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Declarations
Conflict of interest: The authors declare that there is no conflict of interest.
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Acute monocular oligemia in a patient with migraine with aura demonstrated using OCT-angiography: a case report.

Abstract

Introduction

Migraine is one of the most common causes of transient visual loss. Optical coherence tomography angiography (OCTA) provides fast and non-invasive imaging of the retinal vessels. We report the first case of monocular retinal oligemia demonstrated using OCTA during a migraine attack with aura.

Case description

A 27-year-old man with a previous history of migraine with visual aura was seen in the emergency room due to acute left hemicranial pain with positive visual symptoms in his right eye. The patient reported a blue stain in his right eye. Optical coherence tomography angiography (OCT-A) showed an extensive area of hypoperfusion in the macular region of his right eye. Forty-eight hours later visual symptoms had improved and the OCT-A showed a significant reduction in the area of hypoperfusion. Seven days later the patient was asymptomatic and retinal perfusion had returned to normal values.

Conclusion

Monocular involvement suggests that these retinal vascular changes are independent from cerebral vascular changes, supporting the hypothesis of selective retinal ganglion cell layer spreading depression as the possible cause of some cases of retinal migraine.
Keywords: retinal migraine, OCTA, retina, ischemia, retinal ganglion cell layer, cortical spreading depression, case report.

Introduction

Migraine affects approximately 15% of the global population. It is the most prevalent neurological condition and the third most frequent global health disorder in both genders\(^1\). Migraine is also one of the most common causes of transient visual loss\(^2\). Visual field loss and positive visual symptoms are usually homonymous; nevertheless, some patients develop monocular visual symptoms. The terminology used in these monocular cases has been confusing, but nowadays retinal migraine is the accepted term by the HIS 3 classification\(^3\).

From a physiological point of view, retinal migraine is thought to be a neuro-vascular phenomenon, in which cortical spreading depression seems to be the main mechanism, with vascular changes as a secondary phenomenon\(^4\). Non-arteritic ischemic optic neuropathies and arterial vascular occlusions have been reported in patients with migraine and there is evidence of vasospasm of the retinal arteries occurring in some patients\(^5,6\).

These episodes of ocular ischemia may explain why structural changes in the optic nerve and retina have been consistently reported in populations that suffer from migraines. Several studies have shown that there is a decrease in the retinal nerve fiber layer, with more severe changes in patients that suffer migraine with aura than in those without aura\(^1\).
Optical coherence tomography (OCT) was invented in 1991 and has evolved tremendously since then. Traditionally, fluorescein angiography was used to evaluate the retinal vasculature. However, nowadays OCT angiography (OCTA) provides fast and non-invasive imaging of the retinal vessels. Although fluorescein angiography is still used in certain cases, it has been largely displaced by OCTA.

**Case description**

We report the case of a 27-year-old, right-handed man who suffered from recurrent headaches since he was 14 which fulfilled HIS III criteria for migraine with aura. A CT scan performed when he was seventeen was normal. He had a family history of migraine with aura. The episode for which he consulted had begun 48 hours earlier as a typical episode of migraine with aura with left hemicranial pain and flashes in the contralateral eye. Forty-eight hours later he perceived a bluish stain in the center of his right eye, that spread gradually. The headache was similar to those he had suffered periodically. He referred a non-pulsatile pain in the left side of the head, without nausea and vomiting. He also had photophobia and sonophobia but not osmophobia. The patient was under treatment with Tryptizol and had taken Naproxen at home.

Neurological examination was normal and the neuroophthalmological evaluation showed a decimal uncorrected visual acuity of 0.9 in both eyes. Intraocular pressure, pupil examination and ocular fundus were normal, but optical coherence tomography (OCT-A) performed with OCT Triton, Topcon, Tokyo, revealed the presence of an extensive area of hypoperfusion in his right retina. These changes were more severe in the superficial retinal plexus than in the deep retinal plexus (Figure 1).
Macular OCT showed normal foveal profiles without edema in any of the retinal layers, and normal ganglion cell layer thickness. Optic disc OCT was not performed during the acute phase, but was carried out on the one-year follow-up consultation and did not show any abnormalities (peripapillary retinal nerve fiber layer average thickness was 112 microns in his RE and 109 microns in his LE). Despite the presence of this area of oligemia, central visual fields were normal in both eyes. He was treated with intravenous Metamizol, which reduced the pain. Forty-eight hours later, only mild pain persisted in the left side of his head and the bluish stain was very small and limited to the superotemporal area, next to center of the visual field. OCTA showed normal retinal vasculature (Figure 2). Eight days later the patient was asymptomatic and OCTA remained normal. Cerebral magnetic resonance imaging performed one month later did not reveal any abnormalities.

**Conclusion**

The development of new technologies reshapes our way of thinking. For example, OCT technology has allowed us to measure the retinal ganglion cell layer, showing that occipital lesions can induce anterograde degeneration of these cells. This finding has proven that the paradigm that stated that retrograde trans-synaptic neuronal degeneration did not take place in the human brain was wrong. A decade ago, in an editorial, Winterkorn reported that vasospasm during a migraine attack had been photographically documented in fewer than 10 patients. However, fundus photography can only detect vasospasm in the main retinal arterioles and most cases of hypoperfusion are probably caused by changes in neuronal activity and platelet function, not by vasospasm. OCTA can detect hypoperfusion in smaller...
vessels and thereby constitutes a much more sensitive method to detect retinal
oligemia. In a recent article, Atilla et al reported reversible bilateral retinal
hypoperfusion in the macular area in one patient with migraine.\textsuperscript{10}

Our case is not easy to understand from a topographical point of view, since the retinal
changes were monocular and contralateral to the headache. They may be related
processes but they do not seem to respond to the same migraine phase
pathophysiology. The oligemia could be the consequence of a primary retinal
spreading depression phenomena, similar to classic aura. In our patient, retinal
oligemia was more severe in the superficial retinal plexus and therefore it might have
been due to selective spreading depression of the retinal ganglion cell layer (Figure 1).
This might explain why it was contralateral to the headache as well as the absence of a
retinal lesion after the resolution of the retinal aura (Figure 2). There is one other
report of OCTA performed during a migraine attack. In this case, oligemia affected
both retinas, and the severity of vascular changes was similar in the superficial and
deep plexus\textsuperscript{10}.

We conclude that OCTA allows fast and non-invasive measurements of ocular
circulation and it is probably going to provide new insights into the pathophysiology of
retinal migraine in the future, leading to better characterization and classification. In
this patient, vascular changes were more severe in the superficial plexus, supporting
the hypothesis of selective retinal ganglion cell layer spreading depression as the
possible cause of some cases of retinal migraine. Nevertheless, this idea of selective
retinal ganglion cell layer spreading depression as the cause of some cases of
monocular should be confirmed in the future by more extensive case report series.
Declarations

Conflict of interest: The authors declare that there is no conflict of interest.

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Reference List

Superficial plexus

Deep plexus

Photoreceptors

Choriocapillaris
Figure 1. An extensive area of oligemia was present during the attack. It was more severe in the superficial plexus than in the deep plexus (red arrows). Figures show OCT-A maps of the retinal superficial plexus, retinal deep plexus, photoreceptor (in healthy people this level should be avascular) and choriocapillaris. RE=right eye, LE=left eye.

Figure 2. An extensive area of oligemia was present during the attack in the retina superficial plexus in the right eye. Forty-eight hours later the retinal plexus had returned to normal. RE=right eye; LE=left eye.
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<thead>
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<th>Topic</th>
<th>Item</th>
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