Dural Arteriovenous Fistula: A Rare Finding Identified by Vascular Ultrasonography

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Introduction

Intracranial dural arteriovenous fistulas (AVFs) are abnormal arteriovenous communications located in the intracranial dura mater. The main supply arteries are generally the meningeal branches of the external carotid artery, internal carotid artery, and vertebral artery. Digital subtraction cerebral angiography continues to be the standard method for diagnosing dural AVFs.[1,2]

Vascular ultrasound (VUS) is highly accurate in the diagnosis of diseases that involve extracranial vessels, and the objective of this case report is to demonstrate that, by analyzing the flow in these arteries, it is possible to consider intracranial lesions that are not accessible on conventional Doppler.

Case report

We report the case of a 72-year-old female patient who complained of a murmur and tinnitus in her left ear, which she described as "the sound of a river running behind my ear," without association with vertigo, syncope, or loss of balance. She denied other noteworthy comorbidities. Clinical assessment carried out by the otorhinolaryngology team did not reveal any anatomical or functional changes. The patient was referred to the vascular echography laboratory for VUS study of the carotid and vertebral arteries.

VUS of the carotid and vertebral arteries was performed using Philips Ultrasound Epic 5 equipment (Philips Ultrasound®), with a 3–12 MHz multifrequency linear transducer, with the patient in the supine position.

No atherosclerotic lesions were found along the entire course of the arteries studied. However, the left external carotid artery (LECA) showed a relative increase in caliber, associated with the presence of low-resistance arterial flow, with high systolic and diastolic velocities (Figure 1A and B). Evaluating the LECA, cranially to the occipital region, the posterior auricular branch was observed to be dilated (0.52 cm) maintaining the same flow pattern as the left common carotid artery (Figure 2A and B). These findings were not present in the contralateral external carotid artery.

Given these findings, the suspicion of the presence of an intracranial AVF was raised. The patient underwent cerebral arteriography, confirming the diagnosis of dural AVF (Figure 3A and B).

The conduct adopted was observation alone, without indicating intervention. The patient's symptoms improved, and, approximately 4 years later, she was referred for VUS, which showed normalization of the parameters described in the prior examination (Figure 4).

Discussion

Intracranial dural AVFs can occur anywhere within the dura mater. They mostly involve the transverse, sigmoid, or cavernous sinuses. Symptoms can range from pulsatile tinnitus, murmur, and headache to epileptic seizures and transient or permanent neurological deficit.[1,3]

Dural AVFs are mainly supplied by the occipital artery and meningeal branches of the external carotid artery. The tentorial and dural branches of the internal carotid artery and the vertebral artery may contribute to the blood supply of the AVFs less frequently.[4]

AVFs lead to reduced vascular resistance and increased blood flow in the carotid arteries due to the direct diversion of their branches to the venous sinuses. There is a subsequent increase in systolic and diastolic velocities and a reduction in the resistance index (RI) and the pulsatility index in the extracranial carotid arteries, especially the external carotid artery, given that, in the vast majority of cases, one of its branches is the one that connects with the venous sinus. These repercussions can be identified by VUS, which is thus considered the first-line test in the investigation of dural AVFs.[5,6]

With the aim of validating the diagnostic accuracy of VUS in diagnosing dural AVFs, Tsai LK et al.[5] compared Doppler velocimetry parameters with cerebral arteriography, in 35 patients with dural AVF versus 64 without dural AVF. The parameters evaluated by VUS were peak systolic velocity, end-diastolic velocity, and RI. The RI of the external carotid artery was the best parameter for correlation with angiographic

Keywords

Ultrassonografia das Artérias Carótidas; Artéria Carótida Externa; Fístula Arteriovenosa.

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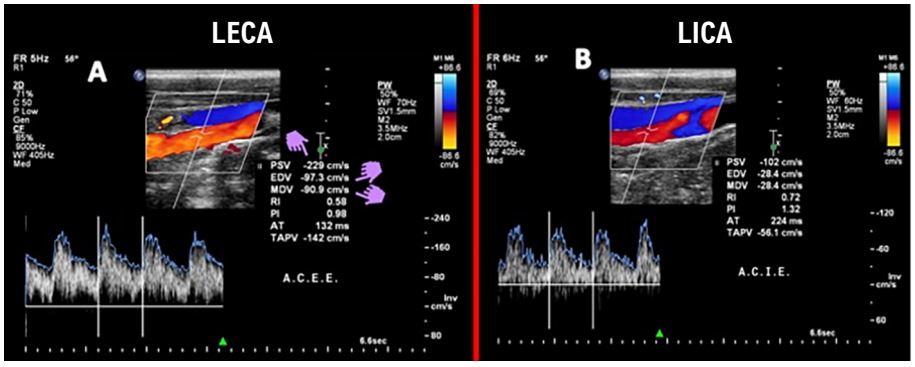

Figure 1 – *Flow pattern shown in the branches of the left carotid artery. A) Spectral Doppler pattern with low-resistance arterial flow and high systolic and diastolic velocities in the LECA; B) Expected flow pattern in the LICA. LECA: left external carotid artery; LICA: left internal carotid artery.*

Table 1 – Velocities shown on spectral Doppler in the carotid system bilaterally.

	PVS (cm/s)	VDF (cm/s)	RI	IP
LICA	102	28	0,72	1,32
LECA	229	97	0,58	0,98
RICA	99	35	0,64	1,20
RECA	102	23	0,77	1,59

ACED: artéria carótida externa direita; ACEE: artéria carótida externa esquerda; ACID: artéria carótida interna direita; ACIE: artéria carótida interna esquerda; IP: índice de pulsatilidade; PVS: pico de velocidade sistólica; RI: índice de resistência; VDF: velocidade diastólica final.

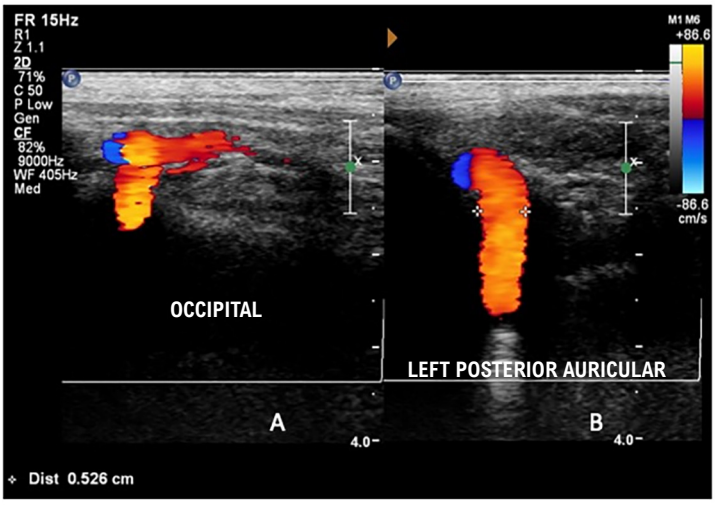

Figure 2 – *A) Left occipital artery with increased dimensions; B) Left posterior auricular artery with increased dimensions.*

presence of dural AVF. The cutoff points for RI of 0.72 on the right and 0.71 on the left showed better accuracy (sensitivity 74%, specificity 89%, positive predictive value 79%, and negative predictive value 86%), as a predictor of dural AVF.[5,7]

Transcranial Doppler with or without contrast is a technique that also makes it possible to evaluate hemodynamic changes before and after occlusion of the dural AVF.

The increase in systolic and diastolic velocities found in the external carotid artery, as described in this case, raises the differential diagnosis with some situations, such as local obstructive lesion, occlusion of the internal carotid artery with internalization of flow in the ipsilateral external carotid artery, or occlusion of the contralateral internal carotid artery. All these possibilities were ruled out because real-time VUS

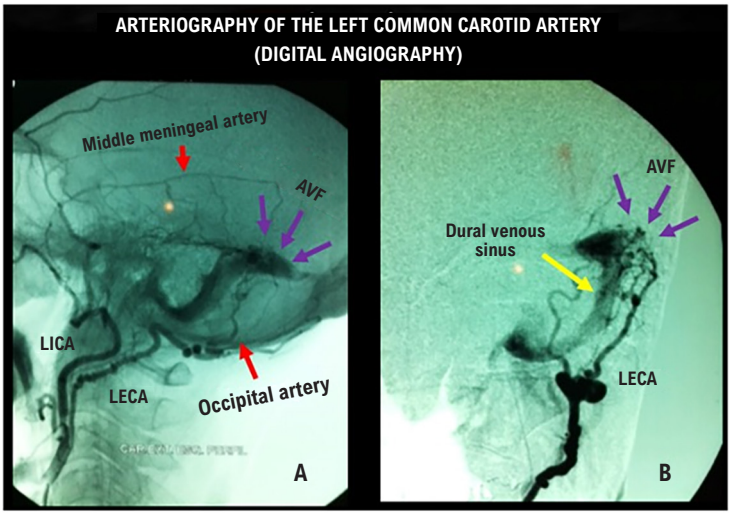

Figure 3 – *Digital cerebral arteriography. A) Dural AVF (purple arrows) originating from both the occipital artery and the middle meningeal artery (red arrows); B) Communication of the fistula with the dural venous sinus is observed. AVF: arteriovenous fistula; LECA: left external carotid artery; LICA: left internal carotid artery.*

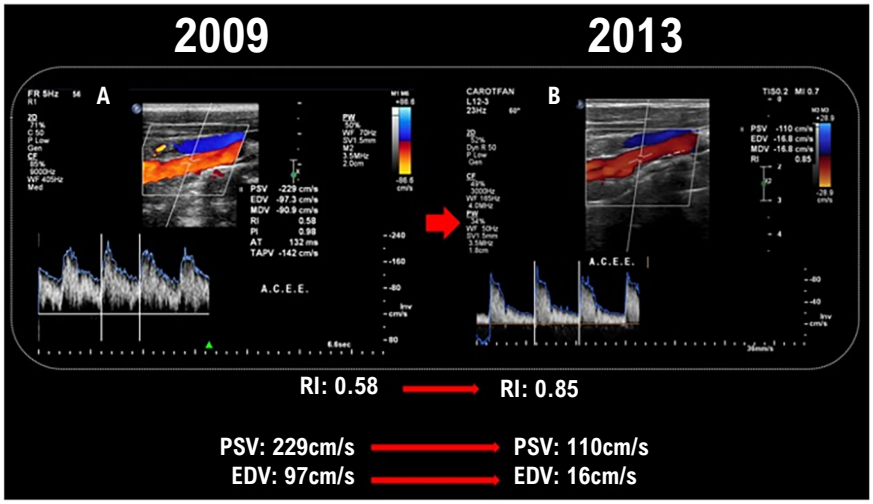

Figure 4 – *Images comparing the spectral Doppler velocity patterns evaluating the LECA in 2009 (A) and 2013 (B), showing a significant reduction in systolic and diastolic velocities and an increase in the RI in this segment. EDV: end-diastolic velocity; LECA: left external carotid artery; PI: pulsatility index; PSV: peak systolic velocity; RI: resistance index.*

did not demonstrate any of these situations. The external carotid artery is little investigated due to its low relationship with vascular events; nonetheless, it is important for the sonographer to pay attention to changes in wave patterns, as they reflect the intracranial status in several brain diseases.[8]

Conclusion

VUS is a reliable screening test for the diagnosis of dural AVF, and the sonographer must pay attention to the wave patterns of extracranial vessels, as they may indirectly reflect intracranial abnormalities.

Author Contributions

Conception and design of the research: Barros FS, Santos AN; acquisition of data: Silva HAGP, Sandri JL; analysis and interpretation of the data and writing of the manuscript: Silva HAGP, Barros FS; critical revision of the manuscript for intellectual content: Santos AN.

Potential Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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Ethics Approval and Consent to Participate

This article does not contain any studies with human participants or animals performed by any of the authors.

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