Original Research Paper

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INSTITUTIONAL BASED CLINICAL STUDY ON VISUAL FIELD DEFECTS IN PRIMARY OPEN ANGLE GLAUCOMA AND ITS CORRELATION WITH VISUAL ACUITY AND OPTIC DISC CHANGES

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ABSTRACT **Background**: Primary Open Angle Glaucoma is typically characterized by an open, normal appearing anterior chamber angle with normal or increased IOP without any apparent ocular or systemic abnormally, but typical Optic Nerve damage due to apostopic death of Retinal ganglion cell of retina, which is mandatory to be associated with glaucomatous visual Field Defect. 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 Defects in Primary Open Angle Glaucoma(POAG). **Material and Methods:** A total of "100" diagnosed case 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 54.85±9.39 years. Incidence of POAG was more in males (68%) as compare to female (32%). In this study maximum number of eyes had vertical cup-disc ratio as 0.6:1. Maximum RNFL thickness was found to be 90.4µm while the minimum was 10µm. The average RNFL thickness was calculated as 72.61±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 ($r=0.3118$, $p=0.001589$) 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, Gonioscopy, OCT, RNFL, Visual Field.

INTRODUCTION:

Glaucoma is a multi factorial progressive Optic Neuropathy that affects around 67 million people worldwide, with 6 million people blind and millions more suffering from visual disability. 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 60.5 million in 2010, 62.5 million in 2013 and expected to increase to 79.6 million in 2020 and 110 million in 2040.

Primary open angle glaucoma (POAG) is typically defined as a **chronic optic neuropathy** with slow progressive estimated to affect 6.48 million people in India alone. According to **World Health Organization (WHO)**, the incidence of POAG is estimated at 2.4 million persons per year. For all types of Glaucoma, the prevalence of blindness was estimated at more than 8 million persons, with 4 million cases being caused by POAG.

Glaucoma is evaluated **structurally** by assessing the ONH cupping, RNFL defects & 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 that optic nerve & retinal structures aid in clinical decision and management of subjects with Glaucoma.

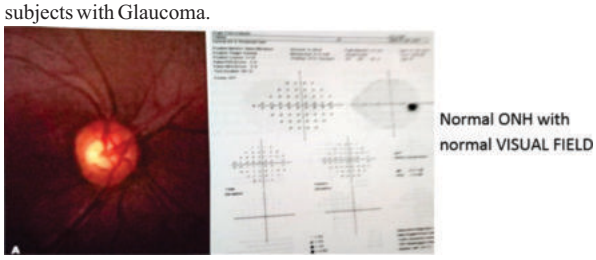

Fig.1

Glaucoma is a chronic progressive neuropathy & ONH is the first site to get damaged. Therefore, **stereoscopic ONH photography** is one of the most common imaging methods of the posterior pole, which allows documenting the ONH & its surrounding region for subjective evaluation & 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 & diffuse RNFL thinning. Therefore, retinal thinning/loss are always associated & correlate with visual field abnormalities, which is mandatory for glaucoma diagnosis. (Fig. 1 and 2)

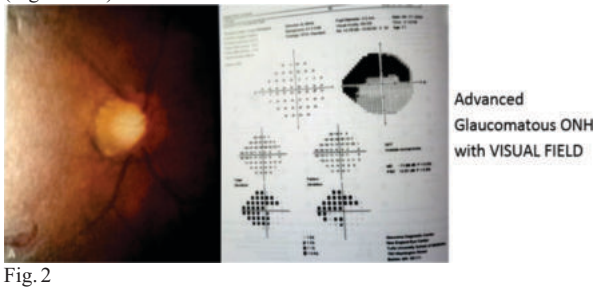

Fig. 2

MATERIAL AND METHODS :

The study was conducted for a period of one year and a total number of 100 patients who were diagnosed as POAG were selected from the outpatient department for the study. Informed consents were taken from each patient before including them in the study.

Inclusion Criteria:

All patients, 40 years and above, investigated, diagnosed and treated accordingly as primary open angle glaucoma.

Exclusion Criteria:

1. Primary angle closure glaucoma
2. Secondary glaucoma
3. Congenital glaucoma
4. Cases with lenticular opacity, corneal scarring or opacity which would make it difficult to evaluate fundus.

A detailed history and thorough ocular examination were carried out including visual acuity, Refraction, Applan Tonometry to record IOP, Slit lamp biomicroscopy, Fundus evaluation with +90D convex lens, Perimetry with Humphrey visual field analyser, Posterior segment optical coherence tomography.

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 damdge[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:

IOP(mmHg)	No. of Eyes	Percentage (%)
10-20	20	20
21-30	63	63
31-40	15	15
>40	2	2

Table: IOP Distribution In Left Eye:

IOP(mmHg)	No. of Eyes	Percentage %)
10-20	25	25
21-30	64	64
31-40	7	7
>40	4	4

In our study majority of the eyes had intraocular pressure(IOP) in the range of 21-30mmHg i.e., 63 (63%) in the right eye and 64 (64%) in the left eye. 20 (20%) right eyes and 25 (25%) left eyes had IOP in the range of 10-20mmHg. 15 (15%) right eyes and 7 (7%) left eyes had IOP in the range of 31-40mmHg. 2 patients (2%) in right eye and 4 (4%) had more than 40 mmHg IOP. The highest IOP recorded was 52 mmHg. The mean IOP recorded was 24.96 mmHg (right eye) and 23.58 mmHg (left eye).

Table: Cup-disc Ratio In Both Eyes:

Cup: disc ratio	Right eye	Left eye
0.4:1	6	7
0.5:1	12	12
0.6:1	25	33
0.7:1	22	23
0.8:1	24	15
0.9:1	11	10

In our study, maximum number of eyes had vertical cup disc ratio as 0.6:1, that is 25 in the right eye and 33 patients in the left eye. 22 patients in right eye and 23 in left eye had vertical cup disc ratio as 0.7:1. 24 had cup disc ratio of 0.8:1 in right eye and 15 patients in the left eye.

Table: Retinal Nerve Fiber Layer Thickness In Both Eyes:

RNFL THICKNESS (µm)	Right EYE	LEFT EYE
<40	1	1
40-50	12	18
51-60	9	10
61-70	9	13
71-80	22	20
81-90	37	27
>90	10	11

Table: Statistics Of Retinal Nerve Fiber Layer Thickness:

PARTICULARS	RIGHT EYE	LEFT EYE
MEAN RNFL THICKNESS	75.12	72.02
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	100.2

In our study, we found the mean thickness of retinal nerve fiber layer to be 75.12±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 be100µm, while the minimum was 37 µm. The average RNFL thickness was calculated as 72.61±16.325µm. This observation was statistically extremely significant (p=0.0001)

Table: Visual Field Defect Distribution In Both Eyes:

	RIGHT EYE (%)	LEFT EYE (%)
VISUAL FIELD DEFECT	47	52

Table: Detectable Various Visual Field Changes In Patients:

NATURE OF VISUAL FIELD	TOTAL EYES= 99	PERCENTAGE
Enlargement of blind spots	9	9.09
Paracentral, Seidal, Arcuate, Double Arcuate	52	52.52
Roenne's central nasal step	16	16.16
Localized or generalized field constriction	24	24.24

Table: Correlation Of Visual Acuity With Retinal Nerve Fibre Layer Thickness:

VISUAL ACUITY	AVG RNFL (µm)	VISUAL ACUITY	AVG RNFL (µm)
6/6	89.24	6/60	60.78
6/9	84.41	Fc (1m-5m)	53.98
6/12	83.45	HMCF	53.48
6/18	80.50	PL+	46.03
6/24	69.42	PL-	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=0.5034. p=0.001) with RNFL of right eye and left eye.

Table: Correlation Between Optic Disc Changes And Visual Field Defect

	VFD (RE)	N	P=value
VISUAL ACUITY (RE)	Present/Absent	47/53	<0.00001
OPTIC DISC CHANGES(RE)	Present/ Absent	47/53	P=0.001589
VISUAL ACUITY (LE)	VFD (LE) Present/Absent	52/48	P=<0.00001
OPTIC DISC CHANGES(LE)	Present/Absent	52/48	P=0.000177

Our study showed statistically significant correlation between visual field defect of right eye (r=0.3118, p=0.001589) and left eye (r=0.3664, p=0.000177) with Cup Disc Ratio of right & left eye.

DISCUSSION:

Age Distribution:

Present study showed maximum number of patients was in the fifth decade of life. The mean age of the patients in our study was found to be 54.78 years. The mean age in our study was similar with other Indian studies like Chennai Glaucoma study[6]; Narayan Met al[7] ;Tidake P et al[8].

Sex Distribution:

Males were found to be more affected 68(68%) than female 32(32%). Similar studies 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 0.67±0.137. Al Obeidan et al (2011)[12], Gyasi et al found the mean vCDR to be 0.72±0.22 and 0.83±0.14 respectively. While examining the Cup Disc ratio, 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 76.61±16.325 µm. This was statistically extremely significant (p<0.0001). Irrespective of eyes, maximum RNFL thickness was found to be 100.4µm, while the minimum 37µm; similar results were found by various authors in different studies.

Thus the result of our study in agreement with other studies showed that there was a significant decrease of RNFL thickness in POAG, which directly correlates with ONH damage. The Visual Field changes also correlates 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 Field is 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 and reduction of macular thickness.

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