



The Retinal Layers in the Preservation of Visual Acuity in the Early Stages of Idiopathic Intracranial Hypertension

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Authors' contributions

This work was carried out in collaboration between all authors. Authors Reşat Duman and GFY designed the study. Author EN performed the statistical analysis. Authors Reşat Duman and Rahmi Duman wrote the protocol and wrote the first draft of the manuscript. Authors Reşat Duman and Sİ managed the analyses of the study. Author Reşat Duman managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Purpose: To investigate the thickness of the retinal layers in the preservation of visual acuity in the early stages of the disease in patients with papilledema associated with idiopathic intracranial hypertension (IIH).

Study Design: Retrospective clinical study.

Methods: Right eyes of 23 IIH patients and 28 healthy control subjects were included in the study. Peripapillary retinal nerve fiber layer (RNFL) thickness in four quadrants and average ganglion cell layer (GCL) thickness measured by high-definition optical coherence tomography (at a

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presentation in both groups, and also at 6-months after the presentation in the patient group) were retrospectively analysed.

Results: Mean age was 38.9±11.9 years in the patients and 42.8±10.2 years in the control subjects (p=0.19). All of the participants were female. Mean RNFL in all quadrants was significantly higher in the patients compared to controls. Mean RNFL in all quadrants was considerably lower at 6-months of presentation compared to that at presentation (p<0.005), whereas mean GCL was similar in both groups.

Conclusion: No changes were observed in the GCL of IIH patients in the early stage, despite significant RNFL changes. This may explain the preservation of visual acuity in the early stages of the disease.

Keywords: Pseudotumor cerebri; ganglion cell complex; nerve fiber layer; papilledema.

1. INTRODUCTION

Idiopathic intracranial hypertension (IIH), also known as pseudotumor cerebri, is a condition of increased intracranial pressure, headache and visual disturbances without a space-occupying lesion. Obesity and female gender are the most common risk factors for IIH [1,2]. Visual symptoms of patients with IIH include blurred vision, temporary loss of vision or visual field loss [2]. Loss of vision in IIH is usually insidious, and visual acuity is affected in later stages. The aetiology is not precisely known, however, some cases associated with anaemia, corticosteroid therapy, and antibiotic use have been reported [3-6].

Neuroimaging is quite essential in the diagnosis and follow-up of IIH. However, neuroimaging is inadequate to monitor the morphologic and functional characteristics of the optical disc. One of the imaging modalities used in the diagnosis and follow-up of papilledema in IIH is Optical coherence tomography (OCT). OCT is an easy, quick and non-invasive technique to obtain in vivo cross-sectional images of the macula and optic nerve head, and it can be used in the diagnosis and follow-up of both newly diagnosed and chronic IIH cases [7].

This study aimed to investigate the thickness of the retinal layers in the preservation of visual acuity in the early stages of the disease in patients with papilledema associated with idiopathic intracranial hypertension (IIH).

2. MATERIALS AND METHODS

This retrospective study followed the ethical standards of the Declaration of Helsinki and was approved by the institutional review board. Afyon Kocatepe University clinical research ethics committee waived the requirement for informed consent for this retrospective study.

Right eyes of 23 IIH patients (who met the modified Dandy diagnostic criteria) and 28 healthy control subjects matched for age and gender, were included in the study. Acetazolamide was used to treat all IIH patients routinely. The best-corrected visual acuity (BCVA) was measured with Snellen and converted to a logMar for statistical analysis. Peripapillary retinal nerve fiber layer (RNFL) thickness in four quadrants and average ganglion cell layer (GCL) thickness measured by high-definition OCT (Spectral Domain, Carl Zeiss Meditec) (at the presentation in both groups, and also at 6-months after a presentation in the patient group) were retrospectively analysed. The GCL analysis was performed through dilated pupil with a software of the ganglion cell analysis (GCA) algorithm. Also, peripapillary retinal nerve fiber layer (RNFL) thickness measurements were made using the 200 × 200 optical disc cube Cirrus HD-OCT software in four quadrants (Fig. 1).

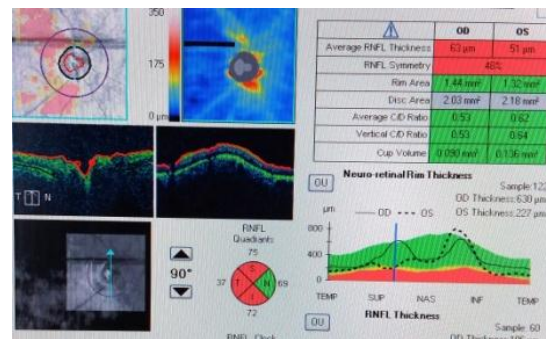


Fig. 1. The OCT image (Peripapillary retinal nerve fiber layer (RNFL) thickness in four quadrants

Differences between patients and control subjects and follow-up differences in patients were evaluated using Wilcoxon test and Mann-Whitney U test.

3. RESULTS

Mean age was 38.9 ± 11.9 years in the patients and 42.8 ± 10.2 years in the control subjects ($p = 0.19$). The mean converted BCVA was 0.0 in healthy control subjects. The mean BCVA at presentation was 0.3 ± 0.1 at the presentation and at 6-months after presentation 0.2 ± 0.1 in IIH patients.

All of the participants were female. Mean GCL thickness at presentation was $80.1 \pm 13.3 \mu\text{m}$ in the patients and $81.7 \pm 13.5 \mu\text{m}$ in the control subjects ($p = 0.88$). Mean GCL thickness at 6-months after presentation was $81.1 \pm 11.4 \mu\text{m}$ in the patients ($p = 0.85$) (Table 1).

Mean RNFL thickness in all quadrants was significantly higher in the patients at the presentation compared to control subjects [in superior quadrant: $138.2 \pm 40.9 \mu\text{m}$ vs. $120.0 \pm 16.1 \mu\text{m}$ ($p = 0.046$), in temporal quadrant: $91.9 \pm 64.9 \mu\text{m}$ vs. $66.5 \pm 9.3 \mu\text{m}$ ($p = 0.037$), in inferior quadrant: $172.3 \pm 65.4 \mu\text{m}$ vs. $126.7 \pm 15.9 \mu\text{m}$ ($p = 0.005$), in nasal quadrant: $96.7 \pm 39.2 \mu\text{m}$ vs. $75.0 \pm 12.5 \mu\text{m}$ ($p = 0.010$)] (Table 2).

Mean RNFL thickness in all quadrants was significantly lower at 6-months after presentation compared to that at presentation ($p < 0.005$)

(Table 3), whereas mean GCL thickness was similar in both groups.

4. DISCUSSION

The primary goal of treatment in patients with IIH is to prevent irreversible damage to the optic disc. In this regard, optical disc imaging methods are quite significant. However, there is still controversy about the role of RNFL thickness as a diagnostic and follow up tool in the IIH. Huang-Link et al. and Kaufhold et al. showed that RNFL thickness did not differ between IIH patients and healthy controls [7,8].

However in contrast to their findings, Skau et al. and Rebolleda et al. reported higher RNFL thickness in all four quadrants in newly diagnosed IIH patients compared with controls [9,10]. Similarly, in the present study, we observed significantly higher RNFL thickness in the newly diagnosed IIH patients compared to control subjects.

Furthermore, Rebolleda et al. and Yri HM et al. also showed that the mean RNFL thickness declined rapidly after treatment [10-11], which is in consistence with our follow-up findings. According to our findings, we suggest that RNFL thickness measured by OCT can be used as a sensitive tool in the diagnosis and follow-up of papilledema in patients with IIH.

Table 1. Comparison of GCL thickness between IIH patients and control subjects

	IIH	Control	p value
Mean GCL thickness at the presentation μm	80.1 ± 13.3	81.7 ± 13.5	0.88
Mean GCL thickness at 6-months after presentation μm	81.1 ± 11.4	81.7 ± 13.5	0.85

μm : micrometre

Table 2. Comparison of mean RNFL thickness between IIH patients (at the presentation) and control subjects

	IIH	Control	p value
Superior RNFL μm	138.2 ± 40.9	120.0 ± 16.1	0.046
Temporal RNFL μm	91.9 ± 64.9	66.5 ± 9.3	0.037
Inferior RNFL μm	172.3 ± 65.4	126.7 ± 15.9	0.005
Nasal RNFL μm	96.7 ± 39.2	75.0 ± 12.5	0.010

μm : micrometre

Table 3. Comparison between mean RNFL thickness at the presentation and at 6-months after presentation in IIH patients

	At the presentation	At 6-months after presentation	p value
Superior RNFL μm	138.2 ± 40.9	114.5 ± 20.6	0.005
Temporal RNFL μm	91.9 ± 64.9	68.6 ± 10.5	0.005
Inferior RNFL μm	172.3 ± 65.4	134.3 ± 25.1	0.008
Nasal RNFL μm	96.7 ± 39.2	76.4 ± 19.7	0.001

μm : micrometre

However, as RNFL thickness can be affected by various other diseases such as retinal vein occlusion, anterior ischemic optic neuropathy and severe hypertensive retinopathy, it may be not specific enough to monitor IIH process [8,11-14]. So, evaluating it together with other parameters such as GCL may be needed. GCL thickness is an important parameter to evaluate optic atrophy in some optic neuropathies (glaucoma-associated, compressive or demyelinating) [15-17]. And previously, it has been shown that GCL thickness correlates with visual function better than RNFL thickness [18]. There is limited controversial literature data on the role of GCL thickness in the diagnosis and follow-up patients with IIH. Previously, Marzoli et al. suggested that GCL thickness was a more reliable estimate of early optic atrophy in patients with IIH, even in cases without papilledema or visual loss [19]. However, Huang-Link et al. did not show significant changes in GCL in IIH patients compared to healthy controls. And they suggested that GCL thickness was not affected by optic nerve head swelling, even in severe papilledema [7]. Moreover, in the study of the NORDIC Idiopathic Intracranial Hypertension Study Group, minor GCL thinning was observed at 3 and 6 months compared to baseline ($p = 0.06$) [20]. Similarly, we observed no significant changes in the GCL in IIH patients in the early stage, despite significant RNFL changes. This finding may explain the preservation of visual acuity in the early stages of the disease.

In IIH patients, visual damage is insidiously advancing and the central visual acuity is preserved until late stages. In some previous studies, the overall thinning of the macula in resolving papilledema was reported [21,22]. Brian E. et al reported significant thinning of the GCL and inner plexiform layer in patients with papilledema compared to controls, and suggested that thinner nuclear layers in the macula might be a reliable method to quantify subclinical atrophy in eyes with resolving papilledema [23]. Thus, performing OCT in patients with IIH is gradually becoming more important to measure and follow-up subclinical atrophy.

5. CONCLUSION

In conclusion, in newly diagnosed IIH patients, significant RNFL changes are observed despite preserved visual acuities and regular GCL. OCT, especially measurement of RNFL thickness, can be used as a quick and non-invasive imaging

technique in diagnosis and follow-up of IIH patients. However more specific tests for IIH are still needed.

CONSENT

Afyon Kocatepe University clinical research ethics committee waived the requirement for informed consent for this retrospective study.

ETHICAL APPROVAL

As per international standard or university standard written ethical permission has been collected and preserved by the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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