Three-dimensional imaging by spectral domain optical coherence tomography in central serous chorioretinopathy with fibrin

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Introduction

Central serous chorioretinopathy (CSCR) is characterized by detachment of the neurosensory retina. Elevated circulating cortisol and epinephrine are involved in the pathogenesis of CSCR [1, 2]. Indocyanine green angiography highlighted the importance of the choroidal circulation in the pathogenesis of CSCR [3].

The acute form is classically unilateral and characterized by one or more focal leaks at the level of retinal pigment epithelium (RPE) on fluorescein angiography. The neurosensory detachment (NSD) contains clear subretinal fluid but may be cloudy and have subretinal fibrin in some cases [4]. This form of the disease is self-limiting and does not lead to gross visual deficit after resolution. The chronic form is believed to be due to diffuse RPE disease and is usually bilateral. It presents with diffuse RPE atrophic changes,

varying degrees of subretinal fluid, RPE alterations, and RPE tracks. Chronic CSCR is often multifocal, recurrent, and may be associated with subretinal fibrin formation within the blister [5]. It is characterized by diffuse areas of leakage on fluorescein angiography. It has a relatively poor visual prognosis.

With the help of optical coherence tomography (OCT), it is now possible to identify subtle or even subclinical CSCR and also the progression of disease. Three-dimensional optical coherence tomography may be performed using spectral domain optical coherence tomography (SD-OCT) scanning protocol that achieves high sampling density in all three dimensions and acquires high-density volumetric data of the macula.

We report three-dimensional SD-OCT findings in two cases of CSCR with fibrin for the first time.

Materials and methods

The authors confirm adherence to the tenets of the Declaration of Helsinki. After taking a written informed consent, SD-OCT (cirrus high-definition OCT (Carl Zeiss Meditec Inc.), CA, USA) was performed.

Case 1

A 38-year-old male presented with chief complaints of black spot in front of both eyes associated with diminution of vision since 5 days. The patient did not give any history of use of topical as well as oral corticosteroids. On examination, his best corrected visual acuity (BCVA) in the right eye

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(RE) was 20/80 and in left eye (LE), it was 20/100. Amsler test was abnormal in both eyes, and a positive scotoma was demonstrated. Anterior segment evaluation did not reveal any remarkable finding. Dilated fundus examination of the RE revealed dull foveal reflex. NSD with fibrin and pigment epithelial detachment (PED) at macula were observed. These findings were documented by colored and scanning laser fundus photographs (Fig. 1a, b). Fundus of the left eye showed PED temporal to fovea. All the findings were confirmed on SD-OCT, which also showed altered foveal contour with increased macular thickness. Internal limiting membrane (ILM)-RPE false-color-coded map and single-layer ILM map showed retinal elevation. Single-layer RPE map showed multiple PEDs (Fig. 2). SD-OCT scans

Fig. 1 Colored and scanning laser fundus photograph of RPE of the patient showing pigmentary epithelial detachment (*white arrow*), surrounded by subretinal fluid and fibrin deposition (*yellow arrow*)

Fig. 2 ILM-RPE false-color-coded map shows increased retinal thickness. Single-layer ILM map shows retinal elevation. Single-layer RPE map shows multiple PEDs (*white arrows*)

(horizontal and vertical) showed PEDs. Deposition of highly reflective fibrin material in the subretinal space and NSD were also observed (Fig. 3). SD-OCT C-scan, at the level of RPE, also showed PEDs and serous fluid with fibrin (Fig. 4). Three-dimensional (3D) SD-OCT elegantly displayed retinal elevation, PEDs, and deposition of fibrin surrounding the PED (Fig. 5). The left eye showed normal foveal contour with PED and NSD temporal to fovea.

Case 2

A 47-year-old male presented with 1-month history of blurring of vision in both eyes with no other significant history. On examination, BCVA in RE was 20/60 while in LE, it was 20/120. Amsler test was abnormal in both eyes. Anterior segment evaluation showed grade 1 nuclear sclerosis in both eyes. Dilated fundus examination of the RE showed NSD over macula. The LE showed serous fluid with intraretinal deposition of fibrin-like material. Colored and scanning laser fundus photographs of the patient showed diffuse

Fig. 3 Spectral domain optical coherence tomography of the patient shows dome-shaped elevation (*white arrow*) indicating pigment epithelial detachment, deposition of highly reflective fibrin material in subretinal space (*yellow arrows*), and neurosensory detachment (*red arrow*)

deposition of fibrin-like material and pigmentary alterations including RPE tract (Fig. 6a, b). SD-OCT showed obliterated foveal contour due to subretinal fluid in both eyes. ILM-RPE thickness false-color-coded map of the LE showed increased retinal thickness. This retinal elevation was also visible on single-layer ILM map. Single-layer RPE map showed multiple small elevated areas (due to clumps of proliferating RPE cells, visible on SD-OCT horizontal and vertical scans) (Fig. 7). SD-OCT horizontal and vertical scans showed serous fluid and deposition of fibrin-like material along with proliferating RPE cells and NSD (Fig. 8). SD-OCT C-Scan showed serous fluid with associated fibrin, vascular markings, and the proliferating RPE cells (Fig. 9). Three-dimensional imaging showed retinal elevation along with fibrin deposition and proliferating RPE cells (Fig. 10).

Fig. 4 Spectral domain optical coherence tomography C-scan, at the level of retinal pigment epithelium, shows pigment epithelial detachments (*yellow arrow*) and serous fluid with fibrin (*white arrow*)

Fig. 5 Spectral domain optical coherence tomography three-dimensional imaging shows pigment epithelial detachments and deposition of highly reflective material fibrin surrounding the pigment epithelial detachments (*white arrows*)

Fig. 6 **a, b** Colored and scanning laser fundus photographs of the left eye show diffuse deposition of fibrin-like material (yellow arrow) and pigmentary alterations including retinal pigment epithelium tract

Discussion

Optical coherence tomography has demonstrated a variety of characteristic morphological changes in CSCR. Optical coherence tomography provides quantitative measurements of retinal thickness, which could be useful to guide therapeutic decisions and to monitor the efficacy of treatments [6]. Optical coherence tomography reveals even the subclinical findings. It is especially helpful in identifying subtle, or even subclinical, neurosensory macular detachments.

Three-dimensional optical coherence tomography may be performed using an SD-OCT scanning protocol. Volume rendering of the three-dimensional data generates a three-dimensional image. The data can be processed to provide comprehensive structural information. The unprecedented visualization provided by this technology enables determination of specific alterations in the characteristics of the

Fig. 7 ILM-RPE thickness false-color-coded map shows increased macular thickness. Single-layer ILM map shows retinal elevation. Single-layer RPE map shows multiple small elevated areas due to clumps of proliferating RPE cells

retinal anatomy. It is also useful in identifying the level of retinal deposits at which it may get deposited.

The use of SD-OCT enables improved visualization of the pathological structural changes in the foveal photoreceptor layer of patients with macular diseases [7]. Topographic changes in CSC can be visualized with 3D reconstructions in all locations [8]. SD-OCT shows morphologic alterations in retinal pigment epithelium elegantly [9]. Three-dimensional SD-OCT provides a better understanding of the morphological changes and topographic anatomy of the disease process. The C-scan, ILM-RPE and single-layer ILM and RPE maps, and 3D imaging sections provide novel insight. The C-scan highlighted the distribution of fibrin around the PEDs. The ILM-RPE map presented the topographic distribution of increased macular thickness. Single-layer ILM map also depicted the retinal elevation. In acute CSCR, single-layer RPE map displayed the distribution of pigment epithelial detachments. In chronic CSCR, elevated areas on RPE (due to clumps of proliferating RPE cells) could be discerned very well on single-layer RPE maps. Proliferating RPE cells were observed on the SD-OCT scans. 3D imaging helped in documenting the disease. It also provided a combined view of the morphological and topographic changes in retinal anatomy due to the acute and chronic disease process.

Fig. 8 Spectral domain optical coherence tomography of the patient showing increase in central foveal thickness with neurosensory detachment (white arrow) and deposition of fibrin-like material (yellow arrow) and proliferating RPE cells (white arrowhead)

Fig. 9 SD-OCT C-Scan, at the level of RPE, shows serous fluid with surrounding fibrinous deposits (red arrow), vascular markings (white arrowhead), and the proliferating RPE cells (white arrow)

Fig. 10 Spectral domain optical coherence tomography three-dimensional imaging shows increase in central foveal thickness, proliferating RPE cells (white arrow) with fibrin deposition (yellow arrow)

SD-OCT three-dimensional imaging helped in identifying deposition of fibrin and its association with various layers of the retina for the first time. This will facilitate in better understanding of the disease.

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