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Ophthalmology

A CLINICAL STUDY TO EVALUATE THE RISK FACTORS FOR PRIMARY OPEN ANGLE GLAUCOMA- A RESEARCH ARTICLE

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ABSTRACT

Aim : To analyse the risk factors of primary open angle glaucoma

Methods: The study was conducted on sixty patients diagnosed as Primary Open Angle Glaucoma (POAG). Detailed history and a thorough ocular examination including visual acuity, refraction, tonometry, slit lamp biomicroscopy, gonioscopy, ophthalmoscopy, perimetry and optical coherence tomography (OCT) were done.

Results: Age, sex, intra-ocular pressure, myopia, loss of RNFL thickness, hypertension were found to be significant risk factors in primary open angle glaucoma.

Conclusion: Unawareness and ignorance on part of general populations need to be alleviated for early diagnosis and treatment of Primary open angle glaucoma.

KEYWORDS : POAG, Optic disc, IOP, RNFL, myopia, hypertension

INTRODUCTION

Glaucoma is a diverse group of eye diseases with multifactorial etiology, characterized by an acquired loss of retinal ganglion cells, progressive optic neuropathy with morphological abnormalities in optic nerve head (ONH) and, visual field defects, in which raised intraocular pressure (IOP) is a major and only modifiable risk factor. [1]

The diagnosis of POAG may be delayed due to the lack of early symptoms. Glaucoma typically is irreversible, slowly progressive and usually remains asymptomatic until late. When it becomes symptomatic, there usually is severe damage to the visual field of one or both eyes. If not treated, or inadequately treated, glaucoma often results in visual impairment and blindness [2]

Glaucoma is a lifelong disease and is a leading cause of irreversible but preventable blindness (5.80%) in India next to cataract (62.50%). [3,4,]

There are various risk factors, presence of which increases the possibility of having primary open angle glaucoma (POAG). Established and important risk factors for primary open-angle glaucoma (POAG) include age, race/ethnicity, level of intraocular pressure (IOP), family history of glaucoma, low ocular perfusion pressure, type 2 diabetes mellitus, myopia, and thin central cornea.[5]

Presence of wide, deep physiological optic cup' loss of retinal nerve fiber layer (RNFL) have been observed to be the risk factors.[6,7]

MATERIALS & METHODS

The present study was conducted on sixty patients who were diagnosed as Primary Open Angle Glaucoma (POAG) in a tertiary care hospital, during the period of September 2016 to August 2017. All patients' written and informed consent in their vernacular language were taken before including them in the study.

INCLUSION CRITERIA:

All cases that were diagnosed and treated as POAG irrespective of age and gender.

EXCLUSION CRITERIA:

1) Primary angle closure glaucoma
2) Secondary glaucoma
3) Congenital glaucoma
4) Cases with lenticular opacity, corneal scarring or opacity which would make it difficult to evaluate fundus.

Patient evaluation :

Detailed ocular and systemic history and a thorough ocular examination including visual acuity, refraction, tonometry, slit lamp biomicroscopy, gonioscopy, ophthalmoscopy, perimetry and optical coherence tomography (OCT) were done.

Laboratory investigation

Random blood sugar (RBS) was done in all cases. Patients who were found to have raised RBS (more than 140 mg/dl), fasting and 2 hour post prandial blood glucose were tested.

Statistically Chi-Square test (χ^2) ,one sample t- test (t) and Probability values (p) were used . p-value < 0.05 was considered statistically significant.

RESULTS AND OBSERVATIONS

I. Sex

Table 1: Sex Distribution

SEX	Number of cases	Percentage
Male	46	76.67
Female	14	23.33
Total	60	100%

$\chi^2 = 7.82, p = 0.0052$

This study reveals a higher incidence of primary open angle glaucoma in males (76.67%) than in females (23.33%). **(p = 0.0052)**

II. Age

Table 2: Age Distribution

Age in years	19-40	41-60	>60
Males	**6**	**29**	**11**
Females	**5**	**6**	**3**
Total	**11**	**34**	**15**
PERCENTAGE	**18.33%**	**56.67%**	**25%**

$\chi^2 = 11.715$ **p value = 0.006**

In this study population, 49 patients (81.67 %) were above 40 years of age. 18.33% below 40 years, 56.67% between 41-60 years and 25% patients were 60 years and above.

Maximum numbers of patients were in the 5th decade -21 patients (35%). The youngest case in the study population was 19 years old while the oldest was 82 years old. The mean age of presentation was 51.02 years

III. FAMILY HISTORY
Table 3 :family History

	Cases (n)	Percentage (%)
Positive family history	21	35%
Negative family history	39	65%

$p = 0.367, \chi^2 = 0.81$

In this study, family history i.e. in first degree relatives (parents, sibling or offspring) was found to be positive in 35% of cases. This relationship between positive family history and primary open angle glaucoma is not significant. (p = 0.367).

IV. INTRAOCULAR PRESSURE (IOP)
Table 4 : Iop Distribution

a) Right eye

IOP (mm of Hg)	No. of cases	Percentage (%)
10-20	**12**	**20**
21-30	**43**	**71.67**
31-40	**5**	**8.33**

b) Left eye

IOP (mm of Hg)	No. of cases	Percentage (%)
10-20	**4**	**6.67**
21-30	**51**	**85**
31-40	**4**	**6.67**
>40	**1**	**1.67**

Majority of the cases, i.e. 43 right eyes (71.67%) and 51 left eyes (85%) respectively had IOP in range of 21-30mm Hg at presentation. This observation was statistically highly significant (**p =0.0002**,χ^2 = 13.738)

Only one case had IOP more than 40mmHg in left eye. Of all the cases, 12 right eyes and 4 left eyes presented with IOP less than/equal to 20mmHg. The highest pressure recorded was 42mmHg. The mean IOP at presentation was 24.47 mmHg (right) and 25.07mmHg (left).

V. CENTRAL CORNEAL THICKNESS
Table-5 : Central Corneal Thickness Distribution

	Right eye	Left eye
440-460	**5**	**5**
461-480	**8**	**7**
481-500	**19**	**16**
501-520	**10**	**13**
521-540	**5**	**6**
541-560	**11**	**11**
561-580	**3**	**2**

p= 0.2075, t = 1.838

It is evident that, out of 120 screened eyes, 19 right eyes(31.67%) and 16 left eyes(26.67%) had central corneal thickness in range of 501to 520µm.

Table 6: Statistics Of Central Corneal Thickness Distribution

Mean	**RIGHT EYE 504.9**	**LEFT EYE 513.73**
Standard deviation	**32.34**	**28.98**
Standard error of mean (SEM)	**4.175**	**5.04**
95% Confidence Interval	**513.1 496.7**	**523.6 503.9**
Minimum	**440**	**451**
Maximum	**577**	**567**
Median (50th percentile)	**500**	**512**

In this study, the mean central corneal thickness is 504.9µm (right) and 513.73µm (left). Highest central corneal thickness recorded was 577µm and lowest was 440µm. Irrespective of the eyes, mean central corneal thickness was 509.315±30.66 µm.

VI. RETINAL NERVE FIBRE LAYER THICKNESS
Table -7: Average Rnfl Thickness Distribution

Mean	**RIGHT EYE 71.6**	**LEFT EYE 70.78**
Standard deviation	**15.03**	**17.86**
Standard error of mean (SEM)	**1.94**	**2.31**
95% Confidence Interval	**75.4 67.8**	**75.3 66.26**
Minimum	**41.32**	**14**
Maximum	**96.12**	**92.27**
Median (50th percentile)	**75.66**	**77.24**

In our study, we found the mean thickness of retinal nerve fiber layer to be 71.6 ±15.03 µm in right eye and 70.78±17.86 µm in left eye. Irrespective of eyes, maximum RNFL thickness was found to be 96.12µm , while the minimum was 14µm.

VII. REFRACTIVE ERRORS
Table 8 : Refractive errors distribution

	Right eye	Left eye
Myopics	**31 (51.67)**	**29 (48.33)**
Hypermetropes	**27 (45)**	**29(48.33)**
No target found	**2 (3.33)**	**2 (3.33)**

It is observed that the number of myope were equal or more than hypermetrope in the sixty POAG patients. With respect to the patients attending our outpatient department , this was highly significant(**p = <0.0001**, $\chi 2 = 146$). 50% of the cases were myopic.

VIII. CUP DISC RATIO (Vertical)
Table 9 : Cup disc ratio in both eyes

	Right eye	Left eye
0.4:1	6	3
0.5:1	11	11
0.6:1	19	22
0.7:1	11	9
0.8:1	11	12
0.9:1	2	3

As it is evident, maximum number of eyes had vertical cup disc ratio of 0.6: 1 (34%), next was 0.8:1 cup disc ratio (19.16%). Only 9 eyes (7.5%) had vertical cup disc ratio as 0.4:1. There was no difference between right and left eyes. This distribution had significant relationship with development of POAG in this study.(**p = 0.0156,** χ^2= 5.845)

IX.DIABETES MELLITUS
Table 10 : Diabetes mellitus distribution in study population

	Cases	Percentage (%)
Cases with diabetes	**22**	**36.67%**
Cases without diabetes	**38**	**63.33%**

p=0.259

Out of sixty patients, in our study twenty-two patients were diabetic.

X. HYPERTENSION
Table 11 :Hypertension distribution among study population

	POAG cases	percentage
Hypertensive cases	**20**	**33.3**
Non hypertensive cases	**40**	**66.7**

p value = **<0.0001,** χ^2= 127

In this study, out of 60 POAG cases 20(33.3%) cases were hypertensives and the remaining 40 cases (66.7%) were non hypertensives. In this study group presence of hypertension is found to be significantly related to primary open angle glaucoma.

DISCUSSION
SEX DISTRIBUTION:
In this study , males were found to have primary open angle glaucoma three times more than females. (**M:F ratio = 3.3:1**). It is observed that majority of the cases occurred among males (76.67%) than among females (23.3%). In this study **p value= 0.0052** shows that POAG being common in females is **statistically significant. [Table – 1]**.

A study done earlier in 2003, the Aravind Comprehensive Eye Survey[8], also found that males have increased risk of developing POAG in comparison to females. (M:F = 2.2:1). The Rotterdam Study[9] (1994) also found that males were three times more common than females to be diagnosed with POAG.

Table 12- : Sex Distribution In Different Studies Done By Other Authors

Authors	Male POAG (%)	Female POAG (%)
Narayan et al(2016)[10]	58	42
Ramakrishnan et al(2003)[8]	68.75	31.25
Our study	76.67	23.3

Few population based studies like the Blue Mountain eye disease study[11] found higher incidences of females than males.

In our study population, this male preponderance was found in all age groups. Most of the mentioned studies were population based studies instead of ours being hospital based and socio-economic and cultural constraints play an important role, leading to neglect and under-reporting of females with POAG. Most of the young female population detected in this study (45.5%), were chance finding in females who came for their supposedly refractive error correction or doubted to have cataract due to high grade of suspicion.

AGE DISTRIBUTION :

It is evident from our study that primary open angle glaucoma is more common in elderly population, particularly in the fifth decade and above, nearly 60% of total positive cases were above 50 years of age. Mean age at presentation being 51 years. Highest numbers of cases were in age group 40-60 years range (58.33%) and among these patients 57% cases were in 5th decade**. [TABLE -2].**

The mean age in our study was comparable with other Indian studies. Marginally high mean age appears due to the lower cut off age mentioned by these studies ; study done by Narayan M et al [10] and Tidake P et al[12] had fixed the lower age of patients as 45 years and 40 years respectively.

In the Blue Mountain Eye Study the average study population was 66 years and it has been recorded that POAG occurs in relatively younger population in the Indian subcontinent.[13]

Table 13 - : Mean Age Distribution In Different Studies By Other Authors

Authors	Mean age (years)
The Blue Mountain Study (1996)[13]	75.9 ± 8.6
Narayan M et al (2016)[10]	55.26 ± 2.36
Tidake P et al (2017)[12]	54.22 ± 13.28
Our study	51.02 ±13.63

In our study we found less percentage of POAG patients in age group 50-70 years than other mentioned studies as significant number of young POAG patients were found in 41-50 years age group (18.33%) , due to better than before diagnostic approach for OAG being followed in our institution. Also majority of these population based studies have taken age group less than 40years as their exclusion criteria.

FAMILY HISTORY

35% of patients of our study population had their first degree relatives having open angle glaucoma.**[Table – 3]** First degree relatives include parents, son/daughter and siblings. But this association was not found significant with POAG. (p= 0.38) There have been many studies supporting this view like the Baltimore Eye Survey and Blue Mountain Eye Study.

Unawareness on the part of patient and their relatives regarding familial nature of POAG was a limitation in this study.

INTRAOCULAR PRESSURE

In our study, mean IOP out of 120 examined eyes were 24.77 ± 4.27 mmHg (95% CI 25.53-24.00) at presentation. 71.67% of right eyes and 85% of left eyes , i.e. 78.3% of 120 POAG eyes had intraocular pressure in range of 21 to 30mmHg. **[Table -4]** Highest recorded IOP was 42mmHg and lowest was 16mmHg. **[Table-4]**

Our values are comparable with hospital based study done by Tidake et al[12] and Ramakrisnan et al [8] .

Table 14 :Study done by other authors showing mean intraocular pressure

Authors	Mean IOP (mmHg)
Ramakrisnan et al [8]	20.73±8.02
Tidake et al (2017)[12]	27.49 ± 5.50
Our study	24.77 ± 4.27

Many population based studies have shown less mean IOP like – Early Manifest Glaucoma Trial [6], mean IOP -15.92 ± 3.60 mmHg and Barbados Eye Study[14] showed mean IOP as 18.7 ± 5.2 mmHg. A reason could be, in population based study in comparison of ours being hospital based study, where patient report only when they are symptomatic with raised IOP.

CENTRAL CORNEAL THICKNESS

In our present study, mean central corneal thickness of the 120 examined eyes (n=60) was found to be 509.32±30.66µm**[Table - 6]**.This was statistically not significant.(by one sample t-test, p= 0.2075, t = 1.838)

It was found that mean CCT for the right eye was 504.9 ± 32.34µm and for the left eye was 513 ± 28.98µm.**[Table 6]**

Table 15: Mean Central Corneal Thickness By Other Authors

Authors	Mean CCT ± SD (µm) in POAG
Borgohain Y (2008)[15]	499±37.86
Tolesa K et al (2016)[16]	506.69 ± 35.08
Borkotoky R(2014)[17]	501.3 ± 54.3
Our Study	509.32± 30.66

As it is evident from the table , our results are comparable with the mean CCT found in these studies.

RETINAL NERVE FIBER LAYER THICKNESS

In our study, the average RNFL thickness came as 71.89 ±16.44 µm (95%CI – 74.85, 68.93). There was no difference in the laterality of RNFL thickness loss. (mean RNFL right eye-71.51µm and mean RNFL left eye -70.86µm) [Table-7]

Table 16 : average RNFL thickness as per other authors

Authors	Average RNFL thickness in POAG pt. (µm)
Tidake et al (2017)[12]	75.55
Sahli et al (2012)[18]	70.48
Our study	71.19

Our study was consistent with study of Sahli et al (2012), where global average RNFL thickness was found to be 70.48 ± 21.84µm[18]

MYOPIA

In our study, we found 50% of the patients to be myopics**. [Table -8]** All the myopics were either mild or moderate myopics. Majority of cases were mild myopics (upto -3D). There was found a strong relationship between myopia and development of POAG. (p < 0.0001)

Our study has been found to be consistant with the Blue Mountain Study(1996),[19] the Barbados Eye Study (1996) [20]. Among Indian studies, Aravind Comprehensive Eye Survey found association of myopia with POAG.

CUP DISC RATIO

Mean vCDR (vertical cup disc ratio) of both eyes is 0.632 ± 0.129. Maximum cup disc ratio found in both eyes is 0.9:1 and minimum is 0.4:1**[TABLE - 9]** 34% of the eyes had vCDR as 0.6:1. vCDR of this study is comparable with that of Kwon et al[21] , where it was found that 99.5th percentile of the population had vertical optic cup disc ratio as 0.64:1 .

Mukesh et al[22] found that cases with cup disc ratio more 0.7:1,had more chance of developing POAG. It might be argued that a larger cup-disc ratio is not a risk factor for developing POAG but rather an indicator of early glaucomatous damage. A patient with a large cup-disc ratio unaltered by glaucoma may be at greater risk for developing POAG. Hence it has both prognostic significance as well as predictive one too.[6]

DIABETES

Out of 60 patients , in our study 22 (36.67%) patients were found to be diabetic**.[Table -10].** This association was found to be insignificant.(p = 0.259).Our study is found to be consistent with the studies of Kahn et al[23] and Tielsch et al[24].

There are many studies like those done by Dielemans et al (the Rotterdam Study.)[25], Mitchell P et al (the Blue Mountains Eye Study)[26].

These variations and heterogeneity is found in various studies due to difference in diabetes developing propensity in various ethnic groups and also due to inconsistent sample collection methods.

HYPERTENSION

In this study, out of 60 POAG cases 20(33.3%) cases were hypertensives and the remaining 40 cases (66.7%) were non hypertensives.This association was found to be significant ($p<0.0001$). **[Table-11]** This result is consistent with studies of Mitchell et al [27] , Bonomi et al (the Egna-Neumarkt Study)[28] where hypertensive patients have been seen to have increased risk of developing open angle glaucoma.

CONCLUSION

From the present study, we draw the following conclusions :

- Major risk factors found in this study were male patients in elderly age group, myopia and hypertension .
- Examination tools found to be significantly correlating with POAG development were loss of RNFL thickness and large vertical optic cup disc ratio (vCDR).
- Strength of our study was total coverage and screening of all glaucoma patients attending OPD in this one year study period
- This study was hospital based cross-sectional study and this is its limitation.
- Unawareness and ignorance on part of general populations have to be alleviated regarding nature of primary open angle glaucoma.

REFERENCES

1. Dada T, IchhpujanP, LingamV, RamaswamiK, KaushikS, VyasP, P Sarma. Guidelines for medical management of primary open angle glaucoma.All India Ophthalmological Society.2011;p6
2. Rahmani B, Tielsch JM, Katz J, et al. The cause-specific prevalence of visual impairment in an urban population. The Baltimore Eye Survey. Ophthalmology 1996; 103:1721–1726
3. Dr. R. Jose. Community Health J 2008;21(65) S103-S104
4. VijayaL, GeorgeR, ArvindH, BaskaranM ,RajuP,RameshSV, et al.Prevalence and cause of blindness in the rural population of Chennai Glaucoma study
5. Shields textbook of glaucoma, 6th edition
6. Gordon MO, et al. The Ocular Hypertension Treatment Study: baseline factors that predict the onset of primary open-angle glaucoma. Arch Ophthalmol 2002;120:714.
7. Christopher Bowd,Robert N.Weinreb,Linda Zangcoil.The RNFL thickness in ocular hypertensives,normal and glaucomatous eyes with OCT
8. Ramakrishnan R, Nirmalan PK, Krishnadas R et al. Glaucoma in a rural population of southern India: the Aravind Comprehensive Eye Survey. Ophthalmology 2003;110:148 490
9. Dielemans I, Vingerling JR, Wolfs RC, et al. The prevalence of primary open-angle glaucoma in a population-based study in The Netherlands. The Rotterdam Study. Ophthalmology. 1994 Nov;101(11):1851-5
10. Narayan. M, Chandra Kanth Pujar ,Divya evaluation of risk factors in primary open angle glaucoma TJPRC: International Journal of Ophthalmic Surgery and Ocular Pharmacology (TJPRC: IJOSOP) Vol. 1, Issue 2, Dec 2016, 31-36
11. A.G. Actis, E. Versino, B. Brogliatti, and T. Rolle. Risk Factors for Primary Open Angle Glaucoma (POAG) Progression: A Study Ruled in Torino
12. Tidake P, Sharma S. Clinical profile and management of primary open-angle glaucoma patients above 40 years: A rural hospital-based study. J Datta Meghe Inst Med Sci Univ 2017;12:1-6
13. Tielsch JMKatz JSommer AQuigley HAJavitt JC .Family history and risk of primary open-angle glaucoma: the Baltimore Eye Survey. Arch Ophthalmol. 1994;11269-73Article
14. M. Cristina Leske, Suh-Yuh Wu, Anselm Hennis,Robert Honkanen, Barbara Nemesure. Risk Factors for Incident Open-angle Glaucoma. BESs Study Group. The Barbados Eye Studies.Arch Ophthalmol. 1997 Aug;115(8):1051-7.
15. Borgohain Y:Correlation of central corneal thickness in glaucoma and glaucoma suspects: A thesis submitted to Gauhati University in 2008
16. Tolesa K, Gessesse GW. Central corneal thickness in newly diagnosed glaucoma patients in South West Ethiopia: a cross-sectional study. BMC Ophthalmology. 2016;16(1):152.
17. Borkotoky R : A comparative study on the central corneal thickness readings and intraocular pressure changes in primary open angle glaucoma patients and age matched general population – A thesis submitted to Srimanta Sankaradeva University of Health Sciences in 2014
18. Ramanjit Sihota; Parul Sony; Viney Gupta; Tanuj Dada; Rajvir Singh .Diagnostic Capability of Optical Coherence Tomography in Evaluating the Degree of Glaucomatous Retinal Nerve Fiber Damage Investigative Ophthalmology & Visual Science May 2006, Vol.47, 2006-2010.
19. Mitchell P,Hourihan F,Sandbach J,Wang JJ. The relationship between glaucoma and myopia: the Blue Mountains Eye Study. Ophthalmology. 1999;1062010- 2015Article
20. Yingfeng Zheng; Tien Y. Wong; Paul Mitchell; David S. Friedman; Mingguang He; Tin AungDistribution of Ocular Perfusion Pressure and Its Relationship with Open-Angle Glaucoma: The Singapore Malay Eye Study.
21. Kwon, Young H, Kim, Young I.,Pereira, Mary Lucy M.; Montague, Paul R.; Zimmerman, M. Bridget ; Alward, Wallace L.M. Rate of Optic Disc Cup Progression in Treated Primary Open-Angle Glaucoma Journal of Glaucoma: October 2003 - Volume 12 - Issue 5 - pp 409-416
22. Mukesh BN, et al. Five-year incidence of open-angle glaucoma: the visual impairment project. Ophthalmology 2002; 109:1047
23. Kahn HA, et al. The Framingham Eye Study. II. Association of ophthalmic pathology with single variables previously measured in the Framingham Heart Study. Am J Epidemiol 1977;106:33.
24. Tielsch JM, et al. Hypertension, perfusion pressure, and primary open-angle glaucoma: a population-based assessment. Arch Ophthalmol 1995;113:216.
25. Dielemans I, et al. Primary open-angle glaucoma, intraocular pressure, and diabetes mellitus in the general elderly population: the Rotterdam Study. Ophthalmology 1996;103: 1271.
26. Mitchell P, et al. Open-angle glaucoma and diabetes: the Blue Mountains Eye Study, Australia. Ophthalmology 1997; 104:712.
27. Mitchell P, Lee AJ, Rochtchina E, Wang JJ. Open-angle glaucoma and systemic hypertension: the Blue Mountains Eye Study. J Glaucoma 2004;13:319–326
28. Bonomi L, et al. Vascular risk factors for primary open-angle glaucoma: the Egna-Neumarkt Study. Ophthalmology 2000; 107:1287