Advances in Research
3(1): 102-106, 2015, Article no.AIR.2015.010
ISSN: 2348-0394

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Comparison of Choroidal Thickness in Normal Subjects and Patients with Diabetes

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Authors' contributions

This work was carried out in collaboration between all authors. Author IY designed the study, wrote the protocol, and wrote the first draft of the manuscript. Author ZA managed the literature searches, analyses of the study performed the spectroscopy analysis. Author AO managed the experimental process. Author ATY identified the species of plant. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/AIR/2015/13245
Editor(s):
(1) Claudia Borza, "Victor Babes" University of Medicine and Pharmacy, Department of Pathophysiology, România.
Reviewers:
(1) Anonymous, Dicle University, Turkey.
(2) Anonymous, Kansai Medical University, Japan.
(3) A. S. Alhomida, Biochemistry, King Saud University, Riyadh, Saudi Arabia.
Complete Peer review History: http://www.sciencedomain.org/review-history.php?iid=645&id=31&aid=6287

Original Research Article

Received 9th Aug 2014
Accepted 20th August 2014
Published 30th September 2014

ABSTRACT

Aims: To evaluate choroidal thickness in diabetes patients and compare the measurements with normal subjects.
Study Design: Cross sectional study.
Place and Duration of Study: Beyoglu Eye Training and Research Hospital, Department of Retina, between April 2014 and July 2014.
Methodology: 100 eyes of 100 diabetic patients (58 female, 42 male) and 50 eyes of 50 healthy subjects (28 female, 22 male) were included in this study. 50 patients with non-proliferative diabetic retinopathy (NPDRP) and 50 patients with proliferative diabetic retinopathy (PDR) involved consecutively start from April 2014. Patients with macular edema were excluded. Choroidal thickness (CT) measured subfoveal and 500 µm intervals up to 1000 µm temporal and nasal to the fovea via Spectralis OCT EDI mode.
Results: There was no difference in age between the groups (p>0.05). The mean CT was 262.4±14.1 µm in control group, 221.2±34.3 µm in NPDRP group and 201.2±27.8 µm in PDR group. The subfoveal CT was significantly thinner in eyes with NPDRP or PDR than normal

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subjects ($p<0.05$). However, there was no significant difference between eyes with NPDRP and PDR ($p>0.05$).
Conclusion: Diabetic retinopathy effects CT and the central choroid is thinner in patients with NPDRP and PDR.

Keywords: Diabetes mellitus; diabetic retinopathy; choroidal thickness.

1. INTRODUCTION

Exact mechanism of the diabetic eye disease has not fully understood yet but the breakdown of the blood-retinal barrier, retinal vasculature integrity, and hemodynamic abnormalities are key factors [1]. Clinical findings suggest that choroidal vasculopathy might also play a role in the pathogenesis of diabetic retinopathy [2]. Various choroidal abnormalities including obstruction of the choriocapillaris, choroidal aneurysms, and choroidal neovascularization have been reported in previous studies [3]. However, evaluating the choroid was not relatively easy. Until recently, the choroid could be evaluated only by indocyanine green angiography, ultrasound and laser Doppler flowmetry. Recently, Spectral-domain optical coherence tomography (OCT) with enhanced-depth imaging (EDI) software allows for high-quality high resolution cross-sectional retinal and choroidal imaging [4,5].

In this study, we aim to measure and compare choroidal thickness (CT) in patients with non-proliferative diabetic retinopathy (NPDR), proliferative diabetic retinopathy (PDR) and compare the measurements with healthy subjects.

2. MATERIALS AND METHODS

This was a cross-sectional comparative study of 100 diabetic patients (58 female, 42 male) and 50 healthy subjects (28 female, 22 male). Patients have chosen consecutively from patients who applied our clinic in Istanbul. First 50 patients with non-proliferative diabetic retinopathy (NPDRP), 50 patients with proliferative diabetic retinopathy (PDR) and 50 healthy subjects were included. Patients with diabetic macular edema were excludedbecause the macular edema and serous retinal detachment in macular area may also affect the choroidal thickness. Inclusion criteria for healthy subjects was not having any ocular pathology rather than low refractive errors (between -3 and +3 D spherical equivalent), not having prior ocular surgery, and not having any systemic disease. The most effected eye from diabetic retinopathy was enrolled for diabetic patients. For healthy patients, the right eye was designated the study eye for subjects with an even number birth month, and the left eye was selected for those with an odd number birth month. All patients were volunteers and informed consent was taken from the participants. The study was conducted according to the declaration of Helsinki.

Choroidal thickness (CT) was measured via Spectralis spectral-domain OCT (Heidelberg Engineering, Inc., Vista, CA) with EDI software. All measurements were taken at the same time of the day, between 9:00 and 10:30 in the morning. Two measurements were taken for all subjects and CT was measured manually with the software of Spectralis. Averages of two measurements were used for comparison. The data was analyzed in SPSS version 20.0 (SPSS Inc. Chicago, IL, USA). The internal repeatability of the CT measurements was analyzed by calculating the intraclass correlation coefficients (ICC). The ICCs ranged from 0 to 1 and were commonly classified as follows: ICC <0.75, poor agreement; 0.75-<0.90, moderate agreement; and >0.90, high agreement. Comparative analyses of three groups were carried out using an independent samples t test and p-value of less than 0.05 was considered to be statistically significant.

3. RESULTS

A total of 150 eyes of 150 participants (86 females, 64 males; mean age 56.2±14.2 years; range, 36 to 76 years) were enrolled for this study. The study population included 50 eyes with NPDRP, 50 eyes with PDR and 500 eyes from normal control subjects.

There was no difference in age between the groups ($p>0.05$). Table 1 shows the patients characteristics by group (Table 1).

Table 2 shows CT measurements for all groups (Table 2). The CT was significantly thinner in eyes with NPDRP or PDR than normal subjects

in all location were measured ($p<0.05$). There was no significant difference between eyes with NPDRP and PDR in subfoveal CT ($p=0.189$).

Fig. 1 shows Spectralis OCT scans with EDI mode of sample patients from each groups (Fig. 1).

Table 1. Patient characteristics by group

Feature	NPDRP	PDR	Control
Age, years (±SD)	58.6±8.4	54.8±6.6	55.2±7.2
(min/max)	36 / 69	45 / 76	40 / 71
Eyes enrolled, n (right/left)	24/26	23/27	28/22

Table 2. The choroidal thickness in five different locations for all groups

Location	Control	NPDRP	p value	PDR	p value
fovea	262.4±14.1	221.2±34.3	0.032	201.2±27.8	<0.001
T500	259.3±13.4	219.2±31.1	0.038	196.4±22.4	<0.001
T1000	249.3±12.5	213.6±29.8	0.032	192.8±28.6	<0.001
N500	251.2±12.9	218.4±20.6	0.022	200.8±24.2	<0.001
N1000	245.3±13.1	212.2±22.8	0.028	195.4±27.2	<0.001

p values measured with independent samples t test. NPDRP and PDR compared with control group

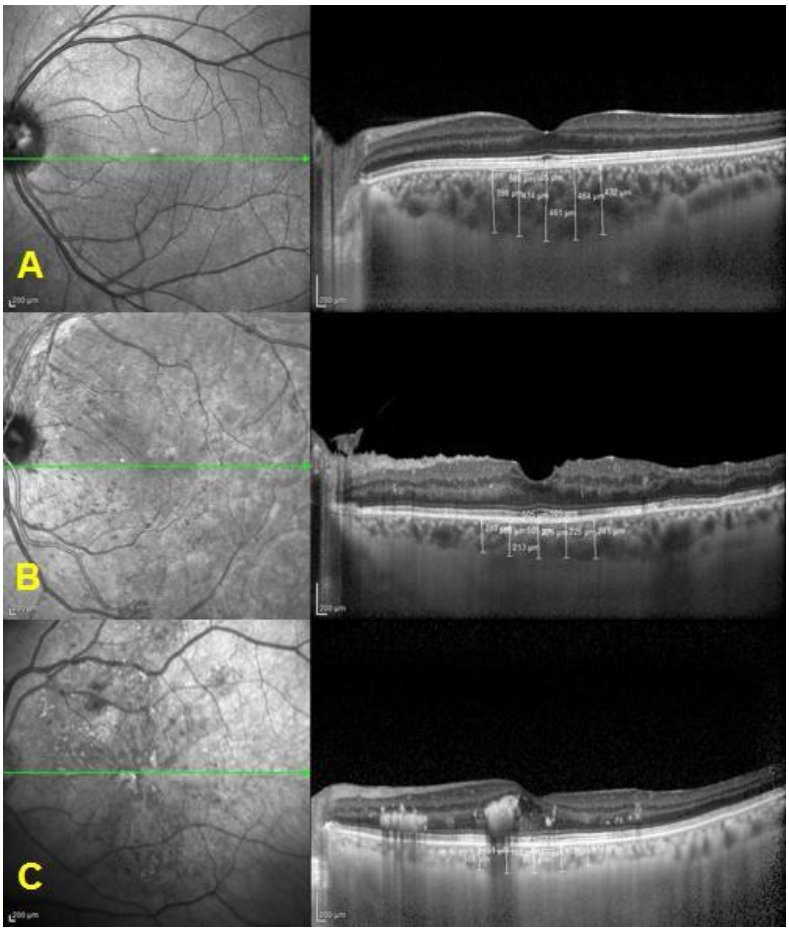

Fig. 1. EDI scans via spectralis OCT. CT is thinner in patients with NPDRP and PDR than healthy subjects

A. Patient from control group, B. Patient with NPDRP, C. Patient with PDR

4. DISCUSSION

The similar metabolic changes affect the retinal and choroidal vascular beds, and that similar growth factors are produced in the diabetic choroid and retina [6]. It was suggested that the choroid is affected from diabetes. Recently, the emergence of spectral-domain OCT technology has allowed for the assessment of the choroidal structure and its thickness [7,8]. OCT allows for assessment of the choroid in vivo and in real time [9]. Spaide et al. [10] described an enhancing depth imaging (EDI) technique to optimize the parameters of OCT acquisition to facilitate visualization of the choroid. In this technique, scan acquisition of the choroid scleral interface is set up adjacent to the zero delay, where sensitivity of the SD-OCT images is highest. A successful examination and measurement of CT in both normal and pathologic states can be achieve with EDI [11].

In this study, individuals manifesting various stages of diabetic retinopathy were compared with healthy controls for the CT measurements on OCT. The results revealed a significant decrease in choroidal thickness for the patients with NPDRP and DRP. There are similar previous studies in literature [12,13]. Regatieri et al. [12] compared NPDR, PDR, and DME patients with healthy controls and reported no significant difference between the NPDR and control groups, but that the CT was decreased in the PDR and DME groups. Unsal et al. [13] reported that CT was found to be significantly decreased in the DME and PDR groups than controls. Lee et al. [2] reported very similar results to our study. They found that both the NPDR and PDR [2].

In our study, similarly to other studies, CT was thickest in the sub-foveal area and got thinner towards the nasal or temporal area [14,15]. This study has some limitations. Some of the PDR patients had laser photocoagulation treatment at different times. However, we found that CT was thinner is in even NPDRP patients, had not any laser treatment, than normal subject. This showed us diabetes changes the CT. Another limitation for this study is some systemic factors which may affect CT such as blood pressure, HbA1c, diabetic duration, smoking and hyperlipidemia have not been researched. Also an axial length was not measured. Strength of this study is the similarity of the groups with age and high case numbers. Also all measurements were taken at about the same time of the day in this study. Unlike retinal thickness, it has been reported that the CT shows a diurnal variation [16,17].

5. CONCLUSION

In conclusion, CT was found to be significantly decreased in patients with NPDRP and PDR, neither patient had previous laser treatment or not. Further investigation will be required to precise the role of choroidal thickness changes in the development of diabetic retinopathy.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sciencedomain.org/review-history.php?iid=645&id=31&aid=6287