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COMPARISON OF PERIPAPILLARY RETINAL NERVE FIBRE LAYER THICKNESS VS PERIMACULAR GANGLION CELL LAYER THICKNESS OF OCT WITH PERIMETRY IN GLAUCOMA SUSPECTS AND EARLY GLAUCOMA INDIVIDUALS

Ophthalmology

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ABSTRACT

According to the World Health Organization (WHO), glaucoma is the leading cause of blindness in the world, second only to cataracts, and is considered the principal cause of irreversible blindness worldwide[1] The histological hallmark of glaucoma is accelerated loss of retinal ganglion cell layer (GCL) [2] Loss of GCL layer results in thinning of the retinal nerve fiber layer (RNFL) [3] topographical changes to the optic nerve head and a reduction in visual field sensitivity, which can ultimately result in visual impairment and blindness. Glaucomatous damage to the optic nerve head and RNFL can be quantified by different techniques.

In this study we have compared different diagnostic techniques i.e peripapillary RNFL loss Vs perimacular GCL thinning Vs VF. We concluded that VF remains the gold standard for diagnosing glaucoma and the peripapillary RNFL thickness on OCT remains the diagnostic test of choice for glaucoma suspect participants i.e. preperimetric glaucoma patients (before perimetry changes occurs). The diagnostic ability of perimacular GCL parameters is similar to that of peripapillary RNFL parameters in perimetric glaucoma i.e mild defect participants.

KEYWORDS

Glaucoma, RNFL thickness, GCL thickness, OCT, Perimetry

Introduction:

Glaucoma describes a group of ocular disorders of multifactorial aetiology united by a clinically characteristic optic neuropathy with potentially progressive, clinically visible changes at the optic nerve head (ONH), comprising focal or generalized thinning of the neuroretinal rim with excavation and enlargement of the optic cup, representing neurodegeneration of retinal ganglion cell axons and deformation of the lamina cribrosa; corresponding diffuse and localized nerve-fibre-bundle pattern visual field loss may not be detectable in early stages; while visual acuity is initially spared, progression can lead to complete loss of vision; the constellation of clinical features is diagnostic.[4]

According to the World Health Organization (WHO), glaucoma is the leading cause of blindness in the world, second only to cataracts, and is considered the principal cause of irreversible blindness worldwide. As one of the most common irreversible eye diseases, early diagnosis and treatment of glaucoma is vital for a good prognosis but difficult in clinical practice.

The histological hallmark of glaucoma is accelerated loss of retinal ganglion cell layer (GCL) [2] Loss of GCL layer results in thinning of the retinal nerve fiber layer (RNFL) [3] topographical changes to the optic nerve head and a reduction in visual field sensitivity, which can ultimately result in visual impairment and blindness. Glaucomatous damage to the optic nerve head and RNFL can be quantified by different techniques.

The aim of the study is to evaluate the relationship between visual field loss and peripapillary RNFL thinning using OCT in glaucoma suspects and early glaucoma individuals and also to determine the diagnostic performance of perimacula GCL thinning on OCT in them.

Literature survey:

It has been proposed that localized RNFL defects may be the earliest observable clinical sign of glaucomatous damage. Localized loss of 28 to 45% of RNFL thickness was required for visible RNFL defects. This suggests that rather than being an early sign of glaucoma, a large number of GCL are likely to have been lost before a visible RNFL defect develops.

Kim KE et al results support the importance of lowering IOP, even at the preperimetric stage. Preperimetric glaucoma patients with disc hemorrhage and insufficient IOP control should be carefully monitored for greater risk of progression. [5]

Bae HW1 et al concluded that an optic disc evaluation and VF test are sufficient to diagnose glaucoma in most cases. However, OCT can play an important role in detecting glaucoma in cases in which it cannot be identified by optic disc examination and VF. [6]

Abadia B et al concluded that peripapillary RNFL thickness measured with Cirrus OCT showed mild to moderate correlations with perimetry in glaucoma patients. [7]

Parikh RS et al concluded that optical coherence tomography has moderate sensitivity with high specificity for the diagnosis of early glaucoma and may have a potential role in screening. [8]

Riga F1 concluded that both OCT and HRT showed early ONH and RNFL changes in their parameters and did not correlate with the normal findings of the automated perimetry. [9]

Methods:

It was a cross sectional analytical (observation) study. Participants of either gender, age between 18-65 years, fitting into either the criteria of glaucoma suspect or early glaucoma (mild defect) and having open anterior chamber angles on gonioscopy were included in the study. Subjects with any secondary cause of glaucoma, with other ocular diseases or previous ocular surgery or laser treatment or who were already on antiglaucoma treatment were excluded from the study.

Detailed ophthalmic examination including VF, OCT peripapillary RNFL thickness and perimacular GCL thickness were carried out and results were compared.

Results and Discussion:

The study was conducted in 60 participants (30 glaucoma suspect and 30 early glaucoma).

Among the participants in both the groups of the study, 63% were females and 37% were males. 35% of the participants were between 18-42 years of age whereas 65% were above 42 years of age. In both the groups together, obvious peripapillary RNFL thinning was evident in 45% of participants, 43% of them had borderline thinning and 12% had normal RNFL thickness. Perimacular GCL thinning was found in 40% of the participants, 32% had borderline thickness whereas 28% had normal thickness.

Most of the mild defect participants i.e. 60% had peripapillary RNFL thinning whereas most of the glaucoma suspect participants i.e. 50% had borderline thinning. This difference was statistically significant.

3% of mild defect and 60% of glaucoma suspect participants had normal RNFL thickness. (p value- 0.028)

13(43.3%) out of the 30 participants from glaucoma suspect group had normal perimacular GCL thickness whereas 16 out of the 30 mild defect participants had perimacular GCL thinning. This difference was statistically significant. 4 mild defect participants had no thinning. (p value- 0.020)

30% (9 out of 30) participants had peripapillary RNFL thinning as compared to 26.7% (8 out of 30) who had perimacular GCL thinning. 50% (15 out of 30) participants had borderline peripapillary as compared to 30% (9 out of 30) who had borderline perimacular GCL.

29 out of the 30 participants (96.7%) who were detected to have early defect on VF had borderline or thinning of peripapillary RNFL. Whereas 6 out of 30 participants (20%) with normal VF had normal RNFL vs 24 (80%) had borderline or thinning of peripapillary RNFL. This finding was statistically significant. (p value- 0.008) Two tests had poor association (0.011)

26 out of the 30 participants (86.7%) who were detected to have early defect on VF had borderline or thinning of perimacular GCL. Whereas 13 out of 30 participants (43.3%) with normal VF had normal GCL vs 17 (56.7%) had borderline or thinning of perimacular GCL.

In both the groups together, obvious peripapillary RNFL thinning was evident in 45% of participants, 43% of them had borderline thinning and 12% had normal RNFL thickness whereas perimacular GCL thinning was found in 40% of the participants, 32% had borderline thickness whereas 28% had normal thickness.

Most of the mild defect participants i.e. 60% had peripapillary RNFL thinning whereas most of the glaucoma suspect participants i.e. 50% had borderline thinning. This difference was statistically significant. 3% of mild defect and 60% of glaucoma suspect participants had normal RNFL thickness. (p value- 0.028)

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This is in accordance with our study proving that VF changes are absent in preperimetric glaucoma. VF changes occur at a later stage hence proving the importance of conducting OCT in glaucoma participants.

The sensitivity and specificity of perimacular GCL thinning in all participants are 93% and 23.5% respectively. In mild defect participants the values are 100% and 25%. Glaucoma suspect participants have 82% and 23% sensitivity and specificity respectively. Perimacular GCL thinning is an excellent test in mild defect participants as its positive and negative predictive values respectively are 90% and 100% respectively with a diagnostic accuracy of 100%.

Overall its positive predictive value and diagnostic accuracy is 75% and 73% respectively.

Springelkamp et al concluded that macular GCL loss is at least as common as peripapillary RNFL abnormalities in population-based glaucoma cases.[10] Our study also proves that GCL thickness is a comparable test to peripapillary RNFL thickness test especially in mild defect participants. The association is weaker in glaucoma suspect participants.

We advise OCT abnormalities to be recorded to demonstrate reproducible results for long-term variability.

Shin HY et al concluded that the GCL parameters were more valuable than the RNFL parameters for detecting glaucoma in eyes with parafoveal VF loss, and the RNFL parameters were better than the GCL parameters for detecting glaucoma in eyes with peripheral VF loss. Clinicians should know that the diagnostic capability of macular GCIPL parameters depends largely on the location of the VF loss. [11] This was the limitation of our study as we didn't compare the OCT parameters with the location of VF loss.

Conclusions:

- Visual field remains the gold standard for diagnosing glaucoma.
- Visual field changes correlate excellently with peripapillary RNFL thickness in all glaucoma patients.
- The peripapillary RNFL thickness on OCT remains the diagnostic test of choice for glaucoma suspect participants i.e. preperimetric glaucoma patients (before perimetry changes occurs).
- Peripapillary RNFL thickness should be measured in all early glaucoma patients to monitor the progression of the disease.
- The diagnostic ability of perimacular GCL parameters is similar to that of peripapillary RNFL parameters in perimetric glaucoma i.e mild defect participants.
- However, in preperimetric glaucoma i.e glaucoma suspect participants, the diagnostic ability of GCL parameters is significantly lower than that of RNFL parameters.
- When both peripapillary RNFL and perimacular GCL parameters are tested simultaneously, it increases the specificity.
- Perimacular GCL parameters can be considered as baseline when peripapillary RNFL parameters are not reliable (eg. myopic disc, disc drusen, disc coloboma etc.)

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