Retinal Nerve Fiber Layer Measurement by Optical Coherent Tomography in Patients with Acute Optic Neuritis

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Introduction. The term optic neuritis (ON) define an acute, demyelinating, or idiopathic optic neuropathy. ON can present in isolation or be associated with multiple sclerosis (MS) or occur in the setting of neuromyelitis optica. MS is more common among young and middle aged individuals [1]. The average onset of the disease is at 30 years of age, and it afflicts women more often than men (a ratio of approximately 2:1) [2].The most important factor is probably the loss of signal transmission in some axons due to a conduction block or ganglion cell death [3]. In adults, optic neuritis typically is unilateral, with visual loss evolving over several days, reaching a nadir within 2 weeks, and frequently associated with peri-orbital pain exacerbated by eye movements [4]. In two-thirds of adult patients with optic neuritis, the optic disc appears normal on direct ophthalmoscopy during the acute phase; however, optical coherent tomography (OCT) reveals that many of these affected eyes have subclinical disc oedema [5] (see Fig. 1).

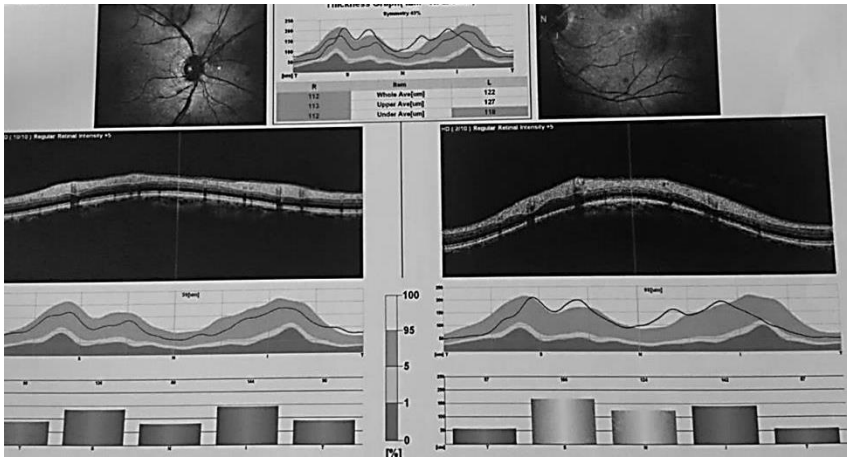

Fig. 1. Optical coherent tomography in patients with acute optic neuritis. We can see swollen RNFL in the superior and nasal quadrants in the left eye (grey colour marks swollen of RNFL).

When visible, optic disc swelling typically is mild, without evidence of haemorrhages or macular exudates. Such atypical findings indicate low risk for subsequent development of clinically definite multiple sclerosis, especially if the brain MRI is normal [6]. As OCT reveals that many patients with ON have subclinical disc oedema [4], the aim of the present study was to analyse retinal nerve fiber layer (RNFL) thickness by using OCT in patients with acute ON.

Methods. Permission to undertake the study was obtained from the Ethics Committee for Biomedical Research. The study was carried out at the Department of Ophthalmology, Lithuanian University of Health Sciences. Twenty healthy controls and 13 patients suffering from acute optic neuritis were included in the study. The inclusion criteria were as follows: 1) patients with primary acute ON; 2) patient's general good condition; 3) patient's consent to take part in the study. The exclusion criteria were as follows: 1) contagious eye diseases, high degree of refraction defects, wall-eye, lens opacities (because of obscurity or poor photography quality of eye fundus), keratitis, acute or chronic uveitis in anamnesis, glaucoma, optic nerve diseases, retina central part degenerations or dystrophy; 2) systemic disease (diabetes, oncological diseases, systemic connective tissue disease, chronic infectious disease, state of the tissue or organ transplant); 3) brain tumours; 4) patient's refusal to participate in the study.

RNFL thickness was analysed with spectral domain OCT (RS 3000 Advance Nidec Co., Japan) after pupil dilatation. Fundus surface images were captured with the confocal laser scanning using a near-infrared light source with a wavelength of 785 nm. Cross-sectional images of the retina were captured with the optical interferometer using an infrared light source with a wavelength of 880 nm. This system is comprised of the main body for capturing images, a computer for storing and analysing captured images, monitor and an isolation transformer. OCT image capture mode - disk circle mode: the patient‘s fundus is scanned circularly around the optic disk in the order of „Temporal“, „Superior“, „Nasal“, and „Inferior“ to obtain OCT images. When the internal fixation lamp is enabled, the internal fixation lamp is positioned so that the optic disk comes to the center of the captured image. The number of A-scan points in the scan direction – 1024.

Results. We investigated 13 patients (13 eyes) diagnosed with acute optic neuritis and included 20 patients (40 eyes) in the control group. Patients group consisted from 4 males and 9 females as control group consisted from 4 males and 9 females. The control and study group was matched for age and gender. RNFL thickness around the optic nerve head we measured in the first day of hospitalization before treatment with metilprednisolone.

Results revealed that RNFL were swelled, but not statistically significant in superior quadrant, comparing the average value in patients with ON and in controls (see Table 1).

Discussion. Optical coherence tomography is a well-established technique that has allowed qualitative and quantitative description of optic nerve disease

with a degree of resolution and precision not previously afforded by clinical examination alone. Since OCT was first applied clinically at the New England Eye Center in the early 1990s, many scientists demonstrated structural changes in the retina and nerve in a variety of optic nerve disorders. As OCT imaging becomes part of the standard of care, a more thorough evaluation and understanding of these structural changes may aid in disease management [7].

Table 1. Changes of retinal nerve fiber layer (RNFL) thickness in healthy controls and in patients with acute optic neuritis

RNFL layer thickness, µM	**Control group**	**Acute optic neuritis group**	**P Value, Control group vs. PA**
Superior	130.5(104;197) 34.81	146(76;317) 47.12	0.058
Temporal	67(50;84) 37.35	65(29;182) 35.38	0.762
Inferior	137(110;155) 35.4	144(82;220) 44.38	0.165
Nasal	90(61;111) 35.86	91(45;189) 42.27	0.323

Our results revealed that there were no statistically significant differences of RNFL thickness comparing patients with acute ON and healthy controls. Kupersmith et al used OCT to quantify deformation of the peripapillary subretinal structures and found that peripapillary retinal pigment epithelium and Bruch's membrane at the optic canal opening was more commonly deflected inward towards the vitreous in cases of papilloedema than in eyes with non-arteritic anterior ischaemic optic neuropathy or optic neuritis [8]. So we are in agreement with Kupersmith et al., because our results revealed swelling of superior quadrant, but results were not statisticaly significant, but results must be replicated in bigger patients group.

Gelfand et al. described macular microcystic changes predominantly involving the inner nuclear layer of the retina identified on spectral domain OCT images in patients with multiple sclerosis who did not have another reason for macular oedema. It was suggested in this paper that this finding may be a result of inner nuclear inflammation and microglial activation resulting in a breakdown of the blood-retinal barrier [9]. These microcystic changes in the inner nuclear layer were also found in eyes with a prior history of optic neuritis in a significant portion of patients with neuromyelitis optica [10]. Therefore, RNFL thickness as measured by optical coherence tomography has been recently suggested as a structural marker of axonal loss in the optic nerve [11, 12]. In fact, significant reduction of RNFL thickness in the fellow eye of MS patients has been reported in several studies as well [13-15]. This implies that the optic nerve of the fellow eye gradually loses axons because of possible subclinical inflammation or slow axonal atrophy.

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Purpose: to measure retinal nerve fiber layer (RNFL) by optical coherent tomography in patients with acute optic neuritis (ON). Methods: Twenty healthy controls and 13 patients suffering from acute ON were included in the study. RNFL thickness was analysed with spectral domain OCT (RS 3000 Advance Nidec Co., Japan) after pupil dilatation. Results: Patients group consisted from 4 males and 9 females as control group consisted from 4 males and 9 females. The control and study group was matched for age and gender. RNFL thickness around the optic nerve head we measured in the first day of hospitalization before treatment with metilprednisolone. Results revealed that RNFL were swelled, but not statistically significant in superior quadrant, comparing the average value in patients with ON and in the controls. Conclusion: optical coherence tomography can provide useful information in the diagnosis of acute optic neuritis.