3D spectral domain OCT in spontaneous retinal pigment epithelial tear

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Introduction

Neovascular age-related macular degeneration is characterized by the presence of the choroidal neovascularization membrane (CNVM) and is associated with pigment epithelial detachment (PED) [1]. RPE tears are a serious complication that can follow PED [2–6]. Fibrovascular contraction of choroidal neovascular membranes, mechanical forces from vitreomacular traction, or interruption of tight junctions due to anti-VEGF therapy are the most probable causes [5]. The RPE tear creates an area where photoreceptors have no RPE support. If the fovea lies within the RPE-denuded area, a marked decrease in visual acuity is observed, often accompanied by eccentric fixation [7].

Materials and methods

The authors confirm adherence to the tenets of the Declaration of Helsinki. After taking a written informed consent, spectral domain optical coherence tomography (SD-OCT) [Cirrus high-definition OCT (Carl Zeiss Meditec Inc.), CA, USA] was performed in two cases of spontaneous retinal pigment epithelium (RPE) tear in neovascular age-related macular degeneration (AMD). 3D SD-OCT has been used for the first time for documenting an RPE tear in neovascular AMD.

Case report 1—A 57-year-old female presented at our tertiary center with the chief complaint of gradual progressive diminution of vision in both eyes since 5 years with recent diminution of vision in the left eye since 10 days. Vision in the right eye was 20/60 and that in the left eye was finger counting 5 m. On slit lamp biomicroscopic examination, the anterior segment was found to be unremarkable. On fundus examination, the right eye showed retinal pigment epithelial alteration in the macula. The left eye showed a large crescentic RPE tear in the macular area with bare choroid above and rolled-up RPE below (Fig. 1). Fluorescein angiography showed a crescent-shaped area of hyperfluorescence corresponding to a bare choroid with an area of hypofluorescence below it corresponding to reflected RPE (Fig. 2).

On advanced visualization of the macula, SD-OCT of the right eye revealed retinal pigment epithelial detachment. A hyperreflective area of RPE with loss in its continuity was present at the edge of PED in the left eye (Fig. 3). The area of the tear showed greater reflectivity and thickness as compared to the rest of the RPE and extended in the subretinal space. 3D SD-OCT precisely showed the RPE tear with hyperreflective dusting present around it (Fig. 4).

Follow-up visit after 2 months showed marked changes on SD-OCT. Thickness of the hyperreflective RPE increased markedly with loss of its integrity (Fig. 5). The sub-RPE space was obliterated with both hyperreflective and moderately reflective material representing the choroidal neovascular membrane (Fig. 5). Advanced visualization of the area of bare choroid guided by scanning laser ophthalmology exquisitely showed the presence of CNVM with the absence of RPE (Fig. 6). 3D SD-OCT showed a significant increase in hyperreflective dusting surrounding the area of the tear (Fig. 7).

Case report 2—A 78-year-old male presented with gradually progressive diminution in both eyes for 7 years. Vision in the

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Fig. 1 A colored fundus photograph of the left eye of the first patient shows a large crescentic retinal pigment epithelium tear in the macular area. The *black arrow* shows the area of bare choroid, and the *white arrowhead* shows rolled-up retinal pigment epithelium

right eye was 20/60 and that in the left eye was finger counting 2 m. Anterior segment examination was unremarkable. On fundus examination, the right eye showed multiple drusen throughout the posterior pole. A large old RPE tear was observed in the macular area with rolled-up margins and presence of an area of geographic atrophy. Choroidal neovascularization was observed in the area of bare choroid (Fig. 8). Fluorescein angiography showed leakage in the upper half of the macula

Fig. 2 Fluorescein angiography of the left eye shows a crescent-shaped area of hyperfluorescence corresponding to the bare choroid with an area of hypofluorescence below it corresponding to reflected retinal pigment epithelium

Fig. 3 Advanced macular visualization shows a break in continuity and increased hyperreflectivity of retinal pigment epithelium representing a retinal pigment epithelial tear in the left eye (*white arrow*)

with hyperfluorescent drusen in the right eye. A central large circular hyperfluorescent area with surrounding hypofluorescent margins in the left eye is shown (Fig. 9).

On 3D SD-OCT, unprecedented observations were made. The right eye showed the presence of an RPE tear at the edge of PED which was not detected clinically (Fig. 10). The left eye showed a classic picture of a choroidal neovascular membrane with marked disruption in the

Fig. 4 Advanced 3D analysis precisely shows an RPE tear with hyperreflective dusting present around it (*white arrow*)

Fig. 5 Advanced macular visualization of the left eye on the follow-up visit shows significant changes. Complete loss of integrity of the retinal pigment epithelial layer is observed with obliteration of subretinal space. Hyperreflective and moderately reflective material around the area of the tear also has increased markedly over time (*white arrow*)

integrity of all retinal layers. The area of the tear showed pleating of hyperreflective RPE (Fig. 11). Advanced visualization of the macular area through the bare choroid showed the presence of elevated neuroretinal layers with absence of

Fig. 6 Advanced visualization of the area of bare choroid guided by scanning laser ophthalmology exquisitely shows the presence of choroidal neovascular membrane with absence of retinal pigment epithelium

Fig. 7 Advanced 3D visualization shows loss of integrity of retinal pigment epithelium with marked increase in materials of varied reflectivity in the area of tear

a hyperreflective area (Fig. 12). 3D SD-OCT of the right eye elegantly showed the presence of an RPE tear (Fig. 13). In the left eye, hyperreflective RPE with curled-up margins was observed (Fig. 14).

Follow-up visit at 2 months showed PED very distinctly adjacent to the supero-temporal vascular arcade in the right eye which was consistent with the findings of OCT in last follow-up (Fig. 15). The height of PED in the right eye had also increased (Fig. 16a). In the left eye, there was complete obliteration of the subretinal space and was continuous with the space below RPE with hyperreflective and hyporefective substance (Fig. 16b). 3D SD-OCT also showed an increase in height of PED in the right eye and a prominent neovascular membrane in the left eye (Figs. 17 and 18).

Discussion

The pathogenesis of RPE tear remains unclear. While some believe that CNVMs play only a minor role in the formation of RPE tears, others consider these membranes to be instrumental in the tearing process [8, 9]. It is believed that RPE detachments that are destined to tear tend to become progressively larger and highly detached, generating sufficient tangential stress to cause a rupture [10]. An increase in the incidence of RPE tears is observed after the use of antivascular endothelial growth factor agents. This has been attributed to the rapid contraction of the regressing neovascular membrane resulting in tangential traction of the RPE [5].

Both of our cases presented with a spontaneous RPE tear. The first patient presented with an RPE tear in one eye which showed the presence of a PED with underlying CNVM. On the other hand, the second patient had an RPE

Fig. 8 A colored fundus photograph of the second patient shows multiple drusen throughout the posterior pole (*white arrow*). In the left eye, a large old RPE tear was observed in the macular area with rolled-up margins (*black arrows*). Geographic atrophy with signs of choroidal neovascularization in the area of bare choroid is noted (*blue arrowhead*)

Fig. 9 Fluorescein angiography shows pooling in the late venous phase suggestive of presence of pigment epithelial detachment in the left eye. Hyperfluorescent drusens can also be appreciated. In the right eye, the central hyperfluorescent area corresponding to bare choroid is surrounded by a hypofluorescent area corresponding to reflected retinal pigment epithelium

Fig. 10 Advanced macular visualization of the right eye shows the retinal pigment epithelium tear very distinctly (*white arrow*) which was missed clinically and was only hinted by fluorescein angiography. The location of the area of the tear at the edge of large pigment epithelial detachment can be very well appreciated

Fig. 11 Advanced macular visualization of the left eye shows a classic picture of choroidal neovascular membrane with marked disruption in the integrity of all retinal layers. The area of tear shows pleating of hyperreflective retinal pigment epithelium (*white arrow*)

Fig. 12 Advanced visualization of the macular area through the bare choroid showed the presence of elevated neuroretinal layers with absence of hyperreflective retinal pigment epithelium

tear in both eyes. The right eye had an RPE tear at the edge of a large PED with absence of any underlying CNVM, in contrast to his left eye that showed an old RPE tear with presence of a prominent underlying CNVM. The presence of PED as well as CNVM both seem to play a role in the formation of an RPE tear.

The actual composition of RPE tears is not well established. Histological study of the surgically removed RPE tear has revealed that the torn RPE margin rolls up and the bare area of the tear is covered by a thin fibrovascular tissue which covers the remains of the outer segment [10]. In the present study, an increase in hyperreflective and

Fig. 14 Advanced 3D visualization shows a retinal pigment epithelial tear in the left eye with pleating and curled-up retinal pigment epithelial layer

moderately reflective material around the tear with increase in reflectivity of RPE was noted. Also, there was obliteration of the subretinal space in the follow-up visit supporting the theory of fibroproliferative changes with time.

As stated earlier, if the fovea lies within the RPE-denuded area, a marked decrease in visual acuity is observed [7]. This observation is also reflected in our study as the second patient had a fresh RPE tear in his right eye yet had good visual acuity as his fovea was spared. In contrast, the first patient had marked diminution of vision as the RPE tear involved the fovea. This signifies the importance of location of the RPE tear. We also observed that with time, integrity of the retinal layers is lost with associated fibroproliferative changes.

In the present study, 3D SD-OCT imaging provided us with unique observations. It has given us explicit information through advanced macular visualization and 3D

Fig. 13 **a** Advanced 3D visualization gives us an unparalleled view of the area of tear (dotted yellow circle) and also highlights the location of the tear at the edge of large pigment epithelial detachment. **b** Magnified view of the area of tear

Fig. 15 A colored fundus photograph of the right eye shows the presence of pigment epithelial detachment (*black arrow*) which could not be discerned in the last visit. The left eye shows an increase in choroidal neovascularization

Fig. 16 **a** Advanced macular visualization of the right eye shows increase in the height of pigment epithelial detachment and increased reflectivity of retinal pigment epithelium in the area of tear (*white arrow*). **b** In the left eye, there was complete obliteration of the subretinal space with hyperreflective and hyporeflective substance. The typical choroidal neovascular membrane can be appreciated in the left eye

Fig. 17 Advanced 3D visualization of the right eye shows an increase in size of pigment epithelial detachment at the follow-up visit

Fig. 18 Advanced 3D visualization shows the precise morphology of the choroidal neovascular membrane highlighting fibroproliferative changes with time

imaging. 3D SD-OCT has been used for the first time for documenting an RPE tear in neovascular AMD. It provided us with an unparallel topographical view of retinal layers. The presence of an RPE tear in the right eye of the second case could not be detected clinically and was only hinted by fluorescein angiography by the presence of PED. Not only was the area of tear picked up by 3D SD-OCT but the exact location was also identified. This highlights the fact that SD-OCT can serve as an important noninvasive tool for prompt diagnosis of an RPE tear. 3D SD-OCT provided us with global perspective of the disease. In both cases, we noted significant changes with time. It provided an understanding of the structural changes in the retina as well as the disease process. Increase in height of PED, loss of integrity of RPE, obliteration of subretinal space, and progress in formation of CNVM were exquisitely demonstrated on 3D SD-OCT. 3D SD-OCT thus serves as a valuable tool in the diagnosis as well as follow-up of an RPE tear in neovascular AMD.

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