INDIRECT CAROTID-CAVERNOUS FISTULA OF LOW-FLOW TYPE: COLOR DOPPLER IMAGING OF RETROBULBAR VESSELS FINDINGS

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ABSTRACT

Background. Carotid-cavernous fistulas (CCF) of low-flow type are the results of development of communication between small arteries and veins of cavernous sinus.
Aim. To assess the role of CDI of retrobulbar vessels in the study of two patients with CCF of low-flow type.
Methods. We have used a sonographer with 9MHz linear probe.
Results. The initial diagnosis was suspected clinically: both patients presented unilateral chemosis and orbital bruit. It was sustained by CDI of retrobulbar vessels: reversed flow in the superior ophthalmic vein, with a venous arterialisation and confirmed with complet selective digital substraction angiography, which is essential for a correct diagnosis(early opacification of veins draining cavernous sinus, etc).
Conclusions. CDI of retrobulbar vessels is a repetitive non-invasive technique, which is used for monitoring carotid-cavernous fistulas of low-flow type, because they are sometimes a self-limiting pathology (spontaneous venous thrombosis).

Key words: carotid-cavernous fistulas of low-flow type, CDI of retrobulbar vessels, selective digital substraction angiography

BACKGROUND

The cavernous sinus is situated ouside of the dura, whereas other dural sinuses are located between two dural walls. In a carotid-cavernous fistula (CCF) there is an abnormal communication between the carotid artery and the cavernous sinus (1, 6, 7).

There are two types of CCF (table 1).

TABLE 1. *Classification of carotid-cavernous fistula (CCF)*

Type of CCF	Arterial supply	Dural shunts supplied by meningeal branches
Barrow type A	Internal carotid artery (ICA)	No
Barrow type B	ICA	Yes
Barrow type C	External carotid artery (ECA)	Yes
Barrow type D	ICA+ECA	Yes

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a) Direct: In this type of fistula arterial blood passes directly through a defect in the wall of the intracavernous portion of the internal carotid artery (ICA). They often arise after trauma (75% of cases) and are usually associated with high flow rates and have a sudden and dramatic onset of symptoms and signs (1,6, 7).

b) Indirect: The intracavernous portion of the ICA remains intact and arterial blood flows through the meningeal branches of the external carotid artery (ECA), and/or ICA indirectly into the cavernous sinus. They often present a spontaneous rupture and because they have a slow blood flow the clinical features are much more subtle than in a direct fistula (1, 6, 7).

Purpose

The main purpose of our study was to assess the role of Color Doppler Imaging (CDI) of retrobulbar vessels in the study of two patients with indirect carotid-cavernous fistula (CCF of low-flow type).

METHODS

Both patients with indirect CCF of low-flow type were examined following the next protocol:

1. complete history and physical examination, including blood pressure;
2. complete ophthalmic examination;
3. examination of orbital (retrobulbar) vessels with a sonographer (Logiq 500, General Electric) with 8-15 MHz linar probe for detecting (by Color Doppler Sonography), and measuring (by spectral analysis pulsed doppler sonography) the blood flow in the orbital vessels: the ophthalmic artery (OA); the central retinal artery (CRA), and vein (CRV); posterior ciliary arteries (PCA), and the superior ophthalmic vein (SOV).
4. assessement of extracranial arteries with a sonographer (MyLab 50 Esaote) with a 7.5MHZ linear array transducer, combining B mode and Color Doppler/ pulsed-wave Doppler ultrasound.
5. orbital and cranial computed tomography (CT) scanning (Aura Philips Spiral Single slice).
6. cerebral angiography (complete selective digital substraction angiography-DSA) (coloscop Siemens).

RESULTS

1. History and physical examination (1, 6, 7, 10).

Both patients were post-menopausal hypertensive women, with no head trauma history.

2. Ocular manifestations (1, 6, 7, 10).

They were homolateral to the fistula, affecting the right eye in both cases.

a) exophthalmus (second case)
- right eye=19 mm
- left eye=13 mm

b) chemosis of the conjunctiva (both patients) (fig. 1)

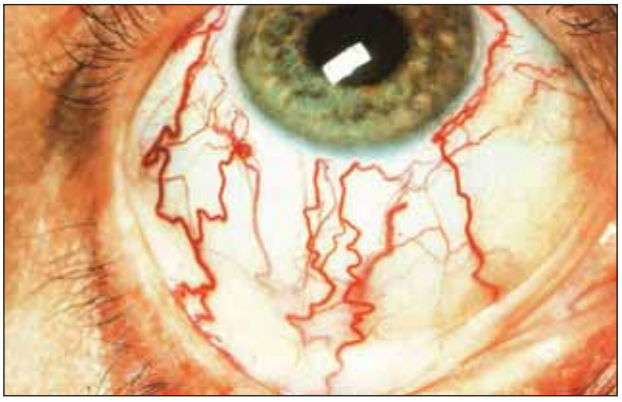


FIGURE 1. *Second patient-engorgement of the conjunctival and episcleral blood vessels, corkscrew (arterialized) vessels, caused by low-flow CCF*

c) dilated episcleral blood vessels, with arterialization of episcleral veins (hallmark of CCF) (both patients) (fig. 1)

d) mild orbital bruit, which was heard best when the examiner used a bell stethoscope over the closed eye (second patient)

e) diplopia due to a right sixth nerve palsy (both patients)

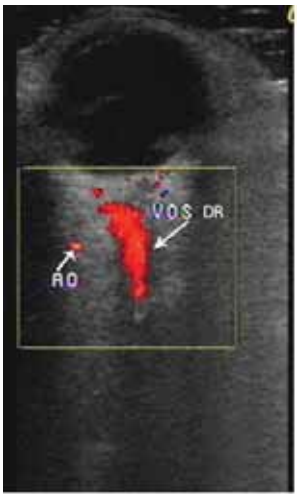
f) increased intraocular pressure (second case):
- right eye=26 mmHg
- left eye=14 mmHg

3. Color Doppler Imaging (CDI) of indirect carotid-cavernous fistula (CCF of low-flow type) (2, 3, 4, 5, 8, 9).

a) a modulatelly, dilated, arterialized right superior ophthalmic vein (SOV). Flow reversal within the vein is despicted in red. First patient fig. 2 (a,b), second patient fig. 3 (a,b)

b) spectrum analysis of the right arterialized SOV shows characteristic shunt pattern. First patient fig. 2 (c,d), second patient fig. 3 (c,d)

c) spontaneous partial thrombosis of the right superior ophthalmic vein (SOV). The blunted



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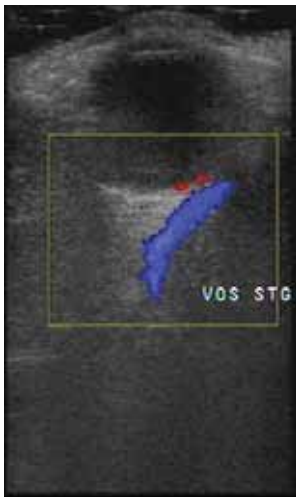

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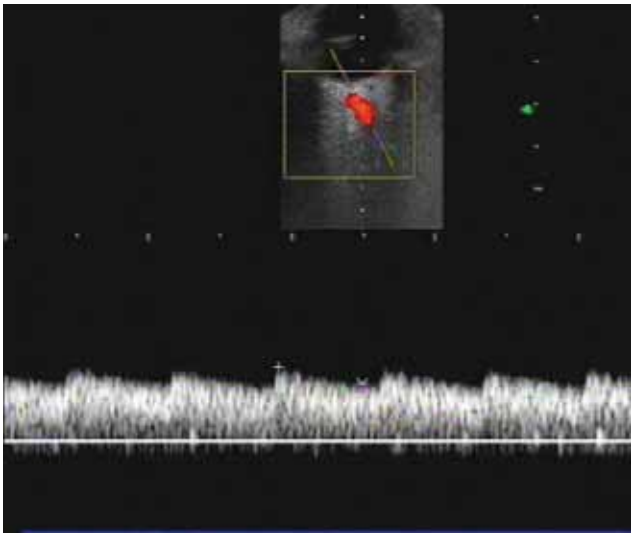

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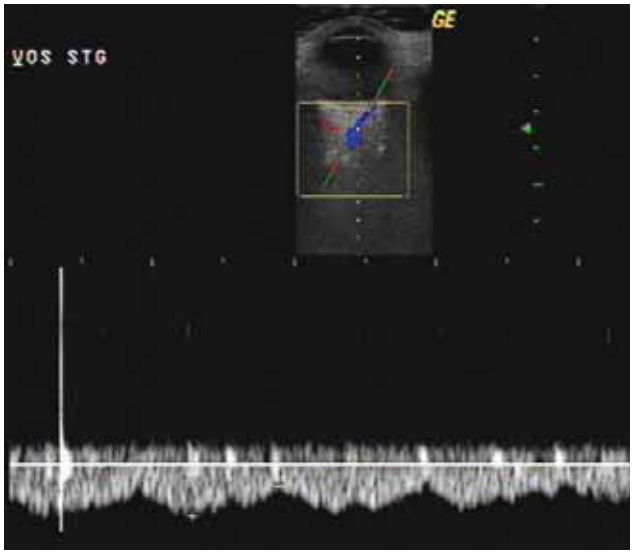
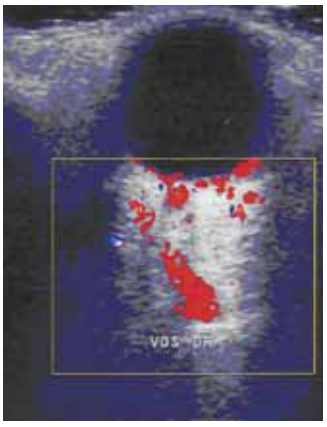


d)

FIGURE 2. *a,b,c,d. First patient-CDI of carotid – cavernous fistula (CCF) of low-flow type*



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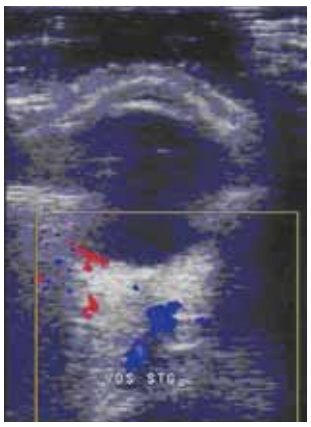

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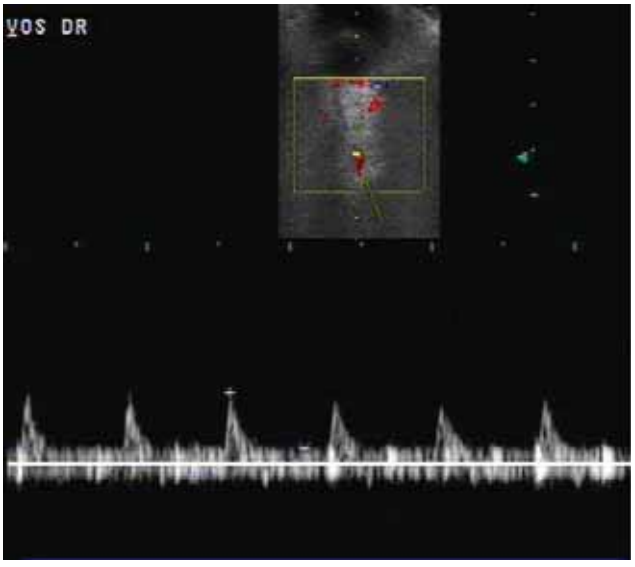

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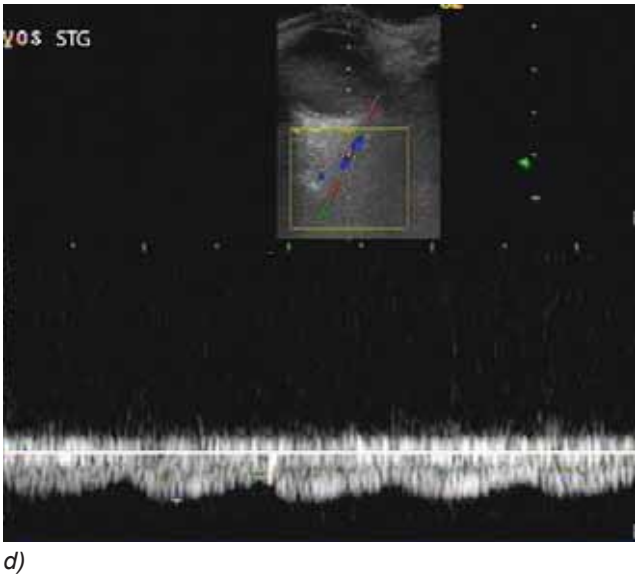

d)

FIGURE 3. *a,b,c,d. Second patient-CDI of carotid-cavernous fistula (CCF) of low-flow type*

spectrum within the vessel is a sign of diminished flow. Second patient (fig. 4).

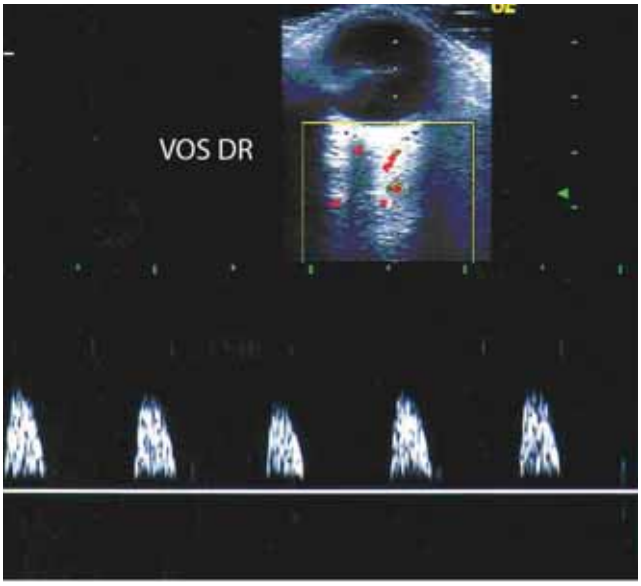

FIGURE 4. *Second patient-CDI of CCF-spontaneous partial thrombosis of the right SOV.*

4. Duplex Sonography of extracranial vessels (8, 9).

a) moderately reduced RI with moderately increased flow volum in the homolatera; ECA (second patient)

b) normal RI with normal flow volum in the homolateral ICA (both patients)

5. Orbital and cranial CT with contrast (1, 6, 7, 10).

Enlargement and increased opacity in right cavernous sinus (both patients) (fig. 5 a,b,c)

a) axial CT image with contrast shows enlargement and increased opacity in right cavernous sinus. The opacification extend directly into the orbit, which shows marked enlargement of SOV.

b) and c) coronal views show the enlarged right cavernous sinus and the ophthalmic veins. The right ICA is displaced up-ward and flatterned. (arrow)

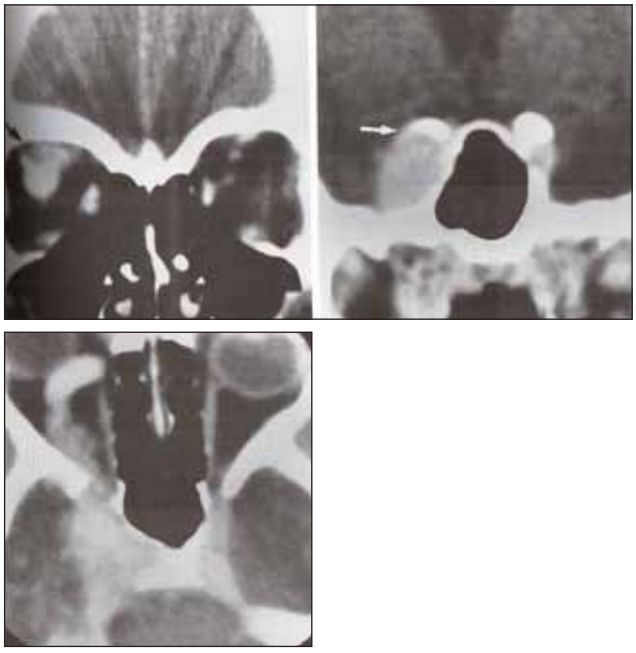

FIGURE 5. *First patient-carotid cavernous fistula shown by CT*

6. Cerebral angiography (1, 6, 7, 10).

a) dilated right, superior and inferior ophthalmic veins (both patients)

b) retrograde flow of contrast material into the right SOV (both patients) (fig. 6)

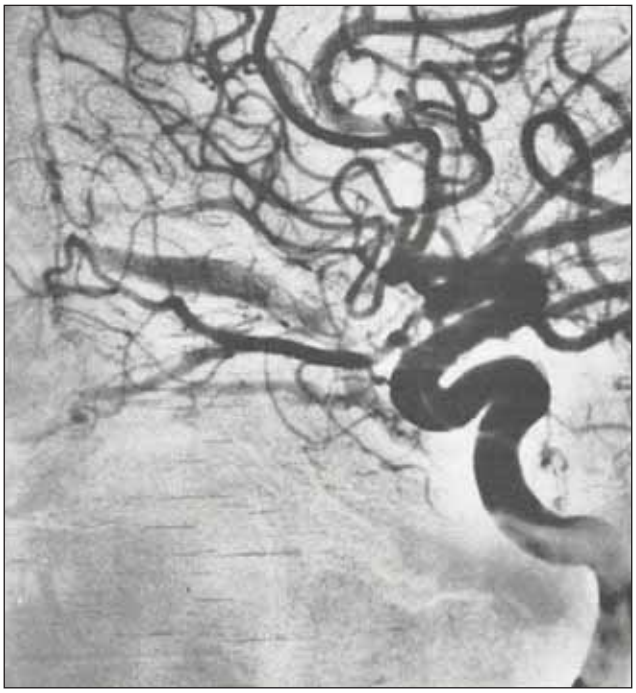

FIGURE 6. *Second patient (6 months later). The selective ICA angiograms reveals an indirect CCF, with enlarged intracavernous branches suppling a malformation in the wall of the right cavernous sinus. There is an opacification of the anterior part of the right cavernous sinus and retrograde flow of contrast material into the SOV.*

DISCUSSIONS

Because an indirect fistula has a slow blood flow the clinical features are much more subtle than in a direct fistula so that the condition may be misdiagnosed or missed altogether. Dural shunts may be mistaken for chronic conjunctivitis, orbital cellulitis, or thyroid disease. However, in dural shunts the bulbar vessels are not affected as diffusely as in inflammatory processes, and the palpebral conjunctiva is not involved, like in conjunctivitis. Signs of dural shunts are usually unilateral, like in our two cases (1, 6, 7, 10).

Exophthalmus generally occurs to a varying degree, like in our second patient.Many patients with dural shunts improve spontaneously, like our first

case.Thus, proper diagnosis, reassurance, and conservative follow-up usually suffice (1, 6, 7, 10).

CONCLUSIONS

The insidious onset of a red eye (both patients) and elevated intraocular pressure (second case) in older women suggest a indirect carotid-cavernous fistula of low-flow type.

Using CDI of retrobulbar vessels, the examiner can diagnose the CCF by the presence of arterialized flow in the superior ophthalmic vein together with the clinical signs (both cases).

CDI can also be used to monitor the clinical course of CCF of low-flow type; because they are sometimes a self-limiting pathology (spontaneous partial venous thromboses in the second case).

Complete selective angiography is essential for a correct diagnosis/many presumed direct carotid-cavernous fistula have been found to be indirect shunts through dural arte riovenous malformations.

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