

The Topography of the Optic Disc in Diabetic Patients

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Received: June 19, 2016

Revised: July 6, 2016

Accepted: July 9, 2016

Published online: September 18, 2016

Key words: Diabetes mellitus; Optic nerve head; Topography

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Erol YO, Elgin U, Tırhis H, Karakaya J. The Topography of the Optic Disc in Diabetic Patients. *International Journal of Ophthalmic Research* 2016; 2(3): 162-164 Available from: URL: <http://www.ghrnet.org/index.php/ijor/article/view/1761>

INTRODUCTION

Diabetic retinopathy (DR) is one of the most important conditions leading to blindness throughout the world. Etiopathogenesis of DR is still unclear, and current research has been directed at understanding neuro-vascular insufficiency leading to diabetes-associated posterior segment complications such as diabetic retino-choroidopathy, papillopathy and maculopathy^[1,2].

The optic nerve head (ONH) and the peripapillary retinal nerve fiber layer (RNFL) can be evaluated by using confocal scanning laser systems. Heidelberg retinal tomography (HRT) is one of these systems and has become widely used^[3-9]. Structural features of the ONH are well known to predispose to a number of ocular diseases such as nonarteritic ischemic optic neuropathy (NAION)^[10-12]. Therefore, it can be suggested that there may be an interaction structure of the ONH and the eyes of diabetic cases.

The purpose of this study was to evaluate topographic features of the ONH by using HRT in diabetic patients and to compare these results between the patients with and without diabetic retinopathy and the healthy controls, and to investigate the association of ONH topography with DM.

MATERIALS AND METHOD

Fifty-eight diabetic patients and 98 control subjects were enrolled in this prospective study. The diabetic patients were outpatients at the Retina Department of Ankara Ulucanlar Eye Research Hospital. The diabetic participants were divided into two groups; Group 1 [no diabetic retinopathy (NDR)] and Group 2 [non proliferative diabetic retinopathy (NPDR)]. DR was graded according to the

ABSTRACT

AIM: To evaluate the optic disc area by using Heidelberg Retinal Tomograph (HRT) in patients with diabetes mellitus (DM) and to compare it with age and sex matched healthy controls.

METHOD: Fifty-eight diabetic patients and 98 healthy control subjects were enrolled in the study. Diabetic patients were divided into 2 groups: no diabetic retinopathy (NDR) and non proliferative DR (NPDR). Measurement of optic disc area was performed by HRT III. Anova and Kruskal Wallis tests were used for statistical analysis and the degree of association between variables was calculated by Spearman's rho correlation coefficient.

RESULTS: There were 28 eyes in the NDR group and 30 eyes in the NPDR group. Demographic characteristics of patients and control subjects were similar ($p > 0.05$). Disease duration was similar in two groups. Mean disc area was 1.93 ± 0.35 mm in eyes with NDR and 2.08 ± 0.49 mm in eyes with NPDR. Disc area of eyes with NPDR was not different from those with NDR ($p = 0.13$).

CONCLUSION: This study demonstrated that topographic features of the ONH did not differ between the diabetic patients and the control group. There may not be an interaction between DM and ONH topography.

Early Treatment Diabetic Retinopathy Study criteria and the classification of DR was made by the same authors. Time from the date of diagnosis to the beginning of the study was considered as the duration of diabetes. Age at presentation was recorded.

The patients and control subjects had no previous ocular surgery or any laser treatment. None of them had history of trauma, inflammation, migraine attacks, central nerve system and optic nerve diseases or glaucoma or family history of glaucoma. The control subjects had no diabetes mellitus or other systemic diseases. All the control subjects and the patients with DM underwent detailed ophthalmologic examination including the best corrected visual acuity, evaluation of biomicroscopic anterior segment and dilated fundus examination with a 90-D lens. Intraocular pressure (IOP) was measured using a Goldmann applanation tonometer and perimetric examinations were performed by Humphrey automatised perimeter (standart threshold 24-2 programme).

Diabetic patients and control subjects who had intraocular pressures of >21 mmHg, glaucomatous optic nerve changes (vertical cup to disk ratio ≥ 0.3), glaucomatous visual field defects (nasal step, arcuate scotome and defects which respect the horizontal meridian), unreliable optic disc image, optic anomaly (large or small disc), cataract, best corrected visual acuity worse than 20/30 and high spherical (>-5 D or $>+3$ D) or cylindrical ($>+1$ D) refractive errors were not included in the study. None of the eyes included in the study had received previous retinal photocoagulation. Patients with proliferative DR (PDR) were not included, either because the disc area could not be assessed accurately due to neovascularization of the disc, ischemia and optic atrophy.

Optic nerve head analyses of all the eyes were performed by using HRT III (Software Version 1.6). Images were acquired by an experienced physician (UE). The procedure was performed with a $15 \times 15^\circ$ field of view under the same intensity of dim room lighting and without pupillary dilatation. Three topographic images were obtained for each eye and a composite image created from these images was used for data analysis. The disc margin contour line was drawn manually at the inner edge of the scleral ring by determining 8 to 10 points. The software calculated various parameters relative to a reference plane 50 mm posterior to the retinal surface at the papillomacular bundle. The ONH parameters examined included cup area, rim area, disc area, cup-to-disc area ratio, cup volume, rim volume, RNFL cross sectional area, mean RNFL thickness, mean cup depth, maximum cup depth and height variation contour. The groups were matched for age, gender, disc size and refraction. All the subjects had the same ethnic features.

This study was approved by the institutional ethics committee. Written informed consent was obtained from all the patients included. The worst affected eye of the diabetic patients was chosen for analysis. Data analysis was performed with SPSS 15.0 (Statistical Package for Social Sciences, SPSS Inc. Chicago, IL, the United States). One way ANOVA, Welch ANOVA, Chi-square test and Kruskal Wallis test were used for statistical analysis and statistical significance was set as $p < 0.05$.

RESULTS

There were 28 patients with 11 males and 17 females in Group 1, 30 patients with 12 males and 18 females in Group 2 and 98 subjects with 58 females and 40 males in the control group. The differences in the gender between the groups were not significant ($p = 0.98$).

The mean age was 56.07 ± 7.75 years in Group 1 and 61.03 ± 7.82

years in Group 2 and 58.58 ± 5.24 years in the control group. The differences in the mean ages between the groups were not significant ($p = 0.065$).

The mean IOP was not statistically different between the groups ($p = 1.0$). The mean disease duration was 13 years and 14 years in Group 1 and Group 2 respectively and no significant difference was found between the diabetic groups ($p = 0.623$) (Table 1).

Measurements of the disc area were within normal limits in all the eyes (normal range: 1.63-2.43). The mean disc area was 1.89 ± 0.41 mm in Group 1, 2.00 ± 0.53 mm in Group 2 and 2.21 ± 0.37 mm in the control group without a significant difference ($p = 0.586$).

The mean retinal nerve fiber layer thickness was 0.24 mm in Group 1, 0.23 mm in Group 2 and 0.24 mm in the control group. The mean RNFL cross sectional area was 1.17 mm^2 in Group 1, 1.16 mm^2 in Group 2 and 1.34 mm^2 in the control group. There were no significant differences in these parameters between Group 1, Group 2 and the control group ($p = 0.475$ for the RNFL and $p = 0.199$ for the RNFL cross sectional area). Also, the other parameters of the ONH (cup area, rim area, cup-to-disc area ratio, cup volume, rim volume, mean cup depth, maximum cup depth and height variation contour) did not differ significantly between the groups (Table 2).

DISCUSSION

Diabetes mellitus associated with neuronal and vascular defects plays an important part in many ocular complications. Effects of DM on neuro-vascular components and the association of DM with glaucoma may be reflected in the ONH and the RNFL of diabetic eyes^[1,3-7].

The development of optical imaging instruments provided objective and quantitative information for the assessment of the ONH and the RNFL. Confocal scanning laser ophthalmoscopy, scanning laser polarimetry and optical coherence tomography (OCT) are various technologies which make use of different properties of light and different characteristics of tissue to obtain their measurements. HRT has been designed specifically for imaging of the ONH. It enables comprehensive mapping of the contour of the ONH as well as quantitative measurement of disc parameters. In addition, it has some advantages such as obtaining rapid imaging without pupil dilatation, imaging in blurred media and high repeatability. The HRT analysis simply yields more information and more parameters^[8-13]. In this study, topographic features of the ONH in diabetic eyes were investigated with HRT III.

The quantification of the ONH (topographic parameters) has been utilized primarily in the evaluation of glaucoma; and reports of HRT usage in non-glaucomatous optic nerve diseases are still quite limited^[8,9]. However, there are only a few reports regarding changes in RNFL and ONH structures in diabetic patients by using HRT^[14,15]. In a study by Tekeli *et al*, HRT I was used in order to analyse topographic characteristics of the optic disc in eyes with diabetes. They compared optic nerve topographic changes between healthy subjects (50 eyes) and diabetic patients with NPDR (18 eyes) and

Table 1 Number, gender, mean age, mean intraocular pressure (IOP) and mean disease duration of all patients (SD: Standard Deviation, F: female, M: male).

	Group 1	Group 2	Control Group	P vaule
Number of patients	28	30	98	
Mean age \pm SD	56.07 ± 7.75	61.03 ± 7.82	58.58 ± 5.24	0.065
Gender (M/F)	11/17	12/18	40/58	0.98
Mean IOP \pm SD	15.38 ± 3.75	16.41 ± 4.19	16.15 ± 3.28	0.318
Mean disease duration (years) \pm SD	13 ± 4.48	14 ± 6.26		0.623

Table 2 Optic disc topographic parameters of group 1, 2 and control group.

	CA	CV	HVC	RA	DA	C/D area	RV	MCD	Max CD	RNFLT	RNFL csA
Mean±SD											
Group 1	0.43 ± 0.31	0.08±0.07	0.41±0.09	1.46±0.35	1.89±0.41	0.22±0.14	0.39±0.15	0.18±0.06	0.54±0.19	0.24±0.08	1.17±0.43
Group 2	0.42 ± 0.40	0.08±0.01	0.43±0.24	1.57±0.30	2.00± 0.53	0.19±0.14	0.43±0.13	0.17±0.08	0.47±0.18	0.23±0.06	1.16±0.36
Control group	0.37 ± 0.31	0.07±0.11	0.39±0.13	1.61±0.37	2.31±0.37	0.15±0.11	0.52±0.22	0.15±0.07	0.48±0.22	0.24±0.06	1.34±0.39
P value	0.593	0.525	0.354	0.431	0.586	0.679	0.761	0.122	0.348	0.475	0.199

CA: cup area; CV: cup volume; HVC: height variation contour; RA: rim area; DA: disc area; C/D area: cup to disc area; RV: rim volume; MCD: mean cup depth; max CD: maximum cup depth; RNFLT: retinal nerve fiber layer thickness; RNFLT csA: retinal nerve fiber layer thickness cross sectional area.

diabetic patients with no DR (29 eyes). Tekeli *et al* reported that the mean disc area, cup area, cup volume and cup depth in control eyes and diabetic eyes were not significantly different and they suggested that DM might not lead to a volume reduction of the neuroretinal rim in non-glaucomatous diabetic patients^[14]. Elgin *et al* using HRT III, compared optic disc topography parameters between cases of juvenile DM without DR and healthy children and they found similar topographic characteristics of the optic discs in the diabetic and the healthy subjects^[15]. Similarly, HRT evaluation of the ONH showed no difference between the diabetic eyes and the control group in the present study.

Also, various studies have reported that topographic features of the ONH has a characteristic role in the progression of some ocular diseases such as NAION and Leber's Hereditary Optic Neuropathy (LHON)^[10-13]. A small optic disc characterizes eyes with optic nerve axon crowding and it is well known that a small and crowded disc is a risk factor for NAION. The ONH in NAION has been characterized by a small disc area and no or minimal cupping. In their study, Saito *et al* compared topographic parameters of the ONH between 33 patients with NAION and 33 patients with open angle glaucoma and they found that the eyes with NAION had quantitatively smaller and shallower cups and larger rim areas than those with open angle glaucoma^[10]. In another study, Ramos *et al* compared ONH morphology between 15 LHON-affected patients and 45 LHON-unaffected carriers and they found that the ONH size was larger in the LHON-unaffected carriers than in the LHON-affected patients. They suggested that a large ONH has a protective role^[13]. In the present study, eyes with NPDR were not different from those with NDR in terms of disc area and the range of disc area was within normal limits. Therefore, it can be suggested that disc size may not be an additional risk factor for DR and that disc area and RNFL thickness do not help to distinguish NPDR from NDR.

In the present study, topographic parameters of the optic discs in the diabetic patients were compared and evaluated by using HRT III according to the grade of diabetic retinopathy. HRT parameters such as mean disc area, cup area, cup volume, rim volume and cup depth were not different in the diabetic patients.

In conclusion, lack of interaction between DM and ONH topography and disc size may not play a role in DR. Effects of disc size on the development of DR should be investigated in diabetic eyes with small disc sizes.

ACKNOWLEDGMENTS

The authors have no proprietary or financial interest in any of the products used in this study.

CONFLICT OF INTERESTS

The authors declare that they do not have conflict of interests.

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