



The association between the quality of life and the retinal nerve fiber layer thickness in patients with glaucoma

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Abstract:

Research found associations between quality of life (QoL) scores, structural and functional measurements in glaucoma. However, structural associations with QoL only used global retinal nerve fiber layer (RNFL) thickness in which individual sectors may demonstrate more RNFL thickness loss than the global thickness. We aimed to evaluate the QoL in glaucoma patients and its association with global, superior and inferior RNFL thicknesses. We recruited 30 glaucoma patients to conduct a self-report questionnaire to assess their QoL. We also evaluated the association between the questionnaire scores and the global, superior and inferior RNFL thicknesses as we retrospectively analyzed them in patients and in age-similar controls. Because the QoL reduction was in percentages, we converted the RNFL thickness loss to percentages, as compared to 30 healthy participants. We found that the most affected category of the QoL by glaucoma was role difficulties (44.73% loss) while the least was color vision (10% loss). The strongest association was between the QoL scores and global RNFL thickness ($R^2 = 0.34$), followed by the association with the inferior sector ($R^2 = 0.28$). We demonstrated the glaucoma effect on the QoL, indicating that early and accurate diagnosis should be potentially implemented to reduce the consequences of glaucoma. We also showed that global and inferior RNFL thicknesses may help understand the association between the QoL scores and the RNFL thickness.

Keywords: Glaucoma, Quality of life, Visual Function Questionnaire-25, Retinal nerve fiber layer thickness, global thickness, Superior and Inferior RNFL thickness.

Introduction

Glaucoma is a leading cause of the irreversible visual impairment worldwide. It has been demonstrated that glaucoma affects several aspects of daily life activities, such as driving, reading, and mobility.(1, 2). This leads to a low quality of life in individuals affected by glaucoma. Meanwhile, the global number of people with glaucoma is expected to increase from 76 in 2020 to 111.8 millions in 2040.(3) The assessment of quality of life in glaucoma patients in correlation with structural and functional changes leads to understand glaucoma consequences the quality of life and to develop effective preventative approaches to reduce these consequences.

Several studies used self-report responses accompanied with functional and structural measurements, in order to evaluate the quality of life in patients with glaucoma. The most commonly used measurement of the self-reported responses of the quality of life, was National Eye Institute Visual Function Questionnaire-25 (NEI-VFQ-25).(4) The questionnaire had been used to correlate the quality of life in glaucoma with functional measurements such as visual field testing.(5-12) These studies demonstrated that the NEI-VFQ-25 was correlated with functional defect in patients with glaucoma, and it can be used to as a measurement parameter to indicate glaucomatous defect in individuals.

Recently, several studies investigated the association between the structural defect in glaucoma in one hand and scores of the vision-related NEI-VFQ-25 with the visual field testing in the other hand.(13-16) The structural measures were obtained with optical coherence tomography (OCT) and

included retinal nerve fiber layer (RNFL) thickness, macular thickness and ganglion cell complex (GCIPL) thickness. The worsening of the NEI-VFQ-25 scores was associated with the thinning of the RNFL and macular thickness. However, the global RNFL thickness was the only parameter used for the RNFL measurement, while clinical evaluation considers superior and inferior sectors of the measured RNFL. Evaluating superior and inferior sectors of the RNFL is critical because these two sectors correspond to the inferior and superior visual fields, respectively, in which glaucoma defect respects the horizontal line of the visual field at the mild and moderate stages.

In the current study, we aimed to evaluate the quality of life in patients with glaucoma and to assess the association between the quality of life in patients with glaucoma and the RNFL thickness using spectral domain OCT. To assess the quality of life, we conducted the NEI-VFQ-25 questionnaire. In addition to the global thickness of the RNFL measurements with the OCT, the measured thicknesses of superior and inferior sectors were included to explore their association with the scores of the NEI-VFQ-25.

Material and methods

Participants:

Thirty patients with glaucoma and 30 age-similar participants were recruited for this prospective study. The questionnaire was prospectively conducted to patients. For the patients and control participants, the OCT data were retrospectively analyzed. Only participants between the age of 40 and 70 years were required. The definition of the glaucoma was based on the diagnosis

reported in the patient clinical charts. Common inclusion criteria were best corrected visual acuity of 20/30 or better, absence of ocular and systemic disease except glaucoma, absence of complicated ocular surgery within the past 6 months, clear ocular media and absence of systemic diseases that affect visual functions. Additional inclusion criteria for control participants were a range of 11-21 mmHg of intraocular pressure and absence of family history with glaucoma. The refractive error was required to be with range of - 6.0 diopters to + 3.0 diopters. We also asked several questions regarding the daily activities to confirm a good cognitive ability of the participants. The study was approved by the institutional review board of Qassim University, Saudi Arabia. Informed consent was obtained from each participant. The procedures of this study adhered the Declaration of Helsinki.

Optical Coherence Tomography data:

Circumpapillary retinal nerve fiber thickness measurements were retrospectively analyzed. These measurements were recorded from the printouts of the spectral-domain OCT (Topcon Maestro 2, Tokyo, Japan) in which circle B-scan around the disc was taken. Global, superior and inferior RNFL thickness measurements were used in the analysis. Scans with segmentation errors or degraded images were excluded.

National Eye Institute Visual Function Questionnaire-25:

The NEI-VFQ-25 is consisted of 11 subscales that contain 51 items. These subscales include general health, general vision, near and distance vision activities, ocular pain,

vision related social function, vision related role function, vision related mental health, vision related dependency, driving difficulties, color vision, and peripheral vision. We used the scoring system as described in the Mangione and colleagues.(4) Accordingly, the quality of life score for each participant and for each category was calculated in percentages. The questionnaire was printed and described to the participants, and opportunity was given to participants to ask questions. The Arabic version of the NEI-VFQ was previously validated,(17) and used in the current study.

Statistical analysis:

Descriptive statistics of the questionnaire scores was performed in order to assess the most activities affected by glaucoma. The optimum scores were considered to be 100% for each subscale, the reduction was expressed in the percentages. In addition, the association between the scores of NEI-VFQ-25 and the measured RNFL thickness was evaluated. To establish comparable measurements, units of the NEI-VFQ-25 and the RNFL thickness measurements were unified, in which the reduction in the RNFL thickness was converted to percentages. The calculation of the of the RNFL reduction, in percentages, in patients was based on the mean values of the RNFL thickness that was found in 30 control participants. This association was evaluated in the superior and inferior sectors of the RNFL thickness measurements.

Results

Figure 1 shows the average scores of the quality of life for each category of the questionnaire in the patients. It can be

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observed that the most affected category by glaucoma was the “role difficulties” (42.3%) followed by “mental health” (51.3%). On the

other hand, the least affected category was “color vision” (90.2%) followed by “social functioning” (81.3%).

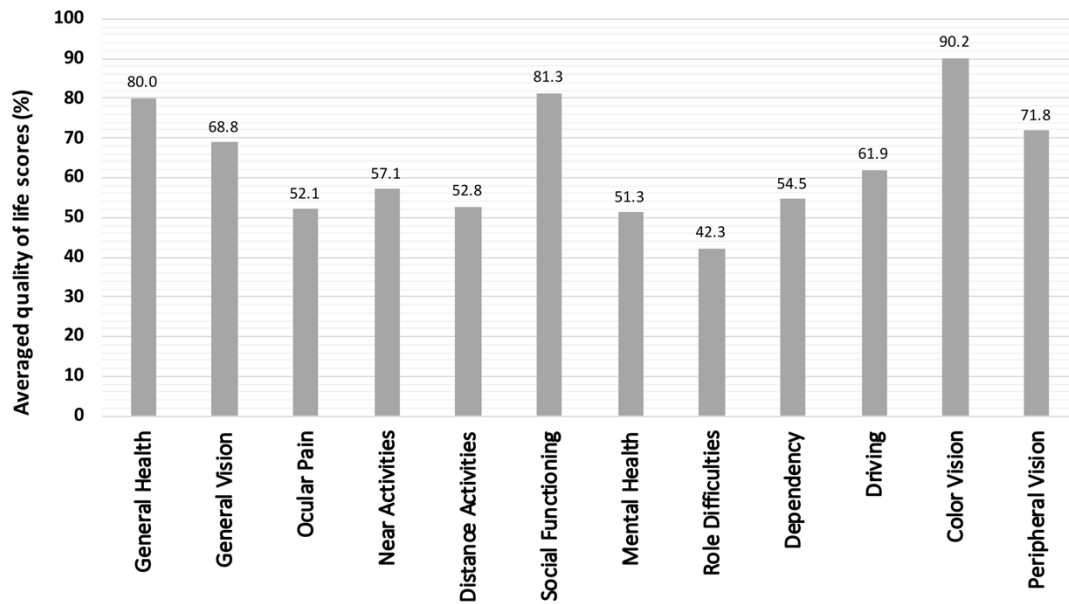


Figure 2: Averaged quality of life scores across all 30 patients, for each category of the National Eye Institute Visual Function Questionnaire (NEI- VFQ25). The lowest quality of life score was the “Role Difficulties” while the least affected category was the “Color Vision”.

in control participants and patients were 122 and 74 microns, respectively ($p < 0.05$). For the inferior RNFL thickness, the average was 124 microns in control participants and 75 microns in the patient group ($p < 0.05$).

Figure 2 shows the association between

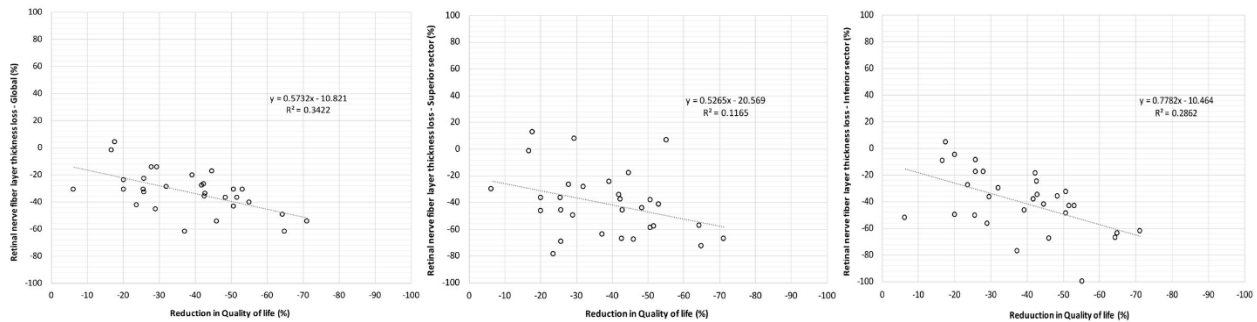


Figure 1: Retinal nerve fiber (RNFL) thickness loss as a function of the reduction in the quality of life in percentages for both. Left panel is for the association with global RNFL thickness, middle panel is the for association when the Superior RNFL thickness is considered and right panel is for the association when the Inferior RNFL thickness was used.

The average global RNFL thickness in control participants and patients were 97.14 and 67.8 microns, respectively ($p < 0.05$). The average of the superior RNFL thickness

the decrease in the quality of life and the loss in the RNFL thickness in the patient group. The strongest association was found to be between the reduction in the quality of life

and the loss of global RNFL ($R^2 = 0.34$), as it can be seen in panel A, followed by the association between the reduction in the quality of life and the loss of the RNFL in the inferior sector ($R^2 = 0.28$), panel C. The weakest association was between the reduction in the quality of life and the loss of the RNFL thickness in the superior sector ($R^2 = 0.11$), panel B.

Discussion

In this study, the aim was to evaluate the quality of life in glaucoma patients using the NEI-VFQ-25 scores, and to determine the association between the reduction in the quality of life and the loss of the RNFL thickness using the spectral domain OCT. The reduction in the quality of life scores was in the range of 50% to 60 % in 6 categories of 11 categories of the questionnaire. It was found that the global RNFL thickness had the strongest association with the reduction of the quality of life in patients. These results could be interpreted as an indication for the potential use of the NEI-VFQ-25 questionnaire for patients with glaucoma in which consequences of glaucomatous defect could be estimated. This study also showed the possible potential use of the inferior RNFL thickness loss in the association with the quality of life score.

The NEI-VFQ-25 showed the reduction of the quality of life in glaucoma patients which is consistent with other studies that found associated visual field loss,(5-7, 9, 18-20) reduction of the RNFL thickness,(9, 16) and reduction macular retinal ganglion cell plus inner plexiform layer thickness.(14) The NEI-VFQ-25 questionnaire is a useful tool because it is easy to conduct and it is a quick tool to indicate the starting point of the glaucoma effect on the quality of life. In

addition, the use of NEI-VFQ-25 scores could be helpful when monitoring the progression of the disease in corresponding with changes in structural and functional measures.(21, 22) The only difference of the current study from others mentioned above is that glaucoma suspects were not included. The reason was that while the association between the questionnaire with superior and inferior sectors of the RNFL thickness was established, the RNFL measurements of the glaucoma suspect would play as confounders within the association.

Several studies evaluated the association between the quality of life and the RNFL thickness in glaucoma patients, using global RNFL thickness.(9, 13, 16) The current study did not have perimetric data as these studies had, this is a limitation of the current study. Visual field data would strengthen the results. On the other hand, the current study demonstrated the association of the superior and inferior sectors of the RNFL thickness which were not used in previous studies. A study by Blumberg and colleagues (23) assessed glaucomatous damage at the macular region using the retinal ganglion cell plus inner plexiform layer thickness and compared it with visual field loss and scores of the NEI-VFQ-25 questionnaire. However, there might be unreported glaucomatous defect in other regions outside the macula such as superior and inferior arcades, which were included in the current study.

It is important to include RNFL sectors to be used as alternative of the global RNFL thickness as there might be cases that have localized glaucomatous defect, that is only detected with one sector and not by the global RNFL thickness.

Although it has been shown that superior temporal and inferior temporal of the RNFL

thickness measurements are limited by the contribution of large retinal vessels,(24, 25) the measurements of these sectors still useful in determining the thinning of the RNFL thickness. This was shown in this study where the RNFL thickness in the inferior sector had a moderate association with the reduction in the quality of life ($R^2 = 0.28$), which is close to the moderate association found between the global thickness loss and the reduction in the quality of life ($R^2 = 0.34$). In a recent studies, the use of en face view of the RNFL bundles enables the detection of the localized defect across the central retina that is not detectable within the circumpapillary RNFL thickness measurements.(26) The addition of the inferior sector of the RNFL thickness might be beneficial component when evaluating the association between the scores of the NEI-VFQ-25 questionnaire and the RNFL thickness. This addition would also help develop potential estimate of the association between the structural and functional measures as well as scores of the NEI-VFQ-25 questionnaire.

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