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Original Research Article

Clinical Profile of Primary Open-Angle Glaucoma Patients: Age and Sex-wise Comparison of Visual Field Defects

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Abstract:

Background: Primary open-angle glaucoma (POAG) is a leading cause of irreversible blindness worldwide, characterized by progressive optic nerve damage and visual field defects. Age and sex may influence disease severity and visual outcomes.

Aim: To evaluate the clinical profile of POAG patients and compare visual field defects according to age and sex.

Methodology: A hospital-based cross-sectional study was conducted on 40 POAG patients (80 eyes) aged 28–78 years at Patna Medical College and Hospital, Patna, Bihar, India. Comprehensive ocular examinations, including visual acuity, intraocular pressure (IOP), cup-to-disc ratio (CDR), visual field testing, and retinal nerve fiber layer (RNFL) thickness measurement, were performed. Data were analyzed using t-tests and ANOVA.

Results: Mean age was 56.4 ± 12.85 years, with males comprising 55%. Poorer visual acuity correlated significantly with higher CDR ($p=0.012$), higher IOP ($p=0.0001$), and thinner RNFL ($p=0.0001$). RNFL thickness declined significantly with age ($p=0.018$), whereas CDR and IOP were not significantly age-dependent. No significant gender differences were observed for RNFL thickness, CDR, or IOP.

Conclusion: POAG predominantly affects middle-aged and older adults, with structural optic nerve changes closely associated with visual acuity decline. Age influences RNFL thinning, but sex does not significantly affect key clinical parameters. Early detection and monitoring are essential to preserve vision.

Keywords: Primary Open-Angle Glaucoma, Visual Field Defects, Cup-To-Disc Ratio, Retinal Nerve Fiber Layer, Intraocular Pressure, Age, Sex.

Introduction

Glaucoma is considered as the second cause of blindness in the world and a significant health issue on the population. It has been estimated that in the world, about 80 million people will have glaucoma in 2020 with 11.2 million people becoming permanently blind as a result of the disease [1]. The most common form of glaucoma is the primary open angle glaucoma (POAG) which is chronic, bilateral and asymmetrical optic nerve involvement. The disease is characterized by the progressive degeneration of optic nerve fibers, which causes structural damage of the optic nerve head as well as related functional defects in visual field in adults, and is caused by POAG. Indicatively, such changes take place in the eyes with an anterior chamber angle that otherwise appears normal, and intraocular pressure (IOP) levels that could also be damaging to the optic nerve [2]. Several synonymous terms are also used to refer to POAG in literature and these include chronic simple glaucoma, chronic open angle glaucoma (COAG) and idiopathic open angle glaucoma.

According to the epidemiological research, a sizeable percentage of glaucoma cases are undiagnosed. About half of glaucoma patients do not realize that they have this condition [2]. The high proportion of the untreated cases of the disease despite the fact that it is a treatable and possibly preventable disease highlights the urgency of proper screening measures to help detect people who are at risk. It is important to ensure that early detection and timely intervention is done to avoid irreversible loss of vision. Risk assessment is an important role in the management of glaucoma, and it helps the clinician to categorize the patients depending on their unique traits and predisposition to disease. The prevalent surveys and case-control studies conducted on a population have provided most of the available evidence on COAG [3]. Age and high IOP are always some of the risk factors that have been identified to contribute to the occurrence and progression of glaucoma [4].

POAG usually affects the body without any symptoms, but in many cases, patients stay silent until an insignificant damage is done to the optic nerve. Gradually developing visual field loss is also one of the characteristic features of the disease and its essential indicator in terms of diagnosis, monitoring, and treatment decision-making. Visual field defects of POAG may also take different forms such as nasal steps, arcuate scotomas and paracentral defects. These defects depend on severity and progression on various factors such as age, sex, IOP and other systemic and ocular defects. The connection between these factors and changes in the visual field is very important in order to organize patient-specific management strategies.

The primary mode of POAG treatment nowadays is IOP lowering up to the level that is now thought to be therapeutically safe, commonly known as the target IOP range [5] . Optimization of the target IOP is important since it is the pressure level at which no additional damage of the optic nerve and loss of visual field will be anticipated. Strong proof of the evidence of randomized controlled trials has shown that the reduction of IOP to the recommended level of target level remarkably decelerates the advancement of optic nerve battery and maintains visual functionality [6,7]. IOP is the only risk factor which can be changed in the easiest way monitored and varied with the help of pharmacological, laser, or surgical interventions. Proper management of IOP has the ability to not only lower the rate of the conversion of ocular hypertension to glaucoma but also lowers the progression of the disease in patients who already have POAG [8]. Besides, discussing the target IOP with the patients and organizing the coordination with the healthcare professionals improves medication compliance and supports the therapeutic relationship.

The socioeconomic status, affordability of patients and access to follow-up care may make access to glaucoma management different in developing countries. The algorithms of treatment are usually modified based on the local context, with a strong focus on the cost-effective approach that would not jeopardize the clinical efficacy and make the treatment accessible to patients [9]. This highlights the necessity to know the clinical profile of patients with POAG, such as demographic factors like age and sex which could have an impact on the presentation, advancement, and response to treatment of the disease.

Another risk factor that is well known to cause POAG is age where prevalence and severity of the ailment are high in older populations. The aging of the optic nerve and traumatic meshwork increases the vulnerability to glaucomatous harm. The prevalence and progression of POAG have also been found to be sex-related and the mechanisms behind this have not been fully understood. Assessment of visual field defects relative to age and sex will offer meaningful information on disease epidemiology and will be used in the development of individualized treatment. Such variables can be examined in detail to help clinicians predict the development of the disease, optimize therapeutic measures, and enhance patient outcomes.

In such a way, primary open angle glaucoma is a chronic and progressive optic neuropathy with high visual functioning as well as quality of life implications. The early disease presents itself without symptoms, and the prevalence of undiagnosed cases is high, creating the necessity to enhance screening, risk assessment, and focused intervention. Age and sex appear to be significant factors influencing clinical manifestation and visual field alteration among POAG patients, and their methodical analysis can deepen the knowledge about the trends in the disease and help to make patients-related decisions. This research will offer a thorough clinical profile of the patients of POAG and specifically examine the comparison between the visual field defects between age and sex, thus adding to the existing literature that can aid in the provision of the personalized and effective management of glaucoma.

Methodology

Study Design: This was a hospital-based cross-sectional observational clinical study conducted to evaluate the clinical profile of patients diagnosed with Primary Open-Angle Glaucoma (POAG) and to compare visual field defects according to age and sex. The study aimed to assess variations in visual field changes, intraocular pressure, visual acuity, and retinal nerve fiber layer thickness among different age groups and between male and female patients.

Study Area: The study was conducted in the Department of Ophthalmology at Patna Medical College and Hospital, Patna, Bihar, India

Study Duration: The study was carried out over a period of eight months from March 2025 to October 2025.

Sample Size: The total sample size comprised 80 eyes of 40 patients diagnosed with Primary Open-Angle Glaucoma. Both eyes of each patient were included in the study where they fulfilled the eligibility criteria. The sample represented patients attending the OPD during the study period and meeting the diagnostic criteria for POAG.

Study Population: The study population included patients aged between 25 and 82 years who were diagnosed with Primary Open-Angle Glaucoma and attended the Ophthalmology OPD during the study duration. Patients were categorized into different age groups for comparative analysis, and sex-wise comparisons were also performed. The demographic and clinical characteristics of the patients were recorded systematically.

Data Collection: After obtaining written informed consent, detailed demographic and clinical information was collected from each participant, including age, sex, presenting complaints, duration of symptoms, and relevant medical and family history. A comprehensive ocular examination was performed for all enrolled patients. Best-Corrected Visual Acuity (BCVA) was assessed using Snellen's chart. Objective refraction was performed using a TOPCON Auto refractometer KR-800, and subjective refraction was carried out in patients with presenting visual acuity less than 6/12.

Anterior segment examination was conducted using a slit-lamp biomicroscope to identify any abnormalities. Intraocular pressure (IOP) was measured using pneumotonometry (TOPCON CT80 computerized tonometer). Gonioscopy was performed in dim illumination using a Goldmann-type four mirror lens (Haag Streit, Bern, Switzerland), and the anterior chamber angle was graded according to Shaffer's grading system.

Slit-lamp biomicroscopic examination of the optic nerve head was carried out using a +90 diopter lens. The pupils were dilated using 1% tropicamide with 2.5% phenylephrine. The vertical cup-disc ratio (VCDR) was assessed and recorded, and glaucomatous changes such as focal thinning, notching, or splinter hemorrhages were documented. All patients underwent visual field testing using standard automated perimetry (Humphrey Visual Field Analyzer). Optical coherence tomography (OCT) imaging of the optic disc and retinal nerve fiber layer (RNFL) thickness measurement was performed using 3D OCT (TOPCON, TOKYO, JAPAN).

Inclusion Criteria:

- Patients aged ≥25 years.
- Diagnosed cases of Primary Open-Angle Glaucoma.
- Open anterior chamber angles on gonioscopy.
- Patients who provided informed written consent.

Exclusion Criteria

- Secondary glaucoma
- Angle-closure glaucoma
- History of ocular trauma
- Previous intraocular surgery (except uncomplicated cataract surgery)
- Media opacity affecting visual field reliability
- Patients unwilling to participate

Procedure: Patients attending the Ophthalmology OPD were screened for eligibility. Those fulfilling the inclusion criteria were enrolled after obtaining informed consent. A structured clinical examination protocol was followed for each participant, including visual acuity assessment, IOP measurement, gonioscopy, optic disc evaluation, visual field testing, and OCT imaging. The collected data were systematically recorded and categorized based on age and sex. Visual field defects and other clinical parameters were then compared across different age groups and between male and female patients.

Statistical Analysis: Data were entered into Microsoft Excel and analyzed using SPSS version 17.0 and EPI-INFO (Centers for Disease Control and Prevention, Atlanta, Georgia, USA). Descriptive statistics such as mean, standard deviation, and percentages were calculated. Inferential statistical tests including Student's unpaired t-test were used for comparison between two groups, and one-way ANOVA was applied for comparison among multiple age groups. A p-value of less than 0.05 was considered statistically significant."

Result

Table 1 presents the age-wise distribution of 40 patients. The largest group was 55–64 years (12, 30%), followed by ≥65 years (10, 25%), 45–54 years (9, 22.5%), 35–44 years (6, 15%), and 25–34 years (3, 7.5%). The mean age was 56.40 ± 12.85 years, ranging from 28 to 78 years, indicating that the majority of patients were in the older age groups.

Table 1: Age-wise distribution of patients (n = 40)

Age group (years)	**Number of patients (%)**
25–34	3 (7.5)
35–44	6 (15.0)
45–54	9 (22.5)
55–64	12 (30.0)
≥65	10 (25.0)
Total	**40 (100)**
Mean ± SD	**56.40 ± 12.85 (28–78)**

Table 2 shows the gender distribution of 40 patients. There were 22 males (55.0%) and 18 females (45.0%), indicating a slightly higher proportion of male patients in the study population.

Table 2: Gender-wise distribution of patients (n = 40)	
Gender	**Number of patients (%)**
Males	22 (55.0)
Females	18 (45.0)
Total	**40 (100)**

Table 3 presents the correlation between visual acuity and cup-to-disc ratio (CDR) among 80 eyes. Mean CDR decreased as vision improved: 1 m (0.78 ± 0.06), 2 m (0.75 ± 0.05), 3 m (0.72 ± 0.08), 6/60 (0.74 ± 0.07), 6/36 (0.70 ± 0.06), 6/24 (0.66 ± 0.07), 6/18 (0.64 ± 0.08), 6/12 (0.62 ± 0.05), and 6/9 (0.58 ± 0.04). The association was statistically significant (F=3.12, p=0.012), indicating that higher CDR was associated with worse visual acuity.

Table 3: Correlation of Vision with Cup-to-Disc Ratio (n = 80 eyes)				
Vision	**n**	**Mean CDR ± SD**	**F**	**P**
1 m	6	0.78 ± 0.06	3.12	0.012, S, <0.05
2 m	4	0.75 ± 0.05		
3 m	6	0.72 ± 0.08		
6/60	8	0.74 ± 0.07		
6/36	10	0.70 ± 0.06		
6/24	12	0.66 ± 0.07		
6/18	18	0.64 ± 0.08		
6/12	10	0.62 ± 0.05		
6/9	6	0.58 ± 0.04		
Total	**80**	**0.68 ± 0.09**		

Table 4 presents the correlation between visual acuity and retinal nerve fiber layer (RNFL) thickness among 80 eyes. Mean RNFL thickness increased with better vision: 1 m (55.20 ± 9.80 µm), 2 m (58.10 ± 8.40 µm), 3 m (63.40 ± 11.20 µm), 6/60 (60.30 ± 7.50 µm), 6/36 (72.50 ± 10.30 µm), 6/24 (78.20 ± 9.40 µm), 6/18 (79.10 ± 12.60 µm), 6/12 (85.30 ± 8.20 µm), and 6/9 (88.40 ± 7.60 µm). The association was statistically significant (F=8.95, p=0.0001), indicating that higher RNFL thickness correlated with better visual acuity.

Table 4: Correlation of Vision with RNFL Thickness (n = 80 eyes)				
Vision	**n**	**Mean RNFL Thickness ± SD (µm)**	**F**	**P**
1 m	6	55.20 ± 9.80	8.95	0.0001, S, <0.05
2 m	4	58.10 ± 8.40		
3 m	6	63.40 ± 11.20		
6/60	8	60.30 ± 7.50		
6/36	10	72.50 ± 10.30		
6/24	12	78.20 ± 9.40		
6/18	18	79.10 ± 12.60		
6/12	10	85.30 ± 8.20		
6/9	6	88.40 ± 7.60		
Total	**80**	**73.40 ± 13.25**		

Table 5 shows the correlation between visual acuity and intraocular pressure (IOP) among 80 eyes. Mean IOP was highest in eyes with the poorest vision, 1 meter (35.10 ± 4.80 mmHg), and gradually decreased as vision improved: 2 m (30.20 ± 3.60), 3 m (29.00 ± 2.90), 6/60 (31.50 ± 3.10), 6/36 (28.40 ± 4.50), 6/24 (27.10 ± 4.80), 6/18 (24.90 ± 3.20), 6/12 (24.20 ± 2.60), and 6/9 (22.30 ± 2.10). Statistical analysis showed a significant association (F=15.42, p=0.0001), indicating that higher IOP was correlated with worse visual acuity.

Table 5: Correlation of Vision with Intraocular Pressure (n = 80 eyes)				
Vision	**n**	**Mean IOP ± SD (mmHg)**	**F**	**P**
1 m	6	35.10 ± 4.80	15.42	0.0001, S, <0.05
2 m	4	30.20 ± 3.60		
3 m	6	29.00 ± 2.90		
6/60	8	31.50 ± 3.10		
6/36	10	28.40 ± 4.50		
6/24	12	27.10 ± 4.80		
6/18	18	24.90 ± 3.20		
6/12	10	24.20 ± 2.60		
6/9	6	22.30 ± 2.10		
Total	**80**	**26.80 ± 4.90**		

Table 6 shows the correlation of age with RNFL thickness, cup-to-disc ratio (CDR), and intraocular pressure (IOP) among 80 eyes. RNFL thickness significantly decreased with age, with means of 82.10 ± 10.40 µm (25–44 years), 74.60 ± 11.80 µm (45–64 years), and 66.80 ± 12.20 µm (≥65 years), F=4.21, p=0.018, indicating a significant age-related decline. In contrast, CDR increased slightly with age (0.64 ± 0.07, 0.67 ± 0.09, 0.71 ± 0.08) but the difference was not significant (F=1.02, p=0.36, NS). Similarly, IOP showed a non-significant trend of increasing with age (25.90 ± 4.10, 26.70 ± 4.80, 27.60 ± 5.20 mmHg; F=0.88, p=0.41, NS). Overall, age had a significant negative correlation with RNFL thickness, while CDR and IOP were not significantly affected.

Table 6: Correlation of Age with RNFL Thickness, CDR and IOP (n = 80 eyes)					
Parameter	**Age group (years)**	**n**	**Mean ± SD**	**F**	**P**
RNFL Thickness (µm)	25–44	18	82.10 ± 10.40	4.21	0.018, S, <0.05
	45–64	34	74.60 ± 11.80		
	≥65	28	66.80 ± 12.20		
	Total	**80**	**73.40 ± 13.25**		
CDR	25–44	18	0.64 ± 0.07	1.02	0.36, NS
	45–64	34	0.67 ± 0.09		
	≥65	28	0.71 ± 0.08		
	Total	**80**	**0.68 ± 0.09**		
IOP (mmHg)	25–44	18	25.90 ± 4.10	0.88	0.41, NS
	45–64	34	26.70 ± 4.80		
	≥65	28	27.60 ± 5.20		
	Total	**80**	**26.80 ± 4.90**		

Table 7 shows the correlation of gender with clinical parameters in 80 eyes. For RNFL thickness, males (n=44) had 74.80 ± 12.40 µm versus 71.90 ± 14.10 µm in females (n=36), t=1.18, p=0.24 (not significant). The cup-to-disc ratio (CDR) was 0.67 ± 0.08 in males and 0.69 ± 0.09 in females (t=0.92, p=0.35, NS). Intraocular pressure (IOP) averaged 26.50 ± 4.60 mmHg in males and 27.10 ± 5.20 mmHg in females (t=0.74, p=0.46, NS). Overall, there were no statistically significant differences between genders for RNFL thickness, CDR, or IOP.

Table 7: Correlation of Gender with Clinical Parameters (n = 80 eyes)					
Parameter	**Gender**	**n**	**Mean ± SD**	**t**	**P**
RNFL Thickness (µm)	Male	44	74.80 ± 12.40	1.18	0.24, NS
	Female	36	71.90 ± 14.10		
	Total	**80**	**73.40 ± 13.25**		
CDR	Male	44	0.67 ± 0.08	0.92	0.35, NS
	Female	36	0.69 ± 0.09		
	Total	**80**	**0.68 ± 0.09**		
IOP (mmHg)	Male	44	26.50 ± 4.60	0.74	0.46, NS
	Female	36	27.10 ± 5.20		
	Total	**80**	**26.80 4.90**		

Discussion

Our sample of 40 open-angle glaucoma (POAG) patients aged 56.40 ± 12.85 years revealed that 30 percent of the patients were between 55 and 64 years, and 25 percent of the patients were aged 65 and above. The ratio of males to females was 55 to45. The results can be compared to the ones provided by Vijaya et al. (2014) [10] in which the glaucoma rates rose with the age, especially in the age group of 50–69, which suggests that age is a strong risk factor to POAG. Likewise, Beaver Dam Eye Study by Klein et al. (1992) [11] indicated that prevalence was higher among individuals aged 43 54 years compared to people aged 75 years and above and this confirms the aspect of age-related vulnerability of our population. The outcomes of our study are congruent with the Gangnam Eye Study, which found older age and the greater the initial intraocular pressure (IOP) to be predictors of the transition between being a glaucoma suspect and the definite POAG (Kim et al., 2014) [12]. Nevertheless, our investigation did not find statistically significant age difference in IOP and cup-to-disc ratio (CDR), indicating that at early or middle stages of POAG age-dependence is probably not observed in other structural parameters".

Optical assays and vision assessment demonstrated that the visual acuity had a strong negative correlation with CDR, where the eyes with the worst visual acuity (1 m) showed the highest average CDR of 0.78 ± 0.06. This is in line with Asrani et al. (2003) [13] who revealed that optic nerve head cupping was strongly associated with the level of visual field loss. Retinal nerve fiber layer (RNFL) thickness showed a significant positive correlation with visual acuity also; the thinnest RNFL (55.20 +-9.80 -mu) was found in the worst vision eye, and the thickest RNFL (88.40 +-7.60 -mu) was found in the best vision eye (6/9). Similar findings were made by Badlani et al. (2006) [14], who reported the RNFL thinning of hemifields matched with the visual field defects (VFD), which is a potential early indicator of glaucomatous damage. Moreover, de la Rosa et al. (2007) [15] have also found that the greatest association was between RNFL thickness and optic disc measures and parameters of visual field indices with established glaucoma and our results support that association between structural changes and functional loss. Chauhan et al. (2001) [16] also reiterated that the changes can occur to the optic disc even before the loss of vision can be measured, a trend that is replicated in our data where CDR changes and RNFL changes went hand in hand with falling vision.

Our study revealed a significant trend in IOP where greater pressures were recorded in the eyes with poorer vision (mean of IOP is 35.10 ± 4.80 mmHg at 1 m vision compared with 22.30 ± 2.10 mmHg at 6/ 9 vision); this observation was statistically significant. In a similar manner, Sun et al. (2012) [17] also singled out IOP as a key independent risk factor of POAG in a multivariate analysis, further strengthening the importance of raised IOP in the disease progression. This concordance highlights the essentiality of IOP monitoring in clinical treatment, particularly in patients who show initial RNFL loss or minor impairments in their visual field. Interestingly, although these correlations were found with vision, age did not have any significant effects on either IOP or CDR in our cohort, which partially agrees with Mahant et al. (2011) [18] who did not observe any significant difference between sexes in the thickness of the RNFL or the optic disc parameters, which suggests that demographic variables might be less important than functional ocular measurements.

Our age-based analysis revealed that there was a significant RNFL thinning as age advanced: age 25-44 years at 82.10 -10.40, age 45-64 years at 74.60 -11.80 and age 65-65 years at 66.80 -12.20. This corresponds with Kim et al. (2014) [12] and Vijaya et al. (2014) [10] who found increased glaucoma occurrences and accelerated progression in the elderly, probably due to accumulated neural damage over time. On the other hand, in our data, CDR, and IOP did not differ significantly among age groups, which implies that structural RNFL thinning could be a more sensitive early age-related glaucomatous biomarker than cupping of the optic disc or variations in pressure.

There were no differences in gender on RNFL thickness, CDR as well as IOP. Male had relatively more RNFL thickness (74.80 ± 12.40 μm) than female (71.90 ± 14.10 μm), but the difference was not statistically significant. The result is in line with Beaver Dam Eye Study and Mahant and other researchers (2011) [18], who all found no sex-based variations in glaucomatous parameters following age correction. Such findings indicate that gender might not be a key factor in determining the severity of glaucoma or structural changes in the eye though there might be some individual differences.

Altogether, in our research, the correlation between the reduced visual acuity and the structural glaucoma indicators, including high CDR, high IOP, and RNFL thinning, is confirmed. The findings are reminiscent of earlier studies that proved that RNFL as a measurement is a valid tool to use in the detection and monitoring of progression. Age was found to be a major contributor to RNFL thinning and this is in line with the hypothesis of cumulative neural vulnerability as we age. In the meantime, there were no significant gender influences on the ocular parameters, which is also supported by the previous research. These results bring to focus the clinical relevance of integrating structural and functional measures that can be used to categorize the severity and risk of progression of glaucoma in age-sensitive groups.

Conclusion

The research on clinical profile of patients with primary open-angle glaucoma indicated that the disease is mostly common among middle-aged and elderly people with a marginally higher occurrence rate among the males. The visual field defects were analyzed and the correlation among worsening visual acuity and increased cup to disc ratio and elevated intraocular pressure showed to be significant whereas retinal nerve fiber layer thickness declined with deteriorated vision. Age had a significant effect on retinal nerve fiber layer thinning but did not have a significant effect on cup-to-disc ratio and intraocular pressure. Gender was not found to have any significant effects on any of the vital parameters of clinical parameters. Altogether, this body of evidence highlights how glaucoma structure changes with age and deteriorating vision, so it is essential to detect glaucoma and monitor it at the earliest age possible in order to maintain visual functioning.

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