Original Research Article

To see relationship between the axial length and diurnal variation curve in primary open angle glaucoma and normal individuals

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Abstract

Background & Method: This study includes 40 cases of POAG patients (Group A) and 40 age matched healthy volunteers (Group B) of age group 40-60 yrs attending O.P.D. or admitted in Ophthalmology Department , G.R. Medical College, Gwalior during the period February 2015 to August 2016. **Result:** The mean IOP is always greater in POAG subjects as compared to normal subjects. The greater value of IOP fluctuation and peak IOP recorded among POAG subjects. The diurnal variation of IOP was significant in males with p value 0.0028, but no correlation of diurnal variation of IOP with increasing age. Females are more prone for development of POAG as compared to males.IOP values were higher among POAG group in >25 mm axial length group as compared to 22-25 mm axial length group, but IOP fluctuation was significant among 22-25mm axial length group. As the degree of refractive error increases among the subjects the mean IOP also increases in the same order. **Conclusion:** Fluctuation in IOP is always seen among POAG and normal subjects. Fluctuation in IOP correlates with IOP level i.e. greater the IOP value, greater the fluctuation in diurnal curve. Increasing age and female gender is a risk factor for POAG. Subjects with longer Axial length and high Myopia is a risk factor for POAG.

Keywords: axial length, glaucoma, diurnal variation, IOP Fluctuation.

Introduction

Glaucoma is described as a chronic progressive optic neuropathy that is recognized by the appearance of characteristic cupping of the optic disc associated with corresponding visual field deficit[1]. The condition has as its basis gradual loss of retinal ganglion cells and their axons, and as a major risk factor intraocular pressure (IOP)[2].

Intraocular pressure (IOP) is easily measurable and identified modifiable risk factor for the prevention of progressive glaucomatous field defects[3].On the basis of the available data, it is estimated that in India there are approximately 11.9 million persons affected with glaucoma who are 40yrs and older[4]. Primary open angle glaucoma if left unchecked may cause irreversible blindness.

Glaucoma is classified as primary if the cause of elevated IOP is unknown and secondary where a cause is known. Conventionally the term primary open-angle glaucoma (POAG) is applied to eyes with primary chronic glaucoma with open anterior chamber drainage angles and elevated IOP[4]. There are multiple mechanisms proposed for damage of optic nerve, amongst which raised IOP is the most important factor.

It has been postulated that elevated IOP exerts mechanical stress on the optic nerve head (ONH) and lamina cribrosa, and its adjacent tissues[5]. In addition, IOP-induced strain may also compress the lamina cribrosa and disrupt axonal transport of trophic factors which are essential to the autoregulation and survival of retinal ganglion cells[6].

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As lamina cribrosa is the site where retinal ganglion cell axons congregate before traversing to the brain, excessive mechanical strain at this structure may initiate glaucomatous damage[7].

Axial length is a basic common factor in determination of intra ocular pressure in primary open angle glaucoma. Higher C/D ratio and greater axial length may lead to higher prevalence of open angle glaucoma and normal tension glaucoma amongst myopes[8]. Numerous clinical based studies shows an association between myopia and POAG. Population based studies in different ethnic groups found rates of open angle glaucoma 2-4 times higher for myopes. Longer axial lengths were also associated with higher prevalence of POAG.

Material & Method

This study includes 40 cases of POAG patients (Group A) and 40 age matched healthy volunteers (Group B) of age group 40-60 yrs attending O.P.D. or admitted in Ophthalmology Department , G.R. Medical College, Gwalior during the period February 2015 to August 2016.

Selection Criteria

- Newly diagnosed cases of primary open angle glaucoma in different age group and sex with intraocular pressure of > 21 mmHg.
- Normal individual willing to sign complete informed consent and able to comply with the requirement of the study.

Exclusion criteria

- Refusal to participate in the study or inability to follow the protocol.
- IOP greater than 40 mmHg.
- Any anterior or posterior segment pathology except glaucoma that could interfere with the applanation tonometry and biometric A

scan (e.g. corneal scarring or keratoconus) or in the perimetric examination (e.g. advanced macular degeneration).

- Any history of ocular inflammation,herpes or trauma in the past 3 months.
- Any history of laser therapy or glaucoma surgery.
- Patients with primary angle closure or secondary glaucoma.
- Patients on medication for open angle glaucoma

Results

Table 1: Comparative Table of Diurnal Variation Curve Among POAG Male and POAG Female

Time (in hrs)	Male (IOP in mmHg)		Female (IOP in mmHg)	
	Right Eye	Left Eye	Right Eye	Left Eye
09:00	26.71±1.05	26.00±0.94	27.89±1.42	27.37±1.08
11:30	25.71±1.06	25.24±0.95	27.43±1.47	26.31±1.27
14:00	24.00±0.85	23.81±0.80	26.21±1.30	24.95±1.38
16:30	23.00±1.17	23.33±0.91	24.32±1.30	24.41±1.60
19:00	22.42±1.00	22.57±1.21	23.89±1.36	23.16±1.25

Table No. 01 suggests fluctuation in IOP among right eye male and right eye female at 09:00 hrs v/s 19:00 hrs was found to be significant with p value of <0.0001and r>0.5. similarly fluctuation in IOP among left eye male and left eye female at 09:00 hrs v/s 19:00 hrs was found to be significant with p value of <0.0001 and r>0.5.

Table 2: Comparative table of Diurnal Variation Curve Among Normal Male and Female

Time (in hrs)	Male (IOP in mmHg)		Female (IOP in mmHg)	
	Right Eye	Left Eye	Right Eye	Left Eye
09:00	13.60±0.78	13.76±0.85	13.33±0.99	12.80±1.00
11:30	12.96±0.78	13.04±0.91	13.33±0.91	13.20±0.56
14:00	12.80±0.68	12.72±0.84	12.80±0.56	12.80±0.56
16:30	12.48±0.57	12.64±0.84	12.27±0.75	12.40±0.78
19:00	12.24±0.69	12.08±0.80	12.13±0.90	12.13±0.89

Table No. 02 suggests the fluctuation in IOP at 09:00 v/s 19:00 in both eyes males was found to be significant with p value of <0.0001. The fluctuation in IOP among right eye female at 09:00 v/s 19:00 was found to be significant with p value of <0.0024. The fluctuation in IOP among left eye female at 09:00 v/s 19:00 was found to be not significant with p value of not <0.0724. In above table fluctuation in IOP among right eye male at 09:00 v/s right eye female at 9:00 was found not significant with p value of 0.3483. The fluctuation in IOP among left eye male at 09:00 v/s left eye female at 9:00 was found to be significant with p value of 0.0028, and, more in males.

Table 3: Comparative Table of Diurnal Variation Curve Among POAG Male And Female V/S Comparative Table of Diurnal Variation Curve Among Normal Male and Female

Gender	Eye	Time (Hrs)	POAG/normal (IOP in mmHg)	Significance
Male	Right eye	09:00	26.71±1.05/ 13.60±0.78	P<0.0001
		19:00	22.42±1.00/12.24±0.69	P<0.0001
	Left eye	09:00	26.00±0.94/13.76±0.85	P<0.0001
		19:00	22.57±1.21/12.08±0.80	P<0.0001
Female	Right eye	09:00	27.89±1.42/13.33±0.99	P<0.0001
		19:00	23.89±1.36/12.13±0.90	P<0.0001
	Left eye	09:00	27.37±1.08/12.80±1.00	P<0.0001
		19:00	23.16±1.25/12.13±0.89	P<0.0001

Table no. 3 shows the comparison of diurnal variation between POAGs and normal subjects in which, the recorded mean IOP is always greater in POAG subjects as compared to normal ,with p value <0.0001 and r>0.5 , when recorded at 09:00 AND 19:00.

Discussion

The present study shows that, diurnal fluctuation in IOP is seen among both male and female subjects and maximum recorded IOP is seen in early morning hour at 09:00. When we compared between the eyes of male and female subjects, females had higher IOP values and more prone for POAG.

Similar results were obtained by Robert David, Linda Zangwill[9] where Overall 41% of peaks were found on the first, earliest IOP measurement, in the morning. The mean IOP was found to be highest in the morning hours (7.45 am until 9.00 am) with a steady decline throughout the day. These differences were found to be statistically significant (p<0.001).

Similar results were obtained by Saccà SC, Rolando M[10] in which IOP was evaluated every 2 hour from 8 a.m. to 8 p.m. In one randomized eye of 33 normal subjects, 95 POAG and 50 NTG patients The results show that the highest IOP values were detected in the morning in all three groups

Sihota R, Saxena R[11] obtained similar results that diurnal IOP fluctuations were significantly higher in POAG (8.31+2.58 mmHg) groups compared to normal controls (4.83 + 2.46 mmHg). At 7 and 10 a.m., IOP peaked more often in POAG eyes compared to control eyes. A plateau type of circadian rhythm was most common in normal eyes. The timing of peak IOP could be significantly correlated with the type of primary glaucoma examined. Morning peaks were more frequent in POAG eyes. Diurnal fluctuation > 6 mmHg, associated with an IOP of 21 mmHg or more was never seen in a normal eye.

Similar results were obtained by Prof. ManSin[12] Here IOP was evaluated for every 2 hour from 8 a.m. to 8 p.m. Result showed that highest IOP values were detected in the morning in all three groups. These variations were most evident in POAG patients. The daily IOP fluctuation was directly proportional to the IOP level.

LR Pasquale and JH Kang[13] found that there is emerging evidence that estrogen metabolism has an important role in the pathogenesis of

primary open-angle glaucoma (POAG). Among women ≥65 years, early age of menopause (≤45 years) was associated with an increased risk of POAG, whereas later age of onset of menopause (≥54 years) was associated with a decreased risk of POAG.

Hulsman CA et al.[14] in the Rotterdam group found that menopause before the age of 45 was associated with a 2.6-fold increased risk of POAG

Conclusion

Fluctuation in IOP is always seen among POAG and normal subjects. Fluctuation in IOP correlates with IOP level i.e. greater the IOP value, greater the fluctuation in diurnal curve. Increasing age and female gender is a risk factor for POAG. Subjects with longer Axial length and high Myopia is a risk factor for POAG.

References

1. Wilson MR, Martine JF. Epidemiology of chronic open-angle glaucoma.. The Glaucomas. 2nd ed. St. Louis: Mosby Yearbook Inc; 1996.
2. Weinreb RN, Khaw PT. Primary open-angle glaucoma. Lancet. 2004;363:1711-20.
3. Kwon YH, Fingert JH, Kuehn MH, Alward WLM. Primary open-angle glaucoma. N Engl J Med 2009 Mar 12; 360:1113-24.
4. Kroese M, Burton H, Vardy S, Rimmer T, McCarter D. Prevalence of primary open angle glaucoma in general ophthalmic practice in the United Kingdom. Br J Ophthalmol. 2002 Sep;86(9):978–980.
5. Burgoyne, C. F., Downs, J. C., Bellezza, A. J., Suh, J. K. & Hart, R. T. The optic nerve head as a biomechanical structure: a new paradigm for understanding the role of IOP-related stress and strain in the pathophysiology of glaucomatous optic nerve head damage. Prog Retin Eye Res 2005;24, 39–73.
6. Quigley, H. A. et al. Retrograde axonal transport of BDNF in retinal ganglion cells is blocked by acute IOP elevation in rats. Invest Ophthalmol Vis Sci 2000; 41, 3460–3466.
7. Downs, J. C. Optic nerve head biomechanics in aging and disease. Exp Eye Res 2015;133, 19–29 .
8. D A Leighton and A Tomlinson Ocular tension and axial length of the eyeball in open-angle glaucoma and low tension glaucoma Br J Ophthalmol 1973 57: 499-502.
9. Robert David, Linda Zangwill, Daniel Briscoe Diurnal intraocular pressure variations :an analysis of 690 diurnal curves, British J'ournal of Ophthalmology1992;76, 280-283.
10. Saccà SC1, Rolando M, Marletta A, Macrí A, Cerqueti P, Ciurlo G. Fluctuations of intraocular pressure during the day in open-angle glaucoma, normal-tension glaucoma and normal subjects. Ophthalmologica. 1998;212(2):115-9.
11. Sihota 1, Saxena R, Gogoi M, Sood A, Gulati V, Pandey RM. A comparison of the circadian rhythm of intraocular pressure in primary Chronic angle closure glaucoma, primary open angle glaucoma and normal eyes. Indian J Ophthalmol. 2005 Dec;53(4):243-7.
12. ManSin Wong, T-Helper1/T-Helper2 Cytokine Imbalance in the Iris of Patients with Glaucoma PLoS One. 2015; 10(3): e0122184.
13. L R Pasquale and J H Kang Female reproductive factors and primary open-angle glaucoma in the Nurses' Health Study Eye 2011;25, 633–641.
14. Hulsman CA et al. Am J Epidemiol. 2001;54(2):138-144.

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