CASE REPORT

Subtle Solar Retinopathy Detected by Fourier-domain Optical Coherence Tomography

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Solar retinopathy is a retinal injury caused by direct or indirect sun-gazing and solar eclipse observation without protection. Subtle changes in the retinal damage might not be evident on fundus photography and fluorescein angiography. A 40-year-old veteran suffered from paracentral scotoma in his left eye shortly after unprotected solar eclipse observation about 1 month earlier. His visual acuity was 6/5 in the right eye and 6/6 in the left. Anterior segments were normal bilaterally. Dilated fundus examination, fluorescein angiography, and central visual field testing did not reveal any abnormal findings. Fourier-domain optical coherence tomography was used for evaluation, and a focal defect in the inner and outer segments of the photoreceptor layer band was noted in the paracentral region of the fovea in the left eye, with central foveal thickness of 198 μm. Solar retinopathy is preventable with adequate eye protection. Education should be reinforced to the public. In mildly affected individuals with subtle retinal damage, Fourier-domain optical coherence tomography could be a useful imaging tool to detect the disease. [*J Chin Med Assoc* 2010;73(7):396–398]

Key Words: Fourier domain, optical coherence tomography, solar eclipse, solar retinopathy

Introduction

Solar retinopathy is described as retinal injury caused by direct or indirect sun-gazing and solar eclipse observation without protection. It is rarely seen in Taiwan because of patient education and disease prevention. Patients who suffer from solar retinopathy usually experience blurred vision, central scotoma, chromatopsia, and visual distortion. Fundus examination can show a small red or yellow–white spot in the fovea. Fundus fluorescein angiography (FAG) might demonstrate early leakage in the fovea in the acute phase of the disease, and a window defect in the retinal pigment epithelium can ensue in the later phases of the disease.[1] With the advent of optical coherence tomography (OCT), the findings of the disease entity have been described as a focal hyperreflective area in the damaged retina 48 hours after injury, and a hyporeflective defect at the outer retinal layer in the chronic phase of non-resolving cases.[2–6] However, traditional time-domain OCT still has limitations in terms of speed and resolution. The new generation of Fourier-domain OCT features ultra-high speed and high resolution. The macula is able to be scanned entirely and simultaneously in a fraction of a second. The acquisition time is much less than that for time-domain OCT, thus the variability due to motion artifact is reduced significantly. Fourier-domain OCT is also capable of performing retinal imaging with improved clarity of information; therefore, subtle changes can be detected efficiently. Here, we report a case of solar retinopathy with subtle changes only detected by Fourier-domain OCT (RTVue Scanner; Optovue Inc., Fremont, CA, USA).

Case Report

A 40-year-old veteran was referred because of paracentral scotoma in his left eye, shortly after unprotected solar eclipse observation about 1 month earlier.

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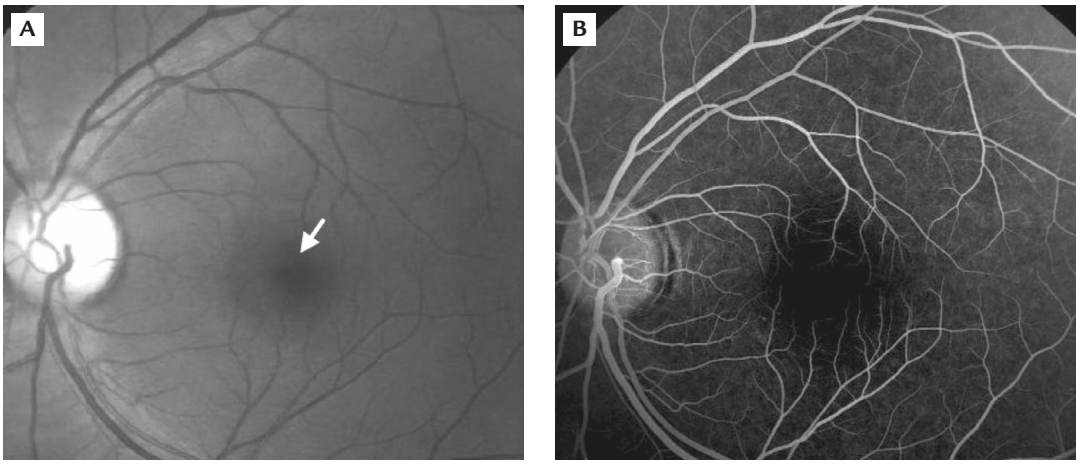

Figure 1. (A) Fundus photography showed slight mottling change in the macula of the left eye (arrow). (B) Fluorescein angiography did not demonstrate any hyperfluorescent lesion or window defect in late transit in the left eye.

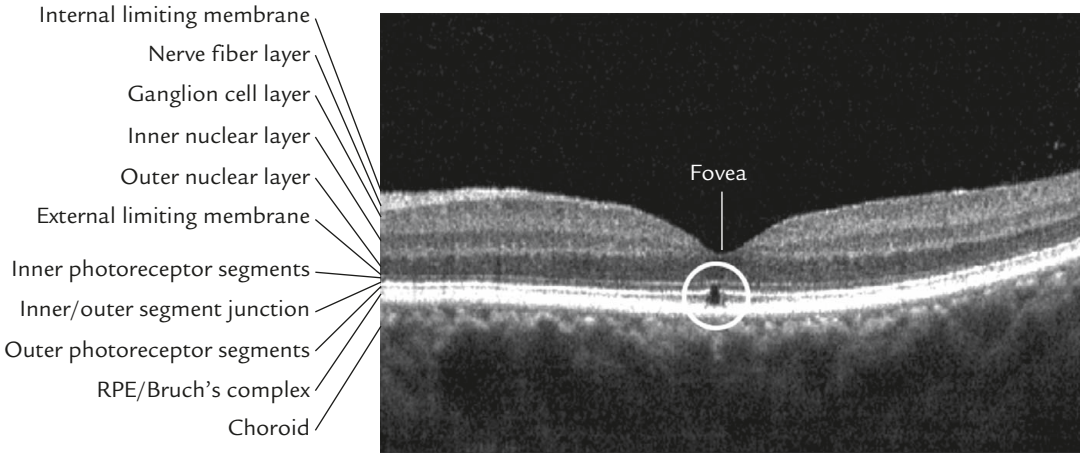

Figure 2. Fourier-domain optical coherence tomography demonstrated a focal defect and disruption in the inner and outer segments of the photoreceptor layer band at the paracentral region of the fovea in the left eye (circle); the central foveal thickness was 198 μm. RPE = retinal pigment epithelium.

The patient said he had gazed at the sun directly and intermittently for about 2 minutes at noon, mainly using his left eye and covering his right eye occasionally with his hand. He was otherwise healthy, without any ocular and medical history. Visual acuity was 6/5 in the right eye and 6/6 in the left. The corneas and the lenses were clear, and intraocular pressures were normal bilaterally. Dilated fundus examination was unremarkable, but there was slight mottling change in the macula in the left eye (Figure 1A). An Amsler grid test drew attention to paracentral scotoma and metamorphopsia in the left eye. However, FAG did not show any abnormal hyperfluorescent lesion during all transits (Figure 1B), and central visual field testing (Humphrey central 10-2 threshold test) did not yield any conclusive finding either. Fourier-domain OCT was then used for evaluation, and a focal defect in the inner and outer segments of the photoreceptor layer band was noted in the paracentral region of the fovea in the left eye, with a central foveal thickness of 198 μm (Figure 2).

Discussion

The retina is vulnerable to damage by light via 3 different mechanisms, including photomechanical, photothermal, and photochemical damage. Solar retinopathy is likely to be a combination of thermal and photochemical reactions or thermally enhanced photochemical damage.[7,8] Patients typically present with visual acuity of 20/30 to 20/100 after gazing at the sun or observing a solar eclipse, and mildly affected individuals mostly have their vision returned to the level of 20/20 to 20/30 after several months.[8] There is usually bilateral but asymmetric involvement. There is no effective treatment for solar retinopathy. Education is the

best method and crucial to the prevention of retinal damage.

In ocular examinations, FAG can show dye leakage in the acute phase as well as window transmission defect in the later phase of the disease; visual field testing can demonstrate scotoma in severe cases.[1]

However, Jain et al have demonstrated that OCT, a breakthrough diagnostic imaging tool which is both noninvasive and useful, might be preferable to FAG for the diagnosis of solar retinopathy; their study detected 100% of affected eyes with OCT, whereas only 90% were detected by FAG.[9] The lower sensitivity of FAG has also been reported in another study.[6] FAG is not ideal for diagnosing solar retinopathy because the size of the lesion is sometimes small, and the retinal pigment epithelium in the foveal area is more pigmented than elsewhere in the fundus, thus reducing light transmission from the choroid.[3]

Some reports have described the time-domain OCT findings of solar retinopathy as a characteristic defect of the outer retinal layer,[3–6,9,10] which corresponds to the junction of the inner and outer photoreceptor segments.[6,9,10] Full-thickness involvement of the photoreceptor layer band of the entire fovea indicates an association with permanent vision loss in patients with late solar retinopathy, whereas isolated involvement of the outer or inner segments and a lesion outside the center of the fovea results in better visual outcome.[6,10] There is also a strong correlation between central foveal thickness and visual acuity.[10] When compared with patients who have no vision loss, those with vision loss have significantly thinner central foveal thickness measurements. Jain et al reported that central foveal thickness measurements ranged from 89 to 189 μm among patients with impaired vision caused by solar retinopathy,[9] whereas Gulkilik et al reported a thickness of 85–150 μm.[10]

Our patient experienced paracentral scotoma after unprotected solar eclipse observation, in spite of having relatively good vision. FAG and other testing could not detect any pathological finding. With the use of the new generation of Fourier-domain OCT, a full-thickness defect in the inner and outer segments of the photoreceptor layer was noted in the left eye. Although there was full-thickness involvement of the photoreceptor layer band, the spared vision was probably to some degree attributed to the paracentral location of the tiny lesion in the fovea, with the relatively preserved thickness of 198 μm at the central fovea.

In conclusion, solar retinopathy is a preventable disease. One must avoid gazing at the sun directly. When viewing a solar eclipse, specially designed eclipse glasses or certified solar filters are required to prevent eye damage. Indirect projection of the image onto a white screen is the safest way to observe an eclipse. Public education about eye protection should be reinforced. In those instances where solar retinopathy is suspected, however, Fourier-domain OCT might be a useful imaging tool to detect subtle retinal damage in mildly affected individuals.

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