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Case Report

Association between the Symptomatic Appearance of Dural Arteriovenous Fistula and Trigeminal Ganglion Radiofrequency Thermocoagulation

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Fluoroscopy-guided radiofrequency thermocoagulation of the trigeminal ganglion is an alternative treatment for symptomatic trigeminal neuralgia. The most common complications of the procedure are circumscribed to sensitivity alterations. We report a case of an 83-year-old female patient with a history of petroclival meningioma resection, radiotherapy at the level of the petrous apex, and radiofrequency thermocoagulation for trigeminal neuralgia who developed a symptomatic dural arteriovenous fistula as an early complication, which required selective embolization. Dural arteriovenous fistula as an immediate complication of percutaneous thermocoagulation of the trigeminal ganglion has not been previously reported.

Keywords: trigeminal neuralgia, radiofrequency thermocoagulation, dural arteriovenous fistula

Introduction

Fluoroscopy-guided radiofrequency thermocoagulation is a treatment alternative for trigeminal neuralgia that is usually reserved for patients with recurrent pain after microvascular decompression, patients with a high surgical risk, or patients with symptomatic trigeminal neuralgia.[1)]

The most common complications of the procedure are sensitivity changes: severe dysesthesia, corneal hypoesthesia, and cheek numbness, which is the most significant complication reported and occurs in up to 21% of cases.[2,3)]

Rare but potential complications of this and other percutaneous procedures through the foramen ovale, which are sporadically described in the literature, include stroke, hemorrhage, pseudomeningocele, deafness, facial paresis, diplopia, cerebrospinal fluid fistula, carotid-cavernous fistula, and carotid-jugular fistula.[4–7)] After an extensive search of the medical literature, we did not find any previous report of the development, or the symptomatic conversion of a symptomatic dural arteriovenous fistula after percutaneous radiofrequency thermocoagulation of the trigeminal ganglion.

Case Report

The patient provided informed consent to publish his case and accompanying images.

An 83-year-old female patient was assessed for trigeminal neuralgia. She had a history of high blood pressure and was receiving treatment. Eighteen years ago, she experienced diplopia and underwent a neurological examination, which revealed paresis of the sixth right cranial nerve and Babinski sign on the left side. Magnetic resonance imaging (MRI) was performed, which revealed a large petroclival meningioma causing severe brainstem compression (25 mm maximum diameter, Grade 2 level of brainstem compression according to AlMefty),[8)] with posterior cavernous sinus extension and displacement, but no encasement, of the basilar artery. Figure 1 shows the initial MRI images. The patient underwent surgical subtotal meningioma resection (remnant attached to the cavernous sinus was left on purpose) through a posterior temporal approach[9)]: the transverse–sigmoid sinus junction was exposed, a mastoidectomy performed exposing the presigmoid dura mater, and keeping the labyrinth intact. The sigmoid sinus was skeletonized to the jugular bulb. The tumor was resected after opening the dura along the floor of the temporal fossa and in the presigmoid region. The vein of Labbé was carefully preserved. There were no postoperative sequelae, and the blood flow of the dural venous sinuses of the posterior fossa was also preserved. Figure 2 shows the 24 hours postoperative computerized axial tomography scan (CAT scan). Radiosurgery was proposed as a treatment alternative for the remnant tumor that can be appreciated in MRI depicted in Fig. 3, but was initially declined by the patient.

Five years after the initial surgical procedure, the patient experienced episodes of trigeminal distribution pain, which was initially isolated and sporadic but later increased to several times a day. The trigeminal pain had characteristics of symptomatic neuralgia, which was attributed to a residual petroclival meningioma and classified as trigeminal neuralgia type 1 due to its clinical features according to the Burchiel classification.[10)] Because of the irregular response to drug treatment, 7 years ago, radiosurgery was proposed again, which she finally accepted. She received a marginal dose of 18 Gy in a single session. The trigeminal neuralgia

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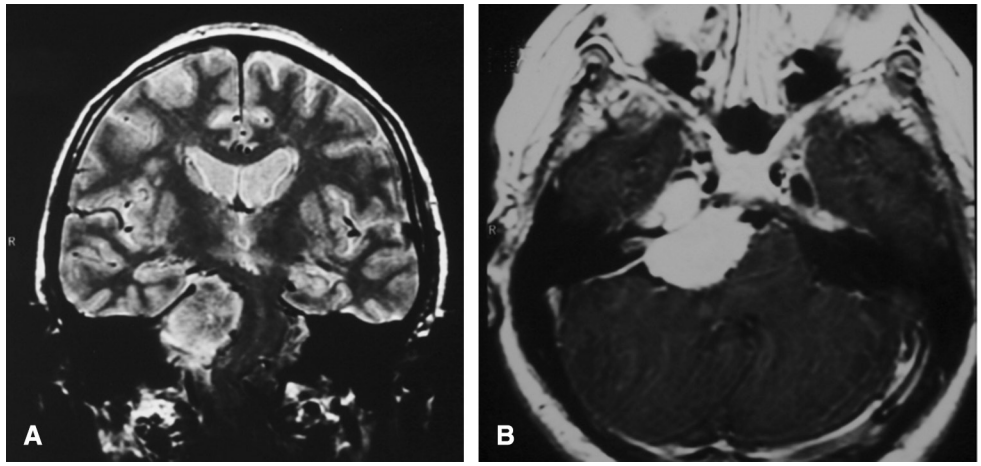

Fig. 1 Preoperative MRI images. (**A**) Coronal T2-weighted magnetic resonance image and (**B**) axial T1-weighted image with gadolinium of a large right petroclival meningioma that completely occupies the cerebello-pontine cistern, protrudes upward trough the tentorial incisura to the subtemporal subarachnoid space, invades the posterior portion of the cavernous sinus, obliterates the Meckel's Cavum, compresses and deviates the brainstem from right to left and compresses the aqueduct of Sylvius and the basilar artery. MRI: magnetic resonance imaging.

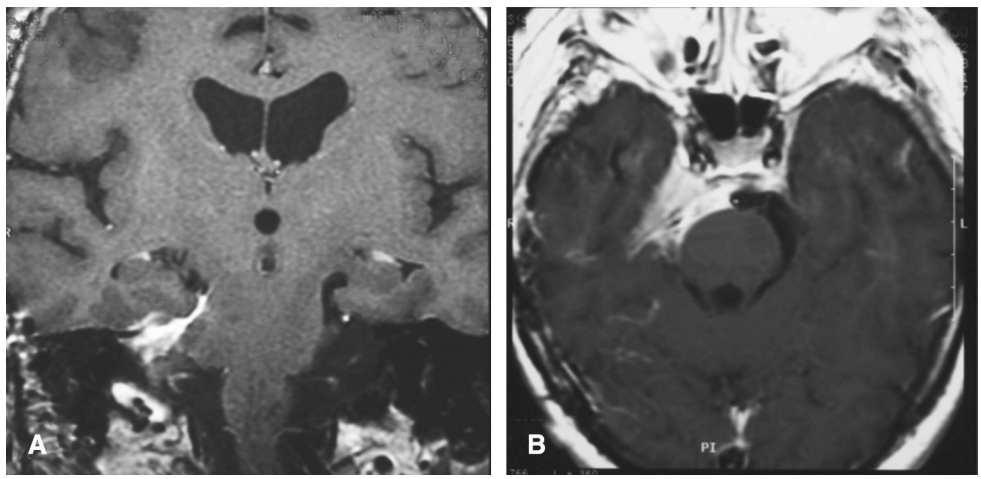

Fig. 2 CAT scan performed 24 hours after surgery. No hemorrhagic complications are seen, brainstem displacement has been corrected. Surgical changes are depicted, a posterior temporal approach has been performed, the transverse–sigmoid sinus junction was exposed, a mastoidectomy performed exposing the presigmoid dura mater, and keeping the labyrinth intact. The sigmoid sinus was skeletonized to the jugular bulb. The tumor was partially resected after opening the dura along the floor of the temporal fossa and in the presigmoid region. CAT: computerized axial tomography.

decreased in intensity and frequency for 6 years, during which time she continued taking carbamazepine.

During the last year, she again experienced episodes of trigeminal neuralgia along the distribution of the second and third branches on the right side, which began as isolated episodes. The patient had a good response to medical treatment, but she experienced more frequent episodes in the last 4 months and daily severe episodes in the last month.

At this point, a new neurological examination did not reveal abnormal findings except for the trigeminal pain already described; a new MRI scan showed the residual meningioma with slight amount of growing toward midline, as shown in Fig. 4. Percutaneous radiofrequency thermocoagulation of the right trigeminal ganglion was proposed. No need to perform a digital subtraction angiography (DSA) was considered at this time since the MRI did not show any abnormalities besides the residual tumor.

The procedure was performed under general anesthesia with propofol. Under fluoroscopic guidance with the patient in the supine position, a dedicated needle was inserted into the right cheek according to Härtel landmarks, the trocar was advanced submucosally to Meckel's cave in a 7-cm path in the anteroposterior axis, without apparent complications. At all times, the tip of the trocar was maintained more than 20 mm lateral to the midline in the occipitomental view with the intention to minimize the possibility of injury to the cavernous carotid artery.[11)]

Fluoroscopic guidance was used to determine the position of the trocar after insertion into the foramen ovale, as shown in Fig. 5. Anesthesia was then reversed, and the patient

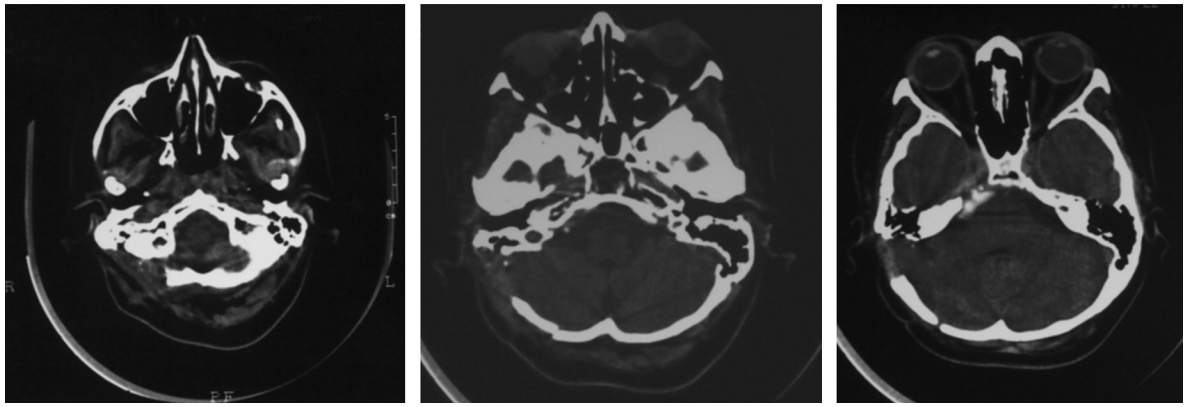

Fig. 3 One month postoperative MRI images. Coronal and axial T1-weighted image with gadolinium. Surgical changes due to partial resection of petroclival meningioma can be seen. Compression of the brainstem and displacement of the basilar artery and cerebral aqueduct have disappeared, partial obliteration of Meckel Cavum persists. MRI: magnetic resonance imaging.

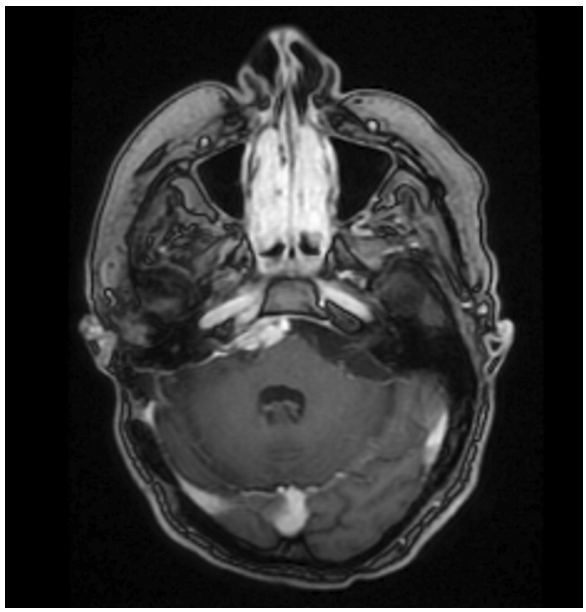

Fig. 4 MRI image 18 years after surgery, 7 years after radiosurgery. Axial T1-weighted image with gadolinium and fat suppression. A residual right petroclival meningioma is observed, which obliterates Meckel's Cave. Surgical changes in the right retromastoid location can be observed. MRI: magnetic resonance imaging.

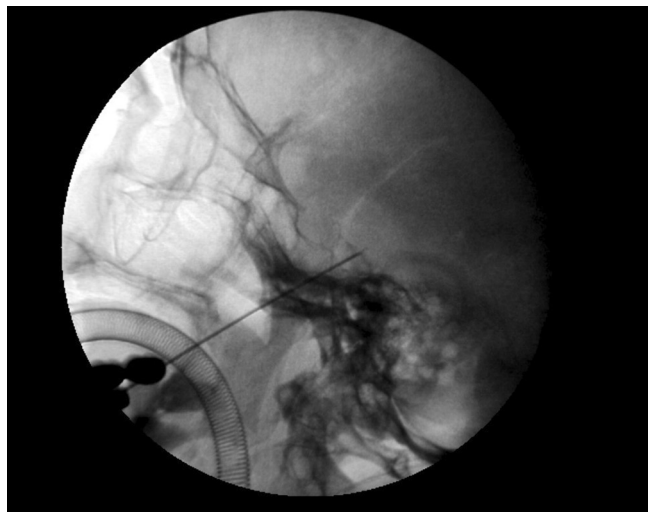

Fig. 5 Fluoroscopic guidance for percutaneous radiofrequency thermocoagulation of the trigeminal ganglion through the foramen ovale.

awakened. The trocar stylet was removed, and cerebrospinal fluid flow through the trocar was confirmed before inserting the radiofrequency electrode. Pulsed stimuli were tested at 50 Hz, 0.1-volt amplitude, and 1-millisecond intervals until paresthesia was elicited in the distribution of the second and third branches of the trigeminal nerve. The patient was again anesthetized for thermocoagulation of the trigeminal ganglion; three lesions were produced at 70°C for 60 seconds each.

The patient awoke from the procedure without neurological changes, pain, or evidence of bleeding or hematoma formation and only with cheek numbness, which is typical. She stayed overnight and underwent a CAT scan the next day, which showed no acute complications. Therefore, the patient was discharged with carbamazepine and anti-inflammatory drugs. At 48 hours later, she reported no trigeminal pain but described an audible murmur on the right side of the head. She was readmitted the same day; a pulse-synchronous murmur could be auscultated with a stethoscope on the right cheek and temporal region. She underwent an MRI scan, which showed no new findings. The next day, the patient underwent DSA which showed a dural arteriovenous fistula supplied by the internal maxillary artery and draining into the pterygoid venous plexus in the right petroclival region, as shown in Fig. 6A, which corresponds to a lesion classified as Cognard Type I.[12,13] Transarterial endovascular fistula embolization was performed in the interventional radiology suite with biplanar, high-resolution DSA after diagnostic angiography using polyvinyl alcohol particles, total occlusion was obtained in a single embolization procedure, as can be seen in Fig. 6B, without complications. The patient awoke from

Fig. 6 Digital subtraction angiography. (**A**) Diagnostic: a dural arteriovenous fistula supplied by the internal maxillary artery with early drainage into the pterygoid plexus. (**B**) Postembolization: complete obliteration of the dural arteriovenous fistula; no other vascular anomalies are seen.

anesthesia without an audible murmur or neurological deficits and was discharged the next day with no complications. She is undergoing a follow-up in the outpatient clinic and has not presented with recurrence or late complications.

Discussion

All percutaneous procedures designed to treat trigeminal neuralgia cause some damage to trigeminal afferent fibers, which is caused by heat in radiofrequency thermocoagulation, chemicals in glycerol rhizotomy, and mechanical action in balloon compression.[14] Radiofrequency rhizotomy is probably the most widely used percutaneous procedure, which reportedly yields long-term results.[15–17]

The complications of radiofrequency thermocoagulation of the trigeminal ganglion are mostly related to trigeminal nerve lesions, such as corneal anesthesia and ulceration, facial dysesthesia, and pain. Other complications are related to injury of cranial nerves II, III, IV, and VI, intratemporal hematomas, seizures, subarachnoid hemorrhage, intratemporal abscesses, stroke, and sporadic carotid-cavernous fistulas.[4–7,18]

Dural arteriovenous fistulas are acquired anomalous connections between dural arteries and venous sinuses, meningeal veins, or cortical veins. Most are idiopathic, but such fistulas have been associated with dural sinus thrombosis, meningitis, paranasal sinus infection, hypercoagulable states, and trauma.[19–21]

In 1987, Nabors and Azzam[22] reported two cases of dural fistulas without a history of trauma or thrombosis of the dural sinuses, which occurred in previously operated sites. In both cases, the clinical sign was a murmur ipsilateral to the fistula that appeared late (at 4 and 24 months).

Xue,[23] very recently, has described in detail one case of dural arteriovenous fistula at the transverse–sigmoid sinus of delayed clinical presentation, attributed to the resection of a petroclival meningioma via far lateral approach, and reviewed 12 published cases. Arguably, our case might be another condition like this, a pre-existing dural arteriovenous fistula already present, worsened or made symptomatic by the percutaneous radiofrequency thermocoagulation procedure.

Some anatomical studies show that meningeal arteries have extensive anastomoses between branches as anatomical variants under normal conditions and that the normal dura mater may have arteriovenous shunts.[11,24,25]

Many authors have written about vascular recruitment and other mechanisms that may be the cause of spontaneous dural arteriovenous fistulas or those occurring after dural sinus thrombosis in proliferating blood vessels in the dura.[26–28]

Posttraumatic dural arteriovenous fistulas are fistulas that develop after mechanical disruption of the meningeal arteries and adjacent veins.[26,29,30]

The case that we report here involves a thoroughly studied female patient without congenital cerebrovascular anomalies, dural arteriovenous fistula, or dural sinus thrombosis suspected or detected during her initial clinical and MRI evaluation. She had a history of a surgically resected petroclival meningioma and underwent radiosurgery at the level of the petrous apex. She developed a symptomatic dural arteriovenous fistula immediately after radiofrequency thermocoagulation of the trigeminal ganglion. We have found no similar previous cases published in the neurosurgical literature.

The mechanism by which the dural arteriovenous fistula occurred is argumentative: it may correspond to a rare case of mechanical disruption of the normal meningeal arteries and adjacent veins or to hypertrophic or morphological vessel alterations caused by the tumor, surgery, or radiation, since it has been described that petroclival meningiomas can gradually affect venous drainage of the posterior fossae,[31] causing congestive venous flow to drain through collateral venous route, and also has been described that dural arteriovenous fistula at the transverse–sigmoid sinus attributed to the resection of a petroclival meningioma can present months or even years after the surgical procedure.[23] In the case we

present, arguably, the lesion causing the fistula, or converting it in a symptomatic one, may have been caused even by thermal injury rather than mechanical disruption if the previous conditions had already caused anatomic alterations in the vascular pattern at the petrous apex, as reported by other authors.[32] Thermocoagulation vascular inadvertent lesions are scantly reported in the medical literature, related to unintended electrosurgical arcs that can occur from monopolar instruments, to insulating sheath defects in the surgical instruments, or to unforeseen anatomical variations.[33,34] In our case, we believe that the possibility of a thermal vascular injury is less probable than a mechanical one for anatomical reasons: the radiofrequency intended lesion was induced inside the trigeminal ganglion verified by its assumed position in fluoroscopy, and performed with a disposable blunt radiofrequency electrode in optimum condition.

The percutaneous thermocoagulation was performed without complications, as a straightforward procedure, the foramen ovale was reached quickly and easy, with no repeated blunt punctures to the cranial base. Blood was not obtained through the needle at any point. As previously described,[11] the internal maxillary artery and its branches, and pterygoid venous plexus lie in the path of the needle since the level of the pterygoid muscles, the V3 branches converge onto the foramen ovale, and join the mandibular nerve. The pterygoid venous plexus communicates with the cavernous sinus by branches through the foramen Vesalii, foramen ovale, and foramen lacerum.[25] Based on the image studies and the anatomical descriptions, we postulate the injury that produced the abnormal vessel communication was a mechanical disruption one and locate it in the dura covering the mandibular nerve, at the level of the anterior margin of the foramen ovale, in the direct trajectory of the needle, just before reaching the trigeminal ganglion.

Conventional transfemoral DSA is not routinely performed in preparation for trigeminal ganglion radiofrequency thermocoagulation, but this report might suggest its value in a patient with such medical and surgical antecedents, in anticipation of dural blood flow that may be different from that found in idiopathic trigeminal neuralgia.

This case report adds to isolated reports of other types of vascular lesions associated to percutaneous procedures targeting the trigeminal ganglion, as these procedures may eventually lead to major complications.

This report emphasizes the possibility of a dural arteriovenous fistula occurring in patients who have previously undergone surgery or radiotherapy at the level of the petrous apex, and the rare possibility that this complication may occur after percutaneous procedures targeting the foramen ovale.

Conflicts of Interest Disclosure

All authors declare no conflict of interest.

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