Original Research Paper

Volume - 10 | Issue - 7 | July - 2020 | PRINT ISSN No. 2249 - 555X | DOI : 10.36106/ijar

Ophthalmology

A CLINICAL STUDY ON STRUCTURAL AND FUNCTIONAL DEFECTS CORRELATION IN THE DIAGNOSIS OF GLAUCOMA.

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ABSTRACT **Background:** Evaluation of Optic Nerve and Retinal Nerve Fiber Layer (RNFL) includes examination of structure and functions. Glaucomatous retinal ganglion cell loss results structurally in RNFL and Optic Nerve Head (ONH) defects; and functionally in visual field changes. **AIM :** to study the Optic Nerve defects in correlation with RNFL thickness and visual field defect in Primary Open Angle Glaucoma(POAG). **Material and Methods :** A total of "70" diagnosed cases of POAG were included in this study which was conducted for a period of one year. All the patients were thoroughly worked up including history, comprehensive ocular & systemic examination ,ONH examination with + 90D , imaging of RNFL, ONH and macula with posterior segment OCT. **Results:** Our study observed that POAG was more common in fifth decade of life, the mean age being 54.88±9.39 years. Incidence of POAG was more in males(68.5%) as compared to female(31.42%).In this study maximum number of eyes had vertical cup-disc ration as 0.6:1. Maximum RNFL thickness was found to be 100.4µm while the minimum was 37µm. The average RNFL thickness was calculated as 73.61± 16.327µm. This observation was statistically extremely significant (P< 0.0001). study showed a decrease in average RNFL thickness with decrease in vision. There was a statistically significant correlation with each other (P=0.0036). However this study suggested that, there was a statistically significant correlation between visual field defect of right (r=0.3844,P=0.0004) and left eye(r=0.5036,P=0.001) with RNFL of right eye and left eye. **Conclusion:** POAG is a chronic progressive irreversible blinding disease in which optic nerve damage correlates with reduction of RNFL thickness. These changes again showed significant correlation between visual field defect and reduction of macular thickness.

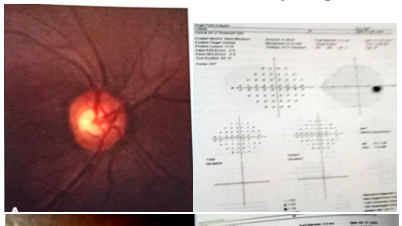
KEYWORDS : POAG, Tonometry, OCT, RNLF,Visual field .

INTRODUCTION:

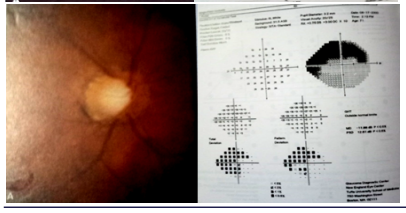
Glaucoma is the leading cause of irreversible blindness globally. It is characterized by apoptosis death of "Retinal ganglion cells with morphological abnormalities in the Optic Nerve Head (ONH) and visual field defects, in which raised IOP is a major risk factor.[1] The estimate prevalence of Glaucoma in the world was 60.5million in 2010, 62.5 million in 2013 and expected to increase to 79.6 million in 2020 and 110 million in 2040.[2]

Glaucoma is evaluated **structurally** by assessing the ONH cupping, RNFL defects and Macular thickness including measurement of the ganglion cell layer/inner plexiform layer. The constant evaluation of advanced ocular imaging technologies that provide non-invasive, objective techniques and novel parameters that evaluate the optic nerve & retinal structures aids in clinical decision and management of subjects with glaucoma.[3]

Glaucoma is a chronic progressive neuropathy and ONH is the first site to get damage. Therefore, **stereoscopic ONH photography** is one of the most common imaging methods of the posterior pole, which allows documenting the ONH and its surrounding region for subjective evaluation and for assessing changes occurring over time. The glaucomatous features usually seen are neural tissue loss with global or localized **thinning** of the neuro-retinal rim(**NRR**) with corresponding enlargement of the cup.[4] Specific retinal abnormalities associated with glaucoma include focal and diffuse RNFL thinning. Therefore, retinal thinning/loss are always associate and correlate with visual field abnormalities, which is mandatory for glaucoma diagnosis.



Normal ONH with normal VISUAL FIELD



Advanced Glaucomatous ONH with VISUAL FIELD

MATERIALS AND METHODS :

The study was conducted for a period of one year and a total number of 70 patients who were diagnosed as POAG were selected from the outpatient department for the study. Informed consent were taken from each patient before including them in the study.

INCLUSION CRITERIA:

All patients 40 years and above investigated and diagnosed as POAG.

EXCLUSION CRITERIA:

1. Primary narrow angle glaucoma
2. Secondary glaucoma
3. Congenital glaucoma
4. Cases with lenticular opacity or scarring

A detailed history and thorough ocular examination were carried out including visual acquity, Refraction, Applan Tonometry to record IOP , Fundus evaluation with +90 D convex lens, Perimetry i.e. visual field examination is done by automatic Humphrey visual field analyser.

Spectral - Domain Optical Coherence Tomography:-

New image system i.e. spectral domain **Optical Coherence Tomography**(**OCT**) enhanced depth imaging, which we have used in this study to assess the relationship between **structure & function.** So, defect in the RNFL precede ONH and Visual field changes. Therefore, correlating RNFL appearance with the corresponding area of presumed loss in the visual field is an objective way to demonstrate **structural- functional** damage.[5]

RESULT AND OBSERVATION:

The data, collected on various aspects of this study were used and p-value<0.05 was considered statistically significant.

TABLE : IOP DISTRIBUTION IN RIGHT EYE :

21-30	46	65.71
31-40	11	15.71
>40	1	1.42

TABLE : IOP DISTRIBUTION IN LEFT EYE

IOP(mmHg)	No. of eyes	Percentage(%)
10-20	18	25.17
21-30	43	61.42
31-40	7	10
>40	2	2.85

In our study majority of the eyes had intraocular pressure in the range of 21-30mmHg i,e 46 (65.71%) in the right eye and 43(61.42%) in the left eye. 12(17.14%) right eyes and 18(25.17%) left eye had IOP in the range of 10-20mmHg. 11(15.71%) right eyes and 7(10%) left eyes had IOP in the range of 31-40mmHg. The highest IOP recorded was 50mmHg. The mean IOP recorded was 25.48mmHg (right eye) and 24.34mmHg (left eye). Overall mean IOP was 24.91±6.26mmHg.

TABLE : CUP-DISC RATIO IN BOTH EYES:

Cup:disc ratio	Right eye	Left eye
0.4:1	4	5
0.5:1	8	8
0.6:1	18	23
0.7:1	15	16
0.8:1	17	11
0.9:1	8	7

In our study maximum number of eyes had vertical cup disc ratio as 0.6:1 i,e 18 in the right eye and 23 in the left eye. 15 in the right eye and 16 in the left eye had cup disc ratio 0.7:1.

TABLE : RETINAL NERVE FIBER LAYER THICKNESS IN BOTH EYES :

RNFL THICKNESS(µm)	RIGHT EYE	LEFT EYE
<40	1	0
40-50	8	13
51-60	6	7
61-70	6	9
71-80	16	14
81-90	26	20
>90	7	7

TABLE : STATISTICS OF RETINAL NERVE FIBER LAYER THICKNESS :

	RIGHT EYE	LEFT EYE
MEAN RNFL THICHNESS	75.13	72.01
STANDARD DEVIATION	16.01	16.71
STANDARD ERROR OF MEAN	1.91	1.99
95% CI	71.31 78.94	68.02 75.99
MAXIMUM	99	40.19
MINIMUM	37	100.4

In our study, we found the mean thickness of retinal nerve fiber layer to be 75.13±16.01 µm in right eye and 72.01±16.71 µm in the left eye. The difference is considered to be statistically not significant (p=0.2613).

Irrespective of eyes, maximum RNFL thickness was found to be 100,4 µm, while the minimum was 37µm. The average RNFL thickness was calculated as 73.61±16.327 µm.

This observation was statistically extremely significant (p=0.0001)

TABLE : VISUAL FIELD DEFECT DISTRIBUTION IN BOTH EYES:

	RIGHT EYE(%)	LEFT EYE(%)
VISUAL FIELD DEFECT	46	47

TABLE :DETECTABLE VARIOUS VISUAL FIELD CHANGES IN PATIENTS:

NATURE OF VISUAL FIELDS	TOTAL EYES=93	PERCENTAGE
ENLARGEMENT OF BLIND SPOT	8	8.6
PARACENTRAL,SEIDEL,ARCQATE, DOUBLE ARCUATE	56	53.76
ROENNE"S CENTRAL NASAL STEP	15	16.12
LOCALIZED OR GENERALIZED FIELD CONDTRICTION	20	21.59

TABLE: CORRELATION OF VISUAL ACUITY WITH RETINAL NERVE FIBER LAYER THICKNESS:

VISUAL ACUITY	AVG RNFL(µm)	VISUAL ACUITY	AVG RNFL(µm)
6/6	89.24	6/60	60.79
6/9	84.41	Fc(1m-5m)	53.99
6/12	83.48	HMCF	53.48
6/18	80.51	PL+ve	46.03
6/24	69.42	PL-ve	49.14
6/36	66.64		

Our study showed a decrease in average RNFL thickness with decrease in vision. There was a statistically significant correlation with each other (p=0.0036). However our study suggested that there was a statistically significant correlation between visual field defect of right (r=0.3844, p=0.0004) and left eye(r=0.5036, p=0.001) with RNFL of right eye and left eye.

DISCUSSION:

Age distribution: Present study showed maximum number of patients were in the fifth decade of life. The mean age of the patients in our study was found to be 54.88 years. The mean age in our sue was similar with other Indian studies like Chenni glaucoma study.[6] Narayan M et al,[7.] Tidake P et al[8.]

Sex distribution: Males were found to be more affected 48(68.57%) than female 22(31.42%) in our study. Similar findings were reported by various authors like Narayan M et al[7], B N Mukesh et al.[11]

Cup Disc ratio: In our study the mean vCDR is 0.66±0.138. Al Obeidan et al(2011)[12.] Gyasi et al found the mean vCDR to be 0.73±0.21 and 0.83±0.15 respectively. While examining the cup disc ratio, in this study, NRR was examined to check if it followed the ISNT rule or not. Our study revealed that patients with vCDR more than 0.7:1 had notching (loss of NRR in the inferior quadrant) which is pathognomic sign of POAG. NRR status is very important to distinguish a glaucomatous cup from a non glaucomatous cup.

Retinal Nerve Fiber Layer thickness: In our study, the average RNFL thickness was found to be 73.61±16.327µm. This was statistically extremely significant (p<0.0001). Irrespective of eyes, maximum RNFL thickness was found to be 100.4µm, while the minimum was 37µm. Similar results were found by various authors in different studies.

Thus the results of our study in agreement with other studies showed that there was a significant decrease of RNFL thickness in POAG, which was directly correlate with ONH damage. The visual field changes also correlated well with thinner RNFL, depending on the severity of POAG. Therefore, defects in the RNFL definitely precede ONH and visual field changes. So, correlating RNFL appearance with the corresponding area of presumed loss in the visual fields in an objective way to demonstrate structural and functional damage.

Conclusion:

POAG is a chronic progressive irreversible blinding disease in which optic nerve damage correlates with reduction of RNFL thickness. These changes again showed significant correlation between visual field defect and reduction of macular thickness.

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