Successful Endovascular Treatment of Trigeminal Neuralgia Caused by a Carotid-Cavernous Fistula: Case Report

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Introduction

Dural arteriovenous fistulas (DAVF s) of the cavernous sinus are arteriovenous connections located in the dura mater leaflets of this region [1]. The usual presentation of a DAVF is predominantly ocular, with symptoms such as diplopia, conjunctival injection, involvement of cranial nerves III/IV/VI, exophthalmos, and chemosis. Trigeminal neuralgia caused by a cavernous DAVF is extremely rare. To the best of our knowledge, this is only the fourth report in the world literature. We describe the case of a patient treated by embolization in whom the only presenting symptom of DAVF was trigeminal neuralgia. After endovascular treatment, the patient became asymptomatic.

Case Presentation

A 46-year-old female smoker sought care with a chief complaint of multiple daily episodes of shock-like right temporal headache and facial pain in a V1/V2 dermatome distribution, of more than 2 years’ duration. A clinical diagnosis of trigeminal neuralgia was established. Conservative treatment had proved ineffective. Physical and neurological examination were within normal limits. The patient undergone balloon compression of the trigeminal ganglion after 6 months of clinical treatment with partial relief of pain lasting approximately 3 months and refused to undergo further procedures. Investigation with magnetic resonance imaging (MRI) of the brain and magnetic resonance angiography of the cerebral and cervical vessels; both were normal, with no evidence of neurovascular compression in the trigeminal territory, before and after balloon treatment. Her symptoms continued to deteriorate, with headache and severe facial pain. The decision was made to perform angiography for diagnostic clarification. The diagnostic hypotheses were sinus thrombosis or a dural fistula not demonstrated by MRI and MR angiography.

Indeed, diagnostic angiography showed a DAVF of the right cavernous sinus, fed by branches of the right external carotid artery, with drainage to the ipsilateral cavernous sinus and backflow into the superficial middle cerebral vein (Figure 1). Treatment was indicated because of the retrograde flow into the middle cerebral vein, which poses a risk of cerebral haemorrhage. Two weeks after diagnostic angiography, the patient was admitted for treatment. A repeat angiogram showed a change in the patient became asymptomatic.
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Two micro catheters were navigated until the "foot" of the vein, one Magic 1.2 (Balt Extrusion, Montmorency, France) for the glue injection and one excelsior SL 10 (Stryker Neurovascular, Fremont, California, USA) for coils deployment. First the coils were placed to reduce the flow inside the ophthalmic vein, and after glue was injected. Control angiography showed only partial occlusion of the fistula. The fistula was again catheterized selectively, via the middle meningeal artery, with a sonic microcatheter (Balt Extrusion, Montmorency, France) and an injection of Onyx® liquid embolic system was administered, with complete obliteration of the fistula (Figure 2). Postoperatively, the patient reported right-sided eye pain and slight proptosis. Dexamethasone 4 mg q6h was prescribed, and symptoms had resolved completely by the fourth postoperative day. The patient was asymptomatic on discharge. At 3-month follow-up, she remained free of symptoms and no longer required analgesia.

Discussion

Dural arteriovenous fistulas are acquired lesions which consist of one or more fistulous connections within the leaflets of the dura mater, more specifically involving the walls of a dural venous sinus or adjacent leptomeningeal veins. DAVFs can arise at any age, but manifest predominantly between the fifth and sixth decades of life. There is no gender predilection, except for lesions of the cavernous sinus, 85% of which occur in women. DAVFs are estimated to account for 15% of intracranial arteriovenous malformations. Their pathophysiology is
Trigeminal neuralgia affects approximately 0.07% of the population. It is characterized by severe, recurring, sudden, short-term, sharp or electric shock-like pain along one or more trigeminal dermatomes, and is usually unilateral [10]. The etiology and pathophysiology of trigeminal neuralgia are still incompletely understood; however, a neurovascular compression syndrome is found in most patients. Based on etiology, it can be classified into idiopathic, typical or classic (caused by neurovascular compression), or secondary [11]. There are reports of trigeminal neuropathy (not neuralgia) causing symptoms such as paresthesia and facial muscle paresis [6, 7, 9]. Trigeminal neuralgia caused by a cavernous DAVF was first reported by Bartlow et al, Du et al and Fukutome et al [8,12,13]. To the best of our knowledge, corroborated by a literature search, our case is the fourth report worldwide.

Classically, patients with a DAVF of the cavernous sinus present with ocular symptoms, such as chemosis, exophthalmos, eye pain, conjunctival injection, loss of visual acuity, and diplopia, as well as more variable symptoms such as pulsatile tinnitus, headache, and cranial nerve deficits (especially of the abducens nerve, due to its intracavernous course). On physical examination, increased intraocular pressure, ocular bruit, venous congestion, and strabismus may be present. These symptoms occur in fistulas with anterior drainage. In case of posterior drainage, with retrograde flow to the cortical veins, the neurological symptoms correspond to the affected area. Venous infarctions and haemorrhage may occur [14]. Involvement of the trigeminal nerve is rare in both situations. What makes our case even more unusual is the fact that, besides presenting with trigeminal neuralgia, the patient did not have any of the classic ocular signs. Trigeminal disorders have been reported as a possible symptom of cavernous-sinus DAVF; however, they are very uncommon and the mechanism by which the fistula affects the trigeminal nerve is variable, differing across reported cases (Table 1).

### Table 1: Reports of carotid-cavernous fistula affecting the trigeminal nerve.

<table>
<thead>
<tr>
<th>Author, year</th>
<th>Classification</th>
<th>Cause of symptoms</th>
<th>Trigeminal syndrome</th>
<th>Treatment</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bartlow et al., 1975 [8]</td>
<td>Direct, high flow (Barrow A)</td>
<td>Superior petros sinus dilatation with compression</td>
<td>Trigeminal neuralgia</td>
<td>Non reported</td>
<td>Non reported</td>
</tr>
<tr>
<td>von Rad et al., 1975 [7]</td>
<td>Non reported</td>
<td>Non reported</td>
<td>Trigeminal neuropathy</td>
<td>Carotid artery compression</td>
<td>Improved</td>
</tr>
<tr>
<td>Rizzo et al., 1982 [6]</td>
<td>Indirect, low flow (Barrow C)</td>
<td>Gasser ganglion compression or steal of blood flow of the ganglion or venous congestion on Meckel’s cave</td>
<td>Trigeminal neuropathy</td>
<td>Surgery</td>
<td>Cure of tinnitus, improved facial paresthesia</td>
</tr>
<tr>
<td>Du et al., 2003 [12]</td>
<td>Indirect, high flow (Barrow D)</td>
<td>Mass effect on gasserian ganglion</td>
<td>Trigeminal neuralgia</td>
<td>Embolization</td>
<td>Absence of pain</td>
</tr>
<tr>
<td>Jensen et al., 2004 [9]</td>
<td>Indirect, low flow (Barrow D)</td>
<td>Venous congestion on foramen ovale</td>
<td>Trigeminal neuropathy with difficulty to close the mouth</td>
<td>Embolization</td>
<td>Absence of symptoms</td>
</tr>
<tr>
<td>Fukutome et al, 2017 [18]</td>
<td>Indirect, high flow (Barrow D)</td>
<td>Pulsatile venous compression Meckel cave</td>
<td>Trigeminal neuralgia</td>
<td>Embolization</td>
<td>Absence of pain</td>
</tr>
<tr>
<td>Present case</td>
<td>Indirect, low flow (Barrow B)</td>
<td>Not identified</td>
<td>Trigeminal neuralgia</td>
<td>Embolization</td>
<td>Absence of pain</td>
</tr>
</tbody>
</table>

Treatments varied widely across reports. Furthermore, one must bear in mind the evolution of techniques over time and the different presentations of fistulas in different patients. Conventional surgery is in disuse due to the difficulty in accessing the cavernous sinus and its high morbidity. Radiosurgery has occlusion rates that vary between 44-87%, but its biggest limiting factor is the time required for occlusion of the fistula, 6 to 12 months, which can cause worsening of symptoms.

Therefore, the treatment of choice for this disease is endovascular [15]. The endovascular treatment aims to occlude the point of the arteriovenous connection (shunt), and in most cases this is achieved by obliterating the involved segment of the cavernous sinus. Venous access is recommended because it is faster, easier and safer than arterial access. The difficulty of arterial access is due to the fact that the meningeal branches originating in both the external and internal carotid arteries are extremely tortuous and short, which makes navigation and the safe injection of embolic agents difficult. In addition, they present anastomoses with arteries of the cranial nerves and connections with pial branches, which makes the injection of the material more dangerous [16].
The preferred venous access is through the inferior petrosal sinus or the facial vein. Other routes of access, such as direct puncture of the sinus or catheterization of the superior petrosal sinus, can be used in case classic routes fail [17]. Embolization can be done with coils, liquid embolic agents, or a combination of the two, with cure rates around 85% and low morbidity and mortality. We chose to inject Onyx® inside the superior ophthalmic vein to avoid creating a mass effect, a complication related when using this last embolic agent [18].

In our case, no single factor was identified that could explain trigeminal involvement. Both MRI and MR angiography failed to show any neurovascular conflict. Cerebral angiography did not identify any findings indicative of direct nerve compression. Nevertheless, endovascular treatment of the fistula was followed by complete remission of symptoms. Fukutome et al. reported a case with possible symptoms due to pulsatile venous compression in Meckel’s cave, and maybe this could explain our case as well.

One thing to consider and was very important in this case was to perform angiogram even though MRI and angioMRI were normal. Physicians must be aware that not all vascular diseases are diagnosed by non invasive exams such as MRI or Computer Tomography angiography, and this fact rises up the question if trigeminal neuralgia caused by DAFs is not being under diagnosed.

Conclusion

Trigeminal neuralgia caused by a cavernous-sinus DAVF is a rare entity. The fistula in this case was only diagnosed after digital cerebral angiography was performed, so clinicians must be aware that not all vascular conditions can be identified non invasively, and that cavernous arteriovenous fistulas may be under diagnosed as a possible cause of trigeminal neuralgia.

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