Original Article

Retinal nerve fiber layer and ganglion cell complex thickness in patients with type 2 diabetes mellitus

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Aim: The aim of the following study is to evaluate the retinal nerve fiber layer (RNFL) and ganglion cell complex (GCC) thickness in patients with type 2 diabetes mellitus (DM). **Materials and Methods:** Average, inferior, and superior values of RNFL and GCC thickness were measured in 123 patients using spectral domain optical coherence tomography. The values of participants with DM were compared to controls. Diabetic patients were collected in Groups 1, 2 and 3. Group 1 = 33 participants who had no diabetic retinopathy (DR); Group 2 = 30 participants who had mild nonproliferative DR and Group 3 = 30 participants who had moderate non-proliferative DR. The 30 healthy participants collected in Group 4. Analysis of variance test and a multiple linear regression analysis were used for statistical analysis. **Results:** The values of RNFL and GCC in the type 2 diabetes were thinner than controls, but this difference was not statistically significant. **Conclusions:** This study showed that there is a nonsignificant loss of RNFL and GCC in patients with type 2 diabetes.

Key words: Ganglion cell complex, optical coherence tomography, retinal nerve fiber layer, type 2 diabetes

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Diabetic retinopathy (DR) is one of the most frequent causes of blindness in the working age population. As the prevalence of diabetes mellitus (DM) increases globally and patients live longer, the development of DR as a microvascular complication of DM also rises.[1] DR classified non-proliferative (NPDR) and proliferative (PDR). The optical coherence tomography (OCT) has been used for evaluation the thickness of retinal nerve fiber layer (RNFL) and ganglion cell complex (GCC) in some diseases.[2-8] The purpose of this study was to compare the RNFL and GCC thickness between diabetic patients and healthy subjects.

Materials and Methods

Two hundred and forty-six eyes of 123 patients were evaluated prospectively.

Inclusion criteria for diabetic patients were type 2 DM. Group 1 (n = 33) included patients who had no DR, Group 2 included 30 patients who had mild NPDR (n = 30 patients) and Group 3 (n = 30) included patients who had moderate NPDR. The control Group 4, included 30 healthy patients who have no systemic or ophthalmologic problems.

All patients in the control group were evaluated for undiagnosed DM [Table 1]. All participants evaluated by retinal specialists through indirect fundoscopy, slit-lamp stereo biomicroscopy and fundus fluorescein angiography. Mild NPDR was defined as microaneurysms only, moderate NPDR was defined more than just microaneurysms, but less than severe NPDR by international clinical DR disease severity scale.[9]

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Exclusion criteria were refractive error (spheric Equivalent) >±3.00 diopters, visual acuity below 0.1 logarithm of the minimum angle of resolution, had significant media opacity, a history of glaucoma, uveitis, retinal disease, grade of DR >moderate DR and history of intraocular surgery in the last 6 months. All subjects underwent pupillary dilation (Tropicamide 1%, Alcon Lab, Inc., USA) and an ophthalmologic examination, including slit-lamp biomicroscopy (SL, Tokyo, Japan) with a +78 diopters handheld lens and OCT. Fundus fluorescein angiography (Kowa VX-10i, Kowa Company, Ltd., Tokyo, Japan) was performed in diabetic patients for excluded severe or proliferative retinopathy. The mean glycosylated hemoglobin (HbA1c) was calculated from all available HbA1c measurements in the last 6 months preceding the study visit in the diabetic patients. RNFL and GCC thickness were measured using spectral domain OCT (RTVue-100, Optovue Inc., Fremont, CA, USA).

The study adhered to the tenets of the Declaration of Helsinki. All participants gave written informed consent. This study was approved by local Ethics Committee. Statistical analyses were performed with SPSS 18.00 for Windows (SPSS, Chicago, IL, USA). Analysis of variance was used to assess differences in average age between diabetic patients with no DR, mild and moderate NPDR and controls. Average HbA1c and duration of diabetes were compared using the unpaired t-test between patients with no DR, mild and moderate NPDR.

Results

One hundred and twenty-three patients (246 eyes) were analyzed. The characteristic features of participants in four groups were summarized in Table 1. HbA1c level significantly higher in the patients with DM compared to the controls. The ratio of HbA1c was similar in diabetic patients. The values of RNFL and GCC are given in Table 2. GCC and RNFL were thinner in patients with DM compared to control but this difference was not statistically significant [Table 2].

Table 1: The characteristic features of participants in four groups

Parameters	Group 1	Group 2	Group 3	Group 4	*P*
n (participants)	33	30	30	30	NS
Mean age	59.4±10.7	59.6±9.8	60±9.4	58.5±10.5	NS
Men/female	15/18	14/16	15/15	16/14	NS
VA (logMAR)	0.1±0.1	0.1±0.1	0.1±0.1	0.1±0.1	NS
IOP	18.0±1.6	19.0±1.9	16.9±2.0	17.9±1.6	NS
HbA1c %	8.1±1.6	8.0±1.9	8.2±2.0	5.1±0.5	S

HbA1c: Glycosylated hemoglobin, VA: Visual acuity, logMAR: Logarithm of the minimum angle of resolution, IOP (mm Hg): Intraocular pressure, SD: Standard deviation, S: Significant, NS: Non-significant

Table 2: The values of GCC and RNFL inf., sup., avg. in four groups

Parameters	Group 1	Group 2	Group 3	Group 4	*P*
Avg. RNFL	103.8±10.2	103.5±11.7	101.3±13.7	106.3±9.2	NS
Sup. RNFL	102.5±12.1	102.1±14.6	99.1±13.8	104.4±9.9	NS
Inf. RNFL	105.3±11.5	104.9±11.7	103.5±16.1	108.3±11.4	NS
Avg. GCC	96.8±7.9	94.4±6.3	95.7±8.5	97.8±8.0	NS
Sup. GCC	96.7±15.7	93.4±7.7	92.6±13.0	97±7.9	NS
Inf. GCC	96.9±9.1	95.5±6.4	97±7.8	98.5±10.3	NS

Avg: Average, Sup: Superior, Inf: Inferior, GCC: Ganglion cell complex, RNFL: Retinal nerve fiber layer, NS: Non-significant

Discussion

The previous studies no showed absolutely agreement for status of RNFL and GCC in patients with type 2 DM. A study found that at early stage of DR, the macula and RNFL thickness were altered.[10] A study showed that only inferior RNFL thinning associated with peripheral neuropathy but age, duration of disease and retinopathy levels did not significantly influence RNFL thickness.[7]

An another study showed that only superior quadrant peripapillary RNFL thickness was slightly less in diabetic patients than normal subjects.[11]

This study was aimed to inspect the thickness of RNFL and GCC thickness in patients with type 2 DM.

The present study had some limitations. The sample size was small and study was not included patients severe NPDR or PDR. The grading of the severity of DR was done through ophthalmologic examination, including indirect fundoscopy and slit-lamp stereo biomicroscopy, instead of the gold standard, namely, seven-field stereoscopic fundus photography assessment by independent trained graders.

Conclusions

The RNFL and GCC thickness were thinner in patients with type 2 diabetes than controls, but this thinning was not statistically significant.

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