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ORIGINAL ARTICLE

ROLE OF SD-OCT IN OCULAR HYPERTENSION

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ABSTRACT: PURPOSE: To compare RNFL thickness in patients with ocular hypertension with that of controls. **AIM:** To study the role of SD-OCT in ocular hypertension. **METHODS:** 25 eyes of 15 patients with ocular hypertension and 25 eyes of 15 normal subjects seen in Regional Institute of Ophthalmology, Gandhi Medical College Bhopal were included in this prospective study conducted in the academic session of the year 2012 to 2013. Informed consent was obtained from all patients and controls. Ocular hypertensive eyes were defined as an IOP reading greater than 21 mmHg on at least two separate occasions, normal optic disc, visual fields and normal open angles. The control was selected from general OPD and staff of RIO. Control subjects were included if they had an IOP measurements less than 21 mmHg on at least two separate occasions, absence of glaucomatous optic nerve head, normal visual fields and no family history of glaucoma or other risk factors. Age and sex matched controls were included in the study. **CONCLUSION:** OCT can be useful adjuvant in ocular hypertensive patients for measurement of structural loss which precedes functional loss alerting ophthalmologist to start early treatment especially in presence of risk factor and contributes to quality of life. SD-OCT could determine significant differences between ocular hypertensive patients and healthy subjects in RNFL thickness measurement.
KEYWORDS: SD-OCT, Ocular Hypertension, RNFL thickness.

INTRODUCTION: Glaucoma is the leading cause of irreversible blindness in the world. POAG is a chronic, progressive optic neuropathy that is accompanied by a characteristic cupping and atrophy of the optic disc, visual field (VF) loss, open angles and no secondary cause.[1]

Ocular Hypertension is defined as an IOP of 21mmHg or greater, normal visual fields, normal optic disc, open angles and absence of any ocular or systemic disorders contributing to the elevated IOP.[2]

The concept of ocular hypertension is important because of prevalence of 4-10% of the population over age of 40 yrs.[2] The ocular hypertension treatment study (OHTS) done in late 90s which randomly assigned 1636 patients with IOP between 24 and 32 mmHg and without visual field defects to observation or medical treatment that lowered IOP by least 20% found that, at the end of 5 yrs. 9.5% of the observation group developed glaucoma whereas only 4.4% of the treated group did.[3]

This creates dilemma about management of this condition. On the one hand, ophthalmologist want to intervene as early as possible to prevent optic nerve cupping and visual field loss and on the other hand, most ocular hypertensive individuals will complete their lives without developing substantial visual loss.

Thus, instituting treatment in all patients does not seem reasonable, taking into consideration the low incidence of conversion from ocular hypertension to frank open angle glaucoma, as well as cost, inconvenience, side effects and frequent noncompliance.

4% of the total treated patients in the OHTS study went onto develop progressive optic nerve change and visual field damage. This debate has been sharpened by recent studies showing ocular

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hypertensive patients can lose as many as 50% of their optic nerve axon despite having normal kinetic visual fields,[4] or as many as their 35% of their ganglion cells despite normal automated threshold perimetry.[5]

Glaucomatous optic neuropathy causes progressive death of retinal ganglion cells and their axons. These structural changes may precede VF defects by nearly 5 yrs. as measured by standard automated perimetry. These peripapillary retinal nerve fiber layer (RNFL) thickness evaluation is a useful method to detect early structural damage of glaucoma.[6] Hence treatment should be reserved for those patients who demonstrate early structural damage taking into consideration other risk factors as well and thus at high risk of developing glaucoma.

The purpose of this study is to compare ocular hypertension (OHT) and control groups by measuring RNFL thickness using SD-OCT and to describe the RNFL thickness parameter to discriminate ocular hypertension from normal so as to decide upon when to start treatment in patients of ocular hypertension.

MATERIAL AND METHODS: Prospective study was done on 25 eyes of 15 patients with ocular hypertension and 25 eyes of 15 normal subjects in Regional Institute of Ophthalmology, Gandhi Medical College Bhopal.

Each subject underwent a complete ophthalmological examination including best corrected visual acuity, IOP measurements with goldmann applanation tonometer (Taking central corneal thickness into account), normal diurnal variation, slit lamp biomicroscopy, gonioscopy and fundus evaluation after pupil dilatation on the slit lamp using 90D lens. Detailed history including family history and history pertaining to risk factors were recorded. Optic disc of all the patients and control were evaluated and were classified accordingly.

All patients and control had no ocular surgery. The best corrected visual acuity (BCVA) of all patients was 6/9 or better and of control subject was 6/6.

All subjects underwent standard automated perimetry on Humphrey's field analyzer using 30-2 testing protocol by SITA FAST strategy. Visual field reliability criteria included fixation loss of less than 20% and false positive and negative rates of less than 33%. Patients with no reliable fields at three separate times were excluded.

Gonioscopy was done for all patients and control. Patients and controls with open angles were only included in the study.

All included subjects were scanned with the spectralis domain OCT (OPKO Instrument) by single operator. Scans with minimum signal strength >7 were included in the study. One of the two scan, obtained on the same day, with maximum signal strength was included. For this study we analyzed the global average RNFL thickness, average RNFL thickness in the superior, inferior, nasal, temporal quadrants and average RNFL thickness in 12 clock hours.

The results were analyzed using unpaired t test, p value were calculated for each parameter and relationships were considered significant if $P<.05$. Data were reported as arithmetic mean±SD.

RESULTS:

- 25 eyes of 15 patients (7 males and 8 females) with ocular hypertension and 25 eyes of 15 healthy age matched controls were included in the study.
- The median age in the ocular hypertension group was 45.4 yrs.
- The median IOP at presentation of patients was 25mmHg.

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- The global average RNFL thickness, average RNFL thickness in four quadrants and in 12 clock hours measures by OCT were compared in both the groups. Table 1 summarized RNFL thickness value in all parameters measured by OCT with P value.

OCT PARAMETER	OHT	CONTROLS	P VALUE
AVG. GLOBAL	96.5±15.938	110±7.38	.0004
SUPERIOR	114.16±21.61	135.62±13.76	.0001
INFERIOR	117.32±24.79	132.75±10.60	.0062
TEMPORAL	70.04±15.10	74.875±13.85	.2439
NASAL	86.8±23.26	96.75±22.25	.1288
1 CLOCK HOUR	106±19.88	127.625±12.65	.0001
2 CLOCK HOUR	85.92±18.72	93.125±14.08	.1306
3 CLOCK HOUR	68.08±18.43	76.125±13.07	.0814
4 CLOCK HOUR	70.4±16.19	85.5±17.37	.0026
5 CLOCK HOUR	101.52±27.34	128.875±21.763	.0003
6 CLOCK HOUR	123.84±27.39	133.5±19.47	.1571
7 CLOCK HOUR	117.32±33.51	123.125±15.45	.4354
8 CLOCK HOUR	86.44±27.41	85.125±18.95	.8444
9 CLOCK HOUR	71.32±21.97	75.75±18.50	.4444
10 CLOCK HOUR	89.12±26.80	97.125±19.84	.2359
11 CLOCK HOUR	112.24±23.22	128.25±20.94	.0137
12 CLOCK HOUR	119.24±28.56	139.5±18.49	.0045

Table 1

TABLE 1: The mean and standard deviation values of the RNFL thickness in four quadrants, 12 hour quadrants and average thickness measured by SDOCT IN OHT and controls groups.

- 52% of the cases showed decreased RNFL thickness in one or more quadrant.
- Out of which 69% showed the decreased RNFL thickness in inferior quadrant especially in inferotemporal quadrant. 4 and 5 clock hour have shown to be significantly reduced in comparison to controls.
- 61% of such cases have characteristically and significant reduced RNFL thickness at 11 clock hour position.
- Global average RNFL thickness in cases was 96.5 micron which was significantly less than controls measured to be 110 microns. (P value=.0004).
- RNFL global average thickness in superior and inferior quadrant was significantly reduced in comparison to controls. P value for superior quadrant=.0001 and inferior quadrant=.0062.
- There was no significant difference in temporal and nasal quadrants.
- RNFL thickness was significantly reduced in 1 o'clock, 4 o clock, 5 o'clock, 11 o'clock and 12 o'clock position in ocular hypertensive patients compared with normals.

DISCUSSION: Glaucoma is the second leading cause of blindness in the world so the main goal of glaucoma management is to diagnose this disease when it is asymptomatic. Visual field testing is essential in the diagnosis and monitoring of glaucoma. However it is known that standard perimetry cannot detect VF defects until 20%-40% of ganglion cells have been lost.[7,8] Nowadays RNFL defects have been objectively demonstrated earlier than VF defects with new investigative technologies. Measuring RNFL thickness by OCT enables an objective and quantitative assessment of glaucomatous structural loss. It has been shown that all generations of OCT provide reproducible measurements of RNFL thickness in many previous studies.[9-14]

Analysis of the pattern of RNFL defects with SD-OCT imaging demonstrated that the most frequently RNFL defects have been at the inferotemporal meridian followed by the superotemporal meridian.[15]

Yalvac et al.[16] suggested that the best parameters for distinguishing the high risk OHT group from the moderate and low risk groups, defined according to Scoring Tool for Assessing Risk (STAR) score, were inferior average and 6 o'clock area in Stratus OCT RNFL thickness parameters.[16]

Sommer et al.[17] reported that 60% of patients with ocular hypertension had evidence of RNFL loss that occurred up to 6 years before a detectable change on SAP. Advanced imaging technology enabled the detection of structural changes before the development of SAP abnormality.[18,19]

Studies have mostly reported that RNFL thickness in inferior quadrant and RNFL average thickness have the best performance to discriminate healthy eyes from ocular hypertensive eyes.[11,17-21]

In our study we found that RNFL global average thickness, average thickness in superior and inferior quadrant and at 1, 4, 5, 11, 12 clock hours was significantly lower in ocular hypertensive patients. These clock hours match with superior and inferior quadrant.

H-11 has been found to be characteristically abnormal in majority of the cases showing decreased RNFL thickness.

In our study, the best parameter to differentiate ocular hypertensive at risk from normal eyes was found to be RNFL thickness in superior quadrant. Our results suggest that the RNFL thickness in the inferior quadrant and global average RNFL thickness were other useful parameter for detecting changes in RNFL thickness in ocular hypertensive patients.

We suggest initiating an early treatment for the patients who show structural change in OCT in one or more quadrant so as to prevent the likely damage to optic nerve head in future.

Treatment may also be initiated in the patients without structural changes in OCT in presence of risk factor.

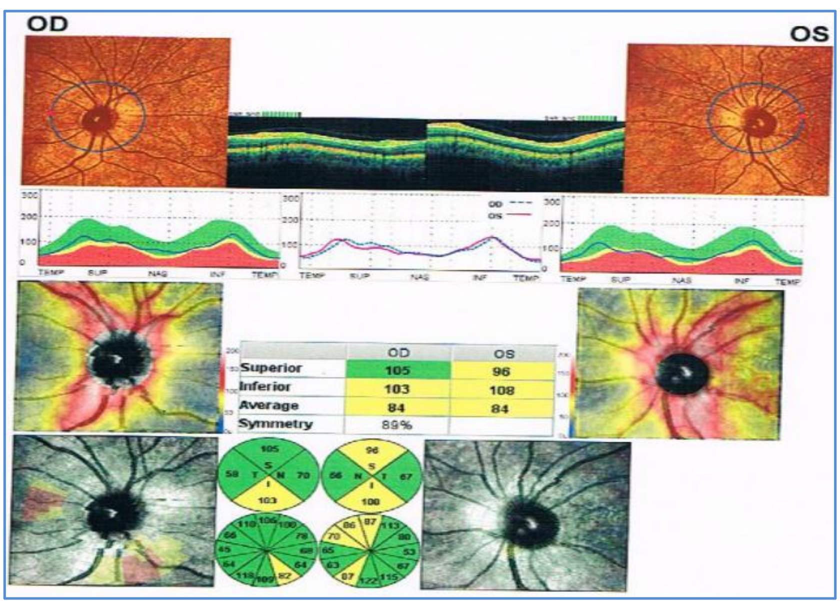

Fig. 1

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CONCLUSION:

- OCT can be useful adjuvant in ocular hypertensive patients for measurement of structural loss which precedes functional loss alerting ophthalmologist to start early treatment especially in presence of risk factor and contributes to quality of life.
- SD-OCT could determine significant differences between ocular hypertensive patients and healthy subjects in RNFL thickness measurement.
- Management of the patients should be initiated in presence of structural changes as suggested by OCT even in absence of risk factors.
- Treatment should also be initiated in patients with risk factor even in absence of structural loss as suggested by OCT.

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