Kocatepe Tıp Dergisi
Kocatepe Medical Journal
20:14-18/Ocak/2019

ARAŞTIRMA YAZISI / RESEARCH ARTICLE

EVALUATION OF SUBFOVEAL CHOROIDAL THICKNESS USING SPECTRALIS OCT IN THE PATIENTS WITH TYPE 1 DIABETES MELLITUS

TİP 1 DİYABETES MELLİTUS HASTALARINDA SUBFOVEAL KOROİD KALINLIĞININ SPEKTRALİS OCT İLE DEĞERLENDİRİLMESİ

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ÖZ

AMAÇ: Bu çalışmada amacımız, endokrin kliniğince tip 1 diyabetes mellitus (DM) tanısı konulmuş herhangi bir diyabetik retinopati (DR) bulgusu olmayan olgularla, sağlıklı bireylerin koroid tabakası kalınlıklarını karşılaştırmaktır.

GEREÇ VE YÖNTEM: Olguların spektral domain optical chorence tomografi cihazı (Nidek SLO/Spectral OCT(RS 3000))ile horizontal düzlemde taraması yapıldı. Koroid kalınlıklarını foveada, nazal ve temporalde horizontal olarak 600µm aralıklarla 1200 µm mesafaye kadar toplam 7 noktada ölçümler yapıldı. Tip 1 diyabet olan hastalar grup 1, kontrol grubu ise grup 2 olarak sınıflandırıldı. Korneal opasite, katarakt, retinal hastalık, ailede glokom ve oküler cerrahi öyküsü, kontrolsüz hipertansiyon, kardiyovasküler bozukluk olan hastalar çalışmaya dahil edilmedi.

BULGULAR: Çalışmaya DR'si olmayan 10 tip 1 DM hastasının 20 gözü ile 8 kontrol grubunun 16 gözü dahil edildi. Yaş, cinsiyet, sferik ekivalan, düzeltilmiş en iyi görme keskinliği, göz içi basıncı ve aksiyel uzunluk değerlerinde gruplar arasında anlamlı farklılık saptanmadı. (Grup 1)'de subfoveal koroidal kalınlık sağ gözde 311.6µm sol gözde 348.7µm olarak bulundu. (Grup 2)'de subfoveal koroidal kalınlık sağ gözde377.1µm sol gözde 368.9µm olarak ölçülmüştür. Hem grup 1 hem de grup 2 de koroid kalınlığının nazalde temporale göre daha ince olduğu bulunmuştur (p=0.039). Her iki grubun koroid kalınlıkları karşılaştırıldığında grup 2 de koroid kalınlıklarının daha yüksek olduğu bulunmasına karşın veriler arasındaki fark istatistiki olarak anlamlı bulunmamıştır (P=0.214).

SONUÇ: Tip 1 diyabetes mellitusun göze olan etkileri tip 2 diyabetten daha ağır seyretmesine rağmen, vasküler yapı yönünden zengin olan koroid üzerine etkisi daha az gibi görünmektedir. Tip 1 diyabette koroid kalınlığında azalma olduğu tespit edilse de sonuçlar istatistiki olarak anlamlı bulunmamıştır. Tip 1 diyabetes mellitusu olan daha fazla hasta ile veri sayısının artırılması durumunda sonuçlarda değişiklik olabileceği düşünülmektedir. Ayrıca SD-OKT cihazları ile koroid kalınlığı ölçümünün manuel olarak yapılması sonuçların farklı çıkmasına neden olabilmektedir.

ANAHTAR KELİMELER: Koroid kalınlığı, optik kohorens tomografi, tip 1 diyabetes mellitus

ABSTRACT

OBJECTIVE: The present study aimed to compare the choroidal thickness of the patients diagnosed with type 1 diabetes mellitus (DM) with no sign of diabetic retinopathty (DR) in the endocrinology policlinic and with the choroidal thickness of healthy subjects.

MATERIAL AND METHODS: The patients were screened at horizontal level using spectral domain optical coherence tomography device (Nidek SLO/Spectral OCT (RS 3000)). Choroidal thickness was measured from a total of seven points in the subfoveal area horizontally at 600µm intervals to a distance of 1200 µm in the nasal and temporal quadrants. The patients with type 1 diabetes were assigned to Group 1 and the control subjects were assigned to Group 2. Patients with corneal opacity, cataract, retinal disease, family history of glaucoma or history of ocular surgery, uncontrolled hypertension, and cardiovascular disorders were excluded.

RESULTS: The study comprised 20 eyes of 10 Type 1 DM patients without DR and 16 eyes of eight control subjects. No significant difference was determined between the groups in terms of age, gender, spherical equivalent, best corrected visual acuity, intraocular pressure and axial length. In Group 1, subfoveal choroidal thickness was 311.6µm in the right eye and 348.7µm in the left eye. In Group 2, subfoveal choroidal thickness was 377.1µm in the right eye and 368.9µm in the left eye. The choroidal thickness has become thinner in the nasal vs. temporal quadrant both in Group 1 and Group 2 (p=0.039). Comparing the choroidal thickness between the groups, it was found to be higher in Group 2, but the difference was not statistically significant (p=0.214).

CONCLUSIONS: Type 1 diabetes mellitus has more aggressive impacts on the eye than those of type 2 diabetes, but it appears to have lower impact on the choroid, which is rich in vascular structure. Although choroidal thickness was determined to be decreased in type 1 diabetes mellitus, the results were not statistically significant. We assume that the results might change in case the data is augmented with larger number of type 1 diabetes mellitus patients. Moreover, manual measurement of choroidal thickness using SD-OCT may give different results.

KEYWORDS: Choroidal thickness, optic coherence tomography, type 1 diabetes mellitus

Geliş Tarihi / Received: 15.01.2018
Kabul Tarihi / Accepted: 28.05.2018

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INTRODUCTION

Type 1 diabetes mellitus (DM) is a chronic metabolic disease, which is prevalent in childhood and characterized by insulinopenia and hyperglycemia resulted from autoimmune or non-autoimmune damage of the pancreatic beta cells that take part in insulin production mediated by T-cells (1). Diabetic retinopathy (DR) is the most common complication of DM resulting in blindness (2). Diabetic retinopathy is the worldwide leading cause of loss of vision (3). Although the complications of type 1 DM are the same with the complications of type 2 DM, they appear in earlier period and are more aggressive (4).

Clinical and experimental data suggest that choroidal vasculopathy in diabetic patients may play a role in the pathogenesis of diabetic retinopathy (5). Various choroidal abnormalities including obstruction of the choriocapillaris, vascular degeneration, choroidal aneurysms and choroidal neovascularization have been reported in the histopathological studies of diabetic eyes (6).

Choroid is a vascular structure that prevents tissue heating by absorbing excessive light received by the retina and retinal pigment epithelium while enabling oxygenation of the prelaminar part of the optic nerve and external retinal layers. Choroidal blood flow is the highest blood flow per tissue mass in the body (7). It was demonstrated that vascular retinal diseases including diabetic retinopathy as well are associated with the choroid. A study showed that subfoveal choroidal blood flow increases particularly in the diabetic patients with macular edema (8). For this reason, various pathological changes are likely to occur in the choroidal structure of DM patients.

OCT is a non-contact and non-invasive scanning method with high reproducibility, which visualizes biological tissue layers by taking high-resolution tomographic sections. Today, methods that better reflect and measure the choroidal thickness using spectral-domain OCT (SD-OCT) have been defined, and it was demonstrated that choroidal thickness is changed by various factors (9). In the recent years, studies have reported different outcomes concerning the choroidal thickness measured by SD-OCT device in the DM patient groups with or without retinopathy (10–11).

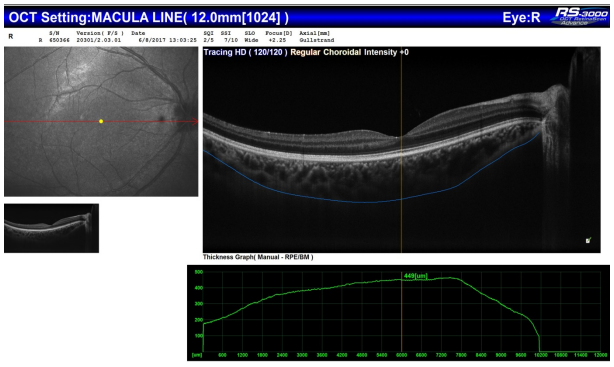
The purpose of this study was to evaluate the changes in choroidal thickness, as well as demographic/clinical parameters in type 1 diabetes mellitus (DM) patients without diabetic retinopathy (DR).

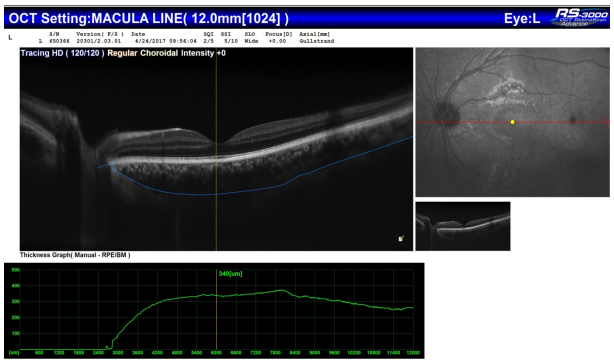
MATERIAL AND METHOD

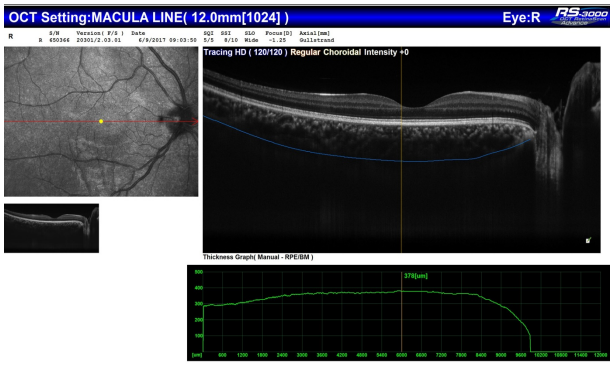
This prospective and comparative study was conducted in Afyonkarahisar State Hospital, Department of Ophthalmology in accordance with the Declaration of Helsinki, and it was approved by the local ethics committee of Afyon Kocatepe University.

A total of 36 eyes of 18 patients (of whom 10 were diagnosed with type 1 DM in the endocrinology policlinic of our hospital, referred to the ophthalmology policlinic for ophthalmological examination for the complications of type 1 DM and had no diabetes-related complication and 8 had no problem other than refractive disorder ≤ 2 diopter on ophthalmologic examination) were included in the study. The patients underwent complete ophthalmological examination including best corrected visual acuity (BCVA) measurement by Snellen chart, biomicroscopic anterior segment examination, intraocular pressure (IOP) measurement (by Goldmann applanation tonometer), and fundus examination. Patients with type 1 DM without clinical DR, with spherical equivalence (SE) lower than ±2 diopter (D), with intraocular pressure <21 mmHg, and with c/d ratio < 0.4 were included in the study. Patients with corneal opacity, cataract, retinal disease, family history of glaucoma or history of ocular surgery, uncontrolled hypertension, or cardiovascular disorder were excluded. The control group consisted of the subjects with no systemic or ophthalmological disease, with spherical equivalence (SE) lower than ±2 diopter (D) and without history of ophthalmological surgery. Choroidal thickness was measured using spectral domain optical coherence tomography (Nidek SLO/Spectral OCT (RS

3000)) and then compared between the groups. The choroidal thickness was measured from total of seven points in the subfoveal area horizontally at 600µm intervals to a distance of 1200 µm in the nasal and temporal quadrants. The measurement was manually performed by the same physician. The region between the posterior edge of retinal pigment epithelium and the internal edge of sclera was measured as the choroidal thickness. The patients with type 1 diabetes mellitus were assigned to **Group 1** and the control subjects were assigned to **Group 2**.







STATISTICAL ANALYSIS

SPSS (Statistical Package for Social Science) 18.0 package program was used for the statistical analysis of data. Comparison of the categorical data between the groups was done using Chi-square test. Whether the data are suitable for normal distribution was analyzed by Kolmogorov-Smirnov test. Choroidal thickness measurements were compared using a mixed model adjusting for age, axial length, spheric equivalent and intra ocular pressure. Independent samples t test was used for pairwise comparison of the groups. The level of statistical significance was predetermined to be <0.05 for all tests.

RESULTS

Visual acuity was normal in all participants. The mean age was 28.8 years for the patients with type 1 DM and 29.1 years for the control group (p=0.465). There was no statistical difference between the refractive values of the groups **(Table 1)**. In Group 1, subfoveal choroidal thickness was 311.6µm (SD:36.56) in the right eye and 348.7µm (SD:47.11) in the left eye. In Group 2, subfoveal choroidal thickness was 371.0µm (SD:73.02) in the right eye and 368.9µm (SD:110.07) in the left eye **(Table 2)**.

Table 1: The demographic and clinical characteristics of participants.

	age	SE	Axial length	İOP
DM+	28,8±8,9	-0.4±0,56	23,2±0,4	16,2±2,4
DM-	29,1±9,8	-0,25±0,62	23,1±0,3	16,4± 2,1
p	0,465	0,651	0,814	0,843

SE: Spheric equivalent, D; IOP: intraocular pressure; p: Mann–Whitney U test.

Table 2: Choroidal thickness differences between the groups.

	DM+ choroidal thickness value	Standard deviation	DM- choroidal thickness value	Standard deviation	P
Subfoveal ChT Right eye	311,6000	36,56714	371,0000	73,02837	0.829
Temporal-600 ChT Right eye	308,0000	31,92352	366,5000	64,30952	0.825
Temporal-1200 ChT Right eye	306,3000	25,47352	363,3750	58,15236	0.879
Temporal-1800 ChT Right eye	301,7000	28,33549	358,5000	59,63700	0.940
Nasal-600 ChT Right eye	308,8000	47,22241	363,3750	73,57006	0.618
Nasal-1200 ChT Right eye	300,7000	51,92313	343,8750	91,14108	0.578
Nasal-1800 ChT Right eye	295,6000	58,60641	317,7500	96,42280	0.609
Subfoveal ChT Left eye	348,7778	47,11363	368,8750	110,07846	0.542
Temporal-600 ChT Left eye	350,1111	44,07790	373,3750	104,56568	0.767
Temporal-1200 ChT Left eye	356,0000	43,71785	380,2500	100,06819	0.484
Temporal-1800 ChT Left eye	359,1111	43,28812	385,2500	94,16058	0.638
Nasal-600 ChT Left eye	336,4444	46,44650	366,8750	97,02641	0.843
Nasal-1200 ChT Left eye	321,6667	43,58612	338,2500	103,14587	0.673
Nasal-1800 ChT Left eye	301,3333	49,83473	305,2500	87,54876	0.594

ChT: choroidal thickness. P: Independent sample t-test.

The choroidal thickness was thinner in the nasal vs temporal quadrant in both Group 1 and Group 2 (p=0.032). While the choroidal thick-ness was higher in Group 2, the difference was not statistically significant (p=0.145). In Group 2, mean duration of DM was 14±6,1. The mean HbA1c level was 7,2 ±1,4.

DISCUSSION

Choroidal thickness shows variation among different regions of the macula. It is the thickest particularly in the central macula, where the highest energy is consumed, and becomes thinner to the periphery and is remarkable particularly in the nasal quadrant. Choroidal thickness is influenced by the axial length and refractive changes. Examination of the peripapillary topography of the choroid revealed that the choroid is the thinnest in the inferonasal aspect of the optic disc. This thinness is consistent with the localization where the optic fissure is closed in the embryological period (12). In the present study as well, we determined that the choroid is thinner in the nasal quadrant in both groups. In a study conducted by Yolcu et al. in 60 healthy subjects and 60 type 1 DM patients with no retinopathy, the choroidal thickness was found to become thinner in the subfoveal nasal 1500µm and temporal 1500µm quadrants in type 1 diabetes patients, but no difference was determined between the groups for the other quadrants (13). Querques et al. found no difference between the diabetic groups of different stages in terms of change in subfoveal choroidal thickness but reduced subfoveal choroidal thickness in diabetic groups vs the control group (14). Sayın et al. compared subfoveal choroidal thickness between 41 children with type 1 diabetes mellitus and age-matched 42 healthy children and found that diabetes, blood glucose and HbA1c levels have no effect on choroidal structure (15). Esmaeelpour et al. found significantly decreased subfoveal choroidal thickness in diabetic patients with and without DR (16). They reported temporal choroidal thinning extending to the superior and inferior aspects in type 1 diabetic patients with and without DR.

In the present study as well, choroidal thickness of the nondiabetic group was higher than that of the diabetes group but the difference was not statistically significant.

There is no consensus about the choroidal thickness among the studies focusing on type 2 diabetes mellitus. While some studies find thinned choroidal thickness, some studies determine no difference in choroidal thickness. One of the reason for this is the manual measurement of choroidal thickness using OCT devices, which makes the standardization difficult (17). Manual measurement both takes time and may lead to errors. In the presents study, high-resolution OCT was performed and the choroidal thickness was measured manually in all quadrants by the same subject in all participants. Unsal et al. evaluated the choroidal thickness in type 2 DM patients and compared with healthy individuals (18). They found choroidal thinning in both proliferative DR (PDR) and DME patients. However, Kim et al. reported increased subfoveal choroidal thickness rather in the eyes with PDR than in those with no DR (19).

CONCLUSION

The impacts of type 1 diabetes mellitus on the eye are more aggressive than those of type 2 diabetes, but it has lower impact on the choroid, which is rich in vascular structure. Although choroidal thickness was found to be decreased in the type 1 diabetes mellitus, the difference was not statistically significant. It was assumed that the results might change in case the data is augmented with higher number of diabetic patients. In addition, SD-OCT devices enable reproducible, high-resolution and non-invasive imaging of the choroid; however, manual measurement can cause different outcomes. Development of a software that would allow automated measurement of the choroidal thickness is required for the outcomes to be evaluated more accurately.

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