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Original Article

Progression Measurement of Visual Field Loss in Medically Controlled Primary Open-Angle Glaucoma (POAG)

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ABSTRACT

Objective: To determine mean visual field parameters loss (Mean deviation and Pattern standard deviation) and frequency of glaucoma hemifield test to evaluate optic nerve damage progression in medically well-controlled primary open-angle glaucoma POAG through standard automated perimetry.

Study Design: Prospective longitudinal study.

Place and Duration of Study: Department of Ophthalmology, Rawal Institute of Health Sciences, Islamabad Pajistan, from Sep 2019 to March 2020.

Methodology: Fifty-four patients were inlcuded. Visual field parameters included the Glaucoma hemifield test, Mean deviation, and Pattern standard deviation. The visual field loss progression was evaluated through Humphry analyzer 30-2. Follow-up was done on the first day of the presentation, then after three and six months.

Results: We found an increase in intraocular pressure (14.59±1.3 vs 15.87±2.1, p<0.001, 16.44±2.4, p<0.001, Mean deviation (-9.381±6.5 vs -10.905±8.9, p=0.05, -11.034±9.9=0.05) and Pattern standard deviation (6.158±4.1 vs 6.133±4.3, p<0.001, 6.502±4.2, p<0.001) at 1st day, 3-monthS and 6-monthS respectively. Glaucoma hemifield test was outside normal in 39(72.2%), 45(83.3%), 50(92.6%) patients, borderline in 5(9.3%), 4(7.4%), 2(3.7%) patients, within normal in 6(11.1%), 3(5.6%), 1(1.9%) patient at 1st-day, 3-months and 6-months respectively.

Conclusion: Primary open-angle glaucoma patients with medically controlled conditions show an increasing trend in visual field parameters, including mean standard deviation, pattern standard deviation and glaucoma hemifield test measurement with the progression of the disease.

Keywords: Glaucoma hemifield test, Mean Deviation, Pattern standard deviation ,Primary open-angle glaucoma,

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INTRODUCTION

Open-angle glaucoma is a chronic, irreversible and progressive multifactorial optic neuropathy.[1] The disease is characterized by anterior chamber open angle, progressive loss of peripheral vision (followed by central visual field loss) and optic nerve head changes.[2] Intraocular pressure is an important risk factor for primary open-angle glaucoma. An estimated 70 million glaucoma are suffering from glaucoma worldwide. However, 74% of these glaucoma patients are affected with primary open-angle glaucoma.[3] An estimated 10% of glaucoma patients were bilaterally blind due to primary open-angle glaucoma. The prevalence of primary open-angle glaucoma (POAG) was 19.46% in Karachi, Pakistan.[4]

The aetiology of POAG is increased resistance drainage in the trabecular meshwork (drainage angle between the iris and cornea remains open. Intraocular pressure increases due to blockage, followed by optic nerve damage and visual loss progression. Open-angle glaucoma is evaluated clinically with three diagnostic tools, including optic disc changes, raised intraocular pressure and visual field changes.[5,6].

Visual field testing (Perimetry) is a diagnostic tool for diagnosing and managing open-angle glaucoma. Visual fields are used to confirm OAG and understand the progression of the disease.[7]

Primary open-angle glaucoma is a preventable cause of blindness, followed by prevention of the progression of the disease. Early diagnosis and effective management of open-angle glaucoma prevent optic nerve atrophy evolution and successfully preserve the patient's vision.[8,9] However, compliance with medical therapy and patient adherence are important risk factors for the management of primary open-angle glaucoma. We planned to determine mean visual field parameters loss (Mean and Pattern standard deviation) and the glaucoma hemifield test frequency to evaluate optic nerve damage progression in medically well-

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controlled primary open-angle glaucoma POAG through standard automated perimetry.

METHODOLOGY

The prospective longitudinal study was conducted at the Department of Ophthalmology, Rawal Institute of Health Sciences, Islamabad, from September 2019 to March 2020, after approval from the IERB (IRB=RIHS-REC/048/19). The sample size was calculated using a WHO calculator, taking a reported standard deviation of 0.158.10

Inclusion Criteria: Patients aged 18-65 years, of either gender and diagnosed with primary open-angle glaucoma (medically controlled cases) were included.

Exclusion Criteria: Patient with glaucoma surgery, patients with any disease-causing refractive media obscuration, patients with total visual loss, and patients with retinal or optic nerve disease not associated with glaucoma, were excluded.

Patients were recruited through a non-probability consecutive sampling strategy. All participating patients were informed about the study protocol and signed a written consent form before the study was conducted.

Primary open-angle glaucoma was defined as mean untreated IOP above 21mmHg, glaucomatous cupping with optic disc changes and neuroretinal rim loss, absence of secondary causes of IOP raise, open drainage angle on gonioscopy (without any pathological changes) and visual field defects (compatible with glaucomatous cupping).[11] Clinical procedures include a detailed history and general, systemic and ocular examination. The ocular examination includes visual acuity measurement (uncorrected and best corrected), refraction (subjective and objective), extra-ocular movement measurement, and anterior chamber detail examination with a slit lamp. Intra-ocular pressure measurement was done with Goldmen applanation tonometer. Fundus examination through indirect ophthalmoscope and gonioscopy was done with a triple mirror. Visual field parameters include the glaucoma hemifield test (GHT), Mean deviation (MD), and Pattern standard deviation (PSD). The visual field loss progression was evaluated through Humphry analyzer 30-2. Follow-up was done on the first day of the presentation, then after 3 and 6 months.

Data was analyzed using Statistical Package for Social Sciences (SPSS) version 24. Quantitative variables were expressed as Mean±SD and qualitative variables were expressed as frequency and percentages. Fisher exact test and Independent sample t-test were applied to explore the inferential statistics. The p-value lower than or up to 0.05 was considered as significant.

RESULTS

A total of 54 patients were included in the study. There were 29(53.7%) male and 25(46.3%) female. The mean age of patients was 51.9±8.3 years. Among all the patients, the right eye was affected in 23(42.6%), and the left was affected in 31(57.4%). GHT was outside normal 39(72.2%), 45(83.3%), 50(92.6%), borderline in 5(9.3%), 4(7.4%), 2(3.7%), within normal 6(11.1%), 3(5.6%), 1(1.9%) at first day, three months and six months respectively as shown in Table-I.

Table-I: Frequency Distribution of Glaucoma Hemifield Test and Mean deviation at 1st Day, 3-Months and 6-Months (n=54)

GHT at 1st Day	Frequency (%)	MD at 1st day	Frequency (%)
Outside Normal	39(72.2%)	Mild(≤6)	16(29.6%)
Borderline	5(9.3%)	Moderate (7-12)	26(48.1%)
Within normal	6(11.1%)	Severe (>12)	12(22.2%)
General reduced sensitivity	4(7.4%)	-	-
GHT at 3-Months	-	Mean deviation at 3-Months	
Outside normal	45(83.3%)	Mild(≤6)	14(25.9%)
Borderline	4(7.4%)	Moderate (7-12)	21(38.9%)
Within normal	3(5.6%)	Severe (>12)	19(35.2%)
General reduced sensitivity	2(3.7%)	-	-
GHT at 6-months	-	MD at 6-Months	-
Outside normal	50(92.6%)	Mild(≤6)	14(25.9%)
Borderline	2(3.7%)	Moderate (7-12)	15(27.8%)
Within normal	1(1.9%)	Severe (>12)	25(46.3%)
General reduced sensitivity	1(1.9%)	-	-

There was a significant change in intraocular pressure from 1st day to 3 months (14.59±1.3 vs 15.87±2.1, p<0.001) and from first day to 6 months (14.59±1.3 vs 16.44±2.4, p<0.001). Mean deviation showed a significant increasing trend from one month to 3 months (-9.381±6.5 vs -10.905±8.9, p=0.05), and a

similar trend was observed from one to 6 months following (-9.381±6.5 vs -11.034±9.9=0.05). Pattern standard deviation also significantly increases with increasing time from 1st day, 6.158±4.1 and at 3 months, 7.133±4.3 (p<0.001). At six months, 6.502±4.2 (p<0.001), as shown in Table-II.

Table-II: Comparison of Intraocular Pressure, Mean Deviation and Pattern Standard Deviation from 1st Day to 3 Month and 1st Day to 6 Month (n=54)

Parameters	Mean±SD	*p*-value
Intraocular pressure At 1st day	14.59±1.3	<0.001
At 3 months	15.87±2.1	
Intraocular Pressure		
At 1st day	14.59±1.3	<0.001
At 6 month	16.44±2.4	
Mean Deviation		
At 1st day	-9.381±6.5	0.05
At 3 month	-10.905±8.9	
Intraocular Pressure		
At 1st day	-9.381±6.5	0.05
At 6 month	-11.034±9.9	
Pattern standard deviation		
At 1st day	6.158±4.1	<0.001
At 3 month	7.133±4.3	
Pattern Standard Deviation		
At 1st day	6.158±4.1	<0.001
At 6 month	6.502±4.2	

GHT at six months showed insignificant association with gender (p=0.565), age (p=0.728), and affected eye (p=0.543), as shown in Table-III.

Table-III: Association between Glaucoma Hemifield Test with Gender, Age and Affected Eye (n=54)

Parameters	Glaucoma Hemi Field Test (at 6-Months)				*p*-value
	Outside Normal	Borderline	Within Normal	General Reduced Sensitivity	
Gender					
Male	27(50%)	1(1.9%)	1(1.9%)	0(0)%	0.565
Female	23(42.6%)	1(1.9%)	0(0%)	1(1.9%)	
Age					
35-45 years	13(24.1%)	1(1.9%)	0(0%)	0(0%)	0.728
46-65 years	37(68.5%)	1(1.9%)	1(1.9%)	1(1.9%)	
Affected Eye					
Right	21(38.9%)	1(1.9%)	1(1.9%)	0(0%)	0.543
Left	29(53.7%)	1(1.9%)	0(0%)	1(1.9%)	

DISCUSSION

Identification of primary open-angle is associated with several clinical and epidemiological research directions.[10] This led us to understand glaucoma development risk factors, visual loss function, optic nerve damage and optimized decision-making strategies for discriminating primary open-angle glaucoma patients from normal populations.[11] In POAG, visual field loss is a functional manifestation associated with optic nerve fibre loss.[12] Visual field measurement helps measure glaucoma progression and the need to change the treatment.[13]

In the present study, POAG patients show deterioration in visual field parameters from 1st day to 6 months. A significant increase in MD and PSD was found from the first day to 3 months and six months (p<0.05). Chen *et al*. reported that the mean deviation was -4.84±0.2 at one month, while at one year, the mean deviation was -15.99±2.3 (p=0.01). They also reported that the patient's quality of life strongly depends upon the severity of the visual field and hemifield location.[14] Hoe *et al*. reported that Primary open-angle glaucoma is associated with central visual field loss in 52.3% of patients.[15] Moreover, the early stage of glaucoma usually involves the nasal area. The majority of patients lie in outside normal glaucoma hemifield tests similar to our study. Rao *et al*. reported that hemifield sector analysis showed a mean deviation -7.63±1.3 at three months and 14.99±4.4 after one year of glaucoma diagnosis. They reported that multifocal visual evoked potential (mfVEP) is also an important part of glaucomatous testing to detect glaucoma suspects from glaucomatous patients.[16] Focal visual field difference (across horizontal lines) is measured to differentiate normal and glaucoma subjects.[17] However, we did not consider mfVEP in our study because our study mainly focused on primary open-angle glaucoma patients.

In our study, primary open-angle patients showed a trend towards high intraocular pressure from the first day to 3 and 6 months follow-up (p= 0.001). Similar results are reported by a study with an increase in intraocular pressure >25 mmHg in patients older than 50 years diagnosed with POAG. They also reported that paracentral areas are the most common locations for visual field defects.[18] Moreover, upper and lower nasal areas showed the deepest scotoma with high mean sensitivity loss (in both superior and inferior hemifields).[19,20]

To the best of our knowledge, our study is unique regarding visual field progression measurement in POAG patients in Pakistan.

LIMITATIONS

Our sample size was small because we included only POAG patients. We did not consider contrast sensitivity and stereopsis.

CONCLUSION

Primary open-angle glaucoma patients with medically controlled conditions show an increasing trend in visual field parameters, including mean standard deviation, pattern

standard deviation and glaucoma hemifield test measurement with the progression of the disease. Further in-depth trials are required to understand effective treatment according to the progression of primary open-angle glaucoma in the Pakistani population.

Conflict of Interest: None.

Authors Contribution

Following authors have made substantial contributions to the manuscript as under:

MZ & MSA: Data acquisition, data analysis, data interpretation, approval of the final version to be published.

EY & WA: Study design, drafting the manuscript, critical review, approval of the final version to be published.

QTA & MS: Concept, data acquisition, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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