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A Cross-Sectional Study of Visual Field Patterns in Advanced Primary Open Angle Glaucoma Patients Attending Ophthalmology OPD in a Tertiary Care Hospital, Kanchipuram.

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(Received: 04 February 2024 Revised: 11 March 2024 Accepted: 08 April 2024) **ABSTRACT: KEYWORDS** The purpose of this study was to evaluate the location and pattern of visual field defects as measured by Humphrey Field Analyzer (HFA 24-2) in newly diagnosed primary open Visual Field angle glaucoma (POAG) attending tertiary care hospital. This was a cross sectional, Patterns. descriptive study. One hundred eyes of 50 patients who fulfilled the inclusion criteria Advanced during one year were included. They were classified as mild, moderate and severe Primary Open glaucoma according to severity. Paracentral scotoma in superotemporal and superonasal Angle region was the most frequent visual field defect observed in mild glaucoma. Superior Glaucoma, arcuate defect and double arcuate defect was commonly seen among moderate and severe tertiary care stages of POAG respectively. There was a significant association between severity of hospital

glaucoma and pattern of visual field defect (p=0.000). The superior hemifield was affected

twice more than the inferior hemifield in newly diagnosed cases of POAG.

Introduction

Glaucoma is the second leading cause of blindness globally and is a significant contributor to preventable blindness¹. It is characterized by irreversible damage to the optic nerve and progressive visual field loss. Generally, patients remain asymptomatic until substantial anatomical and functional deterioration of the optic nerve has occurred.HFA is a useful diagnostic tool that aids in evaluating the optical nerve's functional capacity². It is utilized to identify, assess the severity of, and monitor the progression of the disease³. The onset of visual field defects in patients with primary open-angle glaucoma (HFA) occurs when approximately 40% of the fibers in the retinal ganglion are compromised⁴. However, it is important to note that HFA is not effective for early diagnosis, as the loss of nerve fiber layer fibers in the retina typically occurs before visual field defects manifest⁵. In HFA, the most common initial defect seen is the nasal step, which can be accompanied by a paracentral scotoma⁶. It is widely held that initial glaucomatous visual field abnormalities frequently occur in the periphery, with relative preservation of the central

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field⁷. However, some cases may present with centrally located initial defects⁸. Therefore, this study aimed to evaluate the patterns and locations of visual field defects in patients with primary open-angle glaucoma across different severity levels, as no such study has been conducted in our setting.

Materials & Methods

In this prospective cross-sectional study which is hospital based study was conducted in the outpatient of Ophthalmology Department in a Private medical college between January 2023 and December 2023. The total sample size of the study was 50 patients. Patients with glaucomatous optic disc changes like vertically elongated optic cups, asymmetry of cup disc ratio (CDR) >0.2, thinning or notching of Neuro Retinal Rim (NNR), nerve fibre layer defect, Intraocular pressure (IOP) > 20mmHg were included in the study. Patients with secondary open angle glaucoma, who had undergone glaucoma surgery and patients with neurological diseases that could cause visual field defect were excluded from the study. Informed consent was taken from each patient.

All patients received an ophthalmic examination including visual acuity, anterior segment by slit lamp examination, intraocular pressure measurement by applanation tonometry, central corneal thickness measurement by pachymetry, gonioscopy with single mirror goniolens and evaluation of the optic discs with +90 Diopter lens. All 50 patients were examined with Humphrey visual field using 24-2 Swedish Interactive Threshold Algorithm (SITA) threshold program of both eyes. Only the reliable (fixation losses <20% false positives and false-negatives <33%) visual fields were included in the study. In case of unreliable fields, the test was repeated after few days. Then the more reliable field was selected for analytical purposes. Visual fields were considered to be abnormal according to Hodapp-Parrish-Anderson criteria.

Perimetry:

- 1. Glaucoma hemi field test (GHT) outside normal limits
- 2. Pattern standard deviation (PSD) p < 5%

(Or)

3. Three adjacent non-edge points p < 5% in the pattern deviation probability plot of which at least one point was p < 1% and all points were on the same side of the horizontal meridian.

For this study, we defined POAG as mild, moderate and severe.

- Mild POAG as a vertical CDR ≤0.65, mild VF defect not within 10° of fixation (Mean Deviation (MD) better than -6dB on HFA 24-2)
- Moderate POAG as a vertical CDR 0.7 to 0.85, moderate VF defect not within 10° of fixation (MD between -6 and -12dB on HFA 24-2).
- Severe POAG as a vertical CDR ≥0.9, VF defect within 10° of fixation (MD worse than -12dB on HFA 24-2).17

The collected data was entered in Microsoft Excel. Coding of the variables was done. Analysis was done using SPSS software (Version 27, IBM). Descriptive statistics was used. Association between categorical tests. The outcomes of the treatment groups were compared using a test to reach the hypothesis, a P value less than 0.5 was considered significant.

Result

A total of 100 eyes of 50 patients with newly diagnosed case of POAG were evaluated in the study. 27 (54%) of the cases were male while 23 (46%) were female. The mean age of study subjects was 52.56 ± 12.62 years (age group range 30-87 years). There was no significant association between age and severity of cupping (p=0.06) but there was significant association between age and visual field defect (p=0.04) (Chart-1).

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Tibeto-Mongolian was 31 (62%) while Indo-Aryan was 19 (38%). About 40 (80%) were asymptomatic and 10 (20%) had headache. Among 40 asymptomatic, 21 cases

were of mild glaucoma, 16 were moderate and 3 were severe glaucoma. Out of 10 symptomatic, 5 cases were mild, and 5 were moderate glaucoma (p=0.68). (Chart 2)

Chart 2: shows the pictorial representation of Symptomatic and asymptomatic



Out of 50 patients, 30 (60%) had a refractive error and 20 (40%) had no refractive error. 9 (18%) had simple myopia, 8 (16%) had simple myopic astigmatism, 2 (4%) had compound myopic astigmatism, 6 (12%) had simple hypermetropia, 3 (6%) had simple hypermetropic

astigmatism and 2 (4%) had compound hypermetropic astigmatism. There was no significant association between refractive error and severity of cupping and VF defect (p=0.08, p=0.65). (Chart 3)

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Chart 3: Shows the details of Refractive error

In this study, 15 (30%) were hypertensive patients, 4 (8%) were diabetic, 9 (18%) were both hypertensive and diabetic and 46.2% had no systemic diseases. There was

a significant association between systemic disease and severity of cupping and VF defect (p=0.000, p=0.005) (Table 1)

Co-Morbidities	Frequency	Percentage (%)
Hypertensive	15	30%
Diabetic Mellitus	4	8%
Both (Hypertensive & Diabetic Mellitus)	9	18%
No Comorbidities	22	44%
Total	50	100%

Table 1: details of co-morbidities

The mean IOP was 20.21 ± 4.20 mmHg and it ranged from 13-30 mmHg. The mean CCT was $523.8 \ \mu m \pm 36.22$ ranged from 436 to $632 \ \mu m$. There was a significant association between IOP and CCT (p=0.002). There was a significant association between IOP and severity of cupping (p=0.02) and there was association between VF defect (p=0.04). Whereas there was significant

association between CCT and VF defect (p=0.03) and no association with severity of cupping (p=0.65)

The mean cup disc ratio was $0.60:1 \pm 0.32$, ranged from 0.4:1 to 0.89:1. According to cup disc ratio, mild glaucoma (CDR ≤ 0.65) was seen in 21 (42%) eyes, moderate glaucoma (CDR 0.7 to 0.85) was seen in 15 (30%) and severe glaucoma (CDR ≥ 0.9) was seen in 3 (6%) at the time of diagnosis. There was a significant

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association between CDR and pattern of visual field defect and HFA MD (p=0.001 and p=0.002) respectively.

Out of 100 eyes which were studied, 65 (65%) had thinning of NNR, 20 (20%) had notching and 15 (15%) had intact NNR. The most common site for NNR loss was inferior rim 34 (34%) followed by bipolar rim 23 (23%), superior rim 15 (15%), inferotemporal 9 (9%),

supertemporal 3 (3%), temporal 2 (2%) and nasal 1 (1%). There was a significant association between rim loss and stage of glaucoma (p=0.001). There was significant association between site of rim loss and pattern of visual field defect and HFA MD and HFA PSD (p=0.000, p=0.003) respectively. But there was no significant association between site of rim loss and HFA MD and HFA PSD (p=0.48, p=0.65).

Table 2: Glaucoma parameters and	the association between VI	defect
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Variables	riables Mean with standard deviation			
Age	52.56±12.62	0.04		
Vertical CDR	$0.60:1 \pm 0.32$	0.001		
IOP	20.21±4.20	0.04		
ССТ	$523.8 \ \mu m \pm 36.22$	0.03		
HFA MD	8.63 dB ± 9.14	0.000		
HFA PSD	$6.50 \text{ dB} \pm 4.44$	0.003		
Test Time	6.67 ± 2.63	0.05		

The most common pattern of visual field defect in this study was paracentral scotoma which was seen in 35 (35%) eyes. Among paracentral both superonasal and superotemporal paracentral defect was seen in 22 eyes (22%) each whereas inferonasal paracentral in 7 (%) and

inferotemporal in 6 (6%). Superior arcuate scotoma in 27 (27%), inferior arcuate scotoma in 7 (7%), double arcuate scotoma in 6 (6%), Superior nasal step in 5 (5%), central scotoma in 3 (3%) and 17 (17%) had no VF defect (Table 3).

Table 3: Pattern and location of VF defect in newly diagnosed POAG

VF defect	Frequency (n)	Percentage (%)		
Superonasal paracentral scotoma	9	9		
Superotemporal paracentral scotoma	13	13		
Inferonasal paracentral scotoma	7	7		
Inferotemporal paracentral scotoma	6	6		
Superior arcuate scotoma	27	27		
Inferior arcuate scotoma	7	7		
Double arcuate scotoma	6	6		
Superior nasal step	5	5		

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Central scotoma	3	3
No scotoma	17	17
Total	100	100%

In the early glaucoma, paracentral scotoma was the most frequent visual field defect followed by superior arcuate defect and superior nasal step. In moderate glaucoma, superior arcuate defect was common followed by paracentral scotoma and in severe glaucoma double arcuate and superior arcuate scotoma was common. There was a significant association between severity of glaucoma and pattern of visual field defect (p=0.000) (Table-4).

Severity of glaucoma	Paracentral scotoma	Superior arcuate scotoma	Inferior arcuate scotoma	Double arcuate scotoma	Superior nasal step	Central scotoma	No scotoma	Total	p value
Mild	16	11	4	2	3	1	15	52	0.000*
Moderate	13	10	2	2	1	1	2	31	
Severe	6	6	1	2	1	1	0	17	
Total	35	27	7	6	5	3	17	100	

Table 4: Pattern of VF defect in POAG across different severity

The average test time was 6.67 ± 2.63 , ranged from 4.14 to 11.48 minutes. There was no significant association between test time and pattern of visual field defect (p=0.05)

Discussion:

According to our research findings, the paracentral scotoma in the superotemporal and superonasal regions was the most prevalent visual field defect observed in the early stages of POAG. In moderate and severe stages of POAG, superior arcuate defect and double arcuate defect were frequently observed. There was a statistically significant correlation between the severity of glaucoma and the pattern of VF defect, and this was confirmed with a p-value of 0.000.

In a study by Lichter et al⁹, the earliest glaucomatous visual field defect was evaluated in a consecutive series of patients with primary open-angle glaucoma (POAG). The results showed that paracentral defects and isolated nasal steps were among the earliest signs of

glaucomatous field loss. Another study conducted by Nascimento VC et al¹⁰ found that in the early POAG group, the nasal superior step was the most frequent visual field defect, followed by paracentral scotoma and inferior nasal step, as evaluated by the SITA strategy. The superior hemifield comprised most of the defects.

A study conducted by Alipanahi et al¹¹. revealed that the predominant visual field defect was a nasal and peripheral scotoma extending beyond 20° of fixation at the Tabriz, Nasal, and arcuate visual field defects at Graz patients. According to O'Brien C¹² and Schwartz B's ¹³ study, the distribution of visual field loss in 40 chronic open-angle glaucoma eyes was mainly found in the nasal, supranasal, and superotemporal regions using automated perimetry.

Research by Goldberg I et al¹⁴ discovered that paracentral scotoma and nasal step defects were the earliest visual field changes in POAG. The study by Lewis et al¹⁵ found that superior arcuate scotoma and superior nasal steps were the most prevalent visual field

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defects in both POAG and secondary glaucoma. Our study is similar in that it found paracentral scotoma to be the most common visual field defect in glaucoma (44.4%), followed by arcuate scotoma (23.4%). Additionally, Sharma et al found that paracentral scotoma was the second most common visual field defect in glaucoma (23.4%). Finally, the study by Nicholas SP et al¹⁶ found that superior defects were twice as common as inferior defects.

Schiefer et al.¹⁷ discovered that glaucomatous visual field loss was more prevalent in the upper hemifield compared to the lower hemifield, and it exhibited a retinal nerve fiber-related pattern with a preference for the nasal step region. In more than half of the eyes with primarily mild to moderate glaucomatous field loss, the defective locations were found in the immediate superior paracentral region within an eccentricity of 3°.

In a study conducted by Han et al¹⁸, it was discovered that cases of primary open-angle glaucoma (POAG) experienced the highest incidence of central visual field damage at 52.38%, followed by acute angle-closure glaucoma at 47.6%. On the other hand, cases of chronic angle-closure glaucoma (CACG) suffered the least amount of central visual field damage at 22.6%. The nasal area was the most commonly affected region during the early stages of glaucoma. However, in our study, only 4 patients had central field defects, with 1 being in the mild stage, 1 in the moderate stage, and 2 in the severe stage of glaucoma. The nasal area was not frequently involved in our study, occurring only in 5 eyes (4.8%), with 4 eyes being mild glaucoma cases and experiencing superior nasal VF defects, and 1 being a moderate glaucoma case.

Conclusion:

To summarize, our research indicates that paracentral scotoma in the superotemporal and superonasal regions was the most common visual field defect observed in patients with mild glaucoma. In patients with more advanced stages of the disease, superior arcuate defect and double arcuate defect were frequently seen. However, it is important to note that our findings are based on a cross-sectional study, and further research with a larger sample size and longitudinal design is needed to confirm our results. Acknowledgment: We are thankful to the entire study participants for their participation and full cooperation. We acknowledge the Department of ophthalmology faculties for encouraging and supporting us.

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Conflicts of interest: Nil

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