

A Clinical Study on Prevalence of Primary Glaucoma in Presbyopic Population

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Abstract

Original Research Article

Aim: Present Study was conducted to explore the prevalence of primary glaucoma among presbyopic population and to determine its spectrum of ocular manifestations. It was also aimed to assess the impact of primary glaucoma on visual impairment. **Methods and Methodology:** 1000 individuals are selected and after obtaining informed consent and fulfilling the inclusion criteria, they were subjected to comprehensive eye examination in the form of visual acuity test, slit lamp biomicroscopy, perimetry, gonioscopy, tonometry, ophthalmoscopy, tomography and pachymetry. The results were tabulated, analysed and presented. **Results:** The age of the study population ranged from 40 to 78 years in which males were slightly higher in number than females. 4.9% were found to have primary glaucoma, showing an increasing prevalence of glaucoma with increasing age. The incidence of primary angle closure glaucoma (PACG) (2.6%) was marginally higher than that of primary open angle glaucoma (POAG) (2.3%). The chief complaint of the patients was dimness of vision. Significant association was discovered between primary glaucoma and diabetes, hypertension and family history. Mean intra ocular pressure (IOP) was found raised in primary glaucoma with advancing age. Mean Retinal Nerve Fibre Layer (RNFL) thickness decreased in primary glaucoma and extent of such decrease was more with increasing age. The prevalence of blindness among primary glaucoma patients was 12.24% of which 33.3% were bilaterally blind. **Conclusion:** Since glaucoma is a leading cause of global irreversible blindness and as POAG remains asymptomatic initially, glaucoma screening of all presbyopic population by sensitive diagnostic apparatus should be made mandatory.

Keywords: Prevalence, Primary glaucoma, Presbyopic population, Increasing age, intraocular pressure, Retinal nerve fibre layer, Blindness.

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INTRODUCTION

Glaucoma refers to a group of diseases which have in common a characteristic optic neuropathy with associated visual functional loss. It appears in two major forms: open angle glaucoma and angle closure glaucoma. A troublesome, yet consistent finding across population based studies is that a large portion of glaucoma remains undiagnosed. So, there is the need for better screening strategies to identify those with glaucoma and bring them into care [1].

Glaucoma is the leading cause of global irreversible blindness. In 2013, the number of people (aged 40-80 yrs), with glaucoma worldwide was estimated to be 64.3 million, increasing to 70 million in 2020 and 111.8 million in 2040, disproportionately affecting people residing in Asia and Africa. These estimates are important in guiding the designs of glaucoma screening, treatment and related public health strategies [2].

In the United States, primary open angle glaucoma affects more than 2.2 million persons and this number is projected to increase to 3.4 million by 2020 [3]. Over the same time period in the developing world, prevalence of glaucoma is expected to rise even more dramatically as population of adults older than 60 years is more than doubles [4].

In India, prevalence of POAG in presbyopic age group was found to be 1.7%. Population based study estimated the prevalence of glaucoma in India to be 11.9 million in the year 2010, which is expected to rise to 16 million by the year 2020. Increased incidence of glaucoma with age is a cause for concern since India's population is aging and prevalence is expected to increase exponentially in the years to come. A significant proportion of individuals with glaucoma will reside in the Indian subcontinent by 2030 [5].

Aim of study

The present study was undertaken to explore the prevalence of primary glaucoma in presbyopic population attending Regional Institute of Ophthalmology of Gauhati Medical College and to determine the spectrum of ocular manifestations of primary glaucoma. It was also aimed to assess the impact of primary glaucoma on visual impairment and the ocular morbidities in presbyopic age group.

MATERIALS AND METHODS

The present study was conducted in Regional Institute of Ophthalmology, Gauhati Medical College, in a total of 1000 subjects selected by simple random sampling. Informed consent of the patients was taken. Individuals above 40 years (presbyopic age) of both the sexes were included in the study. Diagnostic criteria for primary open angle glaucoma (POAG) were: (i) Patients with intraocular pressure (IOP) > 21mm of Hg (ii) Typical glaucomatous disc changes (iii) Reproducible visual field defects (iv) open anterior chamber angle on gonioscopy whereas diagnostic criteria for primary angle closure glaucoma (PACG) were: (i) IOP >21mm of Hg (ii) On gonioscopy at least 180 degrees of iridotrabular contact (iii) Typical glaucomatous disc changes (iv) Typical glaucomatous field defects. Patients of <40 years of age, having secondary glaucoma, corneal scarring or media opacity and with other causes of optic atrophy are excluded from the study.

All individuals are subjected to details history and clinical examination and the findings were documented. Visual acuity was recorded with snellen's chart and external examination was performed under slit lamp biomicroscopy. Visual field charting was done by automated perimetry using Humphrey field Analyzer and the indirect sussman four mirror lenses was used for gonioscopy. IOP was measured by Goldmann's

applanation tonometer and fundus examination was performed by ophthalmoscope. Optical Coherence Tomography was done using Stratus OCT for measurement of Retinal Nerve Fibre Layer (RNFL) thickness. To assess the central corneal thickens (CCT). Pachymetry was carried out using Pacscan 300 AP Pachymeter. The datas collected on various aspects of the study were complied, tabulated and subjected to statistical analysis. Only the worse eye was used for analysis in our study. The results have been tabulated and presented.

RESULTS AND OBSERVATIONS

The study population consisted of 1000 patients selected by simple random sampling attending the out patients department of Regional Institute of Ophthalmology, Gauhati Medical College, Guwahati. The results and observations are presented below:-

Demographics of study population (age and sex distribution)

The study population belonged to the presbyopic age and the ages ranged from 40 years to 78 years (mean \pm SD was 59 ± 19 years). The largest (324) of patients were in the age group 40-49 years (32.4%), followed by 303 (30.3%) patients in the 60-69 years group, 237 (23.7%) patients in the 50-59 years age group and 136 (13.6%) in the age group of 70-79 years.

The total number of male participants was 516 (51.6%) and total number of female participants was 484 (48.4%). Among the 516 male participants, the highest number of subjects (32.9%) belonged to the age group 60-69 years while the lowest numbers of subjects (20.3%) belonged to the age group 70-79 years. Of the female subjects, the highest number of subjects (40.1%) belonged to the age group 40-49 years while the lowest number of subjects (6.4%) belonged to the age group 70-79 years (Table- 1 and Figure -1).

Table-1: Demographics of the study population

Age groups (years)	Males Number (%)	Females Number (%)	Total Number (%)
40-49	130 (25.2)	194 (40.1%)	324 (32.4%)
50-59	110 (21.3%)	127 (26.2%)	237 (23.7%)
60-69	170 (32.9%)	133 (27.5%)	303 (30.3%)
70-79	105 (20.3%)	31 (6.4%)	136 (136%)
Total	516 (100%)	484 (100%)	1000 (100%)

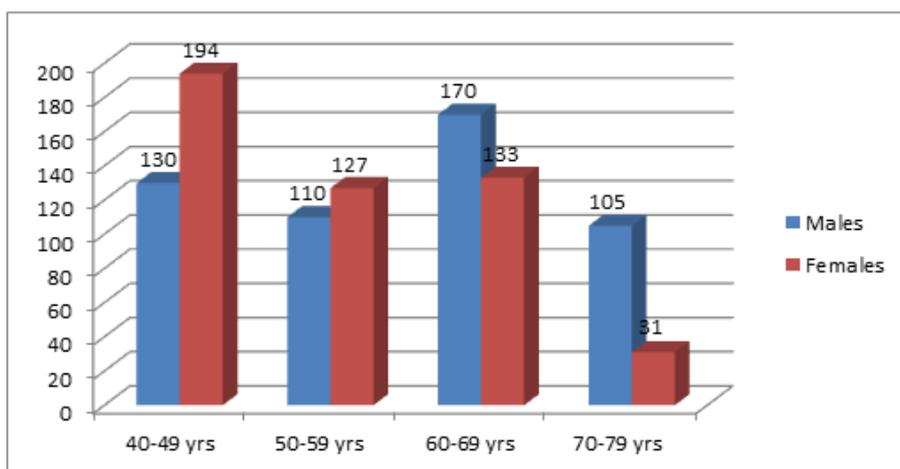


Fig-1: Bar diagram showing age and sex distribution in percentage in the study population

Prevalence of primary glaucoma in the study population

Out of the total 1000 cases, 49 cases (4.9%) were found to have primary glaucoma (Figure-2).

Distribution of primary open angle glaucoma (POAG) and primary angle closure glaucoma (PACG) among primary glaucoma patients

Of the total 49 primary glaucoma cases, 23 (46.9%) were POAG while 26 (53.1%) were PACG cases (Table-3). So out of 1000 study population, 23 patients had POAG showing its incident to be 2.3% and 26 patients had PACG showing its incidence to be 2.6%.

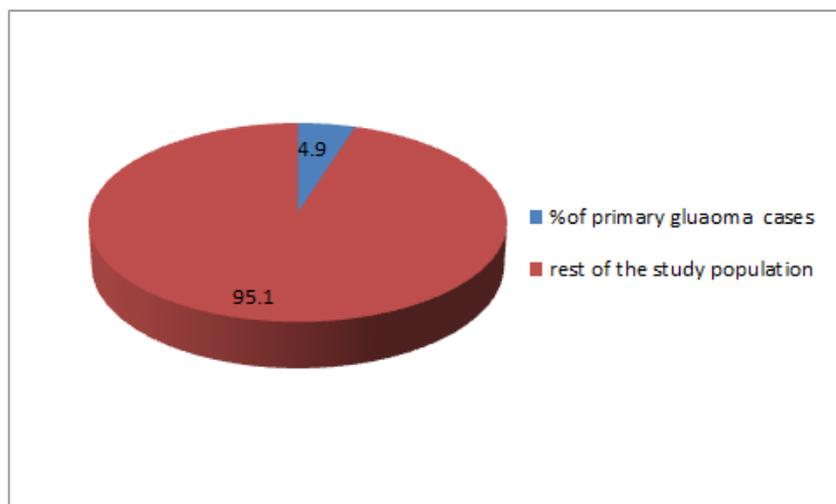


Fig-2: Percentage of primary glaucoma in the study population

Table -3: Distribution of POAG and PACG among primary glaucoma patients

Category	Number of cases (%)
POAG	23 (46.9%)
PACG	26 (53.1%)
Total primary Glaucoma case	49 (100%)

Age and sex wise distribution of all primary glaucoma cases in the study population

Of the total 516 males, 28 (5.42%) had primary glaucoma. Of this, 3 (0.58%) belonged to the

age group 40-49 years, 4 (0.77%) belonged to the age group 50-59 yrs, 10 (1.94%) belonged to the group 60-69 years and 11 (2.13%) belonged to the age group 70-79 years.

Of the total 484 females in the study population, 21 (4.34%) had primary glaucoma. Of this, 2 (0.41%) belonged to the age group 40-49 years, 3 (0.62) belonged to the age group 50-59 years, 8 (1.65%) belonged to the age group 60-69 years and 8 (1.65%) belonged to the age group 70-79 years. Of the total

study population 0.3% belonged to the age group 40-49 years, 2.9% belonged to the age group 50-59 years, 5.9% belonged to the age group 60-69 years and 13.2% belonged to the age group 70-79 showing an increase prevalence of primary glaucoma with increasing age (Table 4 and Figure -3).

Table-4: Age and Sex arise distribution

Age group (years)	Total males Number (%)	Males with primary glaucoma number (%)	Total females Number (%)	Females with primary glaucoma Number (%)	Total Subjects in study population	% of the study population with primary glaucoma
40-49	130 (100%)	30(0.58%)	194 (100%)	2 (0.41%)	324	0.3%
50-59	110 (100%)	4 (0.77%)	127 (100%)	3 (0.62%)	237	2.9%
60-69	170 (100%)	10 (1.94%)	133 (100%)	8 (1.65%)	303	5.9%
70-79	105 (100%)	11 (2.13%)	31 (100%)	8 (1.65%)	136	13.2%
Total	516 (100%)	28 (5.42%)	484 (100%)	21 (4.34%)	1000	

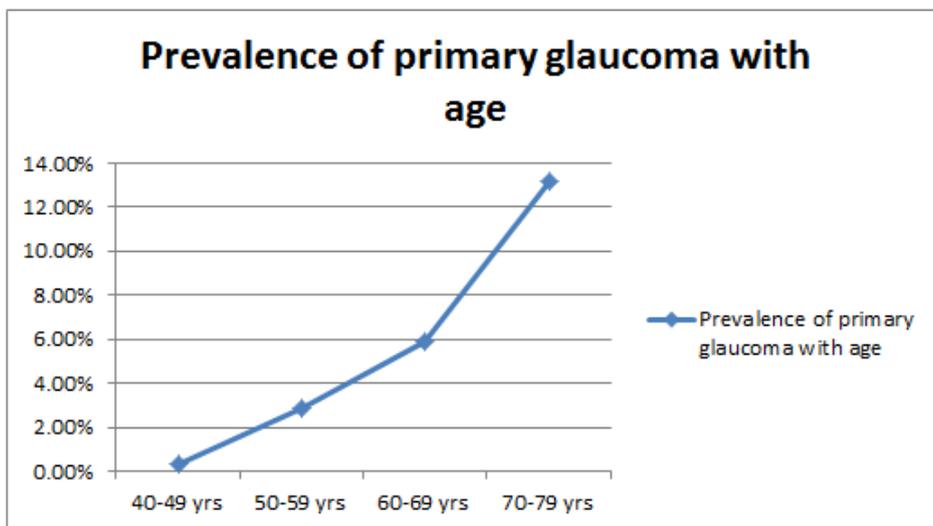


Fig-3: Line diagram showing an increase prevalence of primary glaucoma with age

Presenting complaints in primary glaucoma (PAOG and PACG)

In POAG group, 34.8% patients had chief complaints of diminution vision while 26.1% had eyeache and headache respectively and only 13% had

other complaints. In the PACG group, 43.5% patients had chief complaint of diminution of vision while 34.6% had eye ache, 15.4% had headache and only 11.5% had other complaints (Table -5).

Table -5: Presenting complaints

Chief complaints	PAOG	PACG
Diminution of vision	8 (34.8%)	10 (43.5%)
Eyeache	6 (26.1%)	9 (34.6%)
Headache	6 (26.1%)	4 (15.4%)
Others	3 (13.04%)	3 (11.5%)
Total	23 (100%)	26 (100%)

Comparison of risk factors of glaucoma between POAG and non POAG subjects and also between PACG and non PACG subject

Among POAG cases, there were 8 cases with history of myopia, 4 cases with history of hypermetropia, 3 cases with diabetes, 9 cases with

hypertension, 1 case with history of migraine and 1 case with positive family history of glaucoma. Significant association was found between POAG and diabetes (OR: 1.85), hypertension (OR: 1.32) and family history of glaucoma (OR: 22.1) (Table -6).

Table-6: Comparison of risk factors

Risk factors	POAG	Non POAG	Odds ratio (OR) at 95 % CI
Myopia	8 (34.78%)	341 (34.1%)	0.99
Hypermetropia	4(17.39%)	340 (34%)	0.394
Diabetes	3 (13.04%)	74 (7.4%)	1.85
Hypertension	9 (39.13%)	319 (31.9%)	1.32
Migraine	1 (4.35%)	39 (3.9%)	0.96
Family history of glaucoma	1 (4.35%)	2 (0.2%)	22.1

(CI= Confidence Interval)

Among the PACG cases there were 4 cases with history of myopia, 3 cases with history of hypermetropia, 3 cases with diabetes, 10 cases with hypertension, 1 case with history of migraine and 1 case

with positive family history of glaucoma. Significant association was found between PACG and diabetes (OR 191), hypertension (OR: 1 41), and family history of glaucoma (OR: 19.4) (Table -7).

Table -7: Comparison of Risk factors

Risk factors	PACG	Non PACG Subjects	Odds ratio (OR) at 95 % CI
Myopia	4(15.38)	316 (316%)	0.38
Hypermetropia	3 (11.54%)	361 (36.1%)	0.22
Diabetes	3 (7.7%)	100 (10%)	1.91
Hypertension	10 (38.46%)	300 (30%)	1.41
Migraine	1 (4.35%)	39 (3.9%)	0.96
Family history of glaucoma	1 (3.85%)	2(0.2%)	19.44

Mean intraocular pressure (IOP) distribution

The age wise distribution of mean IOP in normal, POAG and PACG population was observed as shown below (Table -8).

Age wise distribution of mean vertical cup disc ratio (VCDR) in normal, POAG and PACG population

In normal population, the mean VCDR ranged 0.26 to 0.39 with advancing age. In POAG group, the mean VCDR changed from 0.5 to 0.67 while in PACG, the mean VCDR progressed from 0.65 to 0.69 as age advanced (Table -9).

Table -8: Mean IOP distribution

Age group (yrs)	Mean IOP (mm of Hg) Normal	Mean IOP (mm of Hg) POAG	Mean IOP (mm of Hg) PACG)
40-49	12	20	22
50-59	13.5	21	26.5
60-69	14	24.7	31.5
70-79	13.6	26	33

Table-9: Mean VCDR in normal, POAG group and PACG group

Age group (yrs)	Mean VCDR in Normal	Mean VCDR in POAG	Mean VCDR in PACG
40-49	0.26	0.5	0.60
50-59	0.34	0.57	0.65
60-69	0.38	0.62	0.71
70-79	0.39	0.67	0.69

Age wise distribution of mean CCT in normal, POAG and PACG population

The mean CCT in normal population ranged from 522.3μ to 412.3μ, in POAG ranged from 521.4μ

to 489.7μ and in PACG changed from 524.9 μ to 501.1μ with increasing age (Table -10)

Table -10: Age wise distribution of mean CCT

Age (yrs)	Mean CCT (μ) in Normal	Mean CCT (μ) POAG	Mean CCT (μ) in PACG
40-49	522.3	521.4	524.9
50-59	540.2	543.7	535.3
60-69	487.5	501.5	510.4
70-79	412.3	489.7	501.1

Age wise distribution of mean RNFL thickness in normal, POAG and PACG population

The mean RNFL thickness in normal population ranged from 166.78 μ to 94.21 μ, in POAG

changed from 98.74μ to 70.45μ and in PACG ranged from 84.12μ to 68.45μ with increasing age (Table -11).

Table-11: Age distribution of mean RNFL thickness

Age (yrs)	Mean RNFL (μ) in Normal	Mean RNFL (μ) in POAG	Mean RNFL (μ) in PACG
40-49	116.78	98.74	84.12
50-59	104.87	83.90	74.22
60-69	98.72	78.25	70.25
70-79	94.21	70.45	68.45

Prevalence of blindness in primary glaucoma patients

Of the total 49 primary glaucoma cases, there were 8 patients (16.32%) with low vision and 6 patients (12.24%) with blindness. Among 8 patients with low vision, 2 patients (25%) belonged to POAG group while

6 patients (75%) belonged to the PACG group. Of total 6 blind patients, 2 (33.3%) were from POAG while 4 (66.7%) were from PACG group. Among 6 blind cases, 4 (66.7%) were unilaterally blind while 2 (33.3%) cases were bilaterally blind from primary glaucoma (Table - 12).

Table -12: Prevalence of Blindness

	POAG	PACG	Total
Low vision	2 (25%)	6 (75%)	8 (100%)
Blind	2 (33.3%)	4 (66.7%)	6 (100%)
Total	4 (28.6%)	10 (71.4%)	14 (100%)

DISCUSSION

Properly planned and designed glaucoma screening and comprehensive clinical assessment with family history of all patients of presbyopic age group attending eye out patient dept. (OPD) and eye clinic with modern sophisticated diagnostic tools would provide the best opportunity for early detection and early management of all glaucoma cases.

Our study population consisted of subjects belonging to the presbyopic age group and the ages ranged from 40 yrs to 78 yrs. (Mean ± SD was 59 ± 29 yrs). The highest percentage of males (32.9%) belonged to the age group 60-69 yrs, while the highest percentage of females (40.1%) belonged in the age group 40-49 yrs. In west Bengal Glaucoma Study (WBGs)[6], the highest percentage of male and female population belonged to the age group 50-59 yrs each whereas in Chennai Glaucoma Study (CGS) [7], the highest percentage of male and female population belonged to the age group 70-79 yrs.

The prevalence of primary glaucoma in our study was found to be 4.9% with POAG accounting for 2.3% and PACG accounting for 2.6% of the total population. The reported prevalence of POAG among a adult black population ranged from 4.2% to 8.8% whereas the prevalence estimates in predominantly white adult populations ranged from 1.1% to 3%. Hispanics in the U.S. have been found to have a prevalence of 2.0% for those 40 yrs of age and older [8]. These findings are comparable to our findings.

The present study showed the incidence of POAG to be 2.3% and that of PACG to be 2.6%. This can be compared to a study done in Hovsgol province, northern Mongolia [9], in which the prevalence of PACG was 1.4% as against 0.5% of POAG.

5.42% of total males had primary glaucoma, while 4.34% of total female had primary glaucoma in the study population 0.58% and 0.41% of male and female population respectively with primary glaucoma belonged to the age group 40-49 yrs, which increased to

2.13% and 1.65% respectively of the male and female population in the age group 70-79 yrs, showing on increasing prevalence of primary glaucoma with increasing age. In Aravind comprehensive eye survey (ACES) also, the prevalence of primary open angle glaucoma ranged from 0.34% (in 40-49 yrs age) to 2.88% (in age>70 yrs)[10] showing similar increasing prevalence of primary glaucoma with increasing age as our present study. Regarding sex distribution of primary glaucoma, its incidence in males and females were 5.42% and 4.34% respectively in our study. A study by Gyasi *et al.* reported higher rates of POAG amongst males [11] whereas St. Lucia studies reported higher rates of POAG in females [12]. Vajaranant TS *et al.* on the other hand found that women are at higher risks for PACG but there is no clear gender predilection for POAG [13].

In the POAG group, our study observed that the maximum number of patients (34.8%) presented with dimness of vision followed by eyeache and headache whereas in PACG patients, 43.5% had dimness of vision followed by eyeache and headache. But the relevant literature has shown that POAG develops slowly and usually asymptomatic until significant loss of vision has occurred.

Significant association was observed between POAG and PACG with diabetes in our study. The Beaver Dam Eye study also concluded that presence of POAG is increased in patients with older onset diabetes [14].

Similarly significant association was found between POAG and PACG with hypertension in the present study. Bonomi L *et al.* found positive correlations between systemic blood pressure and IOP. Lower diastolic perfusion pressure is associated with a marked progressive increase in the frequency of hypertensive glaucoma [15]. Our study further noticed significant association between POAG and PACG with family history of glaucoma. A. Ralph Rosenthal in his study confirmed that having a family history of POAG puts a person at higher risk of developing the disease [16].

The present study revealed that mean IOP in normal population ranged from 12 mm of Hg to 13.6 mm of Hg, in POAG it increased from 20mm of Hg to 26 mm of Hg whereas in PACG it raised from 26.5 mm of Hg to 33 mm of Hg and was therefore seen to raise with increasing age. In this respect, Anhchuong Le *et al.* concluded that increased age and increased IOP were associated with increased risk of development of POAG [17]. Our study also found that the mean Vertical Cup Disc Ratio (VCDR) in POAG and PACG group was 0.56 and 0.67, the difference of which was not statistically significant ($P>0.05$). Thomas *et al.* also studied an East India population, finding no significant

difference in Heidelberg retinal tomography (HRT) between POAG and PACG group [18].

The mean CCT in POAG and PACG group of our study were 514.07 μ and 517-92 μ respectively, the difference of which was not statically significant ($P>0.05$). Mello PR *et al.* found that the mean CCT in POAG and PACG cases were 535.1 μ and 519.2 μ respectively, the difference of which was also not of statistical significant ($P=0.18$) [19]. Mean RNFL thickness decreased to 94.21 μ in normal population with advanced age where as it decreased to 70.45 μ and 68.45 μ in POAG and PACG cases respectively which were considerably and significantly lower than in normal population as observed in our study. Liu Xing also concluded that RNFL thickness gradually decreases with development of POAG [20].

In our study, of the total blind patients, 2 (33.3%) belonged to POAG while 4 (66.7%) belonged to PACG group. 4 patients (66.7%) were unilaterally blind while 2 patients (33.3%) were bilaterally blind from glaucoma. Persons bilaterally blind due to POAG has been variably reported to be 3.2% and 1.5% (CGS, rural and urban population respectably) and 5.2% in WBGS (West Bengal Glaucoma study). In most studies, PACG was observed to cause 1 to 4 times the proportion of blindness as POAG. The high rates of blindness were probably due to the high rates undiagnosed blindness in the community [21].

CONCLUSION

The present study demonstrated that the prevalence of primary glaucoma in presbyopic population was 4.9% and the prevalence of PACG (2.6%) was slightly higher than the prevalence of POAG (2.3%). The prevalence of primary glaucoma, both POAG and PACG increased with increasing age, among both male and female group. Main presenting complaint of the patients was dimness of vision. Significant association was found between primary glaucoma and diabetes, hypertension and positive family history of glaucoma. Mean IOP raised with advancing age in normal, POAG and PACG population. Mean RNFL thickness measured on OCT decreased in primary glaucoma and the extent of such decrease in RNFL thickness increase with increasing age. The incidence of blindness among primary glaucoma was 12.24% of which 33.3% were bilaterally blind. Glaucoma being the second leading cause of ocular morbidity and blindness around the world and since primary open angle glaucoma is mostly asymptomatic and the patient is not aware of the grave situation till the disease passes to an advance stage, screening of all individuals of presbyopic age with sensitive and sophisticated tools is mandatory. Holding glaucoma screening camps, public awareness meeting, glaucoma rallies, street shows, postering and distributing pamphlets will bring glaucoma population closer to the Ophthalmologist and contribute to an immense extent in

preventing and controlling this sight threatening ocular disorder.

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