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Original Research Article

A Clinical Study on Primary Open Angle Glaucoma in a Tertiary Hospital in South Assam, India

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Abstract

Glaucoma is a group of disorders characterized by a progressive optic neuropathy resulting in a characteristic appearance of the optic disc and a specific pattern of irreversible visual field defects that are associated frequently but not invariably with raised intraocular pressure. It is a potentially blinding disease of global importance and is the second leading cause of blindness after cataract.

Aim: The aims and objectives of the study are to find the prevalence and incidence of primary open angle glaucoma, its ocular morbidity and the various risk factors associated with it.

Methods: A prospective observational study of 50 patients of age 40 years and above with diagnosed Primary open angle glaucoma were taken for the study and followed up for a year. After due informed consent, detail eye examination was done and results statistically analyzed. The correlation of POAG with age, sex, hypertension and T2DM were noted at the initial presentation. Visual acuity, IOP, RNFL thinning, visual field defects and CDR were noted at each follow-up period and analyzed separately and with each other. Awareness of POAG by the individuals under study was also noted at initial time of study.

Conclusions: The prevalence of POAG is found to be 2.8% with a higher prevalence in males (62%). Increased age, family history (24%), hypertension (32%), Diabetes Mellitus (30%) were found to be as risk factors for the disease. There is a positive association between higher IOP (mean 28.4 mm Hg), CDR (mean 0.74), RNFL thinning (frequency-64%) and Visual field defects (frequency-54%) with greater progression and morbidity of the disease.

Keywords: POAG, IOP, CDR, RNFL Thinning.

Introduction

Glaucoma is a group of disorders characterized by a progressive optic neuropathy resulting in a characteristic appearance of the optic disc and a specific pattern of irreversible visual field defects that are associated frequently but not invariably with raised intraocular pressure [1]. It is a potentially blinding disease of global

importance and is the second leading cause of blindness after cataract [2]. It is said that glaucoma is the "silent killer of sight" [2]. It is generally asymptomatic till the late stage of disease. Since glaucoma is a progressive disease and cannot be reversed, early detection and treatment are critical to prevent sight threatening morbidity due to this condition. The disease burden of Glaucoma can be far-reaching. Globally blindness caused by glaucoma is in the figure of approximately 76 million in 2010 and it is expected to increase to 112 million in 2040 [3]. At an individual level, even mild visual field loss can cause significant morbidity, and it is also a common cause of certifiable visual impairment. To the health care system and society, it incurs substantial direct financial costs from medical and surgical treatment, as well as indirect costs from loss of earnings and productivity [4].

Methods and Methodology

Fifty patients attending OPD services of Silchar Medical College & Hospital, Cachar, Assam within the period of January 2021 to December 2021, satisfying the inclusion criteria were evaluated for Primary Open Angle Glaucoma.

Inclusion criteria

1. All patients aged 40 to 85 years and above attending Eye department, SMCH during the period of study.
2. IOP > 21 mmHg (by Applanation tonometry) with visual field defects.
3. IOP > 21 mmHg (by Applanation tonometry) with optic nerve head changes.
4. Optic nerve head changes with visual field defects.
5. Open angle of anterior chamber by Gonioscopy.
6. Patients willing to participate for the study after taking informed consent.
7. Patients who were willing to be followed up for a period of 1 year.

Exclusion criteria

1. Closed angle on gonioscopy
2. Drug induced (or on Corticosteroid)
3. All cases of secondary glaucoma
4. All cases of congenital or developmental glaucoma
5. All cases of post-operative glaucoma (Post cataract/ Post Glaucoma surgeries/ post posterior segment surgeries)
6. All cases who underwent prior laser procedures for glaucoma
7. Patients who dropped out of the study or did not come for follow-up.
8. Patients less than 40 years of age and more than 85 years of age.

Informed consent was taken from the patients selected and detail eye examination was done.

Ethical clearance was taken from the ethical clearance committee, Silchar Medical College & Hospital, Cachar, Assam.

Methods of Data Collection

The study done was a prospective observational study. Hospital records were maintained in the department of Ophthalmology, Silchar Medical College.

Study method used: A total of 1024 patients were screened and evaluated. Using the 2 - Sigma/2 (Z beta +Z alpha 2)/2 d/2 method, a sample size of 50 was taken for the study To observe minimum of 5 % improvement with pooled SD of 9, a total 50 samples were taken to detect 80% power at 5 % level of significance.

The examinations done included:

1. Visual acuity - Distant vision - Assessment done by Snellen's chart
   - Near vision - Assessment done by Times Roman near vision chart
2. Refraction - Assessment by autorefractometer and subjective correction

3. Intraocular pressure measurement - Done by Goldmann applanation tonometer
4. Diurnal Variation testing – IOP is measured over a period of 24 hours duration at every 2 hour interval
5. Gonioscopy– This is done by using Goldmann single-mirror gonioprism or Goldmann two-mirror gonioprism
6. Central Corneal thickness
7. Slit Lamp Examination- The following procedures were mainly done

A. Assessment of anterior segment and Anterior Chamber depth
B. Optic disc evaluation using 90 D lens in slit lamp

8. Ophthalmoscopy – Direct – using 90D lens & Indirect – using 20D lens
9. Visual Field testing- central 30-2 using Humphrey Field Analyzer

Patients with significant disc cupping (and other signs of glaucomatous disc changes), with field defects, regardless of IOP were suspected as having POAG.

Management: The following drugs either in monotherapy or combined therapy were advised based on the patient needs and condition.

- Topical-

1. Beta blocker (Timolol maleate)
2. Alpha2 agonist (Brimonidine tartrate)
3. Carbonic anhydrase inhibitor (Dorzolamide HCL, Brinzolamide)
4. Prostaglandin analogue (Latanoprost, Bimatoprost)

- Oral-

1. Carbonic anhydrase inhibitor (Acetazolamide)

Follow-up:

The cases were followed up at 1 month, 3 months, 6 months, 9 months and at 1 year. In each follow-up, visual acuity, IOP, detailed slit-lamp examination was done. Gonioscopy was redone if the pressure was not under control but generally after 4 weeks. Disc evaluation was done and OCT- RNFL and visual field examination (perimetry) were repeated on each follow-up

Results

From January 2021 to December 2021, the study was carried out at Silchar Medical College. During the course of the trial, a total of 1024 patients between the ages of 40 and 85 years were screened for glaucoma.

The following observations were made and then statistically examined and debated and conclusions were made.

Table 1: Age wise distribution of study subjects (SD stands for standard deviation)

Age	Frequency	Percent
40-50	9	18
51-60	17	34
61-70	16	32
71-80	7	14
81 and above	1	2
Total	50	100
Mean ± SD	**59.86 ± 9.75**	
Median (25th -75th percentile)	59.5 (55-67)	
Range	42-82	

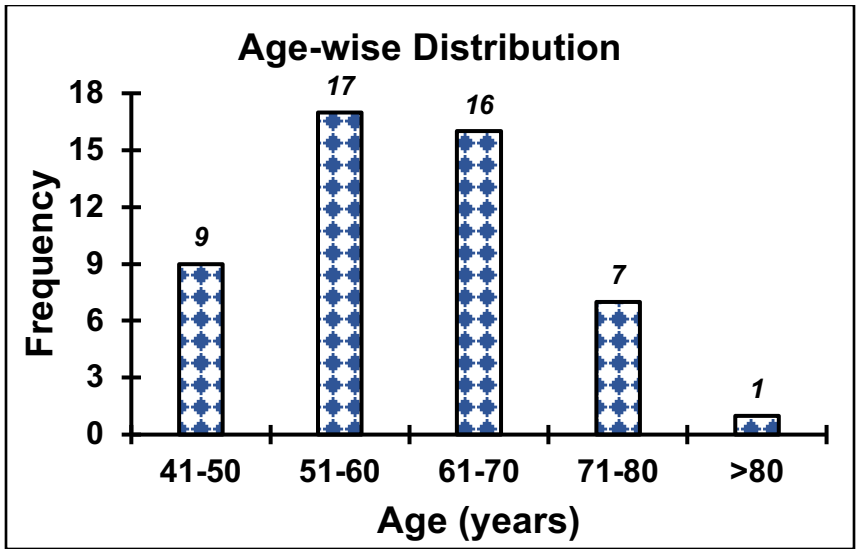

Figure 1: Age wise distribution of study subjects

As per table 1.1 and figure 1 it is seen that 9 (18 %) patients belonged to the age group 41-50 years while, 17 (34%) in the range of 51-60 years, 16 (32%) between 61-70 years, 7 (14%) in between 71-80 years and only 1 (2%) patient was of above 80 years of age. Mean value of the age (years) of the study subjects was calculated as 59.86 ± 9.75 with median (25th-75th percentile) of 59.5(55-67)

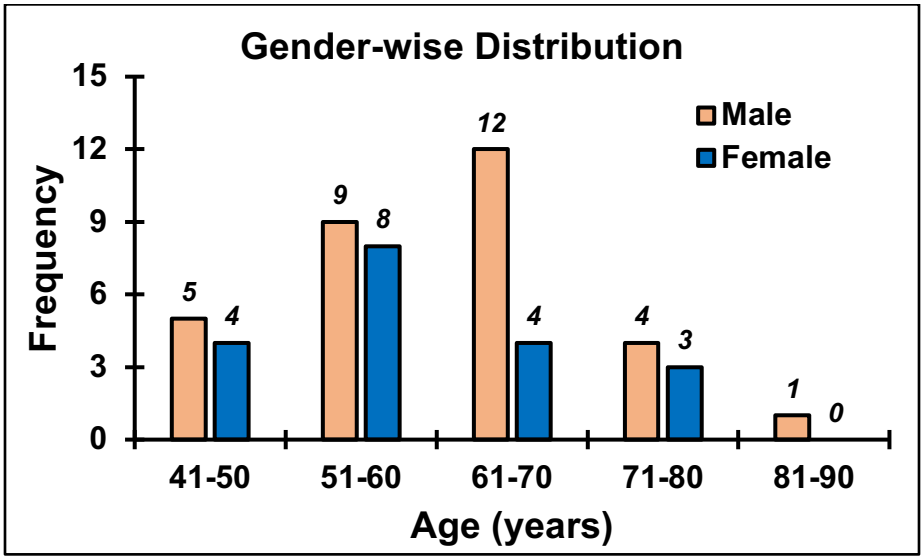

Figure 2: Age-wise distribution based on gender categorization of the study subjects

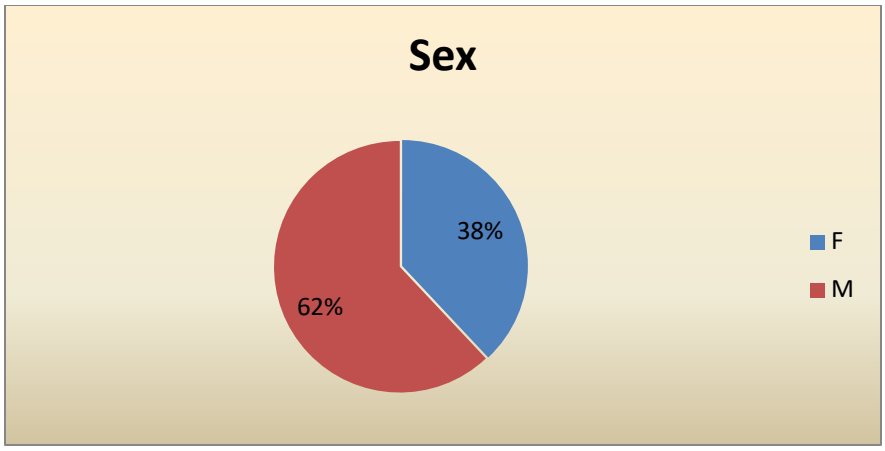

Figure 3: Gender wise distribution of respondents

As per figure 2 and 3, it is seen that among males and females, 5 (55.5 %) patients and 4 (44.9 %) belonged to the age group 41-50 years. It was 9 (52.9 %) and 8 (47.0 %) between males and females in the range of 51-60 years, there was 12 (75.0 %) and 4 (25.0 %) between males and females in the age group of 60 to 70. There were 4 (57.0 %) and 3 (42.8 %) number in males and females between the age group of 70 to 80 years. There was only 1 male above 80 years of age

Table 2: Frequency distribution of family history

Family History	Frequency	Percent
Yes	12	24
No	38	76
Total	50	100

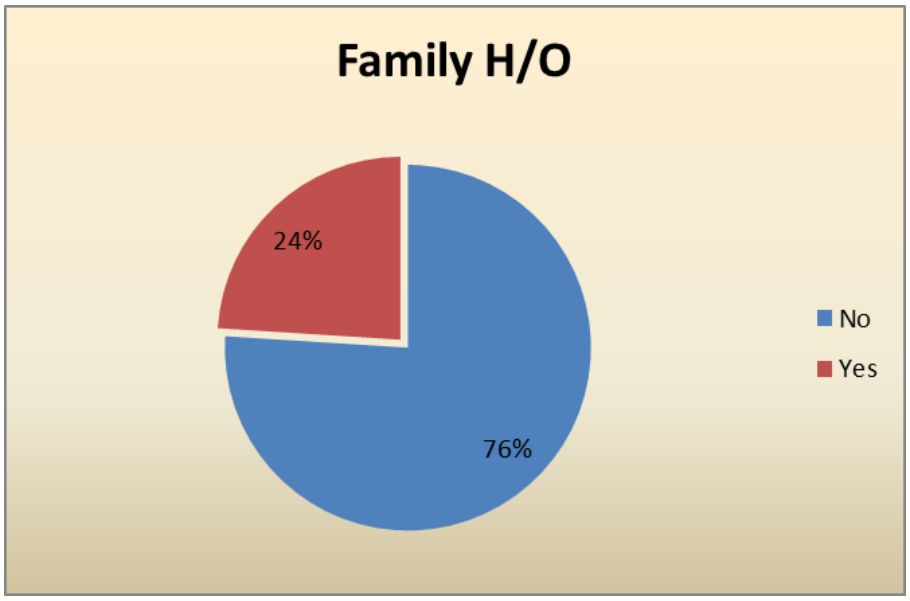

Figure 4: Presence of family history of POAG among respondents

As per table 1.2 and figure 4, among all respondents family history was found to be positive in 12(24%) out of 50 cases. Conversely family history was negative in 38 (76%) of the cases.

Table 3: Frequency distribution of diabetes mellitus among respondents

T2DM	Frequency	Percent
Yes	15	30
No	35	70
Total	50	100

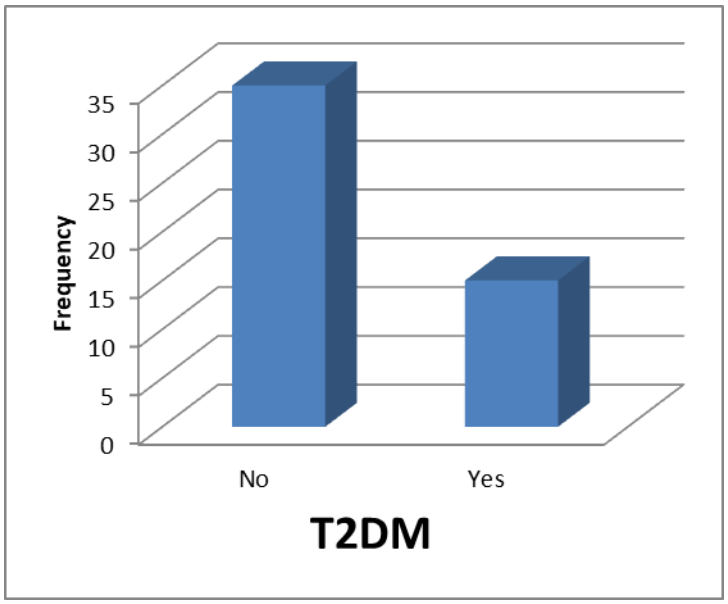

Figure 5: Presence of T2DM among respondents

As per table 1.3 and figure 5, among the respondents Type 2 Diabetes Mellitus was seen 15 (30%) of the total 50 cases.

Table 4: Presence of hypertension among respondents

HTN	Frequency	Percent
Yes	16	32
No	34	68
Total	50	100

As per table 1.4, among the respondents Hypertension was seen in 16 (32%) of the cases.

Table 5: Distribution of number of patients (frequency) in different IOP range during pre-treatment and successive follow up

Range	Pre-treatment		1st month		3rd month		6th month	
	Frequency	%	Frequency	%	Frequency	%	Frequency	%
<20	0	0	36	72	44	88	44	88
20-30	40	80	14	28	6	12	6	12
31-40	9	18	0	0	0	0	0	0
>40	1	2	0	0	0	0	0	0
Total	50	100	50	100	50	100	50	100

As per table 1.5, at the time of initiation of treatment, there were 38 (64%) whose IOP was in the 20-30 range, 9 (18%) having IOP in 30-40 range and 3 (6%) with more than 40 mm Hg IOP. After 1st month follow up, the majority (36 patients) of subjects had there IOP below 20 and the IOP for 14 subjects was in between 20-30. Furthermore, during 3rd month follow up, 44 patients had there IOP below 20, whereas 5 had IOP in 20-30 range and 1 patient had an increased IOP in the 30-40 range. Finally, at the 6th month follow up, it was observed that 44 patients had IOP below 20, while 6 patients had IOP in 20-30 mm Hg.

Table 6: Comparison of mean IOP

	Mean	SD	% change from Baseline	p value
IOP	26.6	5.573		
1 MONTH IOP	18.68	3.909	-29.8%	<0.001
3 MONTH IOP	15.8	3.964	-40.6%	<0.001
6 MONTH IOP	14.60	3.964	-45.1%	<0.001
9 MONTH IOP	13.4800	3.27788	-49.3%	Null
12 MONTH IOP	13.3000	2.85714	-49.9%	<0.001

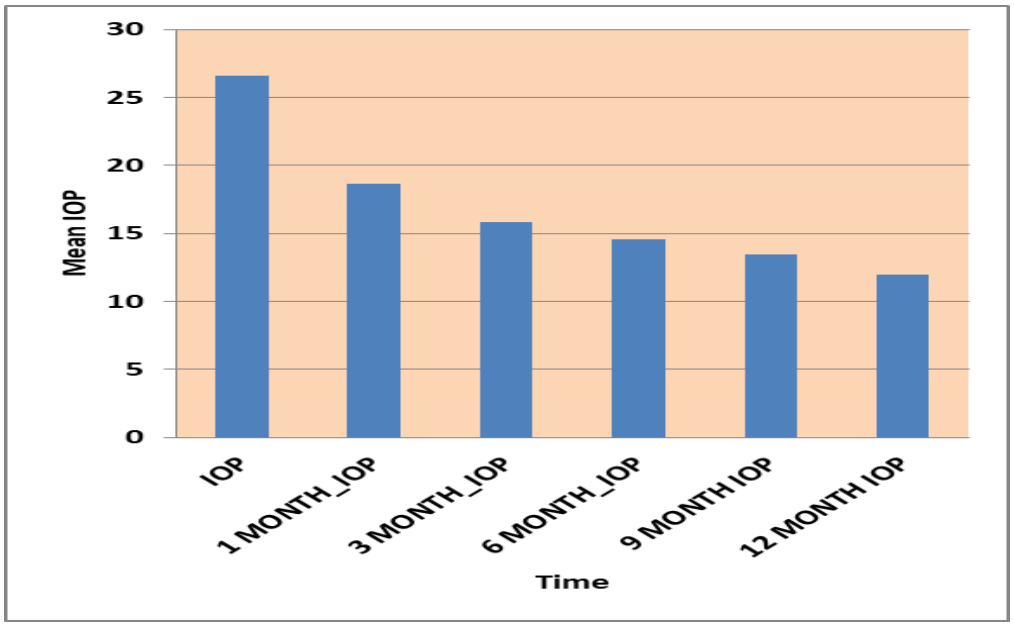

Figure 6: Comparison of Mean IOP

As per table 1.6 and figure 6, the mean IOP at the initial time of presentation for all age groups is found to be 26.6 mm Hg with a Standard deviation of 5.573. The mean IOP at 1 month follow-up is found to be 18.68 mm Hg with 29.8% decrease from baseline IOP. The p-value was found to be less than 0.001 signifying a positive correlation of decline of IOP after 1 month period of study. The mean IOP at 3 months, 6 months, 9 months and at 1 year is found to be 15.8 mm Hg at 3 months, 14.60 mm Hg at 6 months, 13.5 mm Hg at 9 months and 13.3 mm Hg at 1 year respectively. The corresponding decline from the initial presenting IOP is 40.6%, 45.1%, 49.3% and 54.9% from the baseline IOP at 3 months, 6 months, 9 months and at 1 year follow-up. The p value was found to be less than 0.001 in all time intervals except at 9 months interval. Thus there was a corresponding decline in mean IOP at each follow up period in the cases under study.

Table 7: Comparison of mean CDR

	Mean	SD	% change from Baseline	p value
CDR	0.682	0.13952		
1 Month CDR	0.672	0.14714	-1.5%	0.058
3 Months CDR	0.662	0.14553	-2.9%	0.003
6 Months CDR	0.646	0.16439	-5.3%	<0.001
9 Months CDR	0.646	0.16439	-5.3%	<0.001
12 Months CDR	0.646	0.16439	-5.3%	<0.001

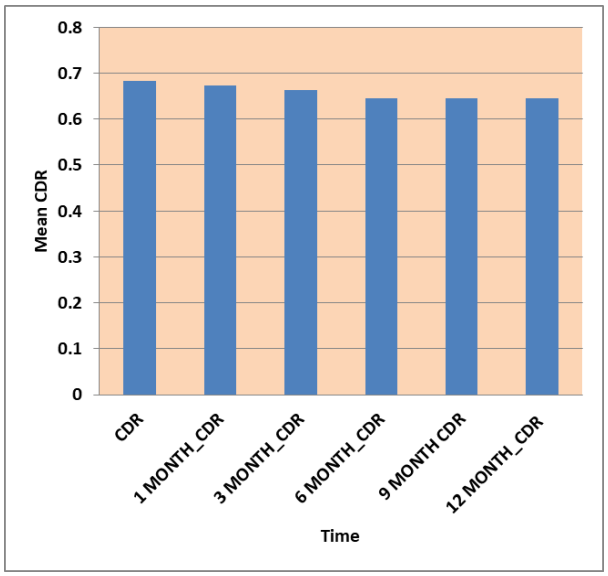

Figure 7: Comparison of mean CDR

Table 8: Mean CDR at various time period

Pearson Correlation with Initial CDR	Initial Check-Up	1 Month_IOP	3 Month_IOP	6 Month_IOP	9 Month_IOP	12 Month IOP
MEAN CDR	0.670	0.659	0.628	0.669	0.631	0.625
Sig. (2-tailed) test	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
N	50	50	50	50		50

As per tables 1.7, 1.8 and figure 7, the mean CDR of all the respondents at initial time of presentation is calculated to be 0.682 with standard deviation of 0.13952. The mean CDR at 1 month interval is found to be 0.672 with baseline change of 1.5 % with p value of 0.058. The mean CDR at 3 months interval is found to be 0.662 with baseline change of 2.9 % with p value of 0.003. The mean CDR at 6 months interval, 9 months interval, 12 months interval are found to be 0.646 with baseline change of 5.3 % with p value of less than 0.001.

Table 9: Comparison of mean IOP in cases with RNFL thinning over the time period

	RNFL THINNING		
	No	Yes	P AVLUE
IOP INITIAL	23±1.2	28.6±6	<0.001
1 MONTH IOP	16.6±1.3	19.9±4.4	0.003

3 MONTH IOP	13.7±1.6	17±4.4	0.003
6 MONTH IOP	12.6±1.9	15.8±4.4	0.005
9 MONTH IOP	12.0±2.1	14.31±3.56	0.015
12 MONTH IOP	11.67±1.53	14.25±3.16	0.012

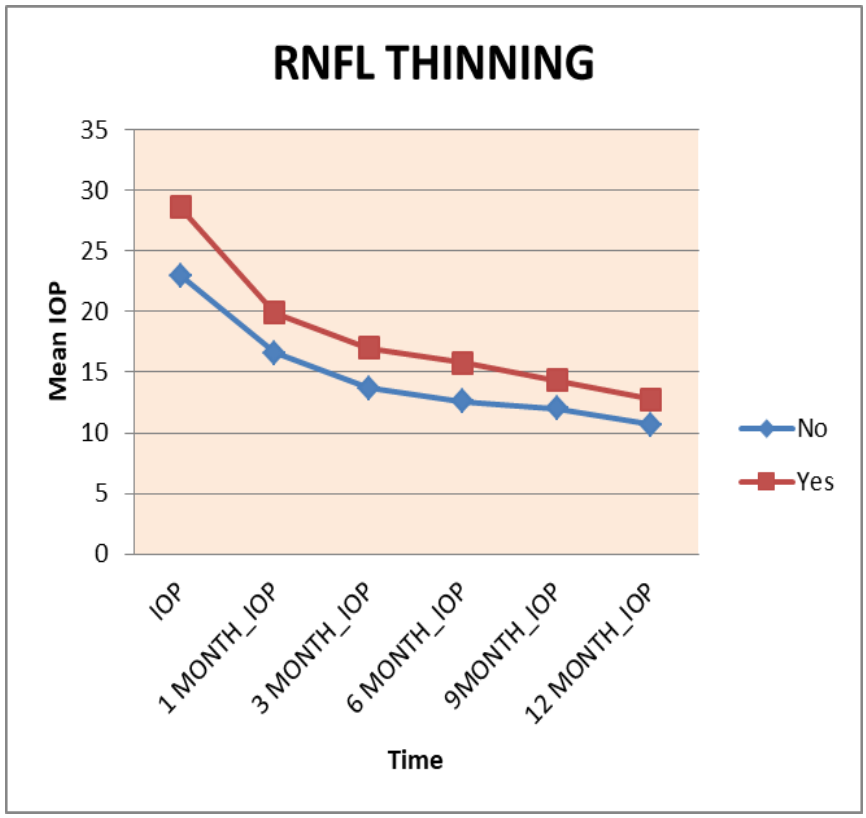

Figure 8: Comparison of mean IOP in cases with RNFL thinning

As per table 1.9 and figure 8, the mean IOP in cases of RNFL thinning was 28.6 mm Hg at initial visit. It was 19.9 mm Hg, 17 mm Hg, 15.8 mm Hg, 14.3 mm Hg and 12.75 mm Hg at 1 months,3 months,6 months,9 months and at 1 year with p value less than 0.005 which is considered to be statistically significant at all follow up intervals. The mean IOP in cases without RNFL thinning was 23 mm Hg at initial visit. It was 16.6 mm Hg, 13.7 mm Hg, 12.6 mm Hg, 12.0 mm Hg and 10.67 mm Hg at 1 months,3 months,6 months,9 months and at 1 year respectively with p-value less than 0.005 at all intervals. Thus it is seen that cases with initial RNFL thinning had higher IOPs than in cases without initial RNFL thinning.

Table 10: Number of cases with visual field defect over the period of study

VFD	1 Month	3 Months	6 Months	9 Months	12 Months	p value
Yes	23	21	21	21	21	0.822
No	27	29	29	29	29	
Total	50	50	50	50	50	

As per table 2.0, it is seen that the number of cases with Glaucomatous visual field defect over the period of study is found to be 23 at first follow up at 1 month and 21 at final follow up at 1 year. The difference was found to be negligible with p value at 0.822 which is not statistically significant.

Table 11: Comparison of mean IOP in cases with visual field defects over the time period

	VFD				
	No		Yes		p value
	Mean	SD	Mean	SD	
Initial IOP	23.93	2.071	30	6.733	<0.001
1MONTH IOP	16.43	1.476	21.55	4.183	<0.001
3 MONTHS IOP	13.71	1.607	18.45	4.49	<0.001
6 MONTHS IOP	12.43	1.834	17.36	4.249	<0.001
9 MONTHS IOP	11.7857	1.91209	15.6364	3.41628	<0.001
12 MONTHS IOP	11.5000	1.40106	14.9091	3.11539	<0.001

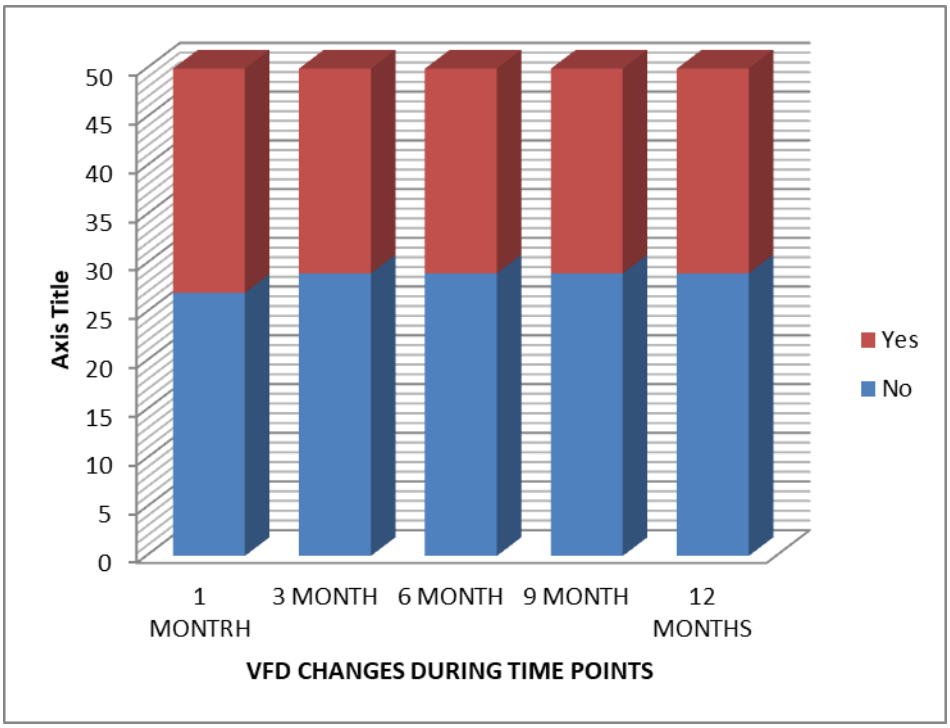

Figure 9: Visual field defect changes over time period

As per table 2.1 and figure 9, it is seen that that the mean IOP is found to be 30 mm Hg at the time of initial presentation in cases with Glaucomatous visual field defects at the time of initial presentation. It was 21.55 mm Hg, 18.45 mm Hg, 17.36 mm Hg, 15.6 mm Hg and 14.9 mm Hg at 1 month, 3 months,6 months,9 months and at 1 year interval with p value less than 0.001 at all intervals. The mean IOP is found to be 23.93 mm Hg at the time of initial presentation in cases without Glaucomatous visual field defects at the time of initial presentation. It was 16.43 mm Hg, 13.71 mm Hg, 12.43 mm Hg, 11.7 mm Hg and 11.5 mm Hg at 1 month, 3 months,6 months,9 months and at 1 year respectively with p-value less than 0.001 at all intervals. Thus it is seen that cases with initial glaucomatous Visual field defects had higher IOPs than in cases without initial

glaucomatous visual field defects. The mean IOP was higher in cases with initial IOP at all intervals than in cases without initial Visual field defects.

Table 12: Relation between awareness and IOP

	Awareness				
	No		Yes		p value
	Mean	SD	Mean	SD	
IOP INITIAL	28.13	6.279	24.30	3.262	0.016
1 MONTH IOP	19.60	4.375	17.30	2.618	0.04
3 MONTHS IOP	16.53	4.577	14.70	2.536	0.11
6 MONTHS IOP	15.60	4.280	13.10	2.936	0.027
9 MONTHS IOP	14.2000	3.41801	12.4000	2.79850	0.056
12 MONTHS IOP	13.7333	3.12866	12.3000	1.99737	0.025

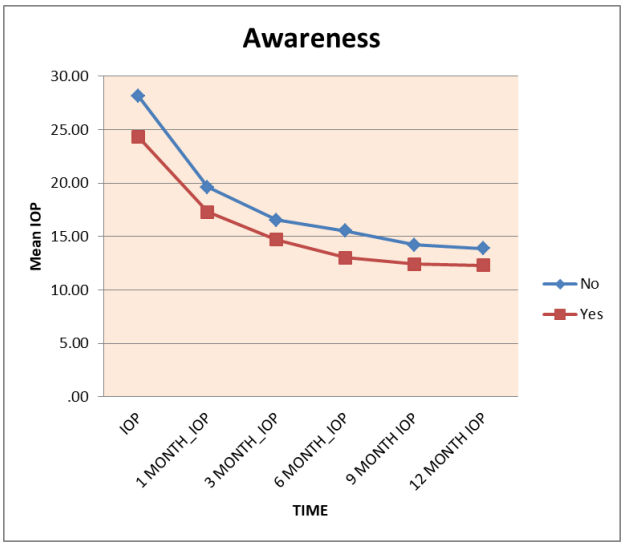

Figure 10: Relation between awareness and family history

As per table 2.2 and figure 10, the mean IOP of patients who were aware of the disease at the first initial diagnosis was 24.30 mm Hg. The mean IOP of patients who were unaware of the disease at first initial diagnosis was 28.13 mm hg. Among the two groups (aware vs unaware) It was 17.30 mm Hg and 19.6 mm Hg at 1 month, 14.70 mm Hg and 16.53 mm Hg at 3 months, 13.10 mm Hg and 15.6 mm Hg at 6 months, 12.4 mm Hg and 14.2 mm Hg at 9 months and 12.3 mm Hg and 13.73 mm Hg mm Hg at 1 year. The p-value was however only found to have a greater difference of <- 0.005 in only at the initial period. From the above charts it is seen that the mean IOP at each interval of study for those who were aware of the disease itself initially was slightly lower than those who were initially unaware of the disease itself.

Table 13: Relation between family history and IOP

	No		Yes		p value
	Mean	SD	Mean	SD	
IOP	26.95	5.477	25.50	5.977	0.439
1 MONTH IOP	18.84	3.796	18.17	4.387	0.607
3 MONTHS IOP	16.00	4.054	15.17	3.762	0.531

6 MONTHS IOP	14.68	3.580	14.33	5.176	0.792
9 MONTHS IOP	13.5263	2.95678	13.3333	4.29235	0.861
12 MONTHS IOP	12.0526	2.80874	11.8333	3.12856	0.819

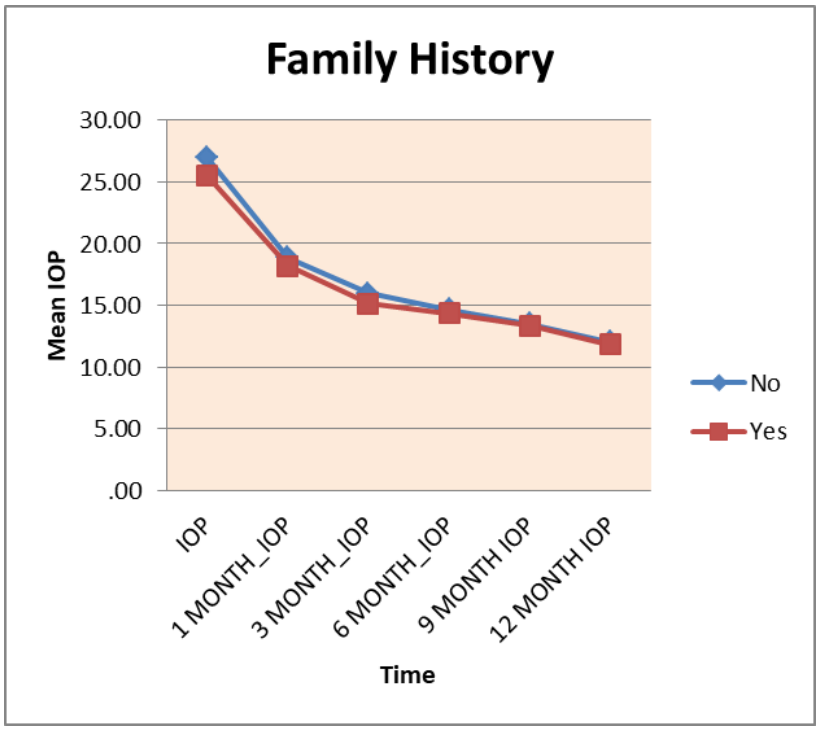

Figure 11: Relation between family history and IOP

As per table 2.3 and figure 11, it is seen that there was negligible difference between family histories of POAG with that of the disease itself. Coming to IOP monitoring over the period of study the mean IOP was found to be comparable between the two groups.

Table 14: Comparison of Visual acuity (at Initial Presentation) with relation to Visual field defect, RNFL thinning and mean IOP

Degree of Visual impairment (Who classification)	Total	RNFL thinning	Visual field defects	Mean IOP
Mild: >6/18	8	2	1	23.0 mm Hg
Moderate: 6/18-6/60	29	16	7	24.7 mm Hg
Severe: <6/60	13	13	13	33.1 mm Hg

As per table 2.4, it is seen that there is less frequency of RNFL thinning (25%) and Visual Field changes (13%) in patients with initial Visual Acuity of more than 6/18. In patients with visual acuity between 6/18 to 6/60 the frequency of RNFL thinning is 55% and of Visual field defects is 24%.In patients with visual acuity less than 6/60 the frequency is RNFL thinning and Visual field defects are both 100%. The mean IOP was found to be 23.0 mm, 24.7 mm Hg and 33.1 mm Hg for mild, moderate and severe Visual impairment respectively.

Discussion

In our study the overall prevalence of POAG was 2.8% among the study population. In our study it was found that the prevalence of POAG is found to be more in higher age groups. This is similar to the Chennai eye disease study [5] in which the incidence rate was 2.3% in 50-59 years and 3.5% in 60-69 years age group.

There is a higher prevalence of POAG in males as per our study. According to our study there is a positive correlation of Diabetes and Hypertension with POAG. Family history is also a significant factor in POAG. Our study shows a positive association between presence of family history and POAG. All these finding are congruent to the finding of other studies like the Framingham eye study [6] and Rotterdam eye study[7]

Our study shows that there is decreased initial visual acuity on presentation in the patients with higher IOPs and initial RNFL thinning or visual field changes. There is higher IOP in patients with visual field changes according to our study. In our study it is seen that Visual acuity is deteriorated in cases in those who had higher initial IOPs, greater glaucomatous changes in optic disc head and in greater visual field defects. The Aravind comprehensive Eye Survey [8] also showed a similar result of severe visual impairment present in 28% of the cases of Primary Open angle Glaucoma.

IOP is as definitive risk factor for screening, diagnosis and deciding the course of treatment of the patients. There is a positive correlation between higher initial IOPs and greater progression of glaucomatous field changes and optic nerve head changes. Our study also shows a positive association of decrease in IOP after initiation of medical therapy. In the Baltimore eye Survey [9], the prevalence of POAG in patients with IOP greater than 35 mm Hg was more than 40 times in patients with IOP less than 15 mm Hg.

There is a positive relation between Cup disc ratio and higher IOPs as per our study. Our study also shows that there is greater association with higher CDR and greater glaucomatous field changes. There is no statistically significant change in CDR on initiation of treatment as per our study.

Our study shows that greater visual field changes have good correlation with the optic disc changes or higher Cup disc ratios. As per our study Visual field changes is seen in both eyes. There is not much increase in patients with visual field defects over the period of our study. Our study also shows higher mean IOPs in patient with visual field defect during the period of our study. The mean vertical cup disc ratio (CDR) was 0.56 in Vellore eye survey test [10] done in an unselected population143 and 0.39 in Chennai glaucoma Study [11]. In our study the mean CDR at initial check-up is found to be 0.682.

There is significant RNFL thinning in cases of POAG during the time period of our study. There is also a positive correlation between RNFL thinning and higher IOPs as per our study.

Our study also shows that there is a positive correlation between awareness of glaucoma and lesser morbidity of the disease. There is lower IOP in patients who were aware of the disease at initial presentation. This trend continues during the period of our study throughout the follow-up period. Greater compliance can also be the possible reason for this finding.

Conclusion

It was a prospective observational hospital based study done in Department of Ophthalmology, Silchar Medical College for a period of 1 year. 50 patients of POAG were examined and followed up for a period of 1 year.

Special attention was given to Visual Acuity, Intraocular Pressure, Visual Field changes and Optic disc head changes, the parameters of which were followed and observed meticulously during the period of the study.

The following factors are observed from our study on POAG

1. The prevalence of POAG is found to be 2.8%.
2. There is a higher prevalence of POAG in males than females.
3. There is a positive association between higher IOP, RNFL thinning and Visual field defects with greater progression and morbidity of the disease.
4. Hypertension, Diabetes Mellitus and family history are positive risk factors for POAG.
5. There is low awareness of glaucoma among the study population.
6. Patients with previous awareness of glaucoma had better compliance and better ocular outcomes.

As POAG is a chronic disorder leading to sight threatening condition so maintaining the integrity of RNFL by preventing axonal damage at least by lowering the IOP plays a key role in prevention of blindness due to POAG. Thus, all patients above the age of 40 need to be screened for Glaucoma. Evaluation of intraocular pressure, Optic nerve head and Visual Field changes should be done in all susceptible patients of age 40 years and above. There should be ideally more awareness and health education about glaucoma amongst general population because early detection and early treatment with fruitful follow up will influence the final outcome and significantly reduce the morbidity due to POAG. The drawbacks of the study were the small sample size and relatively shorter study period and follow-up and it is just a tip of iceberg. It is worth mentioning that in this part of Southern Assam prevalence of POAG is significant but due to poor education and health care facilities and also fewer number of patients seeking eye care services at tertiary level the morbidity and visual impairment due to POAG is noteworthy.

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