Retinal Nerve Fiber Layer and Peripapillary Capillary Density Reduction Detected Using Optical Coherence Tomography Enface Images and Angiography in Optic Tract Syndrome

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Mean Consolidated Responses
OD vs OS Stimulated Responses

FIG. 1. RAPDx automated pupillography. The averaged light reflex response during stimulation of the left eye (blue) is smaller than that of the right eye (red). The RAPD amplitude was 0.62 log units in the left eye. ms, milliseconds; OD, right eye; OS, left eye; RAPD, relative afferent pupillary defect.

Abstract: In a patient with an optic tract syndrome, we describe the loss of retinal nerve fiber layer and retinal microvasculature using enface and optical coherence tomography angiography image analyses.

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A 25-year-old-man was referred to our neuro-ophthalmology service for evaluation of left-sided visual field loss. He had a history being in a traffic accident with loss of consciousness but no other history of ophthalmic or systemic disease. Visual acuity was 20/15 in both eyes, but there was a left relative afferent pupillary defect (RAPD), which measured 0.62 log units using RAPDx automated pupillography (Konan Medical Inc, Irvine, CA). In addition, the pupillary constriction amplitude in the left eye was smaller than that of the right eye (Fig. 1). Slit-lamp examination was normal bilaterally with intraocular pressure of 15 mm Hg in each eye. Kinetic and automated perimetry showed a left homonymous hemianopia (Fig. 2A, B). Ophthalmoscopy

FIG. 2. Visual field testing shows a left homonymous hemianopia on both kinetic (Goldmann) (A) and automated (Humphrey) (B) perimetry.

revealed loss of superior and inferior nerve fiber bundles in the right eye and nasal nerve fibers of the left eye (Fig. 3A). Assessment of the ganglion cell complex (GCC) and circum-papillary retinal nerve fiber layer (cpRNFL) using spectral-domain optical coherence tomography (SD-OCT) (RTVue-100; Optovue Inc, Fremont, CA) revealed inner retinal thinning with a hemianopic pattern corresponding to the visual field loss in each eye (Fig. 3B, 3C). Brain computed tomography and MRI did not demonstrate any abnormality of the retrochiasmal visual pathways. Enface OCT using swept-source OCT (SS-OCT; DRI OCT-1 Atlantis; Topcon Corp, Tokyo, Japan) showed predominant loss of the uncrossing fibers in the right eye and the crossing fibers in the left eye (Fig. 4A). OCT angiography (OCTA) (DRI OCT-1 Atlantis

using FastMap ver.9.30 and IMAGEnet 6 ver.1.16 software) revealed reduction of the radial peripapillary capillary (RPC) density in the temporal superior and temporal inferior region of the right eye and in the nasal and papillomacular bundle regions of the left eye. This lack of RPC density was in accordance with the pattern of hemianopic retinal neural loss in each eye (Fig. 4B). The diagnosis of optic tract syndrome (OTS) was made based on these results.

With regards to previous studies using SD-OCT in patients with OTS, Kanamori et al (1) reported that GCC and cpRNFL analyses were able to demonstrate hemianopic retinal neural loss. In a previous study, we showed that a grid analysis by SS-OCT was capable of detecting characteristic RGC loss due to OTS (2). Therefore, GCC and cpRNFL analyses using both

FIG. 3. Although alterations in retinal anatomy is difficult to detect on ophthalmoscopy (**A**), with SD-OCT, the GCC analysis reveals preferential thinning of the temporal hemiretina in the right eye and of the nasal hemiretina in the left (**B**), whereas the cpRNFL analysis showed hourglass atrophy in the right eye and band atrophy in the left (**C**). cpRNFL, circumpapillary retinal nerve fiber layer; GCC, ganglion cell complex; SD-OCT, spectral-domain optical coherence tomography.

FIG. 4. **A.** Enface images show hyporeflective changes in the superotemporal and inferotemporal fibers of the right eye and in the nasal fibers, including papillomacular bundle in the left eye. **B.** OCTA reveals RPC loss corresponding to hourglass atrophy in the right eye and band atrophy in the left eye. OCTA, optical coherence tomography angiography; RPC, radial peripapillary capillary.

SD-OCT and SS-OCT are useful for diagnosing OTS. Regarding the utility of imaging techniques other than OCT, Monteiro et al (3) found that infrared retinal photography showed a homonymous hemianopic hyporeflective image contralateral to the visual field defect in a patient with long-standing OTS.

Enface images using SS-OCT and OCTA have been used to study various retinal diseases, glaucoma, and some optic nerve disorders (4–6). Enface images facilitate discovery of small RNFL abnormalities, which are difficult to detect with conventional B-scan images. OCTA is able to detect a decreased peripapillary vessel density at the corresponding location of cpRNFL thinning (6,7). In addition, OCTA may be less affected by factors that may alter the cpRNFL thickness analysis such as high myopia and tilted optic disc.

In our patient, enface images with SS-OCT demonstrated retinal nerve fiber layer defects in the superotemporal and inferotemporal regions of the right eye and temporal and nasal regions of the left eye. Enface images can more easily detect these defects compared to ophthalmoscopy. We also found that the loss of RPC density with OCTA in a patient with OTS corresponded to hourglass atrophy in the right eye and band atrophy in the left eye. This was clearly observed in the contralateral eye with temporal hemifield loss than in the ipsilateral eye with nasal hemifield loss. Reduction of RPC density using OCTA due to optic tract lesions appear more visible on nasal and temporal sides of the optic disc where there is less intermingling of crossing and uncrossing fibers compared to the superior and inferior poles. Lee et al (8) reported that a decreased density of the RPC in glaucomatous eyes occurs secondary to thinning of the retinal nerve fiber layer. This observation also holds true in patients with OTS.

STATEMENT OF AUTHORSHIP

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