

To Study the Prevalence of Glaucoma and all its Subtypes and Variants in North Eastern Himalayan Foothills

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ABSTRACT

Introduction: Glaucoma is an Optic neuropathy with optic nerve head damage, nerve fiber loss and visual field loss. It is the largest cause of bilateral blindness, second only to the cataract. There are a few prevalence studies on glaucoma in India, but none of them were conducted in newly formed northern hilly state of Uttarakhand or in Armed Forces. A study was deemed necessary to classify and subtype the various glaucomas in our traditional clientele to project the disease load, treatment modalities and equipment required for early diagnosis and better patient care.

Material and methods: 2000 patients were screened with 04 subgroups of 500 each of age group between 20- 40 years, children below 20 years, males over 40 years and female dependents over 40 years. Variables of interest were intraocular pressure, optic disc-cup to disc ratio, visual field assessment and nerve fibre analysis.

Results: Out of 2000,106 patients (5.3%) had glaucoma. Predominant type of glaucoma was primary open angle glaucoma (POAG) (55%) followed by primary closed angle glaucoma (PACG) (36%). 85% of the patients of glaucoma were in the age group of more than 40 years. Advanced glaucoma was seen in almost 35% of patients for the first time.

Conclusion: It was recommended that all patients at initial entry ocular OPD should be screened for glaucoma.

Keywords: Glaucoma, Visual Field, Optic Nerve Head, Non-Contact Tonometry

INTRODUCTION

Glaucoma is an optic neuropathy characterized by triad of optic nerve head damage, nerve fiber loss and visual field loss in which raised intraocular pressure (IOP) is the most important and commonly modifiable risk factor.¹ Whereas cataract disability can be treated with surgery; the disability caused by glaucoma is irreversible. It is a 'silent killer', as most of the time, it is asymptomatic up to the very advanced stage and at the time of presentation to the ophthalmologist, the visual loss is often irreversible.² Globally it accounts for 7-8 million bilaterally blind people. It was estimated that 79.6 million people worldwide will be affected by glaucoma by 2020³ It is responsible for 8-12% of blindness and 11.5% of low vision morbidity in India.⁴ Glaucoma traditionally has been divided into open angle and narrow angle glaucomas based on the anatomical configuration of the drainage angle. The differentiation is important both therapeutically and prognostically. In blacks and Caucasians, open angle glaucoma is more common,⁵ whereas in India and Asians, narrow angle glaucoma is more common or as equal as open

angle glaucoma.⁶ With further advances in diagnosis and treatment, the basic understanding of glaucoma has changed from a condition of raised intraocular pressure to an optic neuropathy.⁸ The World Health Organization recommended to its member countries to combat this public health problem through a program approach.⁹ To plan the strategies, it is of utmost importance that the prevalence, distribution, subtypes and risk factors of glaucoma are identified. Such a study has been a challenge due to variation in the definitions and diagnostic criteria for glaucoma.¹⁰ There are a few prevalence studies on glaucoma in India.^{11,12,13}, but none of them were conducted in newly formed northern hilly state of Uttarakhand.

The demography of Dehradun shows that it has an approximate population of 84,79,562. The consequent sex ratio has been revealed as 964 females per every 1000 males. The rural population of Dehradun averages about 63,09,317. The demographic structure of the study area is having a large proportion of children and < 15% proportion of the elderly population. This matches with the demographic trends of other developing countries.¹⁴ A study was deemed necessary to classify and subtype the various glaucomas in our traditional to project the disease load, treatment modalities and equipment required for early diagnosis and better patient care. In view of significant glaucoma prevalence in India and especially in Himalayan foothills, the need for mandatory Glaucoma screening and adequate equipment will be highlighted by this study.

MATERIAL AND METHODS

It was a descriptive study with a period of patient entry for 01 year with a cross sectional design. The reference population was the total population of North Eastern Himalayan foothills with the study population being the patients reporting to a referral center in Dehradun. It was assumed that the study

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population will be representative of the reference population as most of the clientele belongs to representative geographical area. Total population of Uttaranchal is about 84 lakh.¹⁴ The dependency of said hospital in Dehradun is about 5 lakh. We assumed that glaucoma in the population would be around 4%. To achieve 95% confidence interval with a confidence limits of 1%, the required sample size for our study was 1656. To compensate for dropouts, we increased the sample size by 20% to 2000.

Sample size: 2000 patients were screened for glaucoma which included 04 subgroups of 500 each.

Sampling Method: All fresh cases presenting to referral center at Dehradun to various primary OPDs were eligible whereas patients presenting directly to Eye OPD were excluded. A simple random sampling technique was used where every 10th patient reporting to each OPD was included in the study and screened and followed up for glaucoma till a total sample size of 500 each in the 4 groups

1. Children below 20 years
2. Age group between 20- 40 years
3. Males over the age of 40 years
4. Female over the age of 40 years

Exclusion criteria: Only fresh patients were taken into the study. Any follow up patients of eye OPD or reporting directly in the eye OPD were excluded.

Techniques: The data was collected by principle worker and trained operating room assistants.

- The visual acuity of each eye with and without correction was measured using Snellen's charts.
- Dynamic refraction was carried out manually using direct retinoscope followed by subjective corrections.
- Anterior segment was examined by slit lamp to note the state of cornea, anterior chamber, lens and pupillary reaction.
- IOP was measured by a non-contact tonometer and confirmed by applanation tonometer. An average of three readings taken at the intervals of 01 min each was used. Tonometry was repeated at a separate day if pressure was noted to be less than 10mm Hg or more than 21mm Hg. Diurnal variation of IOP was checked in all suspected glaucoma cases.
- A gonioscope and slit lamp were used for gonioscopy and to classify the angle of anterior chamber into open or closed and to find out any abnormalities in angle.
- Pupil was dilated using Eye drops tropicamide 0.5% and phenylephrine 5% one drop repeated after 10 minutes and evaluation of disc and neuroretinal rim was done using slit lamp and +90 D lens and findings were captured on camera mounted on slit lamp

Parameters used in survey for suspecting glaucoma

- Disc changes
 - Vertical cup disc ratio > 0.6 in either eye
 - Asymmetry of cup disc ratio of more than 0.2
 - Disc changes like polar notch, haemorrhage on or near disc, bean pot cupping, nerve fibre layer defect

- Intraocular pressure
 - Pressure of >21mm Hg in either eye
 - Difference of more than 6mm Hg pressure in between eyes
- History
 - Family history of glaucoma and past treatment of glaucoma
- Field changes/ optical coherence tomography(OCT) data- in those patients suspected of glaucoma
 - Central/ paracentral scotoma
 - Bjerrum scotoma
 - Arcuate scotoma
 - Ring scotoma
 - Ronne's nasal step
 - Nerve fibre layer defects on OCT

Criteria for classification as glaucoma

- **Open angle glaucoma:** subject with glaucomatous field defects, glaucomatous disc changes or ocular pressure > 21 mm Hg with an open angle in either eye was defined to suffer from POAG.
- **Angle Closure Glaucoma:** subject with glaucomatous field defects, glaucomatous disc changes or ocular pressure > 21 mm Hg with an occludable angle on gonioscopy in either eye was considered to suffer from PACG.
- **Ocular Hypertension:** A patient with IOP consistently higher than 21mm Hg without disc or field changes was classified as ocular hypertension
- **Normotensive glaucoma:** Subject having disc or field changes suggestive of glaucoma but an IOP below 21mm Hg without medication was in this group.

If a subject was having increased intraocular pressure, retinal/ disc changes of glaucoma and evident ocular co-morbidity like hypermature cataract, pseudoexfoliation syndrome or intraocular haemorrhage, he/she was considered to have secondary glaucoma.

Pre-tested data collection forms were used for data collection. Epi info statistical software was used for analysis of data and results.

Outcome variable: The outcome variable was glaucoma per person. The dependent variables were gender, age groups and type of glaucoma.

RESULTS

Of the 2462 enumerated patients, 2000(81.23%) were examined. A total of 462(18.76%) patients were left out. Out of the not examined patients, 88(3.56%) were unwilling to participate in the study, 44(1.78%) did not turn up for follow up and 330(13.40%) had a physical or mental incapacity which rendered them unable to participate in the study. The patients were divided into four groups of 500 each. Out of total of 2000 patients examined, 1027(51.25%) were male and 973(48.65%) were females. 500 patients(25%) were less than 20 years old, 1000(50%) patients were less than 40 years old and 1000(50%) patients were more than 40 years old. 1248(62.4%) patients were from urban and

752(37.6%) patients were from rural background. 722(36.1) patients were either illiterate or had education till primary school.1027(51.4%) patients had education till higher school and 251(12.6%) patients were college educated.(table-1) This demographic profile closely resembled our clientele . A total of 106(5.3%) patients were detected with glaucoma.

Out of this total 3(0.15%) had a family history of glaucoma, 14(0.7%) had a history of eye surgery in the past and 2(0.1%) had a history of glaucoma medications/ surgery in the past i.e 104(5.2%) patients were fresh cases. Overall prevalence of glaucoma in our study population was found to be 5.3%. Out of these 57(2.85%) patients had POAG, 39(1.95%) patients had PACG, 3(0.15%) patients had post traumatic glaucoma, 2(0.1%) patients had ocular hypertension and 5(0.25%) had normotensive glaucoma. POAG was the commonest type of glaucoma closely followed by PACG with combined forming 90.5% of all glaucomas. Out of a total of 106 cases of glaucoma 4(3.77%) cases were in the age group of less than 20 years, 12(11.31%) cases were in the age group of 20 to 40 years and 90(84.9%) patients were in the age group of more than 40 years. Males constituted a total of 69 (66.04%) and females constituted a total of 36(33.96%) of the total cases of glaucoma. The prevalence of glaucoma increased with age.Females had a predominance of PACG, 19(53%) out of a total of 36 cases. Males had a predominance of POAG, 40(57.9%) out of a total of 69 cases. All the post traumatic glaucoma cases were in males and in the age group of less than 40 years. Out of a total of 57 cases of open angle glaucoma, 4(7%) patients had pseudo exfoliation syndrome

Variants	Number	%
Gender		
Male	1027	51.35%
Female	973	48.65%
Age Group		
<20 yrs	500	25%
<40 yrs	1000	50%
>40 yrs	1000	50%
Area of residence		
Urban	1248	62.4%
Rural	752	37.6%
Literacy		
Illiterate	312	15.6%
Primary schooling	410	20.5%
Higher Schooling & above	1278	62.64%

Table-1: Population details

Age Group	Total No	Total Glaucoma	Open Angle Glaucoma*	Angle Closure Glaucoma#	Post Traumatic Glaucoma@	Ocular Hypertension	Normotensive Glaucoma
0-20 yrs	500	4	1	0	2	1	0
20-40yrs	500	12	8	2	1	1	0
>40yrsmales	500	59	36	20	0	0	3
>40years females	500	31	12	17	0	0	2
Total	2000	106	57	39	3	2	5

*Open Angle Glaucoma - Total - 57
 - Pseudoexfoliation syndrome - 4
 - Pigment dispersion syndrome - 3
 #Angle Closure Glaucoma - Total - 39
 - Plateau iris syndrome - 3
 @Post Traumatic Glaucoma - Total - 2
 - Angle recession - 2

Table-2: Age-sex distribution of glaucoma and variants

Age Group	Total No	Diabetes	Hypertensio n	Smoking	Glaucoma + Diabetes	Glaucoma + Hypertensio n	Glaucoma + Smoking	Total Glaucoma
0-20 yrs	500	4	0	8	2	2	0	4
20-40 yrs	500	24	36	69	9	5	3	12
>40 yrs males	500	30	46	70	28	40	16	59
>40 years females	500	30	42	12	19	18	6	31
Total	2000	88	124	149	58	65	25	106

Table-3: Association with Systemic diseases and Smoking

Age Group	DM + HTN	DM+ HTN + Glaucoma	DM + Smoking	DM + Smoking + Glaucom a	HTN + Smoking	HTN + Smoking + Glaucoma	DM + HTN + Smoking	DM + HTN + Smoking + Glaucom a
0-20 yrs	0	0	0	0	0	0	0	0
20-40 yrs	12	6	8	6	14	2	2	2
>40 yrs males	14	8	12	8	20	6	4	1
>40 year s females	10	6	4	1	14	1	2	0
Total	36	20	24	15	48	9	8	3

Table-3: Association with Systemic diseases and Smoking

and 3(5.02%) patients had pigment dispersion syndrome. Out of a total of 39 cases of angle closure glaucoma, 3(7.69%) patients had Plateau iris syndrome. All 2 patients of post traumatic glaucoma had angle recession. In the age group of <20 years, 2(0.4%) patients had post traumatic, 1(0.2%) patient had open angle glaucoma and 1(0.2%) had ocular hypertension. In the age group 20 to 40 years, 8(1.6%) patients had open angle glaucoma, 2(0.4%) patient had angle closure glaucoma, 1(0.2%) patient had post traumatic glaucoma and 1(0.2%) patient had ocular hypertension. In the age group of more than 40 years, 48(4.8%) patients had open angle glaucoma, 37(3.7%) patients had angle closure glaucoma and 5(0.5%) patients had normotensive glaucoma. (fig 1)

Out of a total of 2000 patients enrolled in the study, 124(12.4%) patients suffered from hypertension, 88(8.8%) patients had diabetes and 149(14.9%) patients were smokers. 58(66%) out of the 88 patients of diabetes had glaucoma, 65(46%) of the 124 patients of hypertension had glaucoma and 25(16.7%) of the total 149 patients of smokers had glaucoma. The glaucoma rates were higher in patients with diabetes and combination of diabetes and either of other two lifestyle disorders compared to any other combination. (table-3) 38(35.84%) patients of glaucoma had visually significant glaucomatous visual field loss. Association of glaucoma with diabetes had highest chances of glaucomatous field loss 24(41.37 %) out of a total of 58 patients with glaucoma and diabetes.(fig-2)

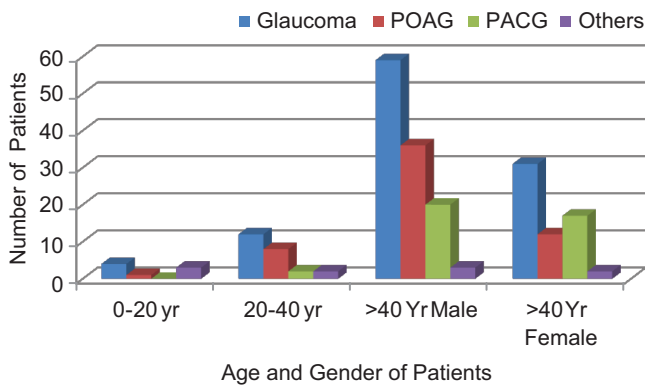


Figure-1: Prevalence of Glaucoma Types

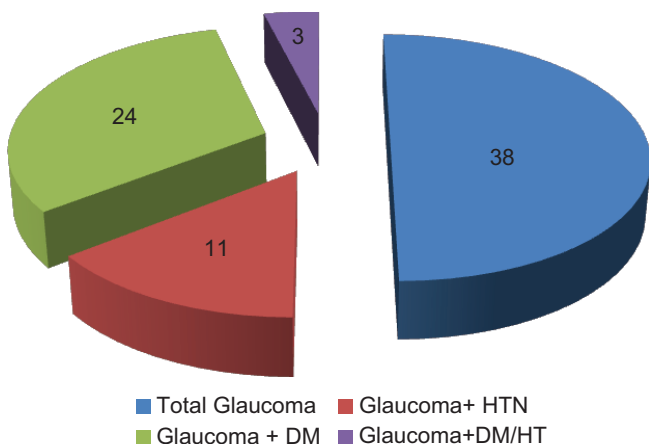


Figure-2: Significant Visual Field Defects

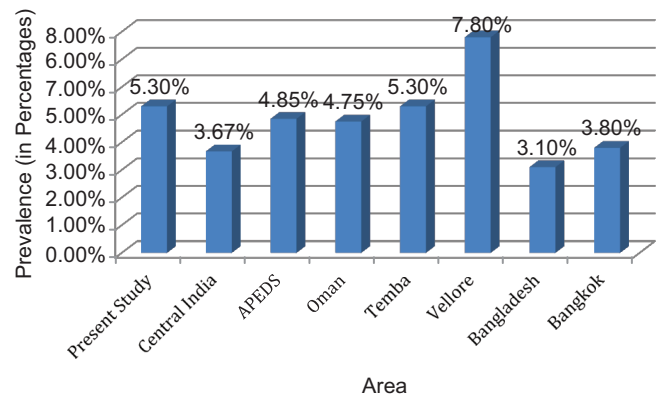


Figure-3: Glaucoma Prevalence

DISCUSSION

Glaucoma is a chronic disabling spectrum of diseases which has been known and treated for a long time but was never a priority due to very high prevalence of cataract and infective disorders of the eye. Accordingly it was decided that instead on focussing primarily at cataract, the current focus in the VISION 2020 initiative will be according to the current state of eye problems including Glaucoma.¹²

The proportion of chronic and age related blinding diseases is high and in coming years it is going to increase further with increasing life expectancy. In this context the assessment of magnitude and risk factors of glaucoma is very important for health planners in our country. The demographic trends of this study closely corresponds to the target population of area. Uniform definition of glaucoma for the survey and to compare the magnitude is a matter of debate. Definitions and classifications for community based glaucoma survey were proposed by Foster, et al in 2002. Our criteria were loosely based on them.¹⁵ Reliable population based data on the prevalence of glaucoma in India are scarce. Besides IOP and disc features, demonstration of characteristic field defect using a full threshold strategy on automated perimetry is required to detect a case of POAG. Similarly, gonioscopy is mandatory to confirm the diagnosis of PACG. Our study is one of the few studies which has been done incorporating these criteria for diagnosis of glaucoma in India. Comparison of our study outcomes to the results of other studies was a challenge. The age groups, the definitions used and the type of glaucoma covered in different studies had wide variations. This shows that standardization of data collection on glaucoma is urgently needed.

Comparisons between various studies as well as the present study are as per figure-3. The Glaucoma study done in Chattisgarh in Rajanandangaon district in 2001 in central India showed a glaucoma prevalence of 3.67% in the age group >35 years. There were a high number of suspects as the study did not include confirmatory tests.¹⁶ The Andhra Pradesh Eye Disease study (APEDS) had a combined glaucoma prevalence of 4.85%. POAG was 50%, PACG was 43% and ocular hypertension was 6.5% of all cases of glaucoma. The study showed POAG prevalence increased with age and PACG was more common in females and most

patients had chronic disease.¹⁷ The Oman eye study of 2005 showed a prevalence of glaucoma of 4.75%. POAG was 53%, PACG was 41% and ocular hypertension was 5% of all cases of glaucoma.¹⁸ The CMC Vellore glaucoma study had a glaucoma prevalence rate of 7.8%. PACG constituted 55% of all cases, Ocular hypertension was 39% and POAG was only 6% of all cases. Since all the patients were less than 40 years old and main emphasis was on a stringent gonioscopy examination, there were a high number of PACG and POAG was underrepresented. The Bangladesh glaucoma study done in 2004 found a total glaucoma prevalence of 3.1% with PACG being the largest group with 37% cases with female predominance, PAOG with 32% of all cases and ocular hypertension having 21% of share.²¹ The Japanese study in Tajimi²², USA studies in Latin Americans and Hispanics²² and Rotterdam study in Netherland all were evaluating only POAG in >40 year olds. The prevalence of POAG varied from 2-4% in these studies. The Andhra Pradesh eye disease study (APEDS) as well as glaucoma survey in Oman closely matched our study and glaucoma rates were comparable. However, the population in our study was a mix of urban and rural whereas the study population in APEDS as well as the study in Oman was primarily urban. Urban/Rural setups and socioeconomic conditions perhaps do not influence glaucoma.

Racial differences might be the main reason for the wide variations in the prevalence of glaucoma that we found when compared our results with the rate of studies conducted in different countries. (Fig 3) In Caucasian races, POAG accounts for 75-95% of the primary glaucomas, the disease presents later and is less severe at presentation. In the other races, the disease appears to occur earlier, is more advanced at presentation and results in blindness 7-8 times more often. We noted a POAG to PACG ratio of 59:41, a mean age of presentation for POAG 50.22 and for PACG as 45.33 in our study group. Only 2 out of 57 cases of POAG and 1 out of 39 cases of PACG presented after 80 years. It could be because of low life expectancy in Indians or due to the fact that glaucoma presents a decade earlier in Indians compared to Caucasians. A very small number of Normotensive glaucoma (NTG), 5 out of 106(4.7%) and pseudo exfoliation glaucoma, 4 out of 106(3.7%) were noted in this study. The gender dominance for POAG is variable. We found a Male predominance (male to female ratio of 1.38:1) in POAG whereas in PACG there was a slight female predominance (female to male ratio of 1.12:1). All the post traumatic glaucomas were in males in active age group (<40 years). Asymmetric glaucoma has been reported in 10% of POAG patients in Blue Mountains Eye study. We documented asymmetric glaucoma in 14.03% cases of POAG and 15.38% cases of PACG. In Wilmer eye clinic study (USA), advanced glaucoma at presentation was seen in 18.5% of Caucasian patients and 33.3% of black patients. We found advanced glaucoma in 19% of patients of POAG and 23.1% patients of PACG. 50% of patients of post traumatic glaucoma had advanced glaucoma with blindness in 14% of POAG and 12.9% of PACG patients. This study results were comparable to studies in India as well as abroad

with similar selection criteria, however there was a wide variations in types and prevalence of glaucomas based on ethnicity and race. However, all the studies showed a significant number of cases of glaucoma as well as advanced cases to warrant high priority to glaucoma screening in populations.

CONCLUSION

This study concludes that Glaucoma is a disease of enormous importance due to its significant numbers, ability to be picked up and treated at an early stage with proper screening, irreversibility of damage and high number of patients presenting with advanced damage due to silent nature of the disease. In summary, we have attempted to define the pattern of glaucoma is target population in Uttranchal area. The main drawback is the hospital and speciality clinic based data collection and analysis. Nevertheless, this study could provide useful background information for glaucoma screening and treatment planning in our target population.

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