■ *Original Article*

Association of diabetes mellitus and high myopia in primary open angle glaucoma

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Abstract

Background: Primary open angle glaucoma (POAG), a chronic, slowly progressive, optic neuropathy, is insidious in onset and painless, until it has caused a significant loss of vision and visual field. Diabetes mellitus and high myopia are the major risk factor of POAG. **Objectives:** To determine correlation of diabetes mellitus and high myopia in POAG and to estimate the duration of onset of POAG from the diagnosis of diabetes mellitus and high myopia. **Method:** This retrospective and cross sectional study was conducted in Prabhudesai eye clinic, Pune, India. All the patients diagnosed as POAG from 1st September 2008 to 1st March 2009 AD were included in this study. Association of high myopia with diabetes mellitus was determined by SPSS 13 software. The average duration of onset of POAG after the diagnosis of diabetes mellitus and high myopia was calculated. **Results:** There were 63.3% (38) male and 36.7% (22) female out of 60 patients of POAG with mean age 54.4±15.4 years. Among them, 27 (45.0%) patients had diabetes mellitus or high myopia. Onset of POAG was found to occur after 11.1±8.3 years of the diagnosis of diabetes and 10.6±3.2 years after the diagnosis of high myopia. **Conclusion:** The incidence of diabetes mellitus and high myopia was high and significantly associated in primary open angle glaucoma. POAG was detected soon after the onset of diabetes mellitus and high myopia.

Keywords: primary open angle glaucoma, diabetes mellitus, high myopia, intraocular pressure, visual field.

Introduction

Primary open angle glaucoma is a chronic, slowly progressive, optic neuropathy which is charactarised by elevated intraocular pressure, cupping of the optic nerve head and visual field.[1] The disease occurs primarily in patients over 50 years of age, but can develop in younger patients as well. In India, it is estimated that 1.6% to 4.0% of the people have POAG and it is one of the leading causes of blindness.[2]

Diabetes mellitus and high myopia have higher prevalence of primary open angle glaucoma than others. Similarly aging, hypertension, cigarette smoking and thyrotoxicosis are considered as other important risk factors for the onset of primary open angle glaucoma.[3]

In initial stage, the intraocular pressure may not be raised permanently, but shows exaggerated diurnal variation.[4] Due to constant pressure on the ciliary muscle and its nerve supply, reading and close work often present with increasing difficulties with mild headache and eye ache. Early glaucomatous changes include asymmetry of the cup, visible fenestrations, vertically oval large cupping, splinter hemorrhages, and pallor areas with atrophy of retinal nerve fiber layers. Advanced glaucomatous changes include thinning of neural retinal rim, bayonetting blood vessels with marked cupping and lamina cribrosa. Visual field defects corresponds to the changes at the optic nerve and gradually spreads centrally as well as peripherally. Eventually only a small island of central vision (tubular vision) and temporal islands are left.[5]

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Patients with glaucoma are more likely to have diabetes mellitus and patients with diabetes are more prone to have glaucoma.[6] Some authors believe that the small vessels involvement in diabetes mellitus makes the optic nerve susceptible to pressure related damage. Due to consequence of hyperglycemia, of modified protein called as Glycoprotein is formed. Abnormal glycoprotein deposition in iris in diabetes affects pupil size and shape, and then alters aqueous drainage channels. Diabetic neuropathy involves the autonomic nervous system of iris. Pupillary responses are reduced and sluggish, dilates poorly, increasing intraocular pressure. In diabetes mellitus, there is usually narrowing of retinal arterioles (microangiopathy), deposition of fat, calcium and cholesterol, which hinders the circulation of blood and nutrition supply of retina. Vascular sclerosis affecting the arterial supply of the optic nerve near the disc produces the ischemic atrophy of optic nerve, without corresponding increase of supporting glial tissues. As a result, cavernous spaces are formed within the optic nerve.

The low ocular rigidity, characteristic of many myopic eyes results in artificially low intraocular pressure measurement. There will be the thinning of lamina cribrosa and sclera. The sclera is continuous with a sieve like network called as the lamina cribrosa through which the optic nerve exits the eye. The mean intraocular pressure increases after the age of 40 years, possibly due to reduced facility of aqueous outflow. So in myopic eyes, slight increment in intraocular pressure, can damage optic nerve head and tissues within it. The risk of developing visual field loss in myopic eyes is five times more in higher degree of myopia with increased intra ocular pressure. So there is an increased incidence of primary open angle glaucoma in myopic eyes.[7]

To the best of my knowledge, such kind of studies have not been done so far in this region to find out the association of diabetes mellitus and high myopia. This study will find out the association of diabetes mellitus and high myopia in primary open angle glaucoma. So, it is expected to be helpful in making the national programme of primary open angle glaucoma screening in patients with diabetes mellitus and high myopia.

Methods

It was retrospective and cross sectional done in Prabhudesai eye clinic, Pune, India. The total of 60 patients suffering from primary open angle glaucoma were enrolled in this study. A written consent was taken from each subject. All subjects underwent complete eye examinations including visual acuity testing, refractions, anterior segment slit lamp examination, Goldman Applanation tonometry, gonioscopy, disc evaluation with plus 90 D lens and retinal examination by using indirect ophthalmoscope.

In addition, patients with glaucoma underwent the reliable measurement of visual field examination with frequency doubling technology, FDT, an advance version of Humphrey visual field analyzer, from Allergens Humphrey, Sanleandro, CA, USA.Fixation loss was taken as <20%, false negative and false positive <25%, mean deviation and corrected pattern standard deviation within 95% normal limits. Glaucoma hemi field test result within normal limit performed using the central 24-2 or 30-2 program of the FDT perimetry.

Patient's history of diabetes mellitus and high myopia was recorded in the case sheet with the help of documentation of blood sugar level and prescription of high minus number. An emphasis had been given for the time of onset of diabetes mellitus and high myopia until the detection of POAG.

All the patients with primary open angle glaucoma at clinical visit were included in this study. However; patients with any other systemic diseases or other active ocular diseases were excluded. In order to estimate the duration between first diagnosis of diabetes mellitus, high myopia and first diagnosis of primary open angle glaucoma, the average duration of history of both were calculated. All the other statistical analysis was done by using SPSS software.

Results

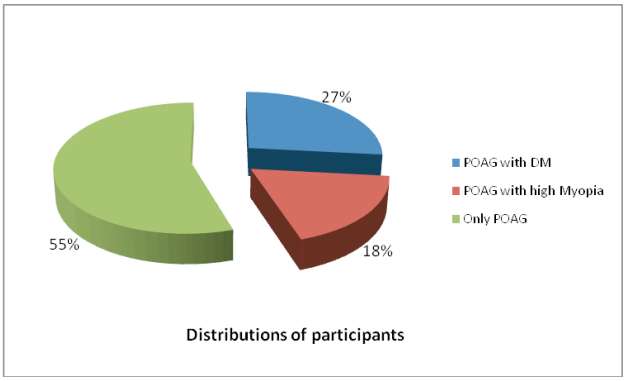
Among 60 patients of primary open angle glaucoma, 41 (68.33%) patients were male and 19 (31.67) were female. The mean age of the study sample was 54.38±15.36 years ranging from 22 to 85. The maximum number of patients was in the age group 42-60 year followed by in 61-80 year group. There was no significant difference in age and gender (p = 0.119) (Table1).

Table 1: Age and sex distribution

Gender	21-40	41-60	61-80	80-100	Total
Male	10	12	14	2	38
Female	2	13	7	0	22
Total	12	25	21	2	60

The total number of diabetes mellitus patients was 16 (26.67%) and high myopic patients was 11(18.33%). Out of the total diabetes mellitus patients, 10(62.50%) were male and 6(37.50%) were female. Among 11 high myopic patients, 9(81.82%) were male and 2 (18.18%) were females (Figure 1).

Figure 1: Distribution of the participants.



One patient was diagnosed as primary open angle glaucoma after the diabetic history of just 1 year and 2 patients after the duration of 25 years. The mean duration of onset of POAG was of 11.06±8.33 years after diabetes problem (Figure 2 and 3). Almost all of the patients (15 out of 16 ie 93.75%) were diagnosed as glaucoma after 40 year of age. Similarly the duration between prescriptions of high myopic numbered lenses (>-5.00D) and onset of primary open angle glaucoma showed a smaller variation with mean duration 10.55±3.17. One patient was diagnosed as primary open angle glaucoma after the duration of 5 years and another one patient after the duration of 15 years. Majority of the patient, 5 out of 11(45.45%) were diagnosed as glaucoma in their ages in years ranging from 21-40 years.

Figure 2: Duration of onset of POAG after diabetes mellitus.

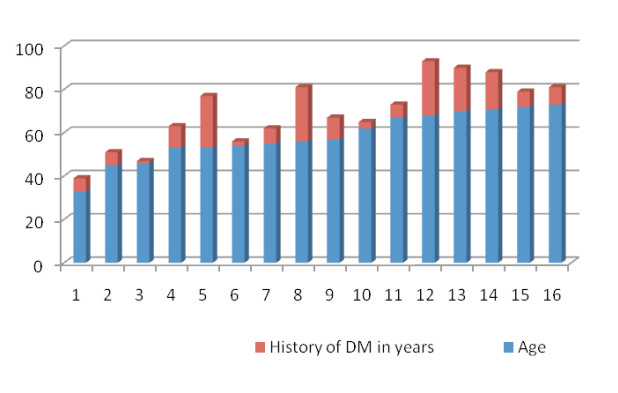
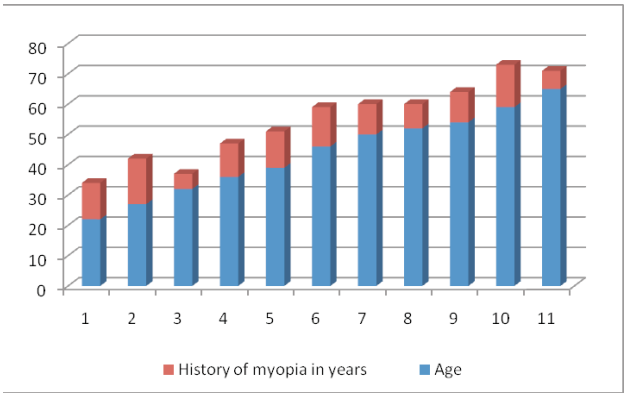


Figure 3: Duration of onset of POAG after high myopia.



The Pearson correlation between diabetes and high myopia in primary open angle glaucoma was found -0.286 with p-value = 0.027. Diabetes and the high myopia were not significantly associated with the gender of the patients (Pearson Chi-Square test, p = 0.957). High myopia was significantly associated with age (two tailed t-test, $p<0.05$) but diabetes mellitus was not significantly associated with age of primary open angle glaucoma patients (two tailed t-test, p=0.221).

Discussion

This study was of a new kind to estimate the duration between the diagnosis of diabetes mellitus, high myopia and the detection of primary open angle glaucoma. Out of the total 60 patients, 26.7% (16) had diabetes mellitus and 18.3% (11) had high myopia. This shows that diabetes mellitus and high myopia are the important risk factors for primary open angle glaucoma. In the diabetic patients, the age at which they developed primary open angle glaucoma was ranging from sixth to seventh and half decades in majority (7) of the patients. The remaining 6 developed primary open angle glaucoma in the range of fifth to sixth decades of life. Only a few patients (2) developed glaucoma at the years of fourth to fifth decades. There was only one patient who developed the primary open angle glaucoma earlier than fourth decades of life. The duration between diagnosis of diabetes mellitus and primary open angle glaucoma seemed a great variation in between the patients. So, it might be difficult to estimate the actual years after which patient can develop glaucoma once diabetes mellitus is detected. Our study demonstrated a significant co-relation between detection of diabetes mellitus and onset of primary open angle glaucoma (Pearson's R= 0.294).

This study correlates well with the study of Bonovas et al[6] who concluded that the association of diabetes mellitus with primary open angle glaucoma was statistically significant. However, Rotterdam study by Vooged et al[8] showed that there is not co-relation between diabetes mellitus and primary open angle glaucoma. Similarly, the study of Ellis et al[9] failed to confirm an association between diabetes mellitus and primary open angle glaucoma.

Among the high myopic patients, the ages on which they developed primary open angle glaucoma were ranging from second decade to middle of sixth decades. The duration between prescription of high power concave lenses and detection of primary open angle glaucoma, there seemed a small variation in between the patients with the standard deviation of 3.2 years and standard error of 1.0 year. The average duration (mean) in years from first prescription of high myopic correction to the onset of primary open angle glaucoma was 10.5 with median and mode value were 11 and 10 years. The shortest and longest duration after which they developed primary open angle glaucoma after prescription of high power concave lenses were 5 and 15 years respectively. Our study matched well with Tajimi study by Suzuki et al[10] which highlighted the high myopia as a risk factor for the onset of primary open angle glaucoma. Similarly the comparative study of risk factors and visual field changes between juvenile onset and late onset primary open angle glaucoma by Ko et al[11] demonstrated that axial high myopia might play a critical role in the pathogenesis juvenile onset primary open angle glaucoma. The prevalence of high myopia in POAG in the study done by Mayama et al[12] showed as 17.2%.

It reveals that there might be higher incidence of diabetes mellitus and high myopia in patients with primary open angle glaucoma. Nielsen NV[13] of Denmark showed that prevalence of primary open angle glaucoma in diabetes mellitus patients showed overall 6%. Similarly the study of Klein et al[14] revealed 4.2% of primary open angle glaucoma in diabetes mellitus patients.

All the participants of this study were Indians. The incidence of diabetes mellitus in our study is quite higher than those found in general Indian population. According to Gupta et al[15] the prevalence of diabetes mellitus was 5.99%. Another study[16] showed that the incidence varies from 2.4% in rural to 11.6% in city areas.

Considering the high myopia, we had 11(18.33%) patients out of 60 which is again much more with compared to general population. Most of the Indian study on incidence of high myopia in general population shows that it is 2 to 3% among the people. According to Rani et al[17] epidemiology of high myopia accounts for 1.6% of the general population of India.

Thus our study showed clear association between diabetes mellitus and high myopia to the onset of primary open angle glaucoma. Both the risk factors which when occurred singly can give rise to primary open angle glaucoma after some duration of time ranging from few months to some years. So such factors should never be neglected in patients.

Conclusion

Diabetes mellitus and high myopia are the major risk factors of primary open angle glaucoma. POAG may occur on the first decade after the onset of diabetes and high myopia. Moreover, diabetes mellitus and high myopia are significantly correlated with each other in POAG. Hence patients with diabetes mellitus and high myopia should undergo glaucoma evaluation for early diagnosis of POAG and further management.

References

1. Mutlukan E. Diffuse and localised visual field defects to automated perimetry in primary open angle glaucoma. Eye(Lond).1995; 9:745-750.
2. Garudadri C., Senthil S., Khanna R.C., Sannapaneni K., Rao H.B. Prevalence and risk factors for primary glaucomas in adult urban and rural populations in the Andhra Pradesh Eye Disease Study. Ophthalmology. 2010;117:1352-1359.
3. Sia D.I., Edussuriya K., Sennanayake S., Senaratne T., Selva D., Casson R.J. (2010). Prevalence of and risk factors for primary open-angle glaucoma in central Sri Lanka: the Kandy eye study. Ophthalmic Epidemiol. 2010;17:211-216.
4. Costa V.P., Jimenez-Roman J., Carrasco F.G., Lupinacci A., Harris A. Twenty-four-hour ocular perfusion pressure in primary open-angle glaucoma. Br J Ophthalmol. 2010;94:1291-1294.
5. Shaikh A.W., Bartlett J.D., Semes L.P., Recupero S.M. (2003). Possible mechanisms responsible for elevated IOP in POAG patients. J Glaucoma. 2003;12:445-449.

6. Bonovas S., Peponis V., Filioussi K. Diabetes mellitus as a risk factor for primary open-angle glaucoma: a meta-analysis. Diabet Med. 2004;21:609-614.
7. Makashova N.V., Eliseeva E.G. Relationship of changes in visual functions and optic disk in patients with glaucoma concurrent with myopia. Vestn Oftalmol. 2007;123:9-12.
8. Vooged S., Ikram M.K., Wolfs R.C., Jansonius N.M., Witteman J.C., Hofman A. et al. (2006). Is Diabetes Mellitus a Risk Factor for Open-Angle Glaucoma? Ophthalmology. 2006;113:1827-1831.
9. Ellis J.D., Evans J.M., Ruta D.A., Bainesa P.S., Leese G., MacDonald T.M. et al. Glaucoma incidence in an unselected cohort of diabetic patient: is diabetes mellitus a risk factor? Br J Ophthalmol. 2000;84:1218-1224.
10. Suzuki Y., Iwase A., Ariae M., Yamamoto T., Abe H., Shirato S. Risk factors for Open-Angle Glaucoma in Japanese Population. Ophthalmology. 2006;113:1613-1617.
11. Ko Y.C., Liu C.J., Chou J.C., Chen M.R., Hsu W.M., Liu J.H. Comparisons of risk factors and visual field changes between juvenile-onset and late-onset primary open-angle glaucoma. Ophthalmologica. 2002;216:27-32.
12. Mayama C., Suziki Y., Makoto A., Ishida K., Akira T., Yamamoto T., et al. Myopia and Advanced–stage Open angle Glaucoma. Ophthalmology. 2002;109:2072-2077.
13. Nielsen N.V. The prevalence of glaucoma and ocular hypertension type 1 and 2 diabetes mellitus. Acta Ophthalmol. 1983;61:662-72.
14. Klein B.E., Klein R., Jensen S.C. Open-angle glaucoma and older-onset diabetes. The Beaver Dam Eye Study. Ophthalmology. 1994;101:1173-1177.
15. Gupta S.K., Singh Z., Purty A.J., Kar M., Vedapriya D., Mahajan P. et al. Diabetes prevalence and it's risk factors in rural area of Tamil Nadu. Indian J Community Med. 2010;35:396-399.
16. Ramchandran A. Epidemiology of type 2 diabetes in Indians. J Indian Med Assoc. 2002;100:425-427.
17. Rani P.K., Raman R., Rachapalli S.R., Kulothungan V., Kumaramanickavel G., Sharma T. Prevalence of refractive errors and associated risk factors in subjects with type 2 diabetes mellitus SN-DREAMS, report 18. Ophthalmology. 2010;117:1155-1162.