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Original Research Article

A clinical study of primary open angle glaucoma (POAG) in myopia-An observational study

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ABSTRACT

Background: The Primary open-angle glaucoma is the most common type of glaucoma causing irreversible blindness. Myopia is one of the risk factor responsible for pathogenesis of glaucoma. The association between myopia and primary open angle glaucoma has been found in numerous case studies. The aim of the study to evaluate the relationship of myopia in primary open-angle glaucoma by classifying the eyes into low, moderate and high myopia.

Materials and Methods: This prospective study was performed on 1414 axial myopic patients more > 18 years. Clinical examination included, slit-lamp biomicriscopy, Goldman applanation tonometry, refraction, dilated optic disc assessment, central corneal thickness, visual field analysis and optical coherence tonography.

Results: Out of 1414 patients, 769(54.38%) were male and 645(45.62%) were female. Low myopia (<-3D) cases are 938(66.32%), moderate myopia (-3D to -D) 309(21.88%), high myopia (>-6D), 107(11.8%). Maximum number of cases were in younger age group (20-30 years). Intraoccular Pressure > 21mmHg in 143 cases of low myopia, 78 cases in moderate myopia, 72 cases in high myopia. There were 138 cases with glaucomatous field changes. Out of 138 cases 86(62.32%) were high myopia, 35(25.36%) were moderate myopia and 17(10.8%) cases were low myopia. The CUP-DISC ratio <0.5 in 75.95% cases, 0.5-<0.9 in 20.37% cases, >0.9 in 3.68% cases. The average values of circumpapilary Nerve Fiber Layer thickness in micrometer of low myopia, moderate myopia, high myopia, with non-glaucomatous cases were 98.9, 97.3, 93.5 and with glaucomatous cases, 74.4, 73.7 and 73.3 respectively. The average values of Ganglion Cell Complex thickness in micrometer in low, moderate and high myopia without glaucoma were 94.9, 93.5, 92.7 and with glaucoma 77.3, 74.6, 70.2 respectively.

Conclusion: This study shows there is strong relationship between myopia and primary open-angle glaucoma. Early detection of glaucoma in myopic patients is necessary in delaying blindness.

1. Background

Myopia or short-sightedness is a refractive condition of the eye that makes distant objects to be blurry while close object appears normal. Among different etiological types myopia, axial myopia is commonest, in which their occurs axial elongation of eyeball. Axial elongation affect the eye's intraocular structure (optic disc or macula), where glaucomatous damage can occur.

Glaucoma, a progressive optic neuropathy causes irreversible blindness.[1] It is characterized by the loss of retinal nerve fiber tissues, recognized clinically as visual field defect and loss of the neuro retinal rim of the optic nerve head. The primary open-angle glaucoma (POAG) is the most common type of glaucoma.

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Elevated intraocular pressure (IOP) is a measure risk factor for POAG.[2] Other risk factors like age, gender, race, refractive errors, heredity and systemic factors may play a role in glaucoma pathogenesis.[3] Most of the studies have suggested that moderate to high myopia is associated with increased risk of POAG.[4,5]

Mechanical theory explains the association between myopia and primary open-angle glaucoma (POAG), which describes that damage to optic nerve head at Lamina Cribosa leads to Retinal Ganglion Cell atrophy and glaucomatous optic neuropathy, induced by increased IOP and a tensile sclera or by exacerbated shearing forces due to longer axial eye length.

2. Materials and Methods

This is a prospective study, was conducted during the period of October 2018- September 2020 at Ophthalmology Department, S.C.B. Medical College, Cuttack, Odisha. Ethical Committee clearance was taken.

Subjects with axial myopia >=-1D identified by a standardized subjective refraction and categorized into low myopia (<=-1D to >-3D), moderate (>-3D<-6D) or high myopia (>-6D) according to Sihota's classification and taken for the study. Primary open-angle glaucoma diagnosed taking into account characteristic visual field loss combined with optic disc cupping and neuro retinal rim thinning with or without raised IOP.

2.1. Inclusion criteria

All the myopic patients (>=-1D) of age >18 years who had given consent for study.

2.2. Exclusion criteria

1. Known case of any form of secondary glaucoma.
2. Angle closer glaucoma.
3. Lenticular opacity.
4. Keratoconus.
5. History of trauma.
6. History of surgery.

A total of 1414 axial myopia patients included in this study. The examination included, medical history, best corrected of visual acuity, refraction by Auto refractometer and subjective refraction, Slit-lamp biomicroscopy, Goldmann applanation tonometry for Intra Ocular Pressure (IOP), Central Corneal Thickness (CCT) measurement by ultrasound Pachymeter, post dilation Optic Disc (OD) and retina evaluation with +90D fundus noncontact lens, visual field analysis by Humphrey Perimeter, Optical Coherence Tomography (OCT) for Optic Nerve Head (ONH), Ganglion Cell Complex (GCC) and circum papillary Retinal Nerve Fiber (cp RNFL) evaluation.

3. Results

The above table shows 769 (54.38%) patients were male and 645 (45.62%) were female. Maximum number of myopic patients were younger age group, between 20-30 years. 438 cases were low myopics, 127 cases were moderate myopics and 68 cases were high myopics. Less number of patients were more than 40 years.Table 1

According to Sihota myopia is classified as low (<-3D), medium (-3D to -6D) and high (>-6D). Low myopia cases were 938 (66.34%), Moderate myopia and high myopia patients were 309 (21.85%), 167 (11.81%) respectively. BCVA of patients varied from 6/6 to <6/60. It could improve up to >6/60 in all the low myopics, 98.7% (305) of the moderate myopics, 97.01% (162) of high myopics and rest with BCVA <=6/60.Table 2

Normal intraocular pressure is taken to be between 11mmHg and 21mmHg with mean IOP as 16+-2.5mmHg. measurement of IOP was done by Goldmann applanation tonometer. 143 cases with low myopia, 78 cases with moderate myopia and 72 cases of high myopia had IOP>21mmHg. 1074 (75.95%) patients had C/D ratio <0.5, 288 (20.37%) patients had 0.5-<0.9 and 52 (3.68%) patients had C/D ratio >0.9.Table 3

Mean CCT in 938 cases low myopic group was 536.6, 309 cases of moderate myopic group was 531 and 167 cases that of high myopic group was 540.9 micrometer.Table 4

1405 patients with BCVA >6/60 were advised for 24-2 visual field test done by Humphrey's perimeter. Out of these 138 patients had glaucomatous field changes and 48 patients had non-glaucomatous changes. 1219 patients had no perimetry changes. Out of 138 patients with perimetric glaucoma 86 (62.32%) cases were high myopics, 38 (25.36%) cases were moderate myopics and 17 (12.32%) cases were low myopics.Table 5

The patients were subjected for SD-OCT scan. The average cp RNFL thickness was 98.9 micrometer in low myopic non-glaucomatous patients, 74.4 micrometer in glaucomatous cases. 97.3 micrometer in moderate myopic non-glaucomatous patients, 73.7 micrometer in glaucomatous cases. 93.5 micrometer in high myopic non-glaucomatous patients, 73.3 micrometer in glaucomatous cases. The superior and inferior cpRNFL thickness in micrometer were found to be less in glaucomatous group than non glaucomatous group like average cp RNFL thickness.Table 6

The average GCC parameters in micrometer measured by SDOCT scan was 94.9 micrometer in low myopic non-glaucomatous patients, 77.3 micrometer in glaucomatous patients. 93.5 micrometer in moderate myopic non-glaucomatous patients, 74.6 micrometer in glaucomatous cases. 92.7 micrometer in high myopic non-glaucomatous patients, 70.2 micrometer in glaucomatous cases. The superior and inferior GCC parameter were found to be less in glaucomatous group than non glaucomatous group like

Table 1:

A. Sex prevalence of myopia			
Category	No. of patients	Percentage	
Male	769	54.38	
Female	645	45.62	
Total	1414	100	
B. Age group in years			
Age Group	Low myopia	Moderate	High myopia
<20	206	78	35
20-30	438	127	68
30-40	197	76	48
>40	97	28	16
Total	938	309	167

Table 2:

A. Degree Of Myopia				
Degree of myopia	Nunber	%		
Low (< -3D)	938	66.34		
Moderate (-3 to -6D)	309	21.85		
High (> -6D)	167	11.81		
Total	1414	100		
B. Classification of patients on the basis of BCVA				
Degree of myopia	BCVA >6/60	Percentage	BCVA <=6/60	Percentage
Low	938	100	0	
Moderate	305	98.7	4	1.3
High	162	97.01	5	2.99

Table 3:

A. IOP by Goldmann applanation tonometry in the patients				
Degree of myopia	Iop range <10mmHg	10-21mmHg	>21mmHg	Total
Low	233	562	143	938
Moderate	87	144	78	309
High	32	63	72	167
B. CUP-DISC ratio (C/D ratio)				
CUP-Disc Ratio	Number of myopes		%	
<0.5	1074		75.95	
0.5-<0.9	288		20.37	
>0.9	52		3.68	

Table 4:

CCT in micrometer in the patients			
Myopia groups	Number	Mean CCT	Range
0 to -3D	938	536.6	305-684
>-3 to -6D	309	531	417-613
>-6D	167	540.9	417-614

Table 5:

A. Perimetric changes			
No of patients done perimetry	Perimetry suggestive of glaucomatous changes	Perimetry suggestive of non-glaucomatous changes	Perimetry having no changes
1405	138	48	1219
B.Grading of POAG on the basis of perimetric findings (Hodapp- Parrish- Anderson criteria)			
No of POAG patients with perimetric glaucoma	No of patients with high myopia and perimetric glaucoma	No of patients with moderate myopia & perimetric glaucoma	No of patients with low myopia and perimetric glaucoma
138	86(62.32%)	35(25.36%)	17(12.32%)

Table 6:

cp RNFL parameters in different grades of myopia (with and without glaucoma)						
cp RNFL thickness (μm)	Low Myopia		Moderate Myopia		High NG Myopia	
	NG	G	NG	G		G
Average cpRNFL	98.9	74.4	97.3	73.7	93.5	73.3
Superior cpRNFL	99.5	76.5	96.8	75.6	92.9	74.3
Inferior cpRNFL	101.8	74.2	98.5	74.3	94.8	75.0

NG= no glaucoma
G= glaucoma

Table 7:

GCC parameters in different grades of myopia (with or without glaucoma)						
GCC parameters	Low myopia		Moderate myopia		High myopia	
(μm)	NG	G	NG	G	NG	G
Average GCC	94.9	77.3	93.5	74.6	92.7	70.2
Superior GCC	96.9	80.3	95.4	77.3	94.8	74.1
Inferior GCC	95.1	71.4	94.6	70.6	94.4	68.1

average GCC thickness.Table 7

3.1. Statistical analysis

The statistical analysis was formed using commercially available software (SPSS, version 15, SPSS Ink, Chicago, Illinois) including chi-square test.

4. Discussion

Out of 1414 patients in our study, 769(54.38%) were male and 645(45.62%) were female (Table 1A). Male to female ratio 1.19:1. Maximum number of myopic patients were in younger age group. (Table 1B). Holden et al suggest variability in gender difference is owing to environmental influences, such as inequitable access to education, participation in physical activity and closed work.[6] In many of the study it is reported that gender prevalence exhibits a particular pattern with a greater prevalence of myopia in girls starting to appear at around the age of 9 years, continuing through teenage years and early adulthood and diminishing to no or minimal gender difference around the age of 50 to 60 years. Out of 1414 patients there were 938(66.34%) low myopia (<-3D), 309(21.85%) moderate myopia (-3D to -6D) and 167(11.81%) of high myopia cases (>-6D) (Table 2A).

Optic nerve head of myopic eyes are more susceptible to glaucomatous damage due to some structural changes. Increasing degree of myopia is a risk factor for glaucoma. Blue Mountains Eye Study, they found a strong relationship between glaucoma and myopia after adjusting for age, sex and other risk factors (odds ratio 2.3 for eyes with low myopia, 3.3 for moderate to high myopia).[7] Myopic subjects had a two three-fold increase risk of glaucoma compared with that of non myopic subjects. The Singapore Malays Eye Study showed Persons with moderate or high myopia had almost 3 times higher risk of POAG compared with those emmetropia.[8]

143 cases with low myopia, 78 cases with moderate myopia and 72 cases of high myopia had IOP>21mmHg. Conversely 17(12.32%) patients of low with low myopia, 35(25.36%) patients with moderate myopia and 86(62.32%) with high myopia had perimetric glaucoma (Tables 3 and 5). There is increase in number patients with perimetric glaucoma as severity of myopia increases. Edgar and Rudnika found that low myopia was associated with doubling of the risk of glaucoma at any age and a three-fold increase with medium and high myopia compared to that emmetropia.[9]

In our study the number of patients with cup-disc ratio 0.5-<0.9 were 288 (20.37%), and C/D ratio>0.9 were 52 (3.68%) patients. Study of ocular hypertention and glaucoma patients[10] found that the incidence of visual field defects increased markedly with CDR greater than 0.7. The mean CCT in low myopic group was 536.6 micrometer, moderate myopic group was 531 micrometer and high myopic group was 540.9 micrometer (Table 4). CCT difference is not statistically significant.

cp RNFL and GCC parameters detected by SD-OCT is essential for glaucoma diagnosis and progression. All the average values were found to be less in glaucomatous group than the non glaucomatous group (Tables 6 and 7). Kim et al found similar results comparing glaucomatous group with non-glaucomatous group by SD-OCT measurements.[11] Assessment of GCC parameters is a useful technique complimentary to cpRNFL thickness assessment, for evaluating patients with glaucoma and high myopia by Shoji T et al.[12]

5. Conclusion

This study shows myopia is a risk factor for POAG as observed by many studies. But it is a proven fact that

prevalence of POAG is more in moderate and high myopics. Myopia is relatively common in younger age group. So early detection of glaucoma in these patients will be helpful in delaying the blindness. Especially for Moderate and high myopia.

6. Conflict of Interest

The authors declare that they have no conflict of interest.

7. Source of Funding

None.

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