

ORIGINAL ARTICLE

Correlation Between Visual Field Functional and Optic Nerve Disc Structural Damage of Patients With Glaucoma

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SUMMARY:

Introduction. Retrospective study were made to find out the correlation between visual field functional and optic nerve disc structural damage of patients with glaucoma in early and late stage of disease.

Aim of the study. The aim of the present research was to characterize the relationships between visual field functional and optic nerve disc structural damage of patients with glaucoma in different stage of disease and create the basis of correlation.

Material and methods. Together 94 patients (137 eyes) were analyzed from Pauls Stradins clinical university hospital ophthalmology clinic, whom during years 2010 – 2012 were made computerized visual field at least more than 3 times and optical coherence tomography (OCT) research in one day. Following data as retinal nerve fiber layer scan with OCT of optic nerve disc and visual field were analyzed. Patients were divided into two groups according to the vision field functional damage severity. First group - patients in moderate stage of glaucoma, but second – in late stage of disease. From visual field examination was rated numerical corrected/pattern deviation map from age related norm values and compared with OCT Spectralis optic nerve retinal nerve fiber layer measurements using Garway – Heath map.

Results. The average age of patients were 73.94 years $\pm$ 6.95 years. Glaucoma in moderate stage was diagnosed in 96 (70.1%) of patients eyes, but in late stage – 41 (29.9%) eyes. In moderate stage the positive correlation was found in 72.9%% (70/96), but in 27.1% the correlation was not found with one of the diagnostic methods. ($p < 0.01$). Looking trough out the results in moderate stage of disease the structural damage was recognized in 91.66% (88/96) cases, but functional visual field loss in 81.25% (78/96) cases. In severe stage of glaucoma the positive correlation between the diagnostic methods was in 92.68% (38/41), but in 7.32% (3/41) the OCT didn't show the damage as wide as visual field. ($p < 0.18$).

Conclusion. Correlation between functional changes diagnosed by OCT RNFL scan and structural damage shown by computerized perimetry data seems to depend on the stage of glaucoma.

Key words: glaucoma, visual field functional damage, optic nerve disc structural damage, optical coherence tomography retinal nerve fiber layer scan, computerized perimetry

INTRODUCTION

Functional loss in glaucoma is usually insidious and starts peripherally, leaving patients asymptomatic in the early stages of the disease. Currently, we do not have any clinically applicable direct way to measure neuronal loss in glaucoma and we use, instead, different surrogate measures to estimate the functional and structural loss in this disease. It is a paramount importance to have sensitive and specific tests to detect subtle optic nerve and/or visual field changes both for early diagnosis of the disease and for monitoring it. Optic disc and visual field assessments are a complex task, that have become an integral part of glaucoma management. Until recently, most studies have relied on subjective and nonquantitative ways to assess structural damage. With the advantage of automated imaging techniques, we have, for the first time, the capability to reliably quantify structural loss in glaucoma. (10) It is fair to say that these new structural tests as optical coherence tomography (OCT) and functional tests as automated perimetry are allowing us to reexamine the nature and the strength of structure – function correlation in glaucoma.

AIM OF THE STUDY

The aim of the present research was to characterize the relationships between visual field functional and optic nerve disc structural damage of patients with glaucoma in different stage of disease and create the basis of correlation.

MATERIAL AND METHODS

In this retrospective study, wich was conducted in Pauls Stradins Clinicac University Hospital, Ophthalmology clinic, together 94 patients with before diagnosed glaucoma were analyzed, whom during years 2010 – 2012 were made computerized visual field and OCT spectralis optic disc retinal nerve fiber layer scan researches in the same day. Patients were divided into two groups according to visual field damage criteria from American Academy of Ophthalmology ICD-9 glaucoma staging. First group of patients, who had moderate-stage of glaucoma (optic nerve disc abnormalities consistent with glaucoma and glaucomatous visual field abnormalities in one hemi field, second group consisted of patients with severe-stage of glaucoma, advanced-stage glaucoma, end-stage glaucoma (optic nerve abnormalities consistent with

glaucoma and glaucomatous visual field abnormalities in both hemi fields. (9)

To assess functional damage, the numerical corrected/pattern deviation map according to age related norm values from the glaucoma hemifield test of computerized visual field were rated, which is highly believed the single most useful statistical analysis for glaucoma diagnostics and monitoring. (1) To differentiate the glaucomatous visual field damage from normal visual field, only deviation of -5dB or greater from age related-normal sensitivity, which is quite unusual-and therefore statistically significant, was accepted for further analysis. (3) To measure the damage of optic disc the optical coherence tomography (OCT spectralis) retinal nerve fiber layer (RNFL) scan and analyses were overlooked. (Table 1. Table 2.)

To evaluate the structure-function relationship the Garway-Heath dot map was used as an example of topographic map for correlating areas of visual field to the optic disc. (11)

In Pauls Stradins Clinical University Hospital, ophthalmology clinic for glaucoma diagnostics generally 30-2 point system of glaucoma hemifield visual field is used, which measure visual sensitivity at 76 locations, but Garway-Heath map is designed for 24-2 visual field point test, which consists of 54 test points, which are the most central test locations and subset of those in the 30-2 test pattern. Essentially a 24-2 test is just a 30-2 with all of the outer ring of test points removed, except for the nasal-most two. (2)

All the comparison of data named before consisted of 3 steps:

1. Modification of the visual field 30-2 pattern test analyses to 24-2 pattern test.
2. Finding out statistically significant (-5 dB or more) visual field damage points.
3. Converting the appropriate visual field areas to OCT retinal nerve fiber layer scan test according to Garway-Heath dot map.

Data were analyzed using SPSS statistical program version 21.0 and Microsoft Office Excel 2007. The obtained results were compared using χ square method correlation test. The p value < 0.05 was accepted as statistically valid.

RESULTS

As mentioned before 94 glaucoma patients (137 eyes) with different stage according to damage of the visual field were included in the study. The average age of patients was 73.94 years $\pm$ 6.95 years. 62.5% females, 37.5% males. Glaucoma in moderate stage was diagnosed in 96 (70.1%) of patients eyes, but in late/severe stage – 41 (29.9%) eyes. In moderate stage of glaucoma the positive and statistically proved correlation between functional and structural damage was found in 72.9% (70/96) of cases, but in 27.1% (26/96) the damage was not found with one of diagnostic methods. (Table 3.) ($p < 0.01$ χ square method). Looking through out the results in moderate stage of disease the structural damage was recognized by OCT in 91.66% (88/96)

eyes, but functional visual field loss in 81.25% (78/96) eyes. (Table 4.) In late stage of glaucoma patients the positive correlation between the diagnostic methods was found in 92.68% (38/41) eyes, but in 7.32% (3/41) the OCT didn't show the damage as wide as visual field. (Table 5.) Unfortunately the correlation between those two diagnostic tests in the late stage of the disease was not statistically proved. ($p < 0.18$ by χ square method).

DISCUSSION

There is no discussion that structure and function are correlated in glaucoma and both are important for making diagnosis of the disease and/or for monitoring it. Studies that examined in greater details the structure-function relationship in glaucoma patients have produced variable results. (5; 7) The strength of the relationship seems to depend strongly on the stage of the disease, as well as on the techniques used to measure the structure and function. (8) It is frequently believed that optic disc changes and, particularly, RNFL changes often occur before detectable visual field loss. According to our results optic disc examination is more useful at earlier stages in glaucoma.

As the disease progresses, and in end-stage glaucoma, visual field examinations become increasingly important in monitoring glaucoma, since often in advanced glaucoma the tests measuring structure do not have any dynamic range left to allow for meaningful clinical decisions. (6) In individuals with well-established glaucoma, there is often disconnection between structural and functional progression, due in part of limitations in our ability determine progression with current clinical measures.

There are a number of limitations in the assessment of the relationship between structure and function in glaucoma: (1) problems related to variability of functional and structural measures; (2) the fact that stimulus size in automated perimetry is typically uniform across the visual field, leading to a mismatch between stimulus size and the respective field size, which increases with eccentricity; (3) the debate as to whether there is selective loss of certain subpopulations of retinal ganglion cells in glaucoma; (4) problems with background luminance in automated perimetry; and (5) peripheral optical defocus due to peripheral refractive errors. (4)

It is only fairly to say that there is no irreplaceable diagnostic method for glaucoma diagnostics and monitoring. The computerized visual field, OCT optic nerve disc retinal nerve fiber layer scan compliments each other.

CONCLUSION

Correlation between functional changes diagnosed by OCT RNFL scan and structural damage shown by computerized perimetry data seems to depend on the stage of glaucoma. Optic disc examination with OCT retinal nerve fiber layer scan is more useful at earlier stages in glaucoma, but in advanced disease the visual field become more important for monitoring glaucoma.

Table 1. OCT RNFL scan of moderate stage glaucoma.

From Ophthalmology department of Pauls Stradins clinical university hospital.

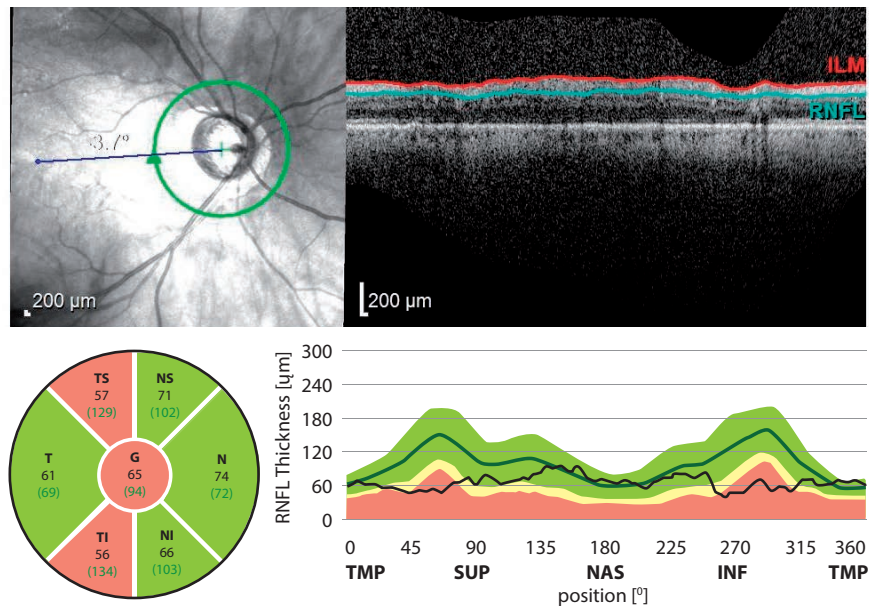


Table 2. OCT RNFL scan for severe stage glaucoma.

From Ophthalmology department of Pauls Stradins clinical university hospital.

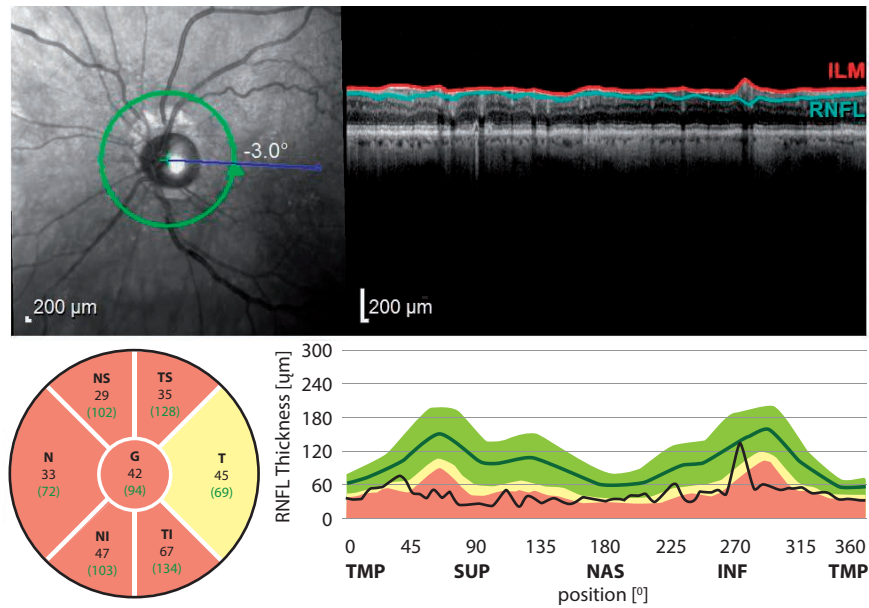


Table 3. Strength of function-structure in moderate stage of glaucoma

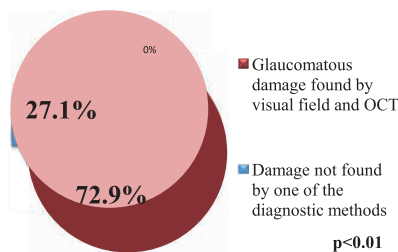


Table 4. Moderate stage of glaucoma

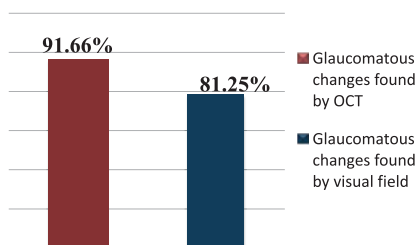
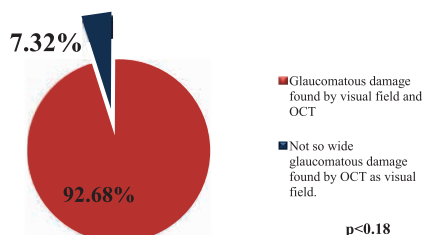


Table 5. Strength of function-structure in severe stage of glaucoma



Conflict of interest: None

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