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Evaluation of choroidal changes in patients with ocular toxoplasmosis using spectral domain optical coherence tomography

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Abstract

We aimed to examine the choroidal changes in ocular toxoplasmosis with spectral domain optical coherence tomography using the enhanced depth-imaging mode. The clinical and laboratory data and spectral domain optical coherence tomography images of patients diagnosed with ocular toxoplasmosis and admitted to Dicle University, Department of Ophthalmology were analyzed retrospectively. The demographic properties such as best-corrected visual acuity intraocular pressure, biomicroscopic findings and dilated fundus examination were noted. The patients were categorized into three groups: active ocular toxoplasmosis, inactive ocular toxoplasmosis and healthy control groups. Enhanced depth-imaging coherence tomography images of both lesion area and subfoveal region were obtained in patients with active and inactive ocular toxoplasmosis, whereas only the enhanced depth-imaging coherence tomography images of subfoveal region were obtained in control group to measure choroidal thickness. A total of 54 subjects were evaluated including 20 individuals in the control group, 10 patients in active ocular toxoplasmosis group and 24 patients in inactive ocular toxoplasmosis group. No statistical significance was observed among the groups in terms of age, gender and intraocular pressure. Significant differences were noted in BCVA and SFCT among three groups. The mean ChT of the lesion area was significantly thicker in active ocular toxoplasmosis group than inactive ocular toxoplasmosis group (p=0.001). Monitoring of choroid is possible by EDI technique of spectral domain optical coherence tomography. This method is easily applicable and beneficial in the examining of ocular toxoplasmosis. Best-corrected visual acuity and the choroidal thickness in lesion area may vary according to activity.

Keywords: Ocular Toxoplasmosis, Enhanced Depth Imaging, Optical Coherence Tomography

Introduction

Ocular toxoplasmosis (OT) is caused by toxoplasma gondii, an obligate intracellular parasite and it is considered the most common cause of infectious uveitis in developing countries [1].

The active disease is presented as retinal yellow-white lesions, vitreous inflammation and haziness. After 6 weeks of active lesion, inflammation resolves by leaving the scars back. Diagnosis in OT is made with clinical findings. Since the serological tests are positive in most of the population, they are not diagnostic, but they are supporting the diagnosis.

The antimicrobial agents used in OT clinical treatment are primetamin, sulfadiazine and clindamycin, which are effective for the trophozoite form of the organism. They do not affect bradyzoites that are responsible for latent infections [2]. Optical coherence tomography (OCT) is a non-invasive, noncontact imaging method that provides cross-sectional views of the ocular structure in micrometer resolution [3].

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Spectral Domain-OCT (SD-OCT) provides high resolution image of the posterior ocular segment.[4]. In recent years, an enhanced depth imaging OCT (EDI-OCT) technique has been used to show changes in the choroid [5,6]. There are studies evaluating the changes of choroid in uveitis by EDI-OCT [7,8]. However, there are only a few studies regarding the choroidal changes in OT.

The purpose of this study is to examine choroidal changes in active and inactive lesions of patients with OT using EDI-OCT.

Material and Methods

The medical records of 34 patients who were diagnosed with OT and taken pictures of SD-OCT were reviewed retrospectively at Department of Ophthalmology between March and December 2013. The study was adhered with the principles of the Declaration of Helsinki and the Institutional Review Board (IRB) of the local ethics committee approved the study protocol. Informed written consent was obtained from all participants.

The cases were divided into 3 groups of those with active toxoplasmic retinochoroiditis (active OT group), with inactive toxoplasmic retinochoroiditis (inactive OT group) and the

control group. OT lesions were diagnosed by binocular direct ophthalmoscopy and 90D lens examination. Serum anti-toxoplasma IgG and IgM antibodies were studied in all cases.

The demographic characteristics of all cases were recorded. Visual acuity (VA), intraocular pressure (IOP), biomicroscopic anterior segment and fundus examination following pupil dilatation were evaluated. VA was measured with a Snellen chart and IOP was measured with Goldman applanation tonometry. The VA values obtained via Snellen chart were converted to LogMAR equivalents for ease to evaluate statistically and defined as best corrected visual acuity (BCVA).

EDI mode of SD-OCT (Heidelberg Engineering, Heidelberg, Germany) was used to evaluate choroidal thickness (ChT). The measurements were performed by an experienced and masked technician using EDI mode. Then, ChT was measured manually by two different masked physicians. The distance between the back edge of the retinal pigment epithelium and the choroid/sclera interface was based on while measuring SFCT (Fig. 1).

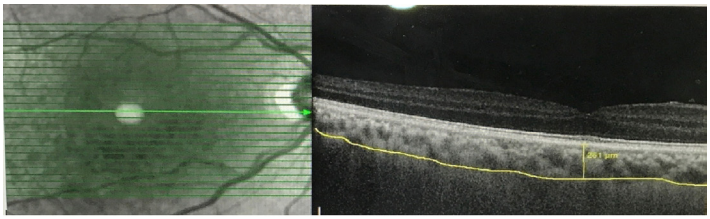

Figure 1. EDI-OCT image showing subfoveal choroidal thickness in a healthy case

The values of ChT in lesion area and SFCT were recorded in patients with active and inactive toxoplasmic retinochoroiditis, whereas only SFCT values were recorded in control group.

The control group was consisting of healthy young individuals had detailed ophthalmologic examinations with; no high refractive disorder (hypermetropia or myopia), no retinal or choroidal disease that could affect the choroidal thickness, and no previous ocular surgery. Exclusion criteria in active and inactive OT groups were; uveitis other than caused by toxoplasmosis, high refractive disorder (hypermetropia or myopia), any retinal or choroidal disease that may affect the ChT (such as choroidal neovascular membrane, macular hole) and any previous ocular surgery.

Data of this study were analyzed with Statistical Packages for the Social Sciences (SPSS) version 15.0. Demographic data were presented as mean±SD. Mann Whitney U test for two groups and Kruskal Wallis test for three groups were used to analyses nonparametric data. P <0.05 was considered for statistical significance.

Results

Twenty individuals, 10 patients and 24 patients were included in control, active OT and inactive OT groups, respectively. Significant differences were noted in BCVA, SFCT and ChT of lesion areas, while no significant differences were observed in age (p = 0.862), gender (p = 0.682) and IOP (p = 0.841) between the groups. The demographic and clinical characteristics of the patients are shown on Table 1 and 2.

Table 1. Demographic Characteristics of the Participants in the Study

	Active Group	Inactive Group	Control Group
Total Patients	10	24	20
Female	8	16	13
Male	2	8	7
Age (years, y)	27.10±6.93	25.62±7.48	25.90±7.91

Table 2. Clinical Characteristics of the Participants in the Study

	Active Group	Inactive Group	Control Group	P* Value
IOP (mmHg)	17.70±3.30	17.83±3.53	18.35±2.49	0.841
BCVA (logMAR)	0.35±0.50	0.36±0.59	0.00	0.005
SFCT (µm)	262.00±47.06	241.08±34.85	277.70±26.72	0.008
ChT (µm)	284.40±41.15	173.58±77.61	-	0.001

*Kruskal Wallis Test. P<0.05 was statistically significant, IOP: Intraocular Pressure, BCVA: Best corrected visual acuity, SFCT: Subfoveal choroidal thickness, ChT: Choroidal thickness

When control and active OT groups were compared; a significant deterioration of BCVA was observed in active OT group (p=0.003), no significance was noted in IOP (P=0.504) and age (P=0.758) between groups and although mean SFCT was lower in active OT group, it was not statistically significant (p = 0.226).

In the comparison of control and inactive OT groups; a significant deterioration of BCVA was observed in inactive OT group (p=0.001), no significance was noted in IOP (p=0.712) and age (p=0.972) between groups and mean SFCT was statistically lower in inactive OT group (p=0.002).

While comparing active and inactive OT groups; No significance was detected in BCVA (p=0.932), IOP (p=0.924) and age (p=0.649) between groups. The mean SFCT was thinner in inactive OT group than active OT group, however it was insignificant (p=0.265). The mean ChT corresponding to the lesion area was significantly thinner in inactive OT group than active OT group (p=0.001).

Correlation analysis showed a negative correlation between SFCT and BCVA in the control group (p=0.034, r = -0.39).

Discussion

Choroid is a highly vascular structure and provides nutrition to retina and removes waste products from the retinal pigment epithelium. Choroidal thickness varies with intraocular and perfusion pressure and choroidal metabolism is regulated by various vasoactive factors, including nitric oxide, endothelin's, and autonomic innervations [9-11]. The macula has the highest metabolic circulation in the retina, and this is thought to be the reason for the greatest choroidal thickness beneath the fovea [12,13].

OT is a common seen form of infectious uveitis. Retinal and choroidal changes occur in these patients. EDI-OCT is an easily applicable, useful and objective method for visualizing choroidal changes caused by OT. The characteristic clinical fundus findings in OT are focal chorioretinitis, adjacent chorioretinitis scarring and

severe vitreous inflammation. In addition papillitis, neuroretinitis and granuloma can be seen on the fundus examination 14].

Only histological techniques were the source of information about retinal and ChT before the development of OCT technology. Histologically measured ChT was around 200 μm. However, these measurements did not reflect the actual thickness due to tissue fluid loss during preparation of the histologic sections and vascular collapse during autopsy [15].

Other methods used in the study of choroid include indocyanine green angiography and magnetic resonance imaging [16]. However, it is not possible with these techniques to perform detailed thickness measurement and morphological evaluation as well as OCT.

Standard SD-OCT is inadequate for choroidal imaging. Recently, choroidal imaging has been possible with EDI technique of SD-OCT [17]. EDI-OCT has been used in many diseases such as age-related macular degeneration (AMD), Behcet's disease, white spot syndromes [18,19]. There are a limited number of publications regarding ChT in patients with OT.

In patients with active OT lesions, choroid in the area of lesion is observed thicker than those in surrounding choroids due to intense inflammation. Whereas, retinitis is healed by leaving choroidal scarring and so choroidal thinning occurs due to choroidal atrophy.

Goldenberg et al. [20] measured the mean ChT as 390±245 μm in patients with active lesions using EDI mode of SD-OCT. Orefice et al.21 reported that ChT of lesion area in acute period of the disease increased by 70.8%. Similarly, we observed that the mean ChT increased in the lesion area of patients with active lesion.

Goldenberg et al. [20] also measured the mean ChT of patients with inactive OT lesions as 189±86 μm, which was significantly lower than in patients with active phase of OT. Similarly, we measured the mean ChT as 173.58±77.61 μm in patients with inactive OT lesion, which was significantly thinner than those with active OT.

We noted that BCVA was better in patients with thicker choroid. The presence of the lesion outside the fovea and the absence of ocular or systemic disease other than toxoplasma showed that this was completely random.

Studies regarding ChT have shown that ChT decreases as the age progresses. Ding X. et al. [22] found that the mean ChT was 294.63±75.90 μm in individuals under 60 years of age and 196.52±74.42 μm in individuals over 60 years of age. Since the patients included in our study were younger patients of similar age group, the effect of age on ChT was not mentioned.

Freitas-Neto CA et al. [23] have reported that submacular choroidal thickness changes even when the active retinochoroidal toxoplasmic lesion occurs outside the macula. These findings illustrate that the inflammation caused by ocular toxoplasmosis has diffuse choroidal involvement.

McCourt et al. [24] indicated that ChT was thinner in patients with glaucoma, diabetic retinopathy and AMD compared to healthy eyes. Sinim et al. [23] observed thinning of choroid in EDI-OCT in patients with high myopia.

Ishikawa S et al. [19] evaluated SFCT using EDI-OCT by observing uveitis activity before and after infliximab treatment in 23 patients with uveitis associated with Behçet's disease. They have shown that SFCT is thicker in acute phase than remission phase following inflammation recovery after infliximab treatment. In a cross-sectional study, Cuskun E. et al. [25] assessed SFCT with EDI-OCT by observing of 35 patients with Behcet-related posterior uveitis, 35 patients with Behcet's disease without ocular involvement and 30 healthy participants. Mean SFCT was thinner in patients with posterior uveitis than in patients without posterior uveitis and healty individuals ($p = 0.026$).

Conclusion

In conclusion, EDI-OCT is an easy applicable, useful and objective method in the assessment of choroidal changes in patients with OT and BCVA and ChT may be depend on the lesion activity level.

Small sample size, absence of ChT comparison before and after treatment are the limitations of the present study. So, novel studies are warranted regarding these limitations.

Competing interests
The authors declare that they have no competing interest.

Financial Disclosure
There are no financial supports

Ethical approval
The study was adhered with the principles of the Declaration of Helsinki and the Institutional Review Board (IRB) of the local ethics committee approved the study protocol.

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