diagnosed a few weeks after trauma and majority of signs and symptoms result from increased venous pressure in the ophthalmic vein that lacks a valve (2). Although CCFs are not life-threatening, timing of diagnosis is of extremely important since a permanent loss of vision may develop within hours to days after the initial injury. The most common signs and symptoms associated with CCFs are pulsatile exophthalmus, orbital murmur, conjunctival hyposphagma, ophthalmoplegia, orbital pain, and impaired visual acuity (1,3).

 CT angiography is helpful for diagnosis with pathognomonic radiological signs and might also be used for screening. Exact point of fistula as well as nature of the lesion might be further studied via Digital Subtraction Angiography (DSA) (4).

Endovascular embolization is preferred treatment approach within the last two decade and surgical treatment remains a treatment option endovascular treatment fails or is not possible (5,6). This report provides a current discussion about the presentation, pathogenesis, and management of carotid cavernous sinus fistulas.

**Key words:** Carotid Cavernous Fistula, Gunshot Injury, Endovascular Intervention, EndovascularTreatment.

**Case report**

A 26-year-old man presented to emergency department with the complaints of pain, redness, blurred and loss of vision in right eye. Initial complaints were mild and first noted 15 days ago before clinical presentation. Past history was unremarkable except a gunshot injury from the face 35 days ago which was managed through conservative measures.

On physical examination, general status was normal and a scar tissue was noted over the right nasal sulcus pointing to the entry hole of a bullet. Neurological examination did not reveal any abnormality. Typical murmur was audible at the right orbit suggesting a diagnosis for CCF. Initial radiographic scans revealed a bullet on the right side of face (Figure 1). The patient was referred to ophtalmology and on their examination his corrected visual acuity was 0.3 at the right side and 1.0 on the left. Biomicroscopic evaluation was compatible with eyelid edema, chemosis, proptosis, dilated fixed pupils and negative light reflex in right eye. Fundoscopic examination revealed marked venous congestion and increased tortuosity, arteriolar thinning, and preretinal hemorrhages at the right eye. Intraocular pressure measured through tonometry was 34 mm Hg on the right eye and 16 mm Hg on the left.

Color Doppler ultrasonography, orbital tomography with and without contrast on axial plane, Magnetic Resonance Imaging (MRI), Magnetic Resonance Angiography (MRA), and DSA scans confirmed the diagnosis of CCF. The examinations revealed a fistula between the right internal carotid artery and right cavernous sinus (Figure 1a). Endovascular treatment was performed for treatment through femoral artery route under general anesthesia without any complication. Postoperative course was uneventful and typical murmurs disappeared on auscultation of the orbit. Complaints of pain, redness, blurred and loss of vision on the right eye markedly improved within 3 weeks after intervention. Postoperative angiographic scans demonstrated complete obliteration of the fistula (Figure 1b).

**Discussion**

Carotid-cavernous fistulas are identified as a direct and abnormal communication between CS and ICA, one of its branches or the External Carotid Artery (ECA) (7). CCFs are rare complications of head trauma and reported incidence is around 0.2-0.3% (3). Several classifications were suggested for CCFs based on angiographic features (high-flow vs low-flow fistulas), mechanism of onset (spontaneous vs traumatic), morphological features as well as angioarchitecture (direct vs indirect fistulas).

The drainage pattern and instant development of a fistula are usually associated with the signs and symptoms. As a rule of thumb, direct fistulasusually exhibit a more dramatic and loud clinical presentation, not infrequently displaying the so-called “classical” triad of exophthalmus, chemosis, and loss of vision. A large patient series studying direct CCFs demonstrated that the most common symptoms at initial presentation were an orbital bruit (80%), proptosis (72%), chemosis (55%), cranial nerve VI palsy (49%), complete ophthalmoplegia (24%), and loss of vision (18%) (6,9). In agreement with the literature, we also observed many of those clinical findings.

CCFs may go undiagnosed after major craniofacial traumas and auscultate eyelids for a potential murmur is an appropriate clinical approach. CCFs are commonly accompanied by diplopia that is due to one of the possible etiologies of ischemic or compressive mechanical cranial neuropathy, as well as restricted orbital motion inside the eye socket secondary to venous hypertension (10). Both direct and indirect fistulas with retrograde cortical venous drainage could lead to intracranial bleeding. The latter is particularly an ominous occurrence with a high rate of rebleeding over a short time window in the setting of a direct CCF. Therefore, the appropriate therapy should be instituted at once if such a devastating complication occurs (11).

Computed tomography and MRI may provide indirect signs of these fistulas, including engorgement of the CS region or abnormally dilated venous segments. Nevertheless, conventional transluminal angiography remains “gold standard” for both detection and typing CCFs. A complete and technically correct cerebellar angiography should provide information about the internal and external carotid supply and, additionally, delineate the contralateral side and posterior circulation (12,13).

In traumatic fistulas, urgent conditions such as progressive loss of vision, intolerable murmur and headache, a traumatic aneurysm showing signs of dilatation behind the cavernous sinus, hemiplegia secondary to intracranial hematoma, impaired drainage in cortical venous drainage, severe epistaxis, and an intraocular pressure exceeding 40 mmHg require intervention. Dural sinus fistulas may spontaneously regress in 20-50% of cases. In cases not requiring an urgent intervention, carotico-jugular compression may be another palliative treatment option (14).

Treatment modalities described in the literature for treatment of CCFs varies from conservative management, surgical management; stereotactic radiosurgery; and endovascular repair through arterial or venous access and the choice of treatment modality for CCFs is made according to the type, exact anatomy of the fistula, size of the arterial defect and operator/institutional preferences (15, 16).

In traumatic CCFs, embolization of the fistula by transarterial placement of detachable balloons, platinum coils, polyvinyl alcohol particulates, and liquid embolic agents has become the preferred procedure while combined approaches as stenting, alone or with coil placement can also be used (17, 18). Although transvenous embolization is the preferred approach in indirect CCFs it can be an alternative approach for direct CCFs in the failure of arteriel route (19). Cerebral ischemia or infarction due to the displacement of embolic material and arterial dissection or pseudoaneurysm formation due to the arteriel wall injury are all possible complications of arteriel approach (20).

Surgicaltreatment of CCFs must be reserved only for the cases in which endovascular treatment fails or is not possible and techniques may include placement of packing within the cavernous sinus to occlude the fistula, suturing or clipping the fistula, sealing the fistula with fascia and glue, and/or ligation of the internal carotid artery (18).

**Conclusion**:

This case demonstrated a traumatic carotico-cavernous sinus fistula which was successfully treated with advanced radiological techniques and interventions in a short period of time. Therefore CCFs should be kept in mind after facial gunshot injuries to avoid various ocular and cerebral complications.

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**Figure Legend**

**Figure 1:** A-P and lateral x-ray graphy of head was revealed a bullet on the right side of face and infront of C1 vertebrae.

**Figure 2: A.** A-P DSA examination shows a high-output arterio-venous fistula at the cavernous segment of the right ICA. **B.** The fistula appears occluded and the filling pattern of the distal segments of the right middle cerebral artery (MCA) and anterior cerebral artery (ACA) appear markedly improved on the A-P angiographic examination after stent-graft procedure.

**Figure 1**



**Figure 2**

