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The importance of optical coherence tomography in papilledema

A importância da tomografia de coerência óptica no papiledema

Papilledema is the edema of the optical disc secondary to the increased intracranial pressure, and represents one of the most frequent causes of edema of the optic disc. Classically, the edema is bilateral, with the preservation of visual acuity in the early stages associated with other signs and symptoms, such as headache, tinnitus, transient obscuration of the vision and diplopia. When dealing with a patient with papilledema it is key to avoid the presence of intracranial expansive lesions or ventriculomegaly by means of neuroimaging. If neuroimaging examination reveals nothing or shows signs of obstruction of the cerebral venous flow system, we should consider the diagnosis of idiopathic intracranial hypertension (IIH), also known more broadly as pseudotumor cerebri syndrome [1].

For the diagnosis and monitoring of these patients, it is crucial the assessment of the visual function, usually by the measurement of the visual acuity and the automated perimetry and fundoscopic changes. Many believe that the eye fundus examination, especially in association with the retinography, is more than adequate for the assessment of these patients. However, the degree of edema based only on fundoscopy, besides being subjective, examiner-dependent and non-quantitative, may be subject to errors [2]. Studies have shown that the degree of agreement on the classification of papilledema is low, even among experienced examiners [3, 4]. In addition, less experienced examiners may have difficulties in assessing more discreet edemas, as well as monitoring more accurately if the edema is shrinking or not.

Given this scenario, the use of non-invasive imaging techniques such as optical coherence tomography or OCT may be a good option to enhance the diagnosis and the follow-up of these patients. In fact, previous studies have shown that OCT may be useful in assessing the optical disc edema by quantifying the thickness of the peripapillary retinal nerve fiber layer (RNFL) [5, 6]. Due to the spectral technology OCT (*spectral fourier-domain,* SD-OCT), the acquisition of high resolution two- and three-dimensional sectional images of the optic disc, the peripapillary RNFL and the macular region enabled significant improvements in diagnosis [7, 8]. However, it is important to mention that in cases of severe edema (grade 3 or higher in the Frisén scale), the quantification of papilledema by the measures the thickness of the peripapillary RNFL obtained by OCT may be subject to errors caused by flaws in the demarcation of the higher and lower boundaries of the peripapillary RNFL, which would prevent a more accurate estimate of the intensity of the edema [2].

The OCT can also be useful in the differentiation between papilledema of other causes and optical disc edema. It was demonstrated by these authors when reviewing the images obtained from the optical disc by SD-OCT in patients with papilledema secondary to IIH [9]. Kupersmith et al. [9] showed that the retinal pigment epithelium and the Bruch's membrane in the peripapillary region at the level of the scleral channel drifts inward (towards the vitreous), and that this mechanical deformation results from an increase in the pressoric gradient between the perioptic subarachnoid space and the eyeball. According to these authors, said deformation shown by OCT in patients with papilledema does not occur in other edematous optic neuropathies.

A decreased visual acuity should be seen as a warning sign in patients with papilledema. The visual loss may be due mainly to progressive axonal loss or macular involvement. The presence of fluid in the subfoveal region is a relatively frequent condition in patients with papilledema. Note that this change does not require any specific treatment, showing improvement as the papilledema is cured. Another potentially severe situation, although rare, but which occurs especially in cases of chronic papilledema, is the formation of a peripapillary subretinal neovascular membrane [10]. In these cases, besides the specific treatment for papilledema, the intra-vitreous antiangiogenic therapy is required, and the prognosis of these membranes is better when compared to secondary age-related macular degeneration. Patients with papilledema may complain of metamorphopsia due to the appearance of folds on the inner limiting membrane (ILM). They are due to the distortion exerted on the back of the eyeball by the increased accumulation of fluid under pressure in the perioptic subarachnoid space near its exit from the eyeball. Although less frequent, in some cases the folds of ILM and metamorphopsia persist even after curing the papilledema.

As mentioned earlier, visual loss can also be indicative of the progressive loss of peripapillary RNFL. However, the quantification of this reduction can be impaired by the concomitant presence of disc edema. Moreover, it is

difficult to establish whether the reduction of the optic disc edema represents a sign of improvement or is due to the progressive loss of RNFL as a result of the death of the retinal ganglion cells (RGCs). What if that loss could be detected as early as possible, when the edema was still present before being succeeded by atrophy? Recent advances incorporated to the SD-OCT allowed the segmentation and assessment of the inner layers of the retina. Studies show that reducing the total macular thickness and its inner layers detected by the SD-OCT, especially by analyzing the RGC layer and the inner plexiform layer (IPL), are an important finding in patients with chronic papilledema, and that this reduction would correlate to the loss of visual function and responses from the RGC accessed by pattern-reversal electroretinogram (PERG), as recently demonstrated by Afonso et al. [11]. Other authors suggest that the reduction of the inner layers of the retina (RGC + IPL) obtained by the SD-OCT in patients with papilledema could reveal early signs of neuronal and axonal loss, even in the presence of optic disc edema [2, 12, 13]. This would allow the adoption of more aggressive therapeutic approaches in order to prevent or minimize further visual loss.

Therefore, the OCT may be, without a doubt, an extremely useful diagnostic tool in cases of papilledema in many ways, such as allowing the quantification of the optic disc edema, enabling the assessment of response to established treatments, aiding in the differential diagnosis with other edematous optic neuropathies, besides enabling the detection of axonal loss and understanding the mechanisms related to visual loss, especially by ultrastructural assessment of the macula.

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