A study of primary open angle glaucoma in Diabetic patients

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ABSTRACT

Introduction:

Primary open angle glaucoma is the commonest form of glaucoma accounting for atleast half of all the glaucomas. Intra Ocular Pressure is a definite and important risk factor for developing glaucomatous damage. Open-angle glaucoma is an optic neuropathy characterized by progressive retinal ganglion cell death and optic disc excavation. Diabetes affects not only vascular tissues but also compromises neuronal and glial functions and metabolism in the retina, which ultimately gives rise to apoptotic death of retinal neurons including retinal ganglion cell.

Aims and Objectives:

To study the prevalence of Primary Open Angle Glaucoma among the diabetic patients.

Materials & Methods:

A prospective study was performed on 100 diabetic patients, both insulin dependent and non insulin dependent, above 40 years of age, attending Ophthalmology OPD of Pratima Institute of Medical Sciences, Karimnagar to know the incidence of primary open angle glaucoma amongst them.

Results: The study population consists of 68 (68.0%) males and 32 (32.0%) females in the age range from 40-73 years with mean age of 53.1±8.28 years. The mean Intra Ocular Pressure values of Normal Tension Glaucoma were 14.60 ± 0.65 ranging from 14.6 to 14.7. The mean IOP values of Primary Open Angle Glaucoma were 28.12 ± 3.99 ranging from 23.1 to 31.8. The mean Intra Ocular Pressure values of Ocular Hypertension were 27.2.

Conclusion: Primary Open Angle glaucoma is typically asymptomatic until significant visual field loss has occurred. Patients usually present with significant visual field loss in one eye and advanced disease in the other. It is associated with irreversible blindness. The public health importance of detecting undiagnosed and treatable glaucoma is important, as blindness has economic and social consequences for the rest of an individual's life.

Keywords: Diabetes, Primary Open Angle Glaucoma, Gonioscopy

INTRODUCTION

The suggestion of an association between diabetes and Primary Open Angle Glaucoma (POAG) is not new. Glaucoma is more prevalent in diabetic than in non-diabetic population". The prevalence of diabetes in POAG was 1.7%. Many studies have shown a higher prevalence of elevated mean Intra Ocular Pressure (IOP) and POAG among persons with diabetes compared to those without, and a higher prevalence of individuals with abnormal glucose metabolism among glaucoma patients than among the general population. It is tempting to accept diabetes as a definite risk factor for chronic open angle glaucoma, since diabetes affects the small blood vessels supplying the optic nerve, thereby rendering it more susceptible to glaucomatous damage. However, a number of studies including population-based investigations have not found an association between diabetes and open angle glaucoma.

MATERIALS AND METHODS

100 diabetic patients above 40 years of age attending ophthalmology OPD, PIMS, were selected randomly and were screened for Primary Open Angle Glaucoma. Patients were enrolled for study after obtaining an informed consent. They were briefly explained about the study and the tests they would have to undergo. These patients were subjected to detailed eye examination in the Department of Ophthalmology, PIMS, Karimnagar.

First, the clinical history, including ophthalmic history, family history of glaucoma, duration of diabetes, treatment for diabetic retinopathy if any was recorded. Visual acuity was recorded using Snellen's vision chart. Best corrected visual acuity for distant and near vision was recorded.

Slit lamp biomicroscopy was performed to identify abnormalities of anterior segment. Examination of the conjunctiva whether it is normal or congested. Cornea was examined to see for clarity of cornea. Anterior chamber was examined for depth or any abnormal contents. Peripheral anterior chamber depth was graded using VanHericks method. This was followed by iris examination to see for normal pattern. Iris neovascularization or sectoral iris atrophic patches were excluded from study. Pupil was examined regarding size, shape

and reaction to direct and indirect light. Lens was examined to see for cataractous changes or any other pathology. Patients with significant media opacities (corneal opacities, mature cataract) were not included in the present study because of difficulty in fundus examination and visual field testing.

Slit lamp examination was followed by intraocular pressure measurement using Goldmann applanation tonometry. Gonioscopy was performed on all subjects with a Sussman 4 mirror lens in dim ambient illumination with a shortened slit that does not fall on the pupil. Dynamic examination was performed after the static gonioscopy of four quadrants was completed. The angle was graded using the Scheie's system, and the peripheral iris contour, degree of trabecular meshwork pigmentation, peripheral anterior synechiae, and other angle abnormalities were recorded.Visual field testing was done using Humphrey Automated perimeter. Pupil was dilated using 1% tropicamide plus 2.5% phenylephrine. Stereoscopic evaluation of the optic nerve head was performed using a +78 diopter (D) lens or +90D lens.

Patients with significant disc cupping (and other signs of glaucomatous disc changes), with field defects, with high IOP were diagnosed to have POAG in the present study. Although Normal Tension Glaucoma is a variant of POAG, it is not included under POAG in the present study because of varied mechanism. Criteria for diagnosis of ocular hypertension are pressure greater than 21 mmHg, with no disc changes, and in the absence of field defect.

RESULTS

100 diabetic patients were included in the study, of which 32 (32.0%) were females and 68 (68.0%) were males. All the subjects were studied in terms of age, IOP, duration of diabetics and blood glucose level. The observations were made in both eyes of all the subjects.

Table 1: Age and sex distribution of diabetics in the study group

Age group	Sex		Total
	Female	Male	
40-49	10 (33.3)	20 (66.7)	30
50-59	15 (31.9)	32 (68.1)	47
60-69	5 (25.0)	15(75.0)	20
>=70	2 (66.7)	1 (33.3)	03
Total	32	68	100
Statistic	**DF**	**Value**	**Prob**
Chi-Square	3	2.1319	0.5455

The study population consists of 68 (68.0%) males and 32 (32.0%) females in the age range from 40-73 years with mean age of 53.1±8.28 years. The total number of diabetic patients observed in 40 to 49 years is 30 (30.0%), 50 to 59 years 47 (47.0%), 60-69 years 20 (20.0%) and >70 years 3 (3.0%). The majority of the diabetics are above 50 years age. (Table 1)

The age specific diabetics in males was 66.7% (20 out of 30) in the age group of 40 to 49 years followed by 68.1% (15 out of 47) in the age group 50 to 59 years, 25.0% (5 out of 20) in 60-69 years and 66.7% (2 out of 3) in >70 years. The age specific diabetics in females was 33.3% (10 out of 30) in the age group of 40 to 49 years followed by 31.9% (32 out of 47) in the age group of 50 to 59 years, 75.0% (15 out of 20) in 60-69 years and 33.3%(1 out of 3) in >70 years. The table shows the majority of diabetic patients in the study are above 50 years (70%). The difference observed was statistically significant (p>0.05). Age and sex distribution was similar in the study.

Table 2: Sex-wise distribution of patients with POAG

Sex	Total No. of patients	Diagnosed			
		POAG	NTG	OH	Normal
Males	68	3 (4.4)	2 (2.9)	0	63 (92.7)
Females	32	1 (3.1)	0	1 (3.1)	30 (93.8)
Total	100	4 (4.00)	2 (2.0)	1 (1.0)	93 (93.0)
Percentage		Statistic	DF	Value	Prob
		Chi-Square	3	3.16	0.3677

This table shows the proportion of POAG cases diagnosed among diabetic patients in the study population. Overall proportion of POAG cases observed was 4.0% (4 out 100), normal tension glaucoma observed 2.0% (2 out of 100) and 1.0% ocular hypertension cases were observed remaining 93% were normal. Among the males 4.41% (3 out of 68) and females 3.12% (1 out 32) POAG cases were diagnosed. The proportion of POAG cases diagnosed between males and females was not statistically significant (p>0.05). (Table 2)

Table 3: Age-wise distribution of POAG among the diabetic population studied

Age Group	Male	Female	Total
50-59	2	1	3
60-69	1	-	3
Total	3	1	4

Table 4: IOP values of right and left eye among patients with POAG

Age	Sex	IOP (mmHg)	
		RE	LE
55	Male	31.8	25.1
50	Female	23.8	22.4
52	Male	25.1	22.4
61	Male	23.1	25.1

Patients with high IOP with significant glaucomatous disc changes, field defects and open angle on gonioscopy were diagnosed to have POAG. Those patients with IOP = 21 mmHg with glaucomatous disc damage, visual field loss and open angle on gonioscopy were diagnosed to have normal tension glaucoma. Those patients with IOP > 21 mmHg with no disc changes and no visual field defects were diagnosed to have ocular hypertension.

The above tables show the mean IOP values of study population according to diagnosis. The Mean Right eye IOP values of Normal were 16.46 ± 2.43 ranging from 12.60 to 22.4. The mean IOP values of NTG were 14.60 ± 0.65 ranging from 14.6 to 14.7. The mean IOP values of POAG were 28.12 ± 3.99 ranging from 23.1 to 31.8. The mean IOP values of ocular hypertension were 27.2. The difference observed in mean IOP values among the group was statistically significant ($p<0.05$). (Table 4 and 5)

Table 5: Comparison of mean intraocular pressure among normal patients and those diagnosed

	POAG	NTG	OH	Normal	F Value	P Value
Right Eye	28.12± 3.99	14.6± 65	27.2	16.46± 2.43	19.76	<0.0001
Left Eye	23.75± 1.56	16.9± 0.57	25.1	17.79± 2.55	10.73	<0.001

The Mean Left eye IOP values of Normal were 17.79±2.55 ranging from 12.60 to 24.4. The mean IOP values of NTG were 16.9±0.57 ranging from 16.5 to 17.3. The mean IOP values of POAG were 23.75±1.56 ranging from 22.4 to 25.1. The mean IOP values of ocular hypertension were 25.1. The difference observed in mean IOP values among the group was statistically significant ($p<0.05$). The further analysis of comparison of mean IOP between the groups (initial diagnosis) revealed that the normal tension glaucoma patients had statistically significant lower IOP than POAG and ocular hypertension patients ($p<0.05$) but no significant difference is seen between normal tension glaucoma and Normal ($p>0.05$). The POAG patients had statistically significant higher IOP than Normal.

Table 6: Distribution of POAG cases according to duration of DM

Duration DM	No. of Patients	POAF	Percentage
<5 Yrs	50	01	2
5-10 Yrs	46	03	6.52
> 10 Yrs	04	--	-
Total	100	04	4.00

The above table shows the duration of diabetes among POAG patients. It was observed that 75% (3 out 4) diagnosed with POAG were suffering from diabetes between 5 to 10 years and 25% (1 out 4) diagnosed with POAG were suffering from diabetes for < 5 years. (Table 6)

In the present study, the Age-wise distribution of POAG among the diabetic population reported 3.0% are between 50-59 years and 1.0%, are between 60-69 years. This can be due to majority of diabetic patients in the study are between 50 - 59 years (47%). The other possible reason is the low rate of visual field performance. Since a visual field defect was essential for diagnosis, those who did not perform visual fields would not be classified as glaucoma.

DISCUSSION

The association between Diabetes and POAG is not new. In 1971 Becker[1] stated "Diabetes Mellitus occurs more often in patients with Primary Open Angle Glaucoma than in non-glaucomatous populations. Similarly, Glaucoma is more prevalent in diabetic than in non-diabetic population".

Considerable controversy exists in literature. While several studies show an association between the two diseases, several others fail to show any significant association. Most of these studies were comparatively small, used differing definitions of glaucoma and were clinical, rather than community based.

The disparity in results of those denying a correlation between diabetes mellitus and POAG and those supporting it could be due to various reasons. One may be glaucoma case misclassification among subjects (as development of visual field loss in diabetics may mimic glaucoma) or different definitions and varying criteria for diagnosis. Another may be the variations in diagnostic criteria for diabetes such as self-reported cases, medication use and fasting / non-fasting / post-lunch blood glucose levels. Besides this, selection bias in cases could also be a factor.

Shital A. Patel et al.[2] in his study of profile of primary open angle glaucoma patients reported that there was no significant gender difference in prevalence of POAG.

Anhchuong Le et al.[3] in his study of risk factors associated with the incidence of open-angle glaucoma showed that development of OAG was not gender related. The Barbados Incidence Eye Study[4] had shown a higher incidence in men, whereas the Dalby Sweden Study[5] showed a higher incidence in women. Naila Ali et al. (2007) had reported that males are more prone to glaucomatous optic neuropathy, whether a gender difference exists in the prevalence of POAG has been controversial. Overall proportion of POAG cases observed was 4.0% (4 out 100).

Among the males 4.41% (3 out of 68) and females 3.12% (1 out 32) were diagnosed with POAG. The proportion of POAG cases diagnosed between males and females was not statistically significant (p>0.05). The present study is in agreement with study conducted by Shital A. Patel et al[2] and Anhchuong Le et al.[3]

Wise LA et al. in his prospective study of diabetes, lifestyle factors, and glaucoma among African- American women, a strong association of diabetes and glaucoma was observed Among African females. Khandekar R et al.[6] in Oman diabetic eye study reported that the prevalence of glaucoma was significantly higher among male diabetics compared to female diabetics.

Further studies are warranted to review the association of gender and POAG among diabetics. Many population-based studies of prevalence and incidence of POAG consistently show a steady increase with age[7]. Anhchuong Le et al.[3] in his study of risk factors associated with the incidence of open-angle glaucoma noted that there was a significant risk of OAG after 60 years of age and the risk increased with each subsequent decade of life. A similar age-related trend was shown in the Barbados Incidence Eye Study[4] and numerous prevalence studies but not in the Dalby Sweden Study.[5] Increased age may reflect the cumulative effects of some other factors that cause the aging optic nerve head to be more vulnerable to IOP, even of normal range[8]. In the present study, the total number of diabetic patients observed in 40 to 49 years is 30 (30.0%), 50 to 59 years 47 (47.0%), 60-69 years 20 (20.0%) and >70years is 3 (3.0%). The majority of diabetic patients in the study are above 50 years (70%).

The risk of POAG per decade in age was highest among Hispanics (2.3 times greater risk per decade in adjusted analyses), followed by White populations with a doubling of risk, South Asians (1.7 greater risk per decade), Black populations and South-East Asians (1.6 greater risk per decade), and lowest among East Asians (with approximately a 1.5 times greater risk per decade).[9]

The mean age of the POAG patients was 54.5 ± 4.80 ranging from 50 yrs to 61 yrs. The mean age of male POAG patients was 56.0 ± 4.58 ranging from 52 yrs to 61 yrs. The mean age of POAG female patients was 50.0 years. Torres-Martínez et al. in his study reported the mean age of diabetic patients with POAG was of 67.04 years. In Barbados *Incidence Study of Eye Diseases*[4] mean age was 56.9 years, in the Melbourne Visual *Impairment Project* mean age was 58.7 years and in the *Rotterdam Eye Study, mean age was 67.7 years.* In the present study mean age of diabetic patients with POAG is 54.5 years. IOP is best considered both a risk factor and a cause of glaucoma. Elevation of IOP is neither a component of the definition of POAG nor a clinical characteristic of it. IOP has been reclassified as a risk factor for the clinical process rather than a clinical feature of POAG.[10]

IOP is important confounder of the association between diabetes and glaucoma because persons with diabetes appear to have slightly higher IOP.[11]

There have been several hypotheses for the association between diabetes and elevated IOP. Diabetes-related autonomic dysfunction may contribute to increase in IOP. Glycation-induced corneal collagen cross-links in diabetes can cause corneal stiffening, which has also been shown to increase the level of measured IOP over the true IOP[6].

The impact of hyperglycemia on the cornea may play a role in the discrepancy in findings between diabetes with IOP and glaucoma. Persons with diabetes have been shown to have greater central corneal thickness which may artifactually increase IOP readings as measured by Goldmann applanation tonometry[12]. Beyond overestimation of IOP, increased corneal thickness has also been associated with a smaller and more robust optic nerve head, which may be less susceptible to developing glaucomatous optic nerve damage in response to increased IOP. Kayako Matsuyama et al. in his study reported the mean (±SEM) IOP was 14.0 ± 0.12 mmHg in the non-diabetic group and 15.5 ± 0.24 mmHg in the diabetic group. The IOP in the diabetic patients was significantly higher than that in the non-diabetic patients ($P < 0.0001$, Mann–Whitney test).

CONCLUSION

Primary Open Angle glaucoma is typically asymptomatic until significant visual field loss has occurred. Patients usually present with significant visual field loss in one eye and advanced disease in the other. It is associated with irreversible blindness. Thus, the public health importance of detecting undiagnosed and treatable glaucoma is important, as blindness has economic and social consequences for the rest of an individual's life. Also there is an increase in the incidence of diabetes mellitus in the general population. So it is important to establish the association between diabetes mellitus and primary open angle glaucoma, as it is an important public health issue.

From our study, we come to a conclusion that there is an excess of POAG in diabetic population, which is 4.0% (as compared to 2.1% in normal population), thereby showing an association between primary open angle glaucoma and diabetes.

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