Arteriovenous fistula: an early color doppler ultrasonographic diagnosis in patients with tinnitus and headache

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Purpose

Intracranial dural arteriovenous fistulas (AVFs) may present an heterogeneous anatomopathological, angiographic and clinical pattern and the prognosis of this condition is extremely variable.

The most applied angiographic classification, made by Cognard et al, distinguishes five main types of AVFs, depending on the venous drainage of the artery: type I drain into a sinus with orthodromic flow, type II drain into a sinus (or into a cortical vein) with reflux, type III and IV drain into a cortical vein, respectively without or with venous ectasia and type V drain into spinal perimedullary veins.

Furthermore, three different sub-type of the type II can be distinguished, depending on the retrograde venous drainage into a sinus, into a cortical vein or both of them: they are named respectively type II a, II b and II a+b.

Patients with AVFs may present either non specific and non aggressive neurological symptoms, like headache or tinnitus or more specific and aggressive neurological manifestations, like haemorrhage, focal neurological deficiency, seizures, and intracranial hypertension or even non neurological, but aggressive manifestations, like cardiac failure.

The angiographic classification of AVFs is related with clinical presentation because the venous drainage and the presence or not of venous reflux are responsible of aggressive or non aggressive clinical findings.

On the other hand, tinnitus and headache may occur in patients who have other types of arteriovenous shunts, like arteriovenous malformations or hemangiomas.

The aim of this study is to present the importance of Color-Doppler Ultrasonography (CDU) to predict arteriovenous shunts in patients with non aggressive neurological symptoms, particularly tinnitus and headache.
Methods and Materials

We performed CDU examination of arterial and venous cervical vessels on three patients: two females and one male (mean age: 58.0 years).

Our patients presented headache, located in retroauricular region and unilateral tinnitus.

All patients were examined with a 9.0-MHz transducer of a computed sonography system, then they underwent angio-CT and digital subtraction angiography (DSA).

Endovascular treatment was performed on two patients: one in emergency, because had a massive ear hemorrhage, the other, in election, for the AVF.
Results

The first patient, a male aged 69 years, presented headache and tinnitus at the left ear. CDU showed arterialized flow in the left internal jugular vein.

This arteriovenous shunt was confirmed by Angio-TC, with a precocious contrast enhancement of the vein in the arterial phase and by digital subtraction angiography (DSA).

Infact DSA allowed to see the communication between some petrous branches of middle meningeal artery and the transverse sinus, without evidence of blood reflux, as the type I, caracterized by a non aggressive, arteriovenous fistula.

The second patient was a female, aged 72 years, with tinnitus at the right ear, headache and right cervical-retroauricular pain; her CDU revealed an arterialized flow in the prossimal, homolateral, jugular vein, confirmed by Angio-TC, showing high contrast enhancement of right jugular vein in the arterial phase.

The DSA showed an arteriovenous fistula, feeding by the right occipital artery, the meningo-hypophyseal trunk and some dural branches of middle meningeal artery of both sides, with orthodromic drainage in the ipsilateral transverse sinus.

According the Cognard classification this patient configures the type I AVF.

The third patient was a 32 years female with headache and tinnitus.

Three days later she developed massive ear haemorrhage; her CDU showed arterialized flow of both jugular vein, more evident in the right side.

DSA showed two wide areas of blush in mastoid region and into the external ear conduct and a precocious enhancement of the right internal jugular vein in the arterial phase.

The arteriovenous shunt of this patient presents an atypical angiographic pattern, not clearly classificate in Cognard AVFs types: at the histopatologic examination it result to be an hemangioma with arteriovenous shunt.

In all patients, with non aggressive symptoms (tinnitus and headache), were present turbulent high-velocity flow spectrum and flow signal in internal jugular vein (IJV) ipsilaterally. Intracranial fistula site was not demonstrated by CDU examination.
Therefore, CDU was able to show indirect signs, such as high resistance flow in supplying artery (external carotid artery), high velocity, arterialized, waveform in the draining vein (IJV) and turbulent high velocity flow spectrum in IJV.

Angio-CT examination confirmed an arterialized internal jugular vein but didn't demonstrate the fistula site.

The intracranial AVFs were confirmed by DSA: two AVFs type I and one hemangioma with arteriovenous shunts.

The third patient underwent emergency endovascular treatment: initially she presented only headache and tinnitus and after few days developed severe ear haemorrhage.

The second patient was treated to prevent severe complications like haemorrhage, focal neurological deficiency, seizures, and intracranial hypertension or cardiac failure.
**Fig. 0:** First patient CDU shows arterialized flow in the left internal jugular vein.

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**Fig. 0:** Second patient CDU: arterialized flow in the prossimal right jugular vein.

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Fig. 0: Third patient CDU. Arterialized flow of both jugular vein, more evident in the right side.

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**Fig. 0:** First patient angio-CT: a precocious contrast enhancement of the left jugular vein in the arterial phase.

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Fig. 0: Second patient angio-CT shows the precocious contrast enhancement of the right jugular vein in the arterial phase.

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**Fig. 0:** Second patient angio-CT

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**Fig. 0:** Third patient angio-CT: high contrast enhancement of both jugular veins, mainly of the right one, in the arterial phase.

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**Fig. 0:** First patient DSA

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Fig. 0: First patient DSA. Communication between petrous branches of middle meningeal artery and the transverse sinus without reflux. Type I arteriovenous fistula in the Cognard classification.

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Fig. 0: Second patient DSA. Arteriovenous fistula feeding by the the right occipital artery, the meningo-hypophisal trunk and some dural branches of middle meningeal artery of both sides. The drainage is orthodromic in the right transverse sinus. Arteriovenous fistula type I in the Cognard classification.

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Fig. 0: Second patient DSA

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Fig. 0: Third patient DSA. A wide area of blush in mastoid region and into the external ear conduct associated with a precocious enhancement of the right internal jugular vein. Hemangioma with arteriovenous shunt (histopathological examination).

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Fig. 0: Third patient DSA. A wide area of blush in mastoid region and into the external ear conduct associated with a precocious enhancement of the right internal jugular vein. Hemangioma with arteriovenous shunt (histopathological examination).

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Fig. 0: Third patient DSA

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Conclusion

CDU examination of the cervical vessels (epiaortic arteries and jugular veins) may demonstrate indirect signs of intracranial arteriovenous shunts.

This is an important diagnostic approach for patients with non-aggressive neurological symptoms such as headache, tinnitus and vertigo.

Moreover clinical underestimated symptoms like tinnitus and headache may be supported by an important and potentially severe condition like AVFs or arteriovenous shunts.

In conclusion the CDU may be considered an important, non invasive, first step diagnostic exam to evaluate this patients: a precocious diagnosis of AVFs may in fact avoid severe intra- or extra-cranial complications.
References

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