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Evaluation of Optical Coherence Tomography Findings in Idiopathic Parafoveal Telangiectasia Type 2

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Authors' contributions

This work was carried out in collaboration between all authors. Author YA designed the study, wrote the first draft of the manuscript. Authors FK and YT managed the literature searches. Authors YA, PAO, SO and AS managed the analyses of the study. All authors read and approved the final manuscript.

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Original Research Article

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ABSTRACT

Background and Objectıves: To evaluate changes in eyes with idiopathic parafoveal telangiectasia type 2 (IPFT) using spectral domain optical coherence tomography (SD-OCT).
Materıals and Methods: SD-OCT images of cases were analyzed for the presence or absence of foveal contour asymmetry, inner and outer retinal cavities, hyperreflective spots, photoreceptor disruption and outer limiting membrane (OLM) integrity.
Results: Twelve eyes of 7 patients with IPFT type 2 were examined by SD-OCT. Foveal contour asymmetry was found in 41.6% of the eyes. Hyporeflective retinal cavities were found in 25% involving only inner layer, 8.3% involving only outer layer and 66.6% involving both inner and outer layers of the eyes. In 50% of the eyes, hyperreflective spots were present. Photoreceptor loss was observed in 66.6% of the eyes and appeared as hyporeflective areas at inner and outer photoreceptor segments (IS-OS) junction. Of the 8 eyes with photoreceptor disruption, the OLM was disrupted in 7 eyes (87.5%). OLM was intact in all 3 eyes with only inner retinal layer cavitation. The all eyes with both inner and outer retinal cavities had photoreceptor disruption.

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Conclusion: This study desribed characteristic changes in IPFT type 2 based on SD-OCT. The pathogenesis of IPFT type 2 is not entirely understood and SD-OCT is a powerful tool for evaluating this disorder. According to our findings, the integrity of both OLM and photoreceptors seem to be closely associated with IPFT type 2 and the primary pathology in these eyes is the Müller cells.

Keywords: Idiopathic parafoveal telangiectasia; spectral domain optical coherence tomography; Müller cell; pathogenesis.

1. INTRODUCTION

Idiopathic parafoveal telangiectasis (IPFT) is an uncommon retinal disorder characterized by dilated retinal capillaries in the foveal region [1]. The etiology and pathogenesis of the disease are unknown and no proven treatment is currently available. In 1982, Gass and Oyakawa were the first to identify patients with retinal telangiectasis limited to the parafoveal area with no apparent specific cause [2]. In 1993, Gass and Blodi classified it into three groups and each group was further subdivided into two other sub-groups [3]. In order to simplify the Gass-Blodi classification, Yannuzzi divided IPFT into two broad groups: Aneurysmal telangiectasia with exudation or type 1, and idiopathic perifoveal telangiectasia (IPFT) also known as type 2 [4]. IPFT type 2 is the most common form, usually occurs bilaterally and is characterized by small telangiectatic vessels characteristically located at the temporal region of the fovea, which shows staining by fluorescein on angiography but without retinal thickening or exudation [5].

Most patients complain of symptoms such as blurring of vision, difficulty in reading and metamorphopsia [6,7]. The first sign is a mild grayish discoloration of the retina with loss of transparency temporal to the fovea. Telangiectatic vessels are usually invisible on clinical examination at this point and fluorescein angiography (FA) is often necessary to demonstrate the abnormal parafoveal capillary network. The typical FA findings include intraretinal hyperfluorescent staining in the temporal parafoveal area. With time the staining may involve the whole parafoveal area but does not extend to the center of the fovea [1].

Optical coherence tomography (OCT) has deepened understanding of IPFT by documenting the structural changes that occur in this disease. OCT is noninvasive imaging technology which provides cross-sectional images of the retina and demonstrates the structural changes that occur in different retinal diseases. The currently described OCT signs of IPFT type 2 include hyporeflective spaces in the inner and/or outer retina, hyperreflective spots and photoreceptor layer disruption [8-15]. Intraretinal hyporeflective spaces are usually not related to retinal thickening or FA leakage.

In this study, we evaluated the OCT characteristics of patients with IPFT type 2 by using SD-OCT B-scan images.

2. MATERIALS AND METHODS

We retrospectively reviewed the medical records and SD-OCT images of seven patients (12 eyes) with diagnosis of IPFT type 2. All patients had type 2 non-proliferative IPFT according to Yannuzzi classification [4]. This study was conducted in Ufuk University Faculty of Medicine. The local ethical committee approved the study. Informed consent was obtained from patients and this research adhered to the tenets of the Declaration of Helsinki. Patients with coexistent diabetes mellitus, systemic hypertension, retinal venous occlusion, blood dyscrasias, and systemic or ocular inflammatory diseases were exluded from the analysis. All patients underwent an extensive ophthalmologic examination comprising best corrected visual acuity (BCVA), slit-lamp examination, color fundus photography as well as fluorescein angiography (Figs. 1a and b) and optical coherence tomograpy.

The diagnosis of IPFT type 2 was based primarily on clinical findings such as reduced retinal transparency (graying), presence of superficial retinal deposits and ectatic capillaries, predominantly in the perifoveal temporal side. Fundus fluorescein angiography was performed in all cases to confirm the diagnosis. Corresponding SD-OCT findings were subsequently studied and evaluated.

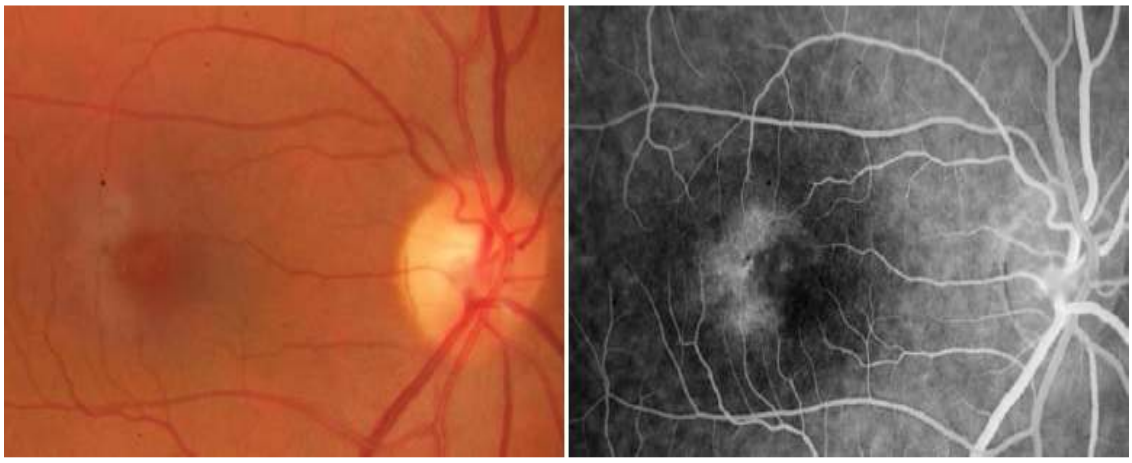

Fig. 1a. Color fundus photography of an eye with IPFT type 2 (Retina pigment epithelium changes with minimal pigment plaques and hard exudates located at temporal parafoveolar retina)
1b. Fundus fluorescein angiography of the same patient (early phase angiogram showing multiple telangiectatic vessels with minimal leakage located at temporal parafoveolar retina)

For all cases, SD-OCT scans were obtained by using Cirrus HD-OCT(Carl Zeiss Meditec, Inc, Dublin, CA). The Macular Cube 512x128 scan protocol was used. The protocol performs 512 horizantal B-scans comprising 200 A-scan per B-scan over 1024 sampling within a cube measuring 6x6x2 mm centered on the fovea. Images with signal strength less than six were considered of poor quality and discarded.

SD-OCT images were analyzed for the following criteria: mean foveal thickness; presence or absence of foveal contour asymmetry; presence or absence of inner retinal cavities; evidence of photoreceptor layer disruption and outer retinal layer cavities; presence or absence of hyperreflective spots; and loss of outer limiting membrane (OLM) integrity.

3. RESULTS

In total, 12 eyes of 7 patients were studied. One was male and 6 were females. Mean age of patients was 51 years (range, 45-58 years). BCVA varied from 20/80 to 20/20.

SD-OCT imaging was used for a layer-by-layer analysis, from the inner to the outer retinal layers.

Foveal contour asymmetry was found in 5 (41.6%) of the eyes.In five eyes, there was inner limiting membrane (ILM)-drape. Hyporeflective retinal cavities were found in 3 eyes (25%) involving only inner layer, in 1 eye (8.3%) involving only outer layer, and in 8 eyes (66.6%) involving both layers. These hyporeflective cavities had an irregular contour in the majority of cases and they were present without an associated increase in retinal thickness. Average foveal thickness was 228 µm (207-263 µm) (Fig. 2).

In 50% of the eyes, hyperreflective spots were present with underlying shadowing, at various levels in the retina but more frequently located in the temporal part of the macula (Fig. 3).

Photoreceptor loss was observed in 8 (66.6%) of the eyes and appeared as hyporeflective areas at (IS-OS) junction (Fig. 4).

Of the 8 eyes with photoreceptor disruption, the OLM was disrupted in 7 eyes (87.5%). OLM was intact in all 3 eyes with only inner cavitation. All eyes with both inner and outer retinal cavities had photoreceptor disruption. SD-OCT B scan findings of all patients showed in Table 1.

4. DISCUSSION

IPFT type 2 is characterized by parafoveolar located telangiectatic vessels, showing fluorescein leakage on angiography, and atrophic changes predominantly of the temporal macula and intraretinal cysts [1,16]. Although known for over three decades, this entity remains obscure,

neither pathophysiology nor the natural course of this disease is understood in detail. Possibly due to low disease awareness, diagnosis of IPFT type 2 is often delayed. IPFT type 2 was reported to occur 0.1% in persons aged 43 to 83 in Beaver Dam Eye Study [17].

The mean age of patients at enrollment in the MacTel study was 61±9 years [18]. Gender distribution was without a clear predilection in the large cohort reported by Gass and Blodi [3]. The proportion of women in the baseline report of MacTel multicenter study is 64% [18].

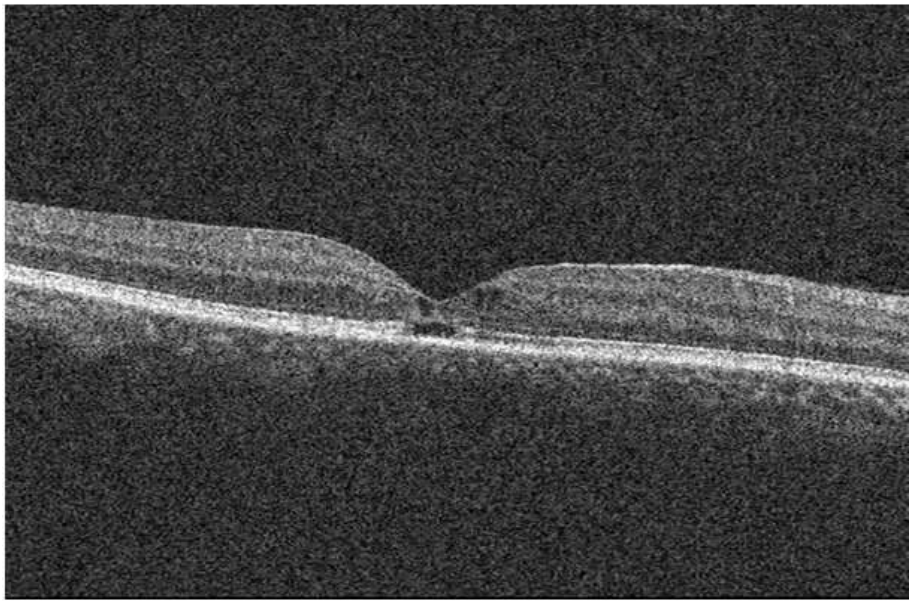

Fig. 2. SD-OCT images of one patient with ILM-drape, inner and outer hyporeflective cavities, photoreceptor loss with OLM disruption

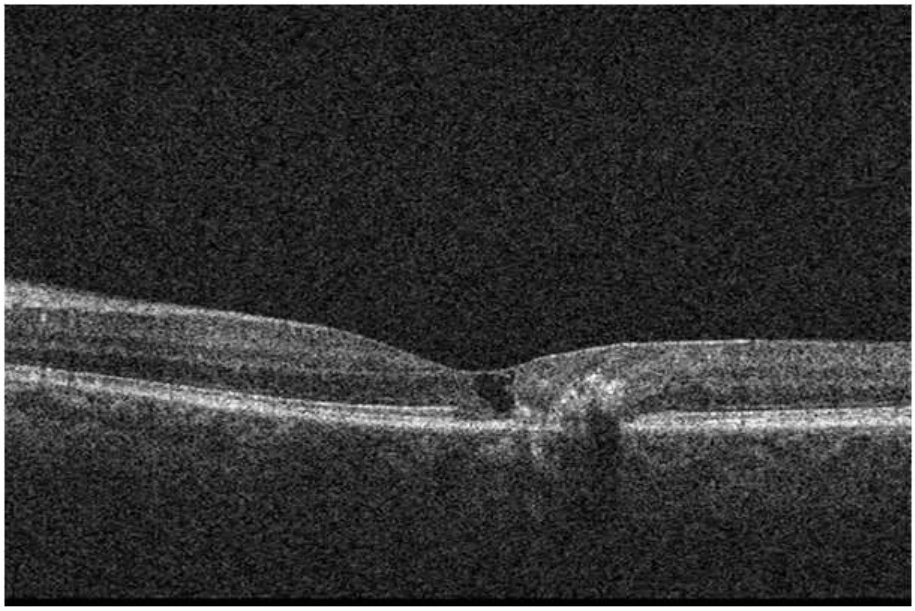

Fig. 3. SD-OCT images of one patient with foveal contour asymmetry , ILM- drape, hyperreflective spot at the level of internal limiting membrane with underlying shadowing and inner retinal cavity . The OLM and the junction of inner and outer photoreceptor segments (IS/OS) are disrupted

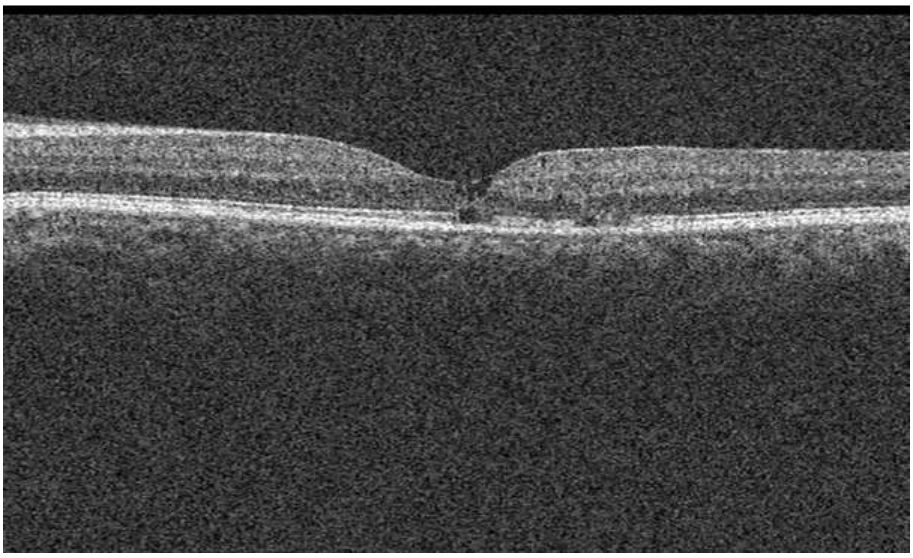

Fig. 4. SD-OCT images of a patient with foveal contour asymmetry, ILM-drape, inner and outer hyporeflective retinal cavities, and photoreceptor loss with OLM disruption

Table 1. SD-OCT characteristics of patients with IPFT type 2

Eye	Foveal thickness (µm)	Foveal contour asymmetry	Inner retinal hyporeflective cavity	Outer retinal hyporeflective cavity	Hyperreflective spots	Photoreceptor layer damage	OLM damage
1	246	No	Yes	No	No	No	No
2	230	No	Yes	Yes	Yes	Yes	Yes
3	263	No	Yes	No	Yes	No	No
4	245	No	No	Yes	Yes	No	No
5	221	Yes	Yes	Yes	Yes	Yes	Yes
6	219	Yes	Yes	Yes	No	Yes	Yes
7	218	Yes	Yes	Yes	Yes	Yes	Yes
8	215	No	Yes	Yes	No	Yes	No
9	207	No	Yes	Yes	No	Yes	Yes
10	216	No	Yes	No	No	No	No
11	210	Yes	Yes	Yes	Yes	Yes	Yes
12	219	Yes	Yes	Yes	No	Yes	Yes

The pathophysiology of IPFT type 2 is stil controversial. Proposed mechanisms are avascular mechanism or a photoreceptor/Müller cell degeneration. The telangiectatic blood vessels are probably the consequence of localized metabolic and/or oxidative damage to the outer retina [19].

We have analyzed SD-OCT images of this case series with IPFT type 2. We found several characteristic findings on SD-OCT imaging that were present in various combination (Table 1). These changes were usually most prominent temporal to the foveal center.

The earliest changes on OCT imaging may include temporal enlargement of the foveal pit, which then appears asymmetric with its thinnest sector temporal to the anatomic foveal center [20]. Foveal contour asymmetry was found in 41.6 % of the eyes in this study (Figs. 3 and 4). This structural alteration appears to be due to changes in the outer nuclear layer thickness. However, if capillary leakage occurs within the same area, this asymmetric thinning may disappear due to slight thickening within the inner retinal layer [5].

The hyporeflective retinal cavities are usually located in the foveal pit with a predilection for the temporal slope. These hyporeflective spaces are different from other diseases such as diabetic maculopathy or Irvine-Gass-Syndrome, the hyporeflective cavities do not appear to be secondary to exudation because they are not associated with macular thickening [1]. By analyzing the light reflectivity profiles from OCT, the density of these hyporeflective spaces can be

measured and compared to the vitreous density. These differences suggest that photoreceptor and Müller cell loss from apoptosis, rather than exudation leads to formation of these cavities in IPFT type 2 [1,13].

We found that all eyes with outer retinal cavitation (9 eyes) had photoreceptor disruption and also 87.5% of these eyes had OLM disruption. Whereas all eyes with only inner cavitation had intact OLM. Our findings were consistent with the study of Zhu et al. in which they found that all eyes with outer retinal cavitation or photoreceptor disruption also had disruption of the OLM whereas eyes with inner retinal cavitation invariably had an intact OLM [12]. The OLM which is a thin membrane at the level of the photoreceptor inner segments, consists of a series of intermediate junctions between the rod and cone inner segments and the apical processes of Müller cells [21]. And it is is the only component of Müller cells that is clinically detectable [22].

Our study is a retrospective case series that lacks statistical validation. However, our observation is consistent with the hypothesis that photoreceptor degeneration in IPFT type 2 is caused by Müller cell dysfunction. The retinal vascular abnormalities seemed to be a secondary rather than a primary phenomenon. The mouse model of Müller cell ablation showed findings reminiscent of IPFT type 2 in humans [23]. Müller cells have a range of functions that are vital to the health of the retinal neurons. They play an important role in the structural integrity of the fovea and provide nutrition to the surrounding retinal neurons. They take up the potentially neurotoxic neurotransmitter glutamate, which they convert to glutamine.They provide a buffer for retinal PH levels by converting carbon dioxide to bicarbonate [24]. They also play a role in inducing and maintaining the integrity of blood-retinal barrier [1]. Their processes are intimately related to the retinal blood vessels in the outer plexus. The SD-OCT findings of hyporeflective spaces may well be cavitary spaces representing Müller cell loss rather than fluid-filled cystic spaces [25].

Hyperreflective spots were present in 50% of the eyes with photoreceptor loss in our case series. These spots may originate from small foci of hyperplasia of the retinal pigment epithelium cells that subsequently migrate into the neurosensory retina. Disruption of the photoreceptor layer seem to precede pigment-hyperplasia [1].

5. CONCLUSION

In conclusion, this study desribed characteristic retinal changes in IPFT type 2 based on SD-OCT. The pathogenesis of IPFT type 2 is not entirely understood and SD- OCT is a powerful tool for evaluating this disorder. According to our findings, the integrity of both the OLM and photoreceptors seem to be closely associated with IPFT type 2. Based on our own and previous observations by other authors, the primary locus of pathology in these eyes is the Müller cells. The patients with IPFT type 2 may have defective Müller cells that selectively degenerate in the parafoveal area over time and eventually give rise to all of the clinical and OCT findings seen in this disease.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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