**Original Research Article**

**Optical coherence tomography (OCT) assessment of morphological changes of the optic nerve head in IIH**

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**Received: 02-12-2020 / Revised: 16-01-2021 / Accepted: 05-02-2021**

**Abstract**

**Background:** Idiopathic intracranial hypertension (IIH), also known as pseudotumor cerebri, is characterized by elevated intracranial pressure with no apparent cause, most commonly in overweight women during childbearing age. **Aims and Objectives:** This is a retrospective study to assess the morphologic changes of the optic nerve head in patients with idiopathic intracranial hypertension (IIH) by optical coherence tomography (OCT) and to assess the correlation between CSF pressure and OCT finding.**Material and methods:**Data were extracted from the medical records of the IIH patients including CSF pressure and Stratus OCT images.**Results:**Twenty eight eyes of 14 IIH patients were compared with twenty four eyes of 14 healthy control subjects in relation to their clinical optic disc appearance. Average retinal nerve fiber layer (RNFL) thickness was statistically different between the two groups: normal optic disc(N = 28) – 98.8 + 13.2m and papilledema group (N = 28) 132.2 + 47.9m (p< 0.05). CSF pressure in not well correlated to RNFL thickness of OCT findings (p> 0.05).**Conclusion:** The study revealed that peri-papillary RNFL thickness measurements and the clinical appearance of the optic discs correlated well; signifying the role of OCT in follow up of IIH patients.However more studies are required for validation of this finding.

**Key Words:** Optical coherence tomography, idiopathic intracranial hypertension, pseudotumorcerebri, CSF pressure.

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original work is properly credited.

**Introduction**

Idiopathic intracranial hypertension (IIH), also known as pseudo-tumor cerebri, is characterized by elevated intracranial pressure with no apparent cause,absent focal neurologic signs and normal cerebrospinal fluid(CSF)composition,most commonly in overweight women during child bearing age. Headache isthe most common presenting symptom of IIH; other symptoms include visual disturbances such as transient visual obscuration, diplopia secondary to abducens nerve paresis,and photophobia, along with tinnitus, nausea and vomiting.The disease course is often lengthy. Several approaches have been used to analyze the papilledema (the ophthalmologic hallmark),either functionally or morphologically. Papilledema may be associated with visual field loss and rarely be asymmetric or absent. The therapy of IIH is guided by the extent of papilledema, clinical signs, and CSF opening pressure. Brain imaging can be normal withoutany evidence of venous obstructive disease, and lumbar puncture demonstrates elevated intracranial pressure >250mmH2O only[1-4].Clinical examination of papilledema includes subjective grading and has been the traditional approach to evaluate the optic nerve head in IIH patients. However it is not very precise and depends on the experience of the examiner [5].The prominent role of automated perimetry in detecting functional losses after progression has been emphasized [6,7].Morphologic techniques include ophthalmoscopic examination, optic disc and retinal nerve fiber layer (RNFL) photography, and echographic transverse optic nerve diameter measurements. Recently, confocal scanning laser ophthalmoscopy (CSLO) has become a reliable quantitative method

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for evaluation of papilledema [6-10].Optical coherence tomography (OCT), a non invasive imaging modality,gives high resolution cross section of retinal images, interpretation of retinal nerve fibre layer surrounding the optic disc, qualitative and quantitative data, and is widely used nowadays for diagnosing and monitoring macular diseases(e.g.,age-related macular degeneration) and optic neuropathies (e.g. glaucoma).The use of OCT in the interpretation of papilledema in various clinical series[11-14] especially in IIH patients[15-18].has been reported in a small number of clinical reports. In the current study we present the morphological changes of the optic nerve head and macula, diagnosed by OCT in IIH patients with papilledema, compared to fundoscopic examination. The relatively small group of patients presented here with may justify the use of OCT in the routine follow up of IIH.

**Material and methods**

This retrospective study was done on 14 IIH patients admitted in SMS Hospital, Jaipur during the years 2013-2015. Newly diagnosed patients of IIH based on modified Dandy’s diagnostic criteria and papilledema were included for the study[19]. Patients underwent MRI brain with CT or MR venography to exclude a diagnosis of venous sinus thrombosis[6,20].Informed consent was taken from all the selected patients. The following data were retrieved for analysis: body mass index (BMI),CSF chemistry and cytology with opening pressure, drug history and current medical treatments, clinical examination such as visual acuity, fundus examination (Frisen scale), results of automated perimetry test (Humphry 30-2 visual field test, Carl Zeiss Meditec, Dublin, CA), optic nerve appearance, and Stratus OCT imaging data (OCT- 3, model 3000, software version 3.0, Carl Zeiss Meditec, Dublin, CA). Peri-papillary RNFL was interpreted by fast RNFL thickness protocol for all the four quadrants and their average mean.Both eyes of patients who met the inclusion criteria, underwent a complete ophthalmic evaluation including Snellen visual acuity(VA),intraocular pressure(IOP) measurement, automated perimetry [21], the degree of papilledema was based on the scheme proposed by Frisen scale[22].

**Inclusion Criteria:**Patients were included in the study as per the modified Dandy criteria for IIH comprising of: -

1. signs and symptoms of increased intracranial pressure;
2. a normal neurologic examination with no localizing signs except for 6th cranial nerve palsy;
3. normal neuroimaging;
4. normal CSF chemistry and cytology with elevated opening pressure of > 250 mm of Hg.

**Exclusion criteria**: Patients with systemic medical conditions, pregnancy and postpartum patients, surgical interventions, shunting procedures, fenestration of the optic nerve sheath and ophthalmo-logical disease such as glaucoma and on medications were excluded from the study. Age and sex matched controls were selected from the healthy relatives of patients. Control subjects without any evidence or history of ocular disease underwent the same OCT evaluation as done for the patients.The treatment regimen in these patients was conservative including acetazolamide (with a dose of 1 gm/day with divided doses of 250 mg QID) and a weight-reduction program with both diet and exercise as prescribed by a nutritionist[23]For statistical analysis, non-parametric tests were used (SPSS 12.0; SPSS Inc., Chicago, IL) as the sample size was small. All statistical tests weretwo-tailed with the significance level (p value) set at 0.05.

**Result**

Twenty eight eyes of 14 IIH patients were compared with twenty eight eyes of 14 healthy control subjects in relation to their clinical optic disc appearance. Average retinal nerve fiber layer (RNFL) thickness was statistically different between the groups: normal optic disc group (N = 28) – 98.8 + 13.2m, and papilledema group (N = 28) 132.2 + 47.9m (p<0.002) and in all four quadrants. CSF pressure did not correlatewell with RNFL OCT findings. (p<0.242).

**Table 1: Comparison of the retinal nerve fiber layer thickness (four quarters) by clinical optic disc appearance**

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Normal(N = 28)** | **Papilledema(N = 28)** | **P Value** |
| **RNFLT average** | 98.8 + 13.2 | 132.2 + 47.9 | 0.002 |
| **Superior** | 114.2 + 6.9 | 146.3 + 42.8 | 0.0001 |
| **Inferior** | 121.9 + 9.7 | 149.3+ 47.6 | 0.008 |
| **Nasal** | 82.7 + 14.0 | 132.3 + 63.5 | 0.002 |
| **Temporal** | 71.5 + 10.3 | 110.1 + 50.5 | 0.0001 |

**Table 2: Correlation between the retinal nerve fiber layer thickness (four quadrants) and CSF pressure.**

|  |  |  |  |
| --- | --- | --- | --- |
| **The retinal nerve fiber layer thickness Average Value X –axis** | **CSF pressure Average Y- axis** | **T** | **p** |
| 98.8 | 337.1 | 1.244 | 0.242 |

**Discussion**

Idiopathic intracranial hypertension, relatively uncommon disorder, having an average of about one to two cases per 1,00,000 people in the general population annually, optic nerve examination and quantitative perimetry are more reliable indicator than visual acuity in its diagnosis[6] and for the prevention of complicationswhich may developed later as the disease progresses. In the present study we noted the morphological changes in optic nerve head and macula of twenty eight eyes of 14 patients diagnosed to have IIH by using Stratus OCT imaging and various other parameters. Frisen et al[22] described a plan for swelling of the optic nerve head.Sometimes when optic disc edema resolves, axonal damage that has already occured, cannot yet be detected anatomically. However, recent advances provide various methods for follow up of optic disc changes. Ultrasonography of the optic nerve of children with IIH correlated well with increased intracranial pressure and was advocated as an important follow up instrument by Shuper A et al [24].The emerging popularity of the OCT relates to excellent imaging of the macula and the retinal nerve fiber layer around the optic disc, signifying its use in wide range of macular and optic disc pathologies. However, the published data of its use is sparse, only a few authors demonstrated OCT characteristics in IIH patients. Rebolleda et al[17] recently compared 22 IIH patients to 22 control subjects. RNFL thickness matched with visual field sensitivity losses, and average RNFL thickness was found to be 74.9% greater. El-Dairiet al[15] studied thicker average RNFL for IIH eyes as compared for controls(125.7m vs. 106.5 m, P < 0.001).The main problem using OCT to observe patients with papilledema is that there is no way to determine that whenever RNFL thickness returns toward normal, patients are improving or losing nerve fibers.In the present study, OCT showed a much greater average RNFL thickness in all the four quadrants in eyes with papilledema compared with controls (p = 0.002). El-Dairi et al reported a thicker average RNFL in eyes of children with pseudotumorcerebri compared with controls, but the RNFL differences were not significant in all quadrants probably because of the small sample size. The mean average RNFL thickness reported by El-Dairi et al[15] (125.7 + 29.6 m) was lower than that in the present study (132.2 + 47.9 m) probably because of milder baseline optic disc edema. In the present study, quantitative data having a significant difference (p = 0.002) was found in the OCT peri-papillary RNFL measurements in all the four quadrants between patients with papilledema and clinically normal optic discs.Follow-up with OCT is essential in case of visual loss either rapid or slowly progressive to determine that irreversible RNFL damage happened or not. Further studies are necessary to evaluate this finding. Use of Stratus OCT in the diagnosis of a swollen disc may have a few potential limitations. These include errors in the appearance of retinal boundary detection, adequate centering of the cursor by the technician around the optic nerve head, and movements of the patient can vary the result. So avoidance of these errors must be made by the technician and interpreter.Newer models of OCTs are currently made available, with higher resolution and better specifications to follow up the patients with IIH, but this requires sequential measurements which are influenced by the patient compliance.A limitation of the present study was the small number of eyes; however, idiopathic intracranial hypertension is a relatively rare clinical entity, and a large number of cases are difficult to collect at one site. The correlations of grading of papilledema support the use of both techniques, OCT and perimetry, for monitoring disc edema and the effectiveness of treatment to reduce intracranial hypertension.These data support the use of OCT as a noninvasive, quantitative method for monitoring the amount and evolution of papilledema.

**Conclusion**

The study suggests that peri-papillary RNFL thickness or measurement and the clinical appearance of the optic discs correlated well, signifying the role of OCT in follow up of IIH patients.

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**Conflict of Interest: Nil**

**Source of support:Nil**