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Case Report

Trigeminal neuralgia secondary to arteriovenous malformation in the brainstem: a case report and a brief review

Luiz Severo Bem Junior[1,2,3], Joaquim Fechine de Alencar Neto[1], Júlio Augusto Lustosa Nogueira[2], Nivaldo Sena Almeida[1,2,3], Hildo Rocha Cirne de Azevedo Filho[3]

[1]College of Medical Sciences, Unifacisa University Center, Campina Grande, Paraíba, Brazil
[2]Department of Neurosurgery, Hospital da Restauração, Recife, Brazil)
[3]Neuroscience Post-Graduate Program, Federal University of Pernambuco, Recife, Brazil

Luiz Severo Bem Junior, MD Neurosurgery Department, Restauração Hospital, Recife, Brazil. Address: Av. Gov. Agamenon Magalhães, s/n – Derby, Recife – PE, zipcode: 52171-011. Email: luizseverobemjunior@gmail.com. Phone number: +558199248201. Fax number: none. https://orcid.org/0000-0002-0835-5995.

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Abstract

Trigeminal neuralgia, a condition characterized by high intensity, paroxysmal and unilateral pain, can be characterized as secondary when associated with conditions such as multiple sclerosis and tumors. However, among these secondary cases, there are also arteriovenous malformations, characterized by a nidus mass of vessels separated by parts of sclerotic tissues, responsible for a small portion of the neuralgias of the trigeminal nerve. The case report described is of a 54-year-old male patient who has a brainstem AVM and refers to lancing and paroxysmal pain in the right hemiface in the territories of V2 and V3 after feeding and brushing the teeth. The treatment of this patient was done from the insertion of a balloon from the foramen ovale, accessed by the Meckel fossa and the trigeminal ganglion. The literature review demonstrated, from the analysis of sex, age, vascularization, localization and treatments of reports of TGN secondary to brainstem AVM, the reduced number of cases described.

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Introduction

The trigeminal nerve is the fifth pair of cranial nerves and originates at the meeting point between the pons and the middle cerebellar peduncle, being the main nerve responsible, from its ophthalmic branches (V1), maxillary (V2) and mandibular (V3), as well as meningeal branches, for sensation of the head and meninge.[1] The neuralgia of the trigeminal nerve, qualified as an acute, sudden, paroxysmal, unilateral pain, which can affect one or more nerve divisions, being characterized by high intensity pain, is responsible for one of the types of headaches described in the literature. Trigeminal neuralgia is divided into primary and secondary. Its classical presentation is characterized by the neurovascular relationship, from the nerve compression by vessels, arteries in most cases, process that causes a failure in the proper conduction of nerve impulses and responsible for triggering action potentials that initiate pain.[2] Secondary neuralgia is caused by space-occupied lesions such as arteriovenous malformation, cavernomas and tumors, or due to multiple sclerosis causing a process of demyelination of trigeminal fibers, so that external impulses are generated, and the somatosensory stimulus conducted. The incidence of neuralgia of the V cranial nerve is higher among men and increases according to age.[3]

Thus, although rare, the presence of arteriovenous malformations, characterized by the absence of a capillary distribution network and by a high blood flow, in the posterior fossa may be a factor in the generation of trigeminal neuralgia. The brainstem AVMs, especially those located in the entry and exit route of the trigeminal nerve, are the main causes of this neuropathy, although malformations in other sites may also be generators of neuropathic pain, in view of the arterial and venous formation that feeds and drains this nidus of vessels, which may compress or come into contact with the branches of the fifth cranial pair. Moreover, although supratentorial and cerebellar AVMs are not common causes for the generation of trigeminal neuralgia, the vessels that supply this formation may be related to the onset of the disease, in spite of this type of malformation is not the focus of this article discussion.

Thus, this case report with literature review has as main objective the evaluation of the cases already published and analyzed about trigeminal neuralgia secondary to brainstem AVMs, demonstrating the different types of possible treatments for this condition and the different clinical manifestations of this situation, which were collected and united in a table.

Method

The article is a case report with literature review. The articles reviewed in this study describe other cases of patients with trigeminal neuralgia secondary to arteriovenous malformations located in brainstem. The search and selection of the articles was made from the analysis of the literature of the PubMed database, between the months of September 2021 and November 2021. The keywords of the article are: trigeminal neuralgia, arteriovenous malformation, nerve compression, brainstem and neuropathic pain. Pubmed advanced search resources were used to search and select the advanced search resources, based on the terms "Trigeminal Neuralgia", "TGN", "arteriovenous malformation" and "AVM". The "boolean operators" "AND" and "OR" were used to filter the articles that were at the intersection of keywords. The descriptors were crossed to increase the number of publications. The search in the electronic database was performed by one of the researchers. The year filter was defined to select articles between 2000 and 2021, with 21 years of search filter. Inclusion criteria: case report articles dealing with neuralgia of the trigeminal secondary to AVM located in brainstem, articles in English and published in a journal. We found 96 articles, of which 14 met the inclusion criteria. Some of the articles were selected from bibliographic references of other articles already found and previously elected during the research in the database, provided that they obeyed the same parameters of the inclusion criteria.

Case Report

A patient, male, 54 years old, arrives at the outpatient service of the Hospital de Ensino e Laboratórios de Pesquisa (HELP), Campina Grande, complaining of a pain in the right hemiface, paroxysmal, high intensity, which covered the territories of V2 and V3, reporting onset and worsening of the symptom mainly when feeding, talking or brushing teeth, hindering activities of daily living. According to the accompanying family member, the pain was of such intensity that the patient banged his head against the wall. After cerebral angiography, by means of transfemoral percutaneous catheterization, the presence of a cortical pial vascular malformation at the level of the pons, the right of the basilar groove, tangentially the projection of the origin of the right trigeminal nerve was identified. The malformation is about 1.2 cm in greater diameter, supplied by the right superior cerebellar artery and by a hypertrofied pons branch of the basilar artery. Venous drainage of this vascular structure is performed by the deep pons venous branch that drains directly into the right sigmoid sinus.

The patient started treatment with antiepileptic drugs, initially with doses of 200 mg of carbamazepine two times a day. However, when performing activities of daily living the pain became unbearable. The dose of carbamazepine was raised to 400 mg three times a day, but pain control was minimal. Thus, the patient was indicated for a surgical procedure of trigeminal ganglion compression with balloon and, after the procedure, the patient reported a control of 70% of pain and improvement of quality of life, maintaining the use of carbamazepine 400 mg three times a day and gabapentin 300 mg two times a day, managing to stabilize the clinical picture of the patient who did not report trigeminal pain for two months after balloon treatment.

Table 1. Articles and case reports of patients with trigeminal neuralgia secondary to AVM of brainstem.

Author/Year	Age/Sex	AVM Localization	Feeding Arteries	Drainage Veins	Used drugs and tretaments	Treatment	Therapeutic Effect
Machet, A. et al.[4]	61/Man	Upper cerebellopontine cistern	R superior cerebellar artery and the meningohypophyseal trunk of the carotid siphon	Drained into the R superior petrous sinus and then into the R lateral sinus	Carbamazepine treatment (200 mg × 2/day) Oxcarbazepine (450 mg × 3/day)	Only medical treatment	Facial Pain-free during the 10-month follow-up
Machet, A. et al.[4]	64/Woman	R Trigeminal REZ	Middle cerebellar artery, the meningohypophyseal trunk of the carotid siphon and the external carotid artery (accessory meningeal artery)	Deep venous system	Carbamazepine (400 mg × 2/day)	Only medical treatment	Facial Pain-free during the 18- month follow-up
Machet, A. et al.[4]	50/Man	L Trigeminal REZ	L middle cerebellar artery, the L superior cerebellar artery and the inferolateral trunk of the carotid siphon	–	Carbamazepine (200 mg × 2/day)	Microcompression of the gasserian ganglion was performed	Facial Pain-free during 6-month follow-up
Choudhri, O. et al.[5]	64/Man	R Trigeminal REZ	–	–	Carbamazepine for 15 years	Craniotomy and microvascular decompression	Complete symptomatic relief following microvascular decompression
Das, KK. et al.[6]	50/Woman	R Trigeminal REZ	R anterior inferior cerebellar artery (AICA) and a dilated right intrinsic pontine artery,	Dilated vein which was probably draining into the superior petrosal sinus	–	Microvascular decompression	At 4 years of follow-up, she was pain-free without any medication
Sumioka, S. et al.[7]	66/Man	R Trigeminal REZ	Branch of the R AICA	–	–	Suboccipital craniotomy and nidus coagulated	After surgery, the patient has complete TN relief
Yip, V. et al.[8]	64/Women	Surrounding the R trigeminal nerve	–	–	Carbamazepine (300 mg twice a day) amitriptyline (10 mg at night)	–	–
Rahme, R. et al.[9]	30/Man	Rostral R cerebello-pontine angle and mildly compressing the R cerebral peduncle	tentorial artery of Bernasconi and Cassinari and a branch of the middle meningeal artery	Petrosal vein and into the superior petrosal sinus	–	R retrosigmoid lateral suboccipital approach and nidus coagulated	Facial Pain-free during 6-month follow-up
Simon, SD. et al.[10]	79/Man	R-sided cerebellopontine angle (CPA)	R superior cerebellar artery (SCA), the anterior inferior cerebellar artery (AICA), and the posterior inferior cerebellar artery (PICA)	Deep venous drainage	Carbamazepine	Catheterized through a distal branch of the right SCA and embolized	17 months later his symptoms had returned
Ferroli, P. et al.[11]	52/Woman	Pontine micro-AVM	–	–	Carbamazepine (1200 mg), phenytoin, lamotrigine, gabapentine, baclofen, and pregabalin	Microvascular decompression	1-month after surgery: pain-free despite a 50% reduction in carbamazepine dose
Anderson, WS. et al.[12]	39/_	R-sided cerebellopontine angle (CPA)	Pontine perforators as well as the superior cerebellar artery	R basal vein of Rosenthal into the straight sinus	Acetaminophen/ oxycodon (325 mg/10 mg) carbamazepine (1500 mg/day)	Gamma Knife therapy for TN and AVMs.	Facial Pain-free during 13-month follow-up and had stopped carbamazepine treatment
Wanke, I. et al.[13]	57/Man	R-sided cerebellopontine angle (CPA)	R superior cerebellar artery	Straight sinus presumed to be a dilated lateral pontomesencephalic vein	Carbamazepine, phenytoine and blockage of the superior cervical ganglion.	Intravascular embolization of the AVM	No recurrence of pain was reported by the patient after embolisation
García-Pastor, C. et al.[14]	68/Man	L-sided cerebellopontine angle (CPA)	–	–	–	–	–

García-Pastor, C. et al.[14]	54/Woman	R-sided cerebellopontine angle (CPA)	–	–	–	–	–
Karibe, H. et al.[15]	55/Man	Intrinsic to the left trigeminal nerve	Branch of the superior cerebellar artery (SCA)	–	Carbamazepine (800 mg/d)	Decompress using a prosthesis without resection of the AVM	Facial Pain-free during 2 years follow-up
Edwards, RJ. et al.[16]	35/Woman	Intrinsic to the trigeminal nerve	–	–	Carbamazepine	Resection of bAVMs	109-month follow-up/ Recurrence pain 4 years after surgery - carbamazepine (400 mg/day)
Edwards, RJ. et al.[16]	38/Man	Intrinsic to the trigeminal nerve	–	–	Carbamazepine	Resection of bAVMs and microvascular decompression	Facial Pain-free during 10-month follow-up
Edwards, RJ. et al.[16]	55/Woman	Intrinsic to the trigeminal nerve	–	–	Carbamazepine	Resection of bAVMs	Facial Pain-free during 64-month follow-up
Edwards, RJ. et al.[16]	46/Woman	Intrinsic to the trigeminal nerve	–	–	Carbamazepine	Resection of bAVMs	Facial Pain-free during 9-month follow-up
Edwards, RJ. et al.[16]	36/Woman	Intrinsic to the trigeminal nerve	–	–	Carbamazepine	Resection of bAVMs	Facial Pain-free during 27-month follow-up
Son, B. et al.[17]	42/Man	R-sided cerebellopontine angle (CPA)	Bilateral vertebral arteries and the R internal carotid artery	R transverse sinus and the vein of Galen via the precentral vein	–	Percutaneous radiofrequency thermocoagulation and botulinum toxin injection only for symptomatic control (Facial spams)	Stable along 2 years of follow-up, with injections of botulinum toxin (Facial spasm)

Results

Initially, we searched the case reports on arteriovenous malformations associated with cases of secondary trigeminal neuralgia in the PubMed database. Without the use of language filters, in order to increase the number of articles published between the years 2000 to 2021, the terms "arteriovenous malformation", "AVM", "TGN" and "trigeminal neuralgia" were used to perform the search and alternated with the operators to achieve more published articles. At the end of the research, articles that, despite describing cases of arteriovenous malformation, but which did not fit the case of brainstem AVM, were discarded from the analysis.

The collection of the collected data was based on the analysis of the sex and age of the affected patients, with the objective of evaluating broadly the possible age group most affected by this condition. The location of the malformation was one of the most important points of the analysis, since AVM's, although they are one of the unusual causes of trigeminal neuralgia generation[18], are often found and classified as cerebellar, or in another distinct region, like brainstem, which is the objective of analyzing this review. In addition, the vessels that feed the vascular tangle of the AVM and the vessels that drain this complex were lifted, although they are often not described in the articles. In view of the possibilities of treatments available for the treatment of trigeminal neuralgia, from the use of antiepileptic drug (AED), such as carbamazepine, to balloon ganglion compression, data related to possible drugs and previous interventions for which patients were submitted were collected. Finally, data on the final treatment performed by these patients were also collected.

In our literature review, based on the cases found in PubMed over the 21-year filter, the data collected are found in Table 1. The review selected 14 articles, among which were reported 21 cases of patients with TGN secondary to brainstem AVM. Among these cases, 11 (52.38%) were male patients and in one of them the patient's sex was not described. In 12 (57.14%) of the cases collected the malformation was in regions closely linked to the trigeminal nerve, among which one part was in the zone of entry or exit of the nerve root (REZ), and another portion were AVMs intrinsic to the nerve. In relation to the other cases, the nidus vessel was located at the cerebellopontine angle and cerebellum pontine cistern or directly on the pons. Moreover, although many cases did not describe well the arteries that participated in this system, among the cases that describe, in only one of them the AVM was fed by the branches of the vertebral artery, the others, even if some presented few branches from the vertebral, were fed by the branches of the cerebellar arteries. In relation to venous drainage, there is a great variation, and there may be drainage to the basal vein of Rosenthal, to the upper petrous sinus or to a deep drainage system.

When analyzing the drugs used in previous attempts to control pain related to trigeminal neuralgia, among the collected cases, 15 (71.4%) patients used AEDs, carbamazepine being the most reported of all cases. In the other reports, no information was available on the previously submitted treatments. Finally, among all the reports collected, three did not describe the form of treatment and recovery of the patient after this intervention. Analyzing among the cases that described the type of treatment adopted, the vast majority, 16 (88.88%) underwent surgical treatment with vascular resection/decompression of arteriovenous malformation, with distinction of endovascular or craniotomy methods. The other two cases were submitted only to drug treatment for pain control. Regarding the therapeutic effect of this intervention, the two who were submitted only to drug treatment remained 10 and 18 years under follow-up and pain-free. The others also reported non-recurrence of pain after the surgical procedure, although one of them continued the use of AED, even if in a reduced dose in relation to the moment before resection.

Discussion

We can broadly enter arteriovenous malformations as a communication between vessel, when arteries and veins are in direct contact, without the connecting capillary bed. The basic characteristic of a malformation is the presence of a nidus of dysplastic vessels, fed by an arterial system and drained by veins that unite directly, creating a system of high blood flow and with reduced resistance.[19] The pathophysiological mechanism that best explains the origin and organization of an arteriovenous malformation is based on failure in the embryogenesis process of vascular formation. Despite this, the possibility of an appearance of this abnormal communication after a mechanism of trauma[20] is also raised.

Posterior fossa AVM represent about 5% to 7% of the described malformations.[21] Although the symptoms are varied according to the vessels that participate in this tangled and the region where the nidus is located, broadly, these malformations present as headache and nausea, but some other signs and symptoms can also be noticed, such as chronic headache, neurological deficits, characterized by ataxia, problems of cranial nerve pairs, paresis of limbs and, in some cases, intracranial bleeding, neurovascular compressions, facial spasms and trigeminal nerve neuralgia.[22,23]

Among the causes for trigeminal neuralgia, vascular contact with the nerve passage route is one of the main ones, especially when we think of the upper or anterior inferior cerebellar arteries. However, demyelinating, idiopathic and compressive causes, as in the case of AVM, are also present, despite the lower prevalence.[24]

Among the possibilities of treatment for intervention on secondary neuralgia there are several possibilities. Initially, as it is possible to notice in the case of the patient reported in this article and for those described in Table 1, there is the possibility of treating this condition by means of anticonvulsants, such as carbamazepine, through dose increases for pain control.[4-17] In addition, retrogasserian glycerol injection, percutaneous embolization of AVM, gamma-knife treatment, compression balloon placement in the trigeminal ganglion, radiofrequency rhizotomy and others can be performed. Each of these treatments will go several according to the location of the AVM and its connections. In the case of the patient reported, considering the risk of postoperative sequel of a procedure in the brainstem, AVM resection was ruled out.

Conclusion

In general, after this review, the complexity of the pathophysiology associated with the approach of a trigeminal neuralgia secondary to an AVM becomes clear, especially when dealing with malformations that are difficult to access surgically, such as that of the brainstem. Based on this discussion and the review, the case report described in this article demonstrates one of the possible treatments for the intervention of trigeminal neuralgia secondary to AVM of the brainstem. In this case, as reported, due to the patient was refractory to drug treatment and contraindicated for resection of the malformation, the trigeminal ganglion compression technique with balloon was chosen and there was a substantial improvement in the patient's clinical situation

Thus, in view of the small number of cases described and the variety of possible treatments, as well the results of Table 1 shows, it is of great importance to carefully evaluate the patient who presents this condition, in order to adapt him or her to the more optimized treatment for his situation. Finally, this review aims to concatenate studies and case reports already described in the literature and contribute to another experience of treatment of an infrequent neurological disease.

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Keywords: Arteriovenous malformation, trigeminal neuralgia, brainstem, neurosurgery, vascular malformation.

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Abbreviations List:
AVM, Arteriovenous malformation
TGN, Trigeminal neuralgia
HELP, Hospital de Ensino e Laboratórios de Pesquisa
REZ, Root entry/exit zone
CPA, Cerebelopontine angle
SCA, Superior cerebellar artery
PICA, Postero-inferior cerebelar artery
AICA, Antero-inferior cereberlar artery
AED, Antiepileptic drugs

Luiz Severo Bem Junior
https://orcid.org/0000-0002-0835-5995
Joaquim Fechine de Alencar Neto
https://orcid.org/0000-0003-2042-4874
Júlio Augusto Lustosa Nogueira
https://orcid.org/0000-0002-4464-8015
Nivaldo Sena Almeida
https://orcid.org/0000-0003-0925-8473
Hildo Rocha Cirne de Azevedo Filho
https://orcid.org/0000-0002-1555-3578

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